Courses having focus on employability/ entrepreneurship/ skill development offered by the institution during 2016-17

Course Name : BASIC ELECTRICAL ENGINEERING					
Course Code: ELEC1001					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module-I: [12 L]

DC Network Theorem: Kirchhoff's law, nodal analysis, mesh analysis, Superposition theorem, Thevenin's theorem, Norton theorem, Maximum power transfer theorem, star-delta conversion.

DC Machines: Construction, EMF equation, Principle of operation of DC generator, open circuit characteristics, external characteristics, Principle of operation of DC motor, Speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of dc motor.

Module-II [8L]

Electrostatics: Gauss's law and its applications to electric field and potential calculation. Capacitor, capacitance of parallel plate capacitor, spherical capacitor and cylindrical capacitor.

Electromagnetism: Amperes law, Biot-savart's law, Ampere's circuital law and their applications, Magnetic circuits, analogy between magnetic and electric circuits, Faraday's law, self and mutual inductance. Energy stored in a magnetic field, Hysteresis and Eddy current losses.

Module-III [10L]

AC single phase system: concept of alternating signal, average and RMS values of alternating signal, peak factor, form factor, phase and phase difference, phasor representation of alternating quantities, phasor diagram, AC series , parallel and series parallel circuits, Active power, Reactive power, power factor, Resonance in RLC series and parallel circuit, Q factor, bandwidth.

Three phase system: balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. Power measurement by two wattmeter method.

Module-IV [10L]

Single phase transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, open and short circuit tests, efficiency.

HOD, EE

3-phase induction motor: Concept of rotating magnetic field, principle of operation, Construction, equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.

Text Books:

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I,Vol-II,Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand &
   Company

Reference Books:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H.Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers
4. Basic Electrical Engineering, N.K. Mondal, Dhanpat Rai
5. Basic Electrical Engineering, Nath & Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

HOD, EE

Course Name : BASIC ELECTRICAL ENGINEERING LAB.					
Course Code: ELEC1011					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

List of Experiments:

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's & Norton's theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method.

HOD, EE

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Syllabus of 2nd Semester

Course Name : Introduction to Computing					
Course Code: CSEN 1201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Learning Objective: Introduction to the concept of computer and computation and solving of problems using C as a programming language. Coverage of C will include basic concepts, arithmetic and logic, flow control, and data handling using arrays, structures, pointers and files.

Module I: [13L]
Fundamentals of Computer
History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Assembly language, high level language, compiler and assembler (basic concepts).

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit). Binary Arithmetic & logic gates. Boolean algebra – expression, simplification, Karnaugh Maps.

Basic concepts of operating systems like MS WINDOW, LINUX. How to write algorithms & draw flow charts.

Module II: [5L]
Basic Concepts of C
C Fundamentals: The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions: Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

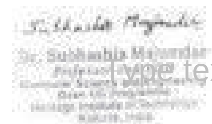
Module III: [8L]
Program Structures in C
Flow of Control: Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes - auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables.

C preprocessor (macro, header files), command line arguments.

Module IV: [14L]
Data Handling in C
Arrays and Pointers: One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality. String and character arrays; C library string functions and their use.

User defined data types and files: Basic of structures; structures and functions; arrays of structures.
Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs();



Text Books
1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Reference Books
1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan

Course Outcomes: (CSEN1201)
CO 1: Understand and remember functions of the different parts of a computer.
CO 2: Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.
CO 3: Understand and remember syntax and semantics of a high-level language (C programming language, in this course).
CO 4: Understand how code can be optimized in high-level languages.
CO 5: Apply high-level language to automate the solution to a problem.
CO 6: Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

Course Name : PHYSICS 1					
Course Code: PHYS 1001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module I: [22 L]
Optics
*Interference :*The principle of superposition of waves, Superposition of waves: Two beam superposition, Multiple-beam superposition, coherent and incoherent superposition. Two source interference pattern (Young's double slit), Intensity distribution. Interference in thin films, wedge shaped films and Newton's rings, applications of interference. Newton's rings: Determination of wavelength of light, refractive index of liquid.
*Diffraction:*Diffraction of light waves at some simple obstacles. Fraunhoffer diffraction through double slit and diffraction grating, grating spectra, resolving power of grating.
Polarisation & Fibre Optics: Elementary features of polarization of light waves.Production and analysis of linearly, elliptic and Circularly polarized light, polaroids and application of polarizations. fibre optics - principle of operation, numerical aperture, acceptance angle
Laser: Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.

Module II : [8L]
Waves & Oscillation: Superposition of two linear SHMs (with same frequency), Lissajous' figures. Damped vibration – differential equation and its solution, Critical damping, Logarithmic decrement, Analogy with electric circuits. Forced vibration – differential equation and solution, Amplitude and Velocity resonance, Sharpness of resonance and Quality factor. Progressive wave- Wave equation and its differential form, Difference between elastic (mechanical) and electromagnetic waves.

Dynamics of Ideal fluids: Introduction, Euler's equation of motion along a streamline; Bernoulli's equation-assumptions and significance of each term of Bernoulli's equation.
Application of Bernoulli's equation-problem on pipe line. Measurement of flow rate: Venturimeter and orificemeter .
Static pressure, Dynamic pressure, Stagnation pressure-measurement of velocity by Pitot tube.

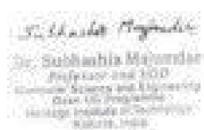
References:

1. Engineering Thermodynamics- Nag, P.K. - T. M. H
2. Fundamentals of Thermodynamics- Sonntag, Borgnakke & Van Wylen, Wiley India
3. Thermodynamics- an Engineering approach - 6e, Cengel & Boles, TM
4. Fluid Mechanics & Hydraulic Machines – R.K. Bansal, Laxmi Publications Ltd, India
5. Introduction to Fluid Mechanics and Fluid Machines- S.K. Som, G. Biswas, & S. Chakraborty , T.M.H
6. Fluid Mechanics – A.K. Jain, Khanna Publishers.

Course Name : Introduction to Computing Lab					
Course Code: CSEN1211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Basic Computation & Principles of Computer Programming Lab
Softwares to be used: Cygwin and notepad++, Tiny C

Day 1: LINUX commands and LINUX based editor
Day 2: Basic Problem Solving
Day 3: Control Statements (if, if-else, if-elseif-else, switch-case)
Day 4: Loops - Part I (for, while, do-while)
Day 5: Loops - Part II
Day 6: One Dimensional Array
Day 7: Array of Arrays
Day 8: Character Arrays/ Strings
Day 9: Basics of C Functions
Day 10: Recursive Functions
Day 11: Pointers
Day 12: Structures and Unions
Day 13: File Handling



Course outcomes:
After completion of this course the students should be able:
1. To interpret and understand syntax errors reported by the compiler.
2. To debug errors.
3. To implement conditional branching, iteration (loops) and recursion.
4. To implement modularity in a program.
5. To use arrays, pointers, and structures to store different type of data.
6. To be able to create, read from and write into simple text files.

Course Name : BASIC ELECTRONICS ENGINEERING					
Course Code: ECEN1001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course outcomes:

1. Categorize different semiconductor materials based on their energy bands and analyze the characteristics of those materials for different doping concentrations based on previous knowledge on semiconductors acquired.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode both from device and circuit perspectives.
3. Design different application specific circuits associated with diodes operating both in forward and reverse bias.
4. Analyze various biasing configurations of Bipolar Junction Transistor and categorize different biasing circuits based on stability.
5. Categorize different field-effect transistors based on their constructions, physics and working principles and solve problems associated with analog circuits based on operational amplifiers.
6. Design and implement various practical purpose electronic circuits and systems meant for both special purpose and general purpose and analyze their performance depending on the type of required output and subsequently the applied input.

Module I: [10 L]

Semiconductors:
Crystalline material, Energy band theory, Fermi levels; Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers.

Diodes and Diode Circuits:
Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener Diode and its Application, Zener and Avalanche breakdown.
Simple diode circuits, load line, piecewise linear model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

Module II: [10 L]

Bipolar Junction Transistors:
Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off, active and saturation modes of operation, transistor action, input & output characteristics, load line & amplifier operation and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor.

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Module III: [9 L]

Field Effect Transistors:
Junction field effect transistor (JEET): Principle of operation, JFET parameters, eqv. Circuit, JFET biasing, self bias, design of bias circuits, load line, amplifier characteristics.

MOSFETs:
Construction & principle of operation of p- & n-channel enhancement & depletion mode MOSFETs, drain & transfer characteristics, threshold voltage & its control.

Cathode Ray Osilloscope:
Construction and working principle of CRO, Lissajous pattern.

Module IV: [9 L]

Feed Back Amplifier:
Concept-block diagram, properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, condition of oscillation, Barkhausen criteria.

Operational Amplifier:
Introduction to integrated circuits, operational amplifier and its terminal properties; Application of operational amplifier; Concept of op-amp saturation, inverting and non-inverting mode of operation, Adders, Subtractors, Voltage follower, Integrator, Differentiator, Basic Comparator Circuit.

References:

1. Boylestad & Nashelsky:Electronic Devices & Circuit Theory
2. R.A Gayakwad:Op Amps and Linear IC's, PHI
3. D. Chattopadhyay, P. C Rakshit : Electronics Fundamentals and Applications
4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
5. Millman & Halkias: Integrated Electronics.
6. Salivahanan: Electronics Devices & Circuits.
7. Albert Paul Malvino: Electronic Principle.

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Course Name : BASIC ELECTRONICS ENGINEERING LABORATORY					
Course Code: ECEN1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

List of Experiments:

1. Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc.
2. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs in CB mode
7. Study of I-V characteristics of BJTs in CE mode
8. Study of I-V characteristics of Field Effect Transistors.
9. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
10. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
11. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.

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Course Name: MATHEMATICS-I					
Course Code: MATH 1101					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:

1. Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.
2. Develop the concept of eigen values and eigen vectors.
3. Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.
4. Analyze the nature of sequence and infinite series
5. Choose proper method for finding solution of a specific differential equation.
6. Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

Module I [10L]

Matrix:

Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

Module II [10 L]

Vector Calculus:

Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems on these topics,

Infinite Series:

Convergence of sequence and series; Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

Module III[10 L]

First order ordinary differential equations:

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

Module IV [10L]

Calculus of functions of several variables

Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables,

Multiple Integration

Concept of line integrals, Double and triple integrals. Green's Theorem, Stokes Theorem and Gauss Divergence Theorem.

Suggested Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2000.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
4. S. L. Ross, Differential Equations", Wiley India, 1984.
5. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.
6.Vector Analysis(Schaum's outline series): M.R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
7. Engineering Mathematics: S. S. Sastry (PHI)
8. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP),Indian Edition.
9. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

09/08/2022

Organic reactions and synthesis of drug molecule: Introduction to reaction mechanisms involving substitution, addition, elimination and oxidation- reduction reactions. Synthesis of commonly used drug molecules.

3. Textbooks

1. Atkins' Physical Chemistry, P.W. Atkins (10th Edition).
2. Organic Chemistry, I. L. Finar, Vol-1 (6th Edition).
3. Engineering Chemistry, Jain & Jain, (16th Edition).
4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, (2nd Edition).
5. Engineering Chemistry -I, Gourkrishna Dasmohapatra, (3rd Edition).

4. Reference Books

1. General & Inorganic Chemistry, R. P. Sarkar.
2. Physical Chemistry, P. C. Rakshit, (7th Edition).
3. Organic Chemistry, Morrison & Boyd, (7th Edition).
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4th Edition).
5. Physical Chemistry, G. W. Castellan, (3rd Edition).
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1st Edition).

Course Name: Mathematics-I					
Course Code: MATH1101					
Contact Hours per week:	L	T	P	Total	Credit points
	3	1	0	4	4

1. Course Outcomes

After completion of the course, students will be able to:

MATH1111.1. Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.
MATH2111.1. Develop the concept of eigen values and eigen vectors.
MATH3111.1. Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.
MATH4111.1. Analyze the nature of sequence and infinite series
MATH5111.1. Choose proper method for finding solution of a specific differential equation.
MATH6111.1. Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

2. Detailed Syllabus

Module 1 [10L]

Matrix: Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

Module 2 [10L]

Vector Calculus: Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems on these topics.

Infinite Series: Convergence of sequence and series; Tests for conver gence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test (statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

Module 3 [10L]

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders: General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

Module 4 [10L]

Calculus of functions of several variables: Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables.

Multiple Integration: Concept of line integrals, Double and triple integrals. Green's Theorem, Stoke's Theorem and Gauss Divergence Theorem.

3. Textbooks

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 2000.
2. Advanced Engineering Mathematics, E. Kreyszig, John Wiley & Sons, 2006.

4. Reference Books

1. Engineering Mathematics for first year, Veerarajan T., Tata McGraw-Hill, New Delhi, 2008.
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson, S. J. Bence., Cambridge University Press, 23-Mar-2006.
4. Differential Equations, S. L. Ross, Wiley India, 1984.
5. Differential Equations, G.F. Simmons and S.G. Krantz, McGraw Hill, 2007.
6. Vector Analysis (Schaum's outline series): M. R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education).
7. Engineering Mathematics: S. S. Sastry (PHI).
8. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP), Indian Edition.
9. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education).

Course Name: Basic Electrical Engineering					
Course Code: ELEC1001					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

1. Course Outcomes

After completion of the course, students will be able to:

ELEC1101.0. Analyze DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
ELEC1201.0. Analyze DC Machines; Starters and speed control of DC motors.
ELEC1301.0. Analyze magnetic circuits.
ELEC1401.0. Analyze single and three phase AC circuits.
ELEC1501.0. Analyze the operation of single-phase transformers.
ELEC1601.0. Analyze the operation of three phase induction motors.

1. Detailed Syllabus

Module 1 [11L]

DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion.
Electromagnetism: Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet.

Module 2 [10L]

AC single phase system: Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and series-parallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit.

Module 3 [11L]

Three phase system: Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method.
DC Machines: Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of DC motor.

Module 4 [10L]

Transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency, Introduction to three phase transformers.
Three-phase induction motor: Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics.

Module III : [9L]
Quantum Mechanics: Need for Quantum physics-Historical overviews, Particle aspects of radiation-Black body radiation, Compton scattering, pair production., Origin of X-ray spectrum. Wave aspect of particles-matter wave, de Broglie Hypothesis, Heisenberg Uncertainty principles- Statement, Interpretation and application.

Module IV: [6L]
Introduction of Crystallography: Space Lattice**,** Unit Cell, Lattice Parameters, Crystal Systems, Bravais Lattices, Miller Indices and its applications, Crystal Planes and Directions, Inter Planar Spacing of Orthogonal Crystal Systems, Atomic Radius, Co-ordination Number and Packing Factor of SC, BCC, FCC. Bragg's law and its applications.

Text Books
1. Atomic Physics Vol 1 – S.N. Ghoshal
2. Optics – Ajoy Ghak
3. Waves & Oscillation – N.K. Bajaj
4. Quantum Physics of Atoms , Molecules, Solids, Nuclei and particles – Eisberg and Resnick

Reference Books
1. Introduction to Special Relativity – Robert Resnick
2. Prespective on Modern Physics - Arthur Beiser
3. Optics – Jenkins and White
4. University Press – Sears & Zemansky
5. Introduction to modern Physics – Mani and Meheta
6. Optics – Brijlal and Subrahmanyam

Course Name : Mathematics II					
Course Code: MATH1201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module I [10 L]
Ordinary differential equations (ODE): First order and first degree: Exact equations, Necessary and sufficient condition of exactness of a first order and first degree ODE (statement only), Rules for finding Integrating factors, Linear and non-linear differential equation, Bernoulli's equation. General solution of ODE of first order and higher degree (different forms with special reference to Clairaut's equation).
Second order and first degree: General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods for finding P.I., Method of variation of parameters, Cauchy-Euler equations.

Module II:[10L]
Basics of Graph Theory: Graphs, Digraphs, Weighted graph, Connected and disconnected graphs,Complement of a graph, Regular graph, Complete graph, Subgraph,; Walks, Paths, Circuits, Euler Graph,Cut sets and cut vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph,Graph isomorphism, Bipartite graph.
Tree: Definition and properties, Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees, Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using DFS, BFS, Kruskal's and Prim's algorithms.

Module III [10L]
Improper Integral: Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.
Laplace Transform: Introduction to integral transformation, functions of exponential order, Definition and existence of LT (statement of initial and final value theorem only), LT of elementary functions, Properties

of Laplace Transformations , Evaluation of sine , cosine and exponential integrals using LT, LT of periodic and step functions Definition and properties of inverse LT Convolution Theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODEs with constant coefficients (initial value problem) using LT.

Module IV [10L]

Three Dimensional Geometry: Equation of a plane. General form. Transformation to the normal form. Intercepts. Equation of the plane through three given points. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Bisectors of angles between two intersecting planes. Parallelism and perpendicularity of two planes.

Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Shortest distance between two lines. Condition of coplanarity of two lines. Length of the perpendicular from a point to a given line.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, (Wiley Eastern)
2. Graph Theory: V. K. Balakrishnan, (Schaum's Outline, TMH)
3. A first course at Graph Theory: J. Clark and D. A. Holton (Allied Publishers LTD)
4. Introduction to Graph Theory: D. B. West (Prentice-Hall of India)
5. Graph Theory: N. Deo (Prentice-Hall of India)
6. Engineering Mathematics: B.S. Grewal (S. Chand & Co.)
7. Higher Engineering Mathematics: John Bird (4th Edition, 1st Indian Reprint 2006, Elsevier)
8. Calculus: Strauss, Bradley and Smith (3PrdP edition, Pearson Education)
9. Engineering Mathematics (Volume 2): S. S. Sastry (Prentice-Hall of India)
10. Introductory Course in Differential Equations: Daniel A. Murray (Longmans & Green).
11. Co-ordinate Geometry – S. L. Loney.
12. Analytical Geometry And Vector Algebra- R M Khan

Course Outcomes:

MATH1201.1 Construct differential equation as a mathematical model of a physical phenomena.
MATH1201.2 Choose proper method for finding solution of a specific differential equation.
MATH1201.3 Discuss the elementary concepts of graph theory, for example, walk, path, cycle, Eulerian graph, Hamiltonian graph and tree.
MATH1201.4 Apply basic graph algorithms for searching and finding minimal spanning tree and shortest path.
MATH1201.5 Solve improper integrals and initial value problems with the help of Laplace transformation.
MATH1201.6 Evaluate distance, angle between planes and shortest distance between two skew lines in three dimension.

Course Name : Basic Electronics Engineering					
Course Code: ECEN1001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module I [10 L]

Semiconductors: Crystalline material, Energy band theory, Fermi levels; Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers.

Diodes and Diode Circuits: Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener Diode and its Application, Zener and Avalanche breakdown.
Simple diode circuits, load line, piecewise linear model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

Chemistry Syllabus

Chemistry-1
Code: CHEM 1001
Contacts: 3L + 1T = 4
Credits: 4

MODULE 1
THERMODYNAMICS & SPECTROSCOPY
Chemical Thermodynamics & Thermochemistry
Concept of Thermodynamic system, Introduction to first law of thermodynamics, Enthalpy Heat Capacity, Reversible and Irreversible processes, Adiabatic changes, Application of first law of thermodynamics to chemical processes, 2nd law of thermodynamics, Evaluation of entropy, Work function and free energy, Phase Changes, Clausius Clapeyron Equation, Chemical Potential, Gibbs Duhem Relation, Activity and Activity coefficient, 8**L**
Spectroscopy
Electromagnetic Radiation, Basic idea of UV-visible & IR spectroscopy. **2L**

MODULE 2
STRUCTURE & BONDING
Chemical Bonding
Covalent bond, VSEPR Theory, Molecular Orbital Theory, Hydrogen bond, Intermolecular forces-vander Waals forces, ionization energy, Electronegativity, hybridisation, Electron Affinity, Dipole moment **4L**
Solid State Chemistry
Introduction to stoichiometric defects (Schottky & Frenkel) and non – stoichiometric defects (Metal excess and metal deficiency).
Role of silicon and germanium in the field of semiconductor. **1L**
Ionic Equilibria and Redox Equilibria
Acid Base Equilibria in water, Strength of acids and bases, Hydrogen ion exponent, Ionic product of water, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation, Redox Equilibria, **2L**
Structure and reactivity of Organic molecule
Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion and free radicals.
Brief study of some addition, eliminations and substitution reactions **3L**

MODULE 3
ELECTROCHEMISTRY & REACTION DYNAMICS
Conductance
Conductance of electrolytic solutions, specific conductance, equivalent conductance, molar conductance and ion conductance, effect of temperature and concentration (Strong and Weak electrolyte). Kohlrausch’s law of independent migration of ions, transport numbers and hydration of ions. Conductometric titrations: SA vs SB & SA vs WB; precipitation titration KCl vs $AgNO_3$. **3L**

Electrochemical Cell

Cell EMF and its Thermodynamic derivation of the EMF of a Galvanic cell (Nernst equation), single electrode potentials, hydrogen half-cell and calomel half cell (construction, representation, cell reaction, expression of potential, Discussion, Application) Storage cell, fuel cell (construction, representation, cell reaction, expression of potential, Discussion, Application). Application of EMF measurement on- a) the change in thermodynamic function (ΔG, ΔH, ΔS) b) the equilibrium constant of a reversible chemical reaction c) the valency of an ion. **4L**

Kinetics

Reaction laws: rate and order; molecularity; zero, first and second order kinetics. Pseudounimolecular reaction, Arrhenius equation.

Mechanism and theories of reaction rates (Transition state theory, Collison theory).

Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics). **3L**

MODULE 4

INDUSTRIAL CHEMISTRY & POLYMERIZATION

Industrial Chemistry

Solid Fuel: Coal, Classification of coal, constituents of coal, carbonization of coal (HTC and LTC), Coal analysis: Proximate and ultimate analysis.

Liquid fuel: Petroleum, classification of petroleum, Refining, Petroleum distillation, Thermal cracking, Octane number, Cetane number, Aviation Fuel (Aviation Gasoline, Jet Gasoline), Bio-diesel.

Gaseous fuels: Natural gas, water gas, Coal gas, bio gas. **5L**

Polymerization

Concepts, classifications and industrial applications. Polymer molecular weight (number avg. weight avg. viscosity avg.: Theory and mathematical expression only), Poly dispersity index (PDI). Polymerization processes (addition and condensation polymerization), degree of polymerization, Copolymerization, stereo-regularity of polymer, crystallinity (concept of Tm) and amorphicity (Concept of Tg) of polymer.

Preparation, structure and use of some common polymers: plastic (PE: HDPE, LDPE, PVC., Bakelite, PP), rubber (natural rubber, SBR, NBR) and Vulcanization., fibre(nylon 6.6, Nylon 6, Polyester).

Conducting and semi-conducting polymers. **5L**

TEXT BOOKS

1. Engineering Chemistry, Gourkrishna Dasmohapatra, Vikas Publishing House
2. A Text book of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co Pvt Ltd
3. Engineering Chemistry, K. L. Chugh, Kalyani Publishers

REFERENCE BOOKS

1. General & Inorganic Chemistry, R. P. Sarkar, New Central Book Agency P Ltd
2. Fuels and Combustion, S. Sarkar Taylor & Francis (3rd Edition), 2009
3. I. L. Finar, Organic Chemistry, Addison Wesley Longman, Inc
4. Organic Chemistry, Morrison & Boyd, Prentice Hall of India
5. Physical Chemistry, K. L. Kapoor, McMillan
6. P. C. Rakshit, Physical Chemistry, Sarat Book House (7th Edition).

Chemistry Lab
Code: CHEM 1011

1. To Determine the alkalinity in a given water sample.
2. Estimation of iron using $KMnO_4$: self indicator.
3. Estimation of iron using $K_2Cr_2O_7$: redox sensitive indicator.
4. To determine total hardness and amount of calcium and magnesium separately in a given water sample.
5. To determine the value of the rate constant for the hydrolysis of ethyl acetate catalyzed by hydrochloric acid.
6. Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).
7. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
8. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
9. Iodometric estimation of Cu^{2+}.
10. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

At least six experiments must be performed in a semester out of above ten experiments.

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis-G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney.
2. Advanced Practical Chemistry- S. C. Das
3. Practicals in Physical Chemistry- P. S. Sindhu

Course Name : WORKSHOP PRACTICE					
Course Code: MECH 1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**4**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Learn to fabricate components with their own hands.
CO 2	Understand and practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding
CO 3	Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping
CO 4	Analyze Welding and soldering operations.
CO 5	Apply basic electrical engineering knowledge for house wiring practice
CO 6	Study, Evaluate and practice on machine tools and their operations

Job 1: General awareness of a typical workshop.

Theory requirements: Workshop definition, various shops in a typical workshop, Carpentry, Fitting, Foundry; Sheet Metal Shop, Welding and Brazing Shop, Machine Shop , Forging & Blacksmithy, Safety precautions to be followed in a workshop, Familiarization of Various safety devices and their uses.

Job 2: Making of a wooden pattern.

Theory requirements: Market forms of converted Timber, e.g., log, balk, plank,batten, beam ,Types of Wood, Hard Wood, Soft Wood, particle board; Seasoning of wood, Natural seasoning, Artificial seasoning, Carpentry Tools- Marking Tools, Cutting Tools, Planing Tools, Boring Tools, Striking Tools , Holding & Misc. Tools, Carpentry Processes (marking, sawing, planning, chiselling, boring, grooving, joining etc.), Safety precautions in Carpentry Shop.

Job 3: Making of a matched profile form MS plate.

Theory requirements: Work Bench, Fitting Tools (Bench Vice,Chisel,Hammer,Different types of Files, (Rough,Bastard, Second Cut, Half Round, Triangular File),Saw(Hack saw etc.), Scriber, Punch, Try Square, Angle Plate, caliper (outside & inside), Universal Surface Gauge, Centre Punch, Prick Punch, Drill (Flat,straight fluted, taper shank twist drill).

Fitting Operations,Filing, Marking, Drilling, Tapping (Rougher,Intermediate, Finisher taps), Tap Drill size (D=T-2d), Sawing, Dieing . Safety precautions in Fitting Shop.

Job 4: Making of an internal and external thread.

Theory requirements : Thread standards and thread classifications, Internal Thread,External Thread, Thread Nomenclature (Major dia, Minor dia, Pitch dia, pitch, Lead, TPI, Metric, BSP , Nominal size), Specifications of threaded fasteners (in Metric System). Safety precautions in Dieing and Tapping.

Job 5: Making of a green sand mould using the pattern made under Job no. 2.

Theory requirements: Mould making, Preparation of sand, (silica, clay, moisture, and misc items and their functions), Properties of a good sand mould, General procedure for making a good sand mould, Different tools used for preparation of a mould, Explanation of various terms , Cope and Drag Box, Runner, Riser, Gating and its utility, Parting sand, Vent holes.

Job 6: Demonstration of metal melting and casting

Theory requirements: Metal melting furnaces: Ladles, Using of Tongs, Molten metal pouring procedure, Safety precautions in pouring molten metal in a mould.

Job 7. Making of a stepped pin in a centre lathe.

Theory requirements: Machining and common machining operations , Lathe M/c and its specifications, Head stock, Tailstock, Chuck-Self centering chuck , 4 jaw chuck, Bed, Carriage, Feed mechanism, Screw cutting mechanism, various lathe operations like turning, facing, grooving, chamfering, taper turning ,Thread cutting, Knurling, Parting, Cutting speed, Feed, Depth of cut , Different types of cutting tools-Safety precautions in a machine shop.

Job 8: Making of square prism from a round shaft by Shaping Machine

Theory requirements: Description of a Shaping machine, Base , Column, Saddle, Clapper box, Quick return mechanism, Feed Mechanism, Table, Rotation of table, Adjustment of stroke length, Adjustment of starting point of cut. Safety Precautions while working in Shaping Machine.

Job 9: Making of square prism from a round shaft by Milling Machine

Theory requirements: Description of a milling machine, Specification of a Milling machine, Types of Milling-Up Milling, Down Milling, Vertical Milling Machine, Horizontal Milling Machine , Safety precautions while working in Milling Machine.

Job 10 : Arc Welding practice and making of a welded joint

Theory requirements: Welding, Weldability, Types of Welding, MMAW, Gas Welding, Electrode , Functions of Flux, Equipment for MMAW, Different types of Flames in Gas Welding and Gas Cutting (Neutral-Oxidising-Reducing Flames), Different types of welding joints, AC Welding , DC Welding; Safety precautions in Welding Shop.

Job 11 : Sheet Metal forming & Brazing

Theory requirement: Specification of sheet metal, SWG vs. mm, HR sheet, CR sheet, GI Sheet, Stainless Steel Sheet, Aluminum sheets, Tin Plates, Sheet metal working Tools, Micrometer, Chisels, Punches, Hammers, Mallets, Hand Shear or Snippets, Various sheet metal forming operations, Shearing, Marking, Punching, Drilling, Bending, Drawing, Brazing, Safety precautions in Sheet Metal Working Shop.

References:

1. Elements of Workshop Technology (Vol- I and II)- Hajra Choudhury, Media Promoter &Publishers Privet Limited.
2. Workshop Technology (Vol- I and II) – Chapman , Viva Books Privet Limited.

09/08/2022

Course Name : ENGINEERING DRAWING					
Course Code: MECH 1012					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**4**	**3**

<u>Course outcomes:</u>

After going through the course, the students will be able to:
CO1: **Define** engineering drawing and **demonstrate** the use of different drawing equipments (level 1, 2)
CO2: **Outline** various standards and symbols (line types, dimensions, scale, etc.) used in engineering drawing (level 2)
CO3: **Develop** ideas to read and **interpret** projection drawings. (level 2, 3, 5, 6)
CO4: **Apply** the concept of orthographic projection to points, lines, laminas and solids. (level 3)
CO5: **Develop** section view of solids cut by section planes onto principal and auxillary planes. (level 6, 3)
CO6: **Analyze** orthographic projection of 3D solids and **develop** isometric view / projection of the same. (level 3, 4, 6)

1. Importance of engineering drawing; Acquaintance with different drafting equipment & accessories;
2. Introduction to lines : Practising different types of lines; Basic concepts in Lettering : Practising vertical & inclined letters (Practice Sheet 1)
3. Different systems of dimensioning with practice. Introduction to the concept of scale of drawing. (Practice Sheet 2)
4. Introduction to concept of orthographic projection: 1^{st} angle and 3^{rd} angle projection method; Symbols; projection of points. (Practice Sheet 3)
5. Projection of straight lines for different orientation including inclined to both the planes. (Practice Sheet 4)
6. Projection of plane surfaces inclined to HP and parallel to VP; Inclined to VP and Parallel to HP (Practice Sheet 5)
7. Projection of solids: Cube, rectangular prism, Hexagonal prism, Cylinder, Pyramid, Cone. (Practice Sheet 6)
8. Section of solids and their projections on principal and auxiliary planes for true shape: Cylinder, hexagonal pyramid. (Practice Sheet 7)
9. Isometric projections: Basic concepts, isometric scale; Isometric projection and view.
10. Practice with simple laminar and solid objects. (Practice Sheet 8)

References:

1. "Elementary Engineering Drawing" by Bhatt, N.D; Charotan Book Stall, Anand
2. "Engineering Graphics" by Narayana, K.L. and Kannaaiah P; TMH
3. "Engineering Graphics" by Lakshminarayanan, V. and Vaish Wanar, R.S, Jain Brothers.

09/02/2022

Course Name : ENGINEERING THERMODYNAMICS AND FLUID MECHANICS					
Course Code: MECH 1201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Analyzea thermodynamic system and evaluatethe corresponding energy transfer in various quasi-static processes.
CO 2	Understand and usefirst and second laws of thermodynamics associated with closed systems.
CO 3	Interpret the importance of entropy and derive thermal efficiency of Otto and Diesel cycles.
CO 4	Learn the physical properties of fluids and classify different types of non-Newtonian fluids.
CO 5	Measurefluid pressure, flow rateetc. and solve problems related to fluid kinematics.
CO 6	Applythe principles of mass and energy conservation to incompressible fluid flow.

Module 1 [10 L]

Basic concepts of Thermodynamics:

Introduction; Macroscopic and microscopic concept; Definition of Thermodynamic systems; Surrounding, universe; Open, closed and isolated systems; Concept of control volume; Thermodynamic properties: intensive, extensive & specific properties; state.

Thermodynamic equilibrium; Change of state; Thermodynamic processes and cycles; Quasi-static processes; Reversible processes; Zeroth law of Thermodynamics -concept of temperature.

Heat & Work:

Definition of Thermodynamic work; Work transfer-displacement work for a simple compressible system, path function, PdV work in various quasi-static processes(isothermal, isobaric, adiabatic, polytropic, isochoric); Free expansion; Indicated diagram (P-V diagram)
.
Definition of heat; Heat transfer-a path function; Similarities and dissimilarities between heat and work.

Module 2 [8 L]

First law of Thermodynamics: Statement; 1st law for a closed system executing a cycle; Concept of stored energy; Energy as a property, different forms of stored energy, internal energy, first law for a non-flow process; Flow work; Definition of enthalpy, C_p, C_v; Energy of an isolated system; Flow energy; First law for an open system - steady flow energy equation; Examples of steady flow devices(nozzle and diffuser, turbine, pump, compressor, boiler, condenser and throttling device); PMM-I

Module 3 [10 L]

Second law of Thermodynamics:

Qualitative difference between heat and work; Definition of source & sink: cyclic heat engine, heat pump and refrigerator, thermal efficiency of heat engine, C.O.P of heat pump and refrigerator; Kelvin-Plank and Clausius statements of second law; Equivalence of the two statements.

Reversible process; Irreversible process; Factors for irreversibility; Carnot cycle and Carnot efficiency; Reversible heat engine and heat pump; PMM-ll

Entropy: Mathematical statement of Clausius Inequality: Entropy as a property; Entropy principle; T-s plot for reversible isothermal, adiabatic, isochoric & isobaric processes.

Air standard Cycles:

Otto cycle & Diesel cycle, P-V & T-s plots, Net work done and thermal efficiency.

Module 4 [10 L]

Properties & Classification of Fluid:

Definition of fluid; Concept of Continuum; Fluid properties- density, specific weight, specific volume, specific gravity; Viscosity : definition , causes of viscosity , Newton's law of viscosity, dimensional formula and units of viscosity, kinematic viscosity; Variation of viscosity with temperature. Ideal and Real fluids; Newtonian and Non-Newtonian fluids; No-slip condition.
Compressibility and Bulk modulus of elasticity.
Difference between compressible and incompressible fluids.

Fluid Statics:

Introduction; Pascal's Law--statement and proof; Basic Hydrostatic Law and its proof; Variation of pressure with depth in incompressible fluid, piezometric head, pressure head;

Unit and scales of pressure measurement.
Measurement of fluid pressure: Piezometer, Manometers -Simple and Differential U-tube manometer, Inverted tube manometer, Inclined tube manometer.
Characteristics and choice of manometric fluid.

Module 5 [10 L]

Fluid Kinematics:
Definition; Flow field and description of fluid motion(Eulerian & Lagrangian method), steady and unsteady flow, uniform and non-uniform flow-examples.
Acceleration of a fluid particle-local acceleration, convective acceleration. Stream line, Stream tube, Path line and Streak line; Laminar and Turbulent flow, Reynolds Number. Equations of streamlines and path lines.
Continuity equation for unidirectional flow and for differential form in 3-D Cartesian coordinate system.
Dynamics of Ideal fluids:

Introduction, Euler's equation of motion along a streamline; Bernoulli's equation-assumptions and significance of each term of Bernoulli's equation.
Application of Bernoulli's equation-problem on pipe line. Measurement of flow rate: Venturimeter and orificemeter .
Static pressure, Dynamic pressure, Stagnation pressure-measurement of velocity by Pitot tube.

References:

1. Engineering Thermodynamics- Nag, P.K. - T. M.H
2. Fundamentals of Thermodynamics- Sonntag, Borgnakke & Van Wylen, Wiley India
3. Thermodynamics- an Engineering approach - 6e, Cengel & Boles, TM
4. Fluid Mechanics & Hydraulic Machines – R.K. Bansal, Laxmi Publications Ltd, India
5. Introduction to Fluid Mechanics and Fluid Machines- S.K. Som, G. Biswas, & S. Chakraborty , T.M.H

Fluid Mechanics – A.K. Jain, Khanna Publishers.

09/08/2022

Department of Humanities

Syllabus

Paper Name-Business English
Paper Code-HMTS-1101
2L/week
Credit: 2

Course |Outcome

Analyze the dynamics of business communication and communicate accordingly

Write business letters and reports

Learn to articulate opinions and views with clarity

Appreciate the use of language to create beautiful expressions

Analyze and appreciate literature

Communicate in an official and formal environment

Detailed Syllabus

Module I – [8L]

Communication Skill
Definition, nature & attributes of Communication
Process of Communication
Models or Theories of Communication
Types of Communication
Levels or Channels of Communication
Barriers to Communication

Module II – [8L]

Business Communication- Scope & Importance
Writing Formal Business Letters
Writing Reports
Organizational Communication: Agenda & minutes of a meeting, notice, memo, circular
Project Proposal
Technical Report Writing
Organizing e-mail messages
E-mail etiquette
Tips for e-mail effectiveness

Suparna Chakrabarti

Module III – [6L]

Language through Literature
Modes of literary & non-literary expression
Introduction to Fiction, (An Astrologer's Day by R.K. Narayan and Monkey's Paw by W.W. Jacobs), Drama (The Two Executioners by Fernando Arrabal) or (Lithuania by Rupert Brooke) & Poetry (Night of the Scorpion by Nissim Ezekiel and Palanquin Bearers by Sarojini Naidu)

Module IV – [2L]

Grammar in usage (nouns, verbs, adjectives, adverbs, tense, prepositions, voice change) -to be dealt with the help of the given texts.

Text Books:

1. Theories of Communication: A Short Introduction, Armand Matterlart and Michele Matterlart, Sage Publications Ltd.
2. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA:
   Advanced Communication Designs.
3. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.

Reference Books:

1. Writing and Speaking at Work: A Practical Guide for Business Communication, Edward Bailey, Prentice-Hall.
2. Business and Administrative Communication, Kitty O. Locker, McGraw-Hill/ Irwin.
3. Intercultural Business Communication, Lillian Chaney and Jeanette Martin, Prentice Hall.

Suparna Chakraborti

Department of Humanities
Syllabus

Paper Name: Language Practice Lab (level 1)-2014-15
Paper Code HMTS 1111
Contact hrs. : 2week
Credit: 1

Course Outcome:

The learner will
1. Acquire the techniques to become an effective listener.
2. Acquire the skill to become an effortless speaker.
3. Organize and present information for specific audience.
4. Communicate to make a positive impact in professional and personal environment.
5. Engage in research and prepare authentic, formal, official documents.
6. Acquire reading skills for specific purpose.

Detailed Syllabus

Module I [6hrs.]
Introduction to Linguistics (Phonology)
Phonetics-Vowel and Consonant Sounds (Identification &articulation)
Word- stress
Intonation (Falling and rising tone)
Voice Modulation
Accent training

Module II [6hrs.]
Listening Skills
Principles of Listening
Approaches to listening
Guidelines for Effective Listening
Listening Comprehension
Audio Visual (Reviews)

Module III [6hrs.]
Discourse Analysis-
Spoken Discourse
Conversational Skills/Spoken Skills
Analyzing Speech dynamics
(Political Speeches
Formal Business Speeches)

Module IV [6hrs.]
Writing Skill-
Descriptive, narrative and expository writing
Writing with a purpose---Convincing skill, argumentative skill/negotiating Skill (These skills will be repeated in oral skills).
Writing reports/essays/articles—logical organization of thoughts
Book review

Suparna Chakraborti.

Reference Books:

1. Munter, Mary. Guide to Managerial Communication. 5thed. Upper Saddle River, NJ: Prentice Hall, 1999.
2. Cypres, Linda. Let's Speak Business English. Hauppauge, NY: Barron's Educational Series, 1999. Crystal, David. 1971. *Linguistics.* Baltimore: Penguin Books.
3. Larsen-Freeman, D. (1986). "Techniques and principles in language teaching." Oxford: Oxford University Press.
4. Littlewood, W. (1981). "Language teaching. An introduction." Cambridge: Cambridge University Press.
5. Savignon, S. J., & Berns, M. S. (Eds.). (1983). "Communicative language teaching: Where are we going? Studies in Language Learning," 4(2). (EDRS No. ED 278 226, 210 pages)

Suparna Chakraborty.

Course Name : Physics I Lab					
Course Code: PHYS1011					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Determination of Young's modulus by Flexure Method and calculation of bending moment and shear force at a point on the beam.
2. Determination of modulus of rigidity by Static/Dynamic Method.
3. Determination of thermal conductivity of a good conductor by Searle's Method.
4. Determination of thermal conductivity of a bad conductor by Lee's and Chorlton's Method.
5. Determination of dielectric constant of a given dielectric material.
6. Use of Carey Foster's bridge to determine unknown resistance.
7. Determination of wavelength of light by Newton's ring method.
8. Determination of wavelength of light by Fresnel's biprism method.
9. Determination of wavelength of light by Laser diffraction method.
10. Determination of dispersive power of the material of a given prism.
11. Determination of co-efficient of viscosity of a liquid by Poiseulle's capillary flow method.

Snayak
10/3/22

Course Name: Physics I					
Course Code: PHYS1001					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I: [22 L]

Optics

1.Interference :

The principle of superposition of waves, Superposition of waves: Two beam superposition, Multiple-beam superposition, coherent and incoherent superposition. Two source interference pattern (Young's double slit), Intensity distribution. Interference in thin films, wedge shaped films and Newton's rings, applications of interference. Newton's rings: Determination of wavelength of light, refractive index of liquid.

2 Diffraction:

Diffraction of light waves at some simple obstacles. Fraunhoffer diffraction through double slit and diffraction grating, grating spectra, resolving power of grating.

3. Polarisation & Fibre Optics:

Elementary features of polarization of light waves.Production and analysis of linearly, elliptic and Circularly polarized light, polaroids and application of polarizations. fibre optics - principle of operation, numerical aperture, acceptance angle

4 Laser

Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.

Module II : [8L]

Waves & Oscillation

Superposition of two linear SHMs (with same frequency), Lissajous' figures. Damped vibration – differential equation and its solution, Critical damping, Logarithmic decrement, Analogy with electric circuits. Forced vibration – differential equation and solution, Amplitude and Velocity resonance, Sharpness of resonance and Quality factor. Progressive wave- Wave equation and its differential form, Difference between elastic (mechanical) and electromagnetic waves.

Nayak
10/3/22

Module III : [9L]

Quantum Mechanics

Need for Quantum physics-Historical overviews, Particle aspects of radiation-Black body radiation, Compton scattering, pair production., Origin of X-ray spectrum. Wave aspect of particles- matter wave, de Broglie Hypothesis, Heisenberg Uncertainty principles- Statement, Interpretation and application.

Module IV: [6L]

Introduction of Crystallography

Space Lattice, Unit Cell, Lattice Parameters, Crystal Systems, Bravais Lattices, Miller Indices and its applications, Crystal Planes and Directions, Inter Planar Spacing of Orthogonal Crystal Systems, Atomic Radius, Co-ordination Number and Packing Factor of SC, BCC, FCC. Bragg's law and its applications.

Text Books

1. Atomic Physics Vol 1 – S.N. Ghoshal
2. Optics – Ajoy Ghak
3. Waves & Oscillation – N.K. Bajaj
4. Quantum Physics of Atoms , Molecules, Solids, Nuclei and particles – Eisberg and Resnick

Reference Books

1. Introduction to Special Relativity – Robert Resnick
2. Prespective on Modern Physics - Arthur Beiser
3. Optics – Jenkins and White
4. University Press – Sears & Zemansky
5. Introduction to modern Physics – Mani and Meheta
6. Optics – Brijlal and Subrahmanyam

Course Outcomes:

After the completion of the course students will be able to

1. Interpret oscillations under different conditions, with the understanding of Resonance phenomena followed by calculation of Q factor
2. Analyze the Quantum phenomenon like Black body radiation , Compton effect and origin of X-ray spectrum
3. Understand the wave character of light through the phenomenon of interference, diffraction and polarization.
4. Study of various crystal structures and classification of different crystal planes.
5. Explain the working principle of LASER, and apply the knowledge in different lasing system and their engineering applications in holography
6. Understand the dual nature of matter, Heisenberg's uncertainty relation and it's various application.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Detailed Syllabus of 3rd Semester:

Subject Name:	**Data Structures & Algorithms**				
Paper Code:	**CSEN 2101**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Pre-requisites:
Introduction to Computing, Mathematics, Set theory

Module -I. [8L] Linear Data Structure I
Introduction (2L): Why we need data structure?
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.
Algorithms and programs, basic idea of pseudo-code.Algorithm efficiency and analysis, time and space analysis of algorithms – Big O, Ω, Θ notations.
Array (2L): Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.
Linked List (4L): Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module -II: [7L] Linear Data Structure II
Stack and Queue (5L): Stack and its implementations (using array, using linked list), applications. Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications. Implementation of deque- with input and output restriction.
Recursion (2L): Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle (Concept of Backtracking).

Module -III. [14L] Nonlinear Data structures
Trees (9L): Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B-Trees – operations (insertion, deletion with examples only).
Graphs (5L): Graph definitions and Basic concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, complete graph, path, shortest path, isomorphism).
Graph representations/storage implementations – adjacency matrix, adjacency list, Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications.

Module - IV. Searching, Sorting (11L):
Sorting Algorithms (6L): Bubble sort and its optimizations, Cocktail Shaker Sort, Insertion sort, Shell sort, Selection sort, Quicksort (Average Case Analysis not required), heap sort (concept of max heap, application – priority queue), Counting Sort, Radix sort.
Searching (2L): Sequential search, Binary search, Interpolation search.
Hashing (3L): Hashing functions, collision resolution techniques (Open and closed hashing).
.
Recommended books:
1. “Data Structures And Program Design In C”, 2/E by Robert L. Kruse, Bruce P. Leung.
2. “Fundamentals of Data Structures of C” by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. “Data Structures in C” by Aaron M. Tenenbaum.
4. “Data Structures” by S. Lipschutz.
5. “Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

Course outcomes:

CO 1: Understand and remember the basics of data structures and how time complexity analysis is applicable to different types of algorithms.
CO 2: Understand the significance and utility of different data structures and the context of their application. (For example, the queue in front of ticket counters uses first-in-first-out paradigm in a linear data structure)
CO 3: Apply different types of data structures in algorithms and understand how the data structures can be useful in those algorithms.
CO 4: Analyze the behavior of different data structures in algorithms. (For example, given an algorithm that uses a particular data structure, how to calculate its space and time complexity.)
CO 5: Evaluate solutions of a problem with different data structures and thereby understand how to select suitable data structures for a solution. (For example, what are the different ways to find the second largest number from a list of integers and which solution is the best.)
CO 6: Evaluate different types of solutions (e.g. sorting) to the same problem.

Subject Name: Discrete Mathematics					
Paper Code: CSEN 2102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module I: 10L

Introduction to Propositional Calculus: Propositions, Logical Connectives, Truth Tables; Conjunction, Disjunction, Negation, Implication, Converse, Contrapositive, Inverse, Biconditional Statements; Logical Equivalence, Tautology, Normal Forms, CNF and DNF; Predicates, Universal and Existential Quantifiers, Bound and Free Variables, Examples of Propositions with Quantifiers.

Module II: 12L

Counting Techniques: Permutations and Combinations, Distinguishable and Indistinguishable Objects, Binomial Coefficients, Generation of Permutations and Combinations; Pigeon-hole Principle, Generalized Pigeon-Hole Principle, Principle of Inclusion and Exclusion; Generating Functions and Recurrence Relations, Solving Recurrence Relations Using Generating Functions and Other Methods; Solving the Recurrence Relation for the Fibonacci Sequence; Divide-and-Conquer Methods, Formulation and Solution of Recurrence Relations in Computer Sorting, Searching and Other Application Areas.

Module III: 18L

Graphs and Trees: Directed and Undirected Graphs, Review of Basic Concepts and Definitions; Connectivity of Graphs, Point and Edge Connectivity, 1- and 2- Connectivity, Examples; Planarity: Examples of Planar and Non-planar Graphs, Kuratowski's Theorem (Statement and Discussion, omit proof); Colorability: Chromatic Numbers, Heuristic Methods for Determining Chromatic Numbers, Independence and Clique Numbers, Chromatic Polynomials, Applications of Graph Coloring; Kempe Chains, Five Colour Theorem for Planar Graphs; Four Colour Theorem (Statement and Discussion, omit proof).
Matchings: Definition and Examples, Perfect Matchings, Maximal Matchings, Hall's Theorem, Applications.

References:

1. K Rosen. Discrete Mathematics and Its Applications (7th Ed), McGraw-Hill
2. Douglas B. West, Introduction to Graph Theory (2nd Ed), PHI.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course outcomes:

CO 1: Understand and remember the basics of data structures and how time complexity analysis is applicable to different types of algorithms.
CO 2: Understand the significance and utility of different data structures and the context of their application. (For example, the queue in front of ticket counters uses first-in-first-out paradigm in a linear data structure)
CO 3: Apply different types of data structures in algorithms and understand how the data structures can be useful in those algorithms.
CO 4: Analyze the behavior of different data structures in algorithms. (For example, given an algorithm that uses a particular data structure, how to calculate its space and time complexity.)
CO 5: Evaluate solutions of a problem with different data structures and thereby understand how to select suitable data structures for a solution. (For example, what are the different ways to find the second largest number from a list of integers and which solution is the best.)
CO 6: Evaluate different types of solutions (e.g. sorting) to the same problem.

Subject Name: Discrete Mathematics					
Paper Code: CSEN 2102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module I: 10L

Introduction to Propositional Calculus: Propositions, Logical Connectives, Truth Tables; Conjunction, Disjunction, Negation, Implication, Converse, Contrapositive, Inverse, Biconditional Statements; Logical Equivalence, Tautology, Normal Forms, CNF and DNF; Predicates, Universal and Existential Quantifiers, Bound and Free Variables, Examples of Propositions with Quantifiers.

Module II: 12L

Counting Techniques: Permutations and Combinations, Distinguishable and Indistinguishable Objects, Binomial Coefficients, Generation of Permutations and Combinations; Pigeon-hole Principle, Generalized Pigeon-Hole Principle, Principle of Inclusion and Exclusion; Generating Functions and Recurrence Relations, Solving Recurrence Relations Using Generating Functions and Other Methods; Solving the Recurrence Relation for the Fibonacci Sequence; Divide-and-Conquer Methods, Formulation and Solution of Recurrence Relations in Computer Sorting, Searching and Other Application Areas.

Module III: 18L

Graphs and Trees: Directed and Undirected Graphs, Review of Basic Concepts and Definitions; Connectivity of Graphs, Point and Edge Connectivity, 1- and 2- Connectivity, Examples; Planarity: Examples of Planar and Non-planar Graphs, Kuratowski's Theorem (Statement and Discussion, omit proof); Colorability: Chromatic Numbers, Heuristic Methods for Determining Chromatic Numbers, Independence and Clique Numbers, Chromatic Polynomials, Applications of Graph Coloring; Kempe Chains, Five Colour Theorem for Planar Graphs; Four Colour Theorem (Statement and Discussion, omit proof).
Matchings: Definition and Examples, Perfect Matchings, Maximal Matchings, Hall's Theorem, Applications.

Dr. Subhashis Majumder
Professor and HOD

References:

1. K Rosen. Discrete Mathematics and Its Applications (7th Ed), McGraw-Hill
2. Douglas B. West, Introduction to Graph Theory (2nd Ed), PHI.

Course Outcomes:
After successfully completing this course the students will be able to:

CSEN2102. 1. Interpret the problems that can be formulated in terms of graphs and trees.
CSEN2102. 2. Explain network phenomena by using the concepts of connectivity, independent sets, cliques, matching, graph coloring etc.
CSEN2102. 3. Achieve the ability to think and reason abstract mathematical definitions and ideas relating to integers through concepts of well-ordering principle, division algorithm, greatest common divisors and congruence.
CSEN2102. 4. Apply counting techniques and the crucial concept of recurrence to comprehend the combinatorial aspects of algorithms.
CSEN2102. 5. Analyze the logical fundamentals of basic computational concepts.
CSEN2102. 6. Compare the notions of converse, contrapositive, inverse etc in order to consolidate the comprehension of the logical subtleties involved in computational mathematics.

Subject Name:	**Object Oriented Programming**				
Paper Code:	**CSEN 2103**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1:

- **Overview of Object Oriented Programming Concepts** **[1L]**
  - Difference between OOP and procedural programming – advantages & disadvantages. class, object, message passing, inheritance, encapsulation, polymorphism
- **OOP with C++:** **[21L]**
  - Basic Programming Concepts: **[2L]**
    - Data Types, Operators, Control Statements & Loops, Functions & Parameters, Arrays, Pointers & References
  - Class & Object, Abstraction / Encapsulation, Access Specifier **[3L]**
  - Static Member, Friend Function **[2L]**
  - Constructor and Destructor **[2L]**

Module 2:

- **OOP with C++:**
  - Function and Operator Overloading **[2L]**
  - Inheritance and Derived Class **[3L]**
  - Abstract Class, Runtime Polymorphism, Virtual Base Class, Overriding **[2L]**
  - Exception Handling **[1L]**
  - Namespaces, Class Template and Function Template **[2L]**

Module 3:

- **OOP with Java:** **[21L]**
  - Features of Java, Byte Code & JVM, Concepts of Java Application and Applet **[1L]**
  - Basic Programming Concepts: **[3L]**
    - Data Types, Operators, Control Statements & Loops, Functions & Parameters, Array
    - String Handling Concepts & related Functions, Command Line Arguments
    - User Input through Scanner
  - Class & Object, Access Specifier, Static Members, Constructor, Garbage Collector, Nested & Inner Class **[3L]**
  - Function Overloading, Inheritance, Runtime Polymorphism, Abstract Class **[3L]**

Module 4:

- Package and Interface **[2L]**
- Exception Handling: **[2L]**

Course Outcomes:

After successfully completing this course the students will be able to:

CSEN2102. 1. Interpret the problems that can be formulated in terms of graphs and trees.
CSEN2102. 2. Explain network phenomena by using the concepts of connectivity, independent sets, cliques, matching, graph coloring etc.
CSEN2102. 3. Achieve the ability to think and reason abstract mathematical definitions and ideas relating to integers through concepts of well-ordering principle, division algorithm, greatest common divisors and congruence.
CSEN2102. 4. Apply counting techniques and the crucial concept of recurrence to comprehend the combinatorial aspects of algorithms.
CSEN2102. 5. Analyze the logical fundamentals of basic computational concepts.
CSEN2102. 6. Compare the notions of converse, contrapositive, inverse etc in order to consolidate the comprehension of the logical subtleties involved in computational mathematics.

Subject Name:	**Object Oriented Programming**				
Paper Code:	**CSEN 2103**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1:

- **Overview of Object Oriented Programming Concepts** **[1L]**
  - Difference between OOP and procedural programming – advantages & disadvantages. class, object, message passing, inheritance, encapsulation, polymorphism
- **OOP with C++:** **[21L]**
  - Basic Programming Concepts: **[2L]**
    - Data Types, Operators, Control Statements & Loops, Functions & Parameters, Arrays, Pointers & References
  - Class & Object, Abstraction / Encapsulation, Access Specifier **[3L]**
  - Static Member, Friend Function **[2L]**
  - Constructor and Destructor **[2L]**

Module 2:

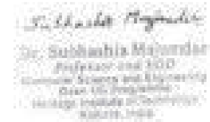
- **OOP with C++:**
  - Function and Operator Overloading **[2L]**
  - Inheritance and Derived Class **[3L]**
  - Abstract Class, Runtime Polymorphism, Virtual Base Class, Overriding **[2L]**
  - Exception Handling **[1L]**
  - Namespaces, Class Template and Function Template **[2L]**

Module 3:

- **OOP with Java:** **[21L]**
  - Features of Java, Byte Code & JVM, Concepts of Java Application and Applet **[1L]**
  - Basic Programming Concepts: **[3L]**
    - Data Types, Operators, Control Statements & Loops, Functions & Parameters, Array
    - String Handling Concepts & related Functions, Command Line Arguments
    - User Input through Scanner
  - Class & Object, Access Specifier, Static Members, Constructor, Garbage Collector, Nested & Inner Class **[3L]**
  - Function Overloading, Inheritance, Runtime Polymorphism, Abstract Class **[3L]**

Module 4:

- Package and Interface **[2L]**
- Exception Handling: **[2L]**



- Types of Exception Classes, Use of Try & Catch with Throw, User-defined Exceptions Classes
- Threads, Communication and Synchronization of Threads: **[3L]**
  - Multithreading, Thread Lifecycle, Thread Priorities, Inter-thread Communication
- Applet Programming (using Swing): **[4L]**
  - Applet Lifecycle, Application & Applet, Parameter Passing, Event Model & Listener, I/O

References:

1. The C++ Programming Language by Stroustrup, Adisson Wesley
2. Object Oriented Programming in C++ by R. Lafore, SAMS
3. Java 2.0 Complete Reference by H. Schildt, McGrawHill
4. JAVA How to Program by Deitel and Deitel, Prentice Hall
5. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH
6. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Outcome:
Students who complete the course will demonstrate the ability to do the following:
1. *Learn* the features of C++ and Java supporting object oriented programming
2. *Understand* the relative merits of C++ and Java as object oriented programming language
3. *Apply* the features learned to design object-oriented software template using C++ and Java
4. *Estimate* the performance of the software written in C++ and Java
5. *Evaluate* the performance of the software and compare the effectiveness of two different language (C++ and Java)
6. *Develop* the object oriented software using C++ and Java.

Subject Name: Digital Logic					
Paper Code: ECEN 2104					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:
1. Students will learn Binary Number system
2. Student should be able to do logic design using combinational gates
3. Student should be able to design Sequential Circuits
4. Student should be able to do design of Finite State Machine
5. Students will learn Memory classifications
6. Students will learn basic CMOS logic
7. Students will prepare to learn various digital component design as used in VLSI applications.

Lecture hours: 40
Module 1: Binary System, Boolean Algebra and Logic Gates [10L]:
Data and number systems; Binary, Octal and Hexadecimal representation and their conversions, BCD, Gray codes, excess 3 codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De-Morgan's theorem, Various Logic gates - their truth tables and circuits, universal logic gates, Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, Karnaugh-map method, Quine-McCluskey method.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Data Structure &Algorithms Lab					
Paper Code: CSEN 2111					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

Introduction, Arrays, Linked Lists:
Day 1: Time and Space Complexity
Create three different 10,000 x 10,000 matrices matrixOne, matrixTwo and result- Matrix, using dynamic memory allocation. Initialize matrixOne and matrixTwo by using rand() or srand() function, limit the values from 0 to 9. Multiply matrixOne and matrixTwo into resultMatrix.
While execution, open another terminal and use top command to see the usage of memory by the process. Calculate the time taken for the execution of the program.
Home Assignment

1. Write a program (WAP) to check whether a matrix is i) identity, ii) diagonal.
2. WAP to reverse the elements of an array without using any other variable.

Day 2: Array

1. WAP to add two polynomials using array. Minimize the memory usage as much as you can.
2. Write a program to convert a matrix into its sparse representation (triple format). Once represented in sparse format, do not revert back to the matrix format any-more. Manipulate the sparse representation to find the transpose of the matrix (which should also be in sparse representation). Calculate and find out whether using triple format for your example is advantageous or not.

Home Assignment

1. WAP to add two matrices using sparse representation. Manipulation of data should be done in sparse format.

Day 3: Singly Linked List
Write a menu driven program to implement a singly linked list with the operations:
i) create the list
ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate)
iv) display the list v) reverse the list
Home Assignment

1. Represent a polynomial as a linked list and write functions for polynomial addition.

Day 4: Doubly Linked List
i) create the list
ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate)
iv) display the list
Home Assignment
Implement a double-ended queue (dequeue) where insertion and deletion operations are possible at both the ends.

Linear Data Structures
Day 5: Stack, Queue - with array

1. Write a menu driven program to implement stack, using array, with i) push, ii) pop, iii) display, iv) exit operations

2. WAP to evaluate a postfix expression.

3. Write a menu driven program to implement a queue, using array, with

i) insert, ii) delete, iii) display, iv) exit operations.

Home Assignment
WAP to convert an infix expression to its corresponding postfix operation.

Day 6: Stack, Queue - with linked list
Write a menu driven program to implement a stack, using linked list, with
i) push, ii) pop, iii) display, iv) exit operations
Write a menu driven program to implement a queue, using linked list, with
i) insert, ii) delete, iii) display, iv) exit operations

Home Assignment
Write a menu driven program to implement a circular queue, using linked list, with
i) insert, ii) delete, iii) display, iv) exit operations.

Non-linear Data Structures

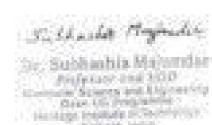
Day 7: Binary Search Tree (BST)
Write a program, which creates a binary search tree (BST). Also write the functions to insert, delete (all possible cases) and search elements from a BST.

Home Assignment
Write three functions to traverse a given BST in the following orders:
i) in-order, ii) pre-order, iii) post-order. Display the elements while traversing.

Algorithms:
Day 8: Searching, hashing
WAP to implement,
i) Linear Search, ii) Binary Search (iterative), iii) Interpolation Search. Plot their running time for different size of input to compare their performance.
NB: As a pre-processing step, use bubble-sort to sort the elements in the search space.
Implement hashing with open addressing or closed hashing.

Home Assignment
WAP to generate integers from 1 to n (input parameter) in random order and guarantees that no number appears twice in the list. While the number sequence is being generated, store it in a text file.

Day 9: Sorting
Write different functions for implementing,
i) Cocktail shaker sort,
ii) Heap sort,
iii) Merge Sort.
Plot a graph of n vs. time taken, for n = 100, 1000, 10,000 and 100,000 to compare the performances of the sorting methods mentioned above.



Home Assignment
Write different functions for implementing, i) Insertion sort, ii) Quick sort.

Graph Algorithms:
Day 10: DFS BFS
Read a graph (consider it to be undirected) from an edge-list and store it in an adjacency list.
Use the adjacency list to run DFS algorithm on the graph and print the node labels.
Detect and count the back-edges.

Home Assignment
WAP to implement BFS algorithm of a given graph (similarly as described for DFS, instead of back-edges count cross-edges).

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcome:

The objectives of this course are:
CO1. To understand linear and non-linear data structures.
CO2. To understand different types of sorting and searching techniques.
CO3. To know how to create an application specific data structures.
CO4. To solve the faults / errors that may appear due to wrong choice of data structure.
CO5. To analyze reliability of different data structures in solving different problems.
CO6. To evaluate efficiency in terms of time and space complexity, when different data structures are used to solve same problem.

Subject Name: **Software Tools**					
Paper Code: **CSEN 2112**					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

CodeLite IDE
Learn to use CodeLite IDE for wrtiing C/C++ programming languages
Compiling with gcc
Learn all the command line options for compiling C programs in the unix environment using gcc
Git for sharing files and version control
Learn how to setup a repository so that it will be easy to sync your local with that on the server. Learn to use cvs for version controlling
Debugging with gdb
gdb is the standard C/C++ debugger to debug your code. Learn to interact with gdb directly via a shell, or use a graphical interface provided by CodeLite IDE.
Makefiles
Learn how you use makefile on Unix to properly build an executable.
Code coverage testing with gcov
Learn about good testing using gcov is used to make sure the tests are exercising all the branches in the code .
Runtime profiling with gprof
Learn about using gprof which is a very useful *profiling* tool for speeding up execution speed of a program: it will show where your program is spending most of its time, so one can know about the most important code to optimize.
Memory profiling with valgrind
Learn to use valgrind which is a critical tool for helping one to find memory leaks in the program: malloc without free, accessing an array outside its bounds, etc.

Course Outcomes:

CO 1. Understand the importance of knowing various tools to make programs more effective.
CO 2. Learn the concept and use of integrated development environment.
CO 3. Analyze the errors in a code using debugging methods in both Windows and Linux environment.
CO 4. Understand the need for version control and learn effective methods to do the same.
CO 5. Analyze a code with code coverage testing and know how to speed up execution using profiling tools.
CO 6. Demonstrate the utility of effectively using software tools to minimize memory leaks and bad memory manipulations in programs.

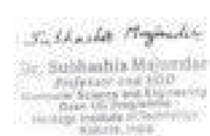
COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcome:

The objectives of this course are:
CO1. To understand linear and non-linear data structures.
CO2. To understand different types of sorting and searching techniques.
CO3. To know how to create an application specific data structures.
CO4. To solve the faults / errors that may appear due to wrong choice of data structure.
CO5. To analyze reliability of different data structures in solving different problems.
CO6. To evaluate efficiency in terms of time and space complexity, when different data structures are used to solve same problem.

Subject Name:	**Software Tools**				
Paper Code:	**CSEN 2112**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

CodeLite IDE
Learn to use CodeLite IDE for wrtiing C/C++ programming languages
Compiling with gcc
Learn all the command line options for compiling C programs in the unix environment using gcc
Git for sharing files and version control
Learn how to setup a repository so that it will be easy to sync your local with that on the server.
Learn to use cvs for version controlling
Debugging with gdb
gdb is the standard C/C++ debugger to debug your code. Learn to interact with gdb directly via a shell, or use a graphical interface provided by CodeLite IDE.
Makefiles
Learn how you use makefile on Unix to properly build an executable.
Code coverage testing with gcov
Learn about good testing using gcov is used to make sure the tests are exercising all the branches in the code .
Runtime profiling with gprof
Learn about using gprof which is a very useful *profiling* tool for speeding up execution speed of a program: it will show where your program is spending most of its time, so one can know about the most important code to optimize.
Memory profiling with valgrind
Learn to use valgrind which is a critical tool for helping one to find memory leaks in the program: malloc without free, accessing an array outside its bounds, etc.



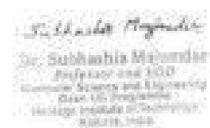
Course Outcomes:

CO 1. Understand the importance of knowing various tools to make programs more effective.
CO 2. Learn the concept and use of integrated development environment.
CO 3. Analyze the errors in a code using debugging methods in both Windows and Linux environment.
CO 4. Understand the need for version control and learn effective methods to do the same.
CO 5. Analyze a code with code coverage testing and know how to speed up execution using profiling tools.
CO 6. Demonstrate the utility of effectively using software tools to minimize memory leaks and bad memory manipulations in programs.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Object Oriented Programming Lab					
Paper Code: CSEN 2113					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

- Assignments on C++: [based on Lectures]
  1. Basic Programming
  2. Class
  3. Overloading
  4. Inheritance
  5. Polymorphism
  6. Templates
- Assignments on Java: [based on Lectures]
  1. Basic Programming
  2. Class
  3. Overloading
  4. Inheritance
  5. Interfaces and Packages
  6. Exception Handling
  7. Threads
  8. Applets



Course Outcomes:

Students who complete the course will demonstrate the ability to do the following:

1. *Learn* the characteristics and the behaviors of object oriented programming and implement them in C++ and Java.
2. *Understand* any given code written in C++ and Java and also write programs in these languages.
3. *Explain and analyze* the building blocks of OOPs (Encapsulation, Overloading, Inheritance and Abstraction) in any real world problem and *design* the solution accordingly.
4. *Defend and argue* the application of the specific tool to solve a given problem.

Subject Name: Digital Logic Lab					
Paper Code: ECEN 2114					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

Choose any Ten

1. Realization of basic gates using Universal logic gates.
2. Four-bit parity generator and comparator circuits.
3. Code conversion circuits BCD to Excess-3 & vice-versa.
4. Construction of simple 3 to 8 Decoder circuit by 2 to 4 Decoders using logic gates.
5. Design a 4 to 1 Multiplexer using logic gates and use it as a Universal logic module.
6. Realization of RS-JK and D flip-flops using Universal logic gates.
7. Construction of simple arithmetic logic circuits-Adder, Subtractor.
8. Realization of Asynchronous Up/Down Counter (Count up to 7) using logic gates.
9. Realization of Synchronous Up/Down Counter (Count up to 7) using logic gates.
10. Realization of Shift Registers using logic gates (Serial in Serial out and Parallel in Serial out)
11. Construction of Serial adder circuit using a D Flip-Flop and a Full adder.
12. Design a combinational circuit for BCD to Decimal conversion to drive 7-Segment display using logic gates.

Joint distribution using joint probability mass/density function. Finding marginal pmf/pdf from joint. Multiplicative property of joint pmf/pdf in case of independent random variables.

References:

1. Miller & Freund's Probability and Statistics for Engineers, R.A.Johnson, Prentice Hall of India
2. Numerical Mathematical Analysis, J.B.Scarborough, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Numerical Methods (Problems and Solution), Jain, Iyengar , & Jain, New Age International Publishers
4. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons
5. A First course in Probability, Sheldon Ross, Pearson
1. Introduction to Stochastic Processes, Paul G. Hoel, Sidney C. Port & Charles J. Stone University Bookstall, New Delhi (Houghton Pliffin Company, 1972)
6. Introduction to Probability Models, Sheldon Ross, Elsevier India

Course Outcome:

After successfully completing this course the students will be able to:

1. Articulate the axioms (laws) of probability.
2. Compare and contrast different interpretations of probability theory and take a stance on which might be preferred.
3. Formulate predictive models to tackle situations where deterministic algorithms are intractable.
4. Summarize data visually and numerically
5. Assess data-based models.
6. Apply tools of formal inference.

Subject Name:	**Design & Analysis of Algorithms**				
Paper Code:	**CSEN 2201**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module I

1. Algorithm Analysis (7 Lectures)

Time and space complexity. Asymptotic Notations and their significance.
Asymptotic Analysis. Finding time complexity of well known algorithms like-mergesort, heapsort, quicksort. Randomized Quicksort. Average Case Analysis. Asymptotic solution to recurrences. Master Theorem.

2. Medians and Order Statistics. (3 Lectures)

Module II

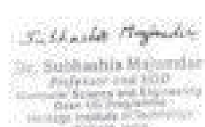
3. Dynamic Programming (6 Lectures)

Basic method, use, Examples: Matrix-chain multiplication, All pair shortest paths, LCS Problem. Optimal Binary Search Trees: Algorithm and speedup using quadrangle inequality.

4. Greedy Method (6 Lectures)

Elements of the greedy strategy. Huffman codes. Matroids and the greedy methods. Minimum cost spanning trees: Prim's and Kruskal's algorithms and their correctness proofs.

Module III



5. Amortized Analysis (2 Lectures)

Aggregate, Accounting and Potential methods.

6. Disjoint Set Manipulation (2 Lectures)

UNION-FIND with union by rank, Path compression.

7. Graphs Algorithms (6 Lectures)

Topological Sorting. Strongly Connected Components. Shortest Path Algorithms: Dijkstra's and Bellman Ford with correctness proofs.

Module IV
8. Lower Bound Theory (1 Lecture)
Bounds on sorting and searching techniques.
9. NP-completeness (4 Lectures)
P class, NP-hard class, NP-complete class. Relative hardness of problems and polynomial time reductions. Satisfiability problem, Vertex Cover Problem, Independent Sets, Clique Decision Problem.
10. Approximation algorithms (3 Lectures)
Necessity of approximation scheme, performance guarantee. Approximation algorithms for 0/1 knapsack, vertex cover, TSP. Polynomial time approximation schemes: 0/1 knapsack problem.

TEXTBOOKS:
1. Introduction To Algorithms by Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design by Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.REFERENCE:
3. Computer Algorithms: Introduction to Design and Analysis by Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

COURSE OUTCOMES
After completion of the course, students would be able to:
1. Remember time complexities of various existing algorithms in different situations.
2. Understand the basic principles of different paradigms of designing algorithms.
3. Apply mathematical principles to solve various problems.
4. Analyze the complexities of various algorithms.
5. Evaluate the performance of various algorithms in best case, worst case and average case.
6. Create/ Design a good algorithm for a new problem given to him/ her.

Subject Name: Computer Organization					
Paper Code: CSEN 2203					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module No-1: Basics of Computer Organization: (10L)
Basic organization of the stored program computer and operation sequence for execution of a program, Von Neumann & Harvard Architecture. RISC vs. CISC based architecture. (4L)
Fetch, decode and execute cycle, Concept of registers and storage, Instruction format, Instruction sets and addressing modes. (6L)
Module No-2: Basics of ALU Design: (10L)
Binary number representation; Fixed and Floating point representation of numbers. (2L)
Adders: Serial and Parallel adders, Ripple Carry / Carry Lookahead / Carry Save; (4L)
Multipliers & Divider Circuits: Multiplication of signed binary numbers Booth Multipliers; (4L)
Module No-3: Basics of Control Unit Design and Pipelining: (12L)
Design of a control unit: Data path design. (8L)
Single Cycle Datapath for : ALU design / Data Movement Instructions / Control Unit Design;
Multi cycle microarchitecture; concept of states and transitions;
Hardwired and Microprogrammed control. The state machine;
Horizontal and Vertical micro instruction, Microprogrammed control design techniques;
Pipelining: (4L)
Basic concepts, Instruction and arithmetic pipeline; Elementary concepts of hazards in pipeline and techniques for their removal.
Module No-4: Memory and I/O Organization: (10L)
Memory system overview, Cache memory organizations, Techniques for reducing cache misses,

Module IV

8. Lower Bound Theory (1 Lecture)

Bounds on sorting and searching techniques.

9. NP-completeness (4 Lectures)

P class, NP-hard class, NP-complete class. Relative hardness of problems and polynomial time reductions. Satisfiability problem, Vertex Cover Problem, Independent Sets, Clique Decision Problem.

10. Approximation algorithms (3 Lectures)

Necessity of approximation scheme, performance guarantee. Approximation algorithms for 0/1 knapsack, vertex cover, TSP. Polynomial time approximation schemes: 0/1 knapsack problem.

TEXTBOOKS:

1. Introduction To Algorithms by Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design by Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.REFERENCE:
3. Computer Algorithms: Introduction to Design and Analysis by Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

COURSE OUTCOMES

After completion of the course, students would be able to:

1. Remember time complexities of various existing algorithms in different situations.
2. Understand the basic principles of different paradigms of designing algorithms.
3. Apply mathematical principles to solve various problems.
4. Analyze the complexities of various algorithms.
5. Evaluate the performance of various algorithms in best case, worst case and average case.
6. Create/ Design a good algorithm for a new problem given to him/ her.

Subject Name: Computer Organization					
Paper Code: CSEN 2203					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module No-1: Basics of Computer Organization: (10L)

Basic organization of the stored program computer and operation sequence for execution of a program, Von Neumann & Harvard Architecture. RISC vs. CISC based architecture. (4L)

Fetch, decode and execute cycle, Concept of registers and storage, Instruction format, Instruction sets and addressing modes. (6L)

Module No-2: Basics of ALU Design: (10L)

Binary number representation; Fixed and Floating point representation of numbers. (2L)

Adders: Serial and Parallel adders, Ripple Carry / Carry Lookahead / Carry Save; (4L)

Multipliers & Divider Circuits: Multiplication of signed binary numbers Booth Multipliers; (4L)

Module No-3: Basics of Control Unit Design and Pipelining: (12L)

Design of a control unit: Data path design. (8L)

Single Cycle Datapath for : ALU design / Data Movement Instructions / Control Unit Design;

Multi cycle microarchitecture; concept of states and transitions;

Hardwired and Microprogrammed control. The state machine;

Horizontal and Vertical micro instruction, Microprogrammed control design techniques;

Pipelining: (4L)

Basic concepts, Instruction and arithmetic pipeline; Elementary concepts of hazards in pipeline and techniques for their removal.

Module No-4: Memory and I/O Organization: (10L)

Memory system overview, Cache memory organizations, Techniques for reducing cache misses.

Hierarchical memory technology: Inclusion, Coherence and locality properties, Virtual Memory, Memory mapped IO. (6L)
Introduction to I/O interfaces. Interrupts, Interrupt hardware, Enabling and Disabling interrupts; Concept of handshaking, Polled I/O, Priorities, Daisy Chaining. Vectored interrupts;
Direct memory access, DMA controller. Instruction sequencing with examples. (4L)

Text Books:
1. Computer Organization, 5th Edition, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, MGH
2. Computer System Architecture, 3rd Edition, Morris M. Mano, Pearson
3. Computer Organization and Design: The Hardware/Software interface, David A. Patterson and John L. Hennessy, 3rd Edition, Elsevier, 2005.
4. NPTEL materials on Computer Organization.

Subject Name: Indian Culture and Heritage					
Paper Code: HMTS 2002					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**1**

Module I
Indian Religion &Philosophy
1. Orthodox Indian Philosophy:
2. Unorthodox Indian philosoph:
3. Essentials of Hinduism
4. An overview of Jainism, Buddhism, Sikhism, Islam, Christianity religions

Module II
Values and Personality
1. Aspects of Indian Values
2. Essentials of Personality Building
3. Ethics at work place
4. Aspects of Leadership qualities

Module III
Indian Scriptures
1. Selections from the Vedas
2. Select verses from Upanishad
3. An overview of Gita
4. XVI the chapter of Gita

Module IV
Indian Psychology
1. Aspects of Yoga Philosophy
2. Mind and its workings according to Yoga
3. Law of Karma
4. Selections from Manusmriti

References:
1. Indian Philosophy by S.C. Chatter and D. M. Dutta, Calcutta University Press
2. Spiritual Heritage of India, Swami Prabhavananda, Sri Ramakrishna Math, Chennai
3. Raja Yoga by Swami Vivekananda, Advaita Ashrama, Mayavati

4. Vedic Selection, Calcutta University Press
5. Gita by Swami Swarupananda, Advaita Ashrama, Kolkata
6. Upanishads by any press
7. Carving a Sky (MSS) by Samarpan
8. Essentials of Hinduism (MSS) by Samarpan
9. The Call of the Vedas — Bharatiya Vidya Bhavan

Subject Name:	**Algorithm Implementation Lab**				
Paper Code:	**CSEN 2211**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

In this laboratory Students should run all the programs using C programming language on LINUX platform and then estimate the running time of their programs in best & worst case situations for large dataset.

A tentative outline of the laboratory is given below:

- Implement Heapsort algorithm, where heap is implemented using priority queue
- Divide and Conquer: Find Maximum and Minimum element from a array of integer using Divide and Conquer approach
- Divide and Conquer: Implement Quick Sort using Divide and Conquer approach. Check the running time for different positions of pivot elements. Implement the randomized version of quick sort
- Dynamic Programming: Find the minimum number of scalar multiplication needed for chain of Matrices
- Dynamic Programming: Implement Single Source shortest Path for a graph (Dijkstra and Bellman Ford Algorithm)
- Dynamic Programming: Implement all pair of Shortest path for a graph (Floyd- Warshall
- Algorithm)
- Greedy method: implement fractional Knapsack Problem, MST by Prim's algorithm
- Greedy method: Implement MST by Kruskal's algorithm by using Union operation on Disjoint data Structures.
- Graph Traversal Algorithm: Implement Depth First Search (DFS), application of DFS (do
- topological sorting, identify strongly connected components)
- Implement KMP algorithm for string matching
- Implement Ford-Fulkerson algorithm to get maximum flow of a given flow network.

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Professor and HOD

Course Outcomes/Learning Objectives:

- On completion this course, students are expected to be capable of understanding basic ability to analyze algorithms and to determine algorithm correctness and time efficiency class.
- Beside this students should be able to understand basic features of different algorithm design paradigms like divide and conquer, greedy, dynamic programming etc.
- Last but not the least, students will be able to apply and implement learned algorithm design techniques and data structures to solve various real life problems.

Subject Name:	**Physics II Lab**				
Paper Code:	**PHYS 2011**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Name : DATA STRUCTURE AND BASIC ALGORITHMS					
Course Code: CSEN2001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

<u>Learning outcome:</u>

Ideally this course should act as a primer/pre-requisite for CS 503 (Design and Analysis of Algorithms). On completion of this course, students are expected to be capable of understanding the data structures, their advantages and drawbacks, how to implement them in C, how their drawbacks can be overcome and what the applications are and where they can be used. Students should be able to learn about the data structures/ methods/algorithms mentioned in the course with a comparative perspective so as to make use of the most appropriate data structure/ method/algorithm in a program to enhance the efficiency (i.e. reduce the running time) or for better memory utilization, based on the priority of the implementation. Detailed time analysis of the graph algorithms and sorting methods are expected to be covered in CS503 but it is expected that the students will be able to understand at least the efficiency aspects of the graph and sorting algorithms covered in this course. The students should be able to convert an inefficient program into an efficient one using the knowledge gathered from this course.

<u>Detailed Syllabus:</u>

Module–I: [8L] Linear Data Structure I

Introduction: Why we need data structure? 2L

Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.

Algorithms and programs, basic idea of pseudo-code.Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.

Array: 2L

Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.

Linked List: 4L

Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module-II: [7L] Linear Data Structure II

Stack and Queue: 5L

Stack and its implementations (using array, using linked list), applications.

Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications.Implementation of deque- with input and output restriction.

Recursion: 2L

Principles of recursion – use of stack, differences between recursion and iteration, tail recursion.

Module-III: [13L] Nonlinear Data structures

Trees: 9L

Basic terminologies, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only).

Graphs: 4L

Graph representations/storage implementations – adjacency matrix, adjacency list,
Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS)

Module-IV: [12L] Searching, Sorting,Hashing:

Sorting Algorithms: 7L

Bubble sort, insertion sort, shell sort, selection sort, merge sort, quicksort, heap sort, radix sort.

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Searching: 2L

Sequential search, binary search, Interpolation Search

Hashing: 3L

Hashing functions, collision resolution techniques (Open and closed hashing).

References:

1. "Data Structures And Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. "Data Structures in C" by Aaron M. Tenenbaum.
4. "Data Structures" by S. Lipschutz.
5. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

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Course Name : DIGITAL ELECTRONICS					
Course Code: INFO2101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

<u>After successfully completing this course the students will be able to:</u>

3(a) **Assess** the utility of combinational logic circuit and sequential logic circuit.
3(b) **Develop** Boolean expression **applying** the knowledge of logic gates and De Morgan's theorem.
3(c)Design logic circuits of corresponding Boolean function **applying** the minimization technique of Karnaugh map Quine-Mc Cluskey methods and MOD-N counter.
- **Compare** between different types of Flip Flops.

3(d) **Apply** their knowledge of number system to convert a number of any given base to another number of required base.
3(e)Describe different types of counters such as Ring Counter, Jhonson counter.
3(f) **Explain** A/D and D/A conversion techniques.

<u>Detailed Syllabus:</u>

Module-I: [7L]
*Number Systems:*Review of number systems, BCD codes and arithmetic, Gray code, self-complimenting codes, Error detection and correction principles.
Digital Circuits: Switching algebra & simplification of Boolean expressions. De Morgan's Theorem. Implementations of Boolean expressions using logic gates.

Module-II: [14L]
Combinational Logic Circuit: Combinational circuit analysis and synthesis, Techniques for minimization of Boolean functions such as Karnaugh map Quine-Mc Cluskey methods. Multiplexers, de-multiplexers, encoders, decoders, comparators, adder, BCD. Parity generators and checker.
Sequential Logic Circuit: Need for sequential circuits, Binary cell, Latches and flip-flops. RS, JK,Master-Slave JK, D & T flip flops.

Module-III: [8L]
Synchronous Sequential Circuit: Registers (SISO, SIPO, PIPO, PISO), Ring counter, Johnson counter, Basic concept of Synchronous and Asynchronous counters ,Shift register, Design of Mod N Counter, Timing issues in synchronous circuits.

Module-IV: [7L]
A/D and D/A conversion techniques – Basic concepts A/D: successive approximation. Logic families-TTL, ECL, MOS and CMOS - basic concepts.
Fundamentals of Asynchronous Sequential circuits. Analysis and design of Asynchronous Sequential circuits. Pulse mode and Fundamental-mode Circuits.

References:

1. Donald D.Givone, ―Digital Principles and Design‖, Tata McGraw Hill, 2002.
2. Morris Mano, ―Digital design‖, Prentice Hall of India ,Third Edition.
3. William I. Fletcher, ―An Engineering approach to Digital Design‖, Prentice Hall of India, 2009.
4. Zvi Kohavi, ―Switching and Finite Automata Theory‖, Tata Mc Graw Hill, second edition.
5. A. Ananda Kumar, ―Switching Theory and Logic Design‖, Prentice Hall of India ,2009.
6. C.H.Roth, ―Fundamentals of Logic Design‖, Thomson, 2000

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Heritage Institute of Technology

Course Name : COMPUTER ORGANIZATION					
Course Code: INFO2102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

- **Justify** the necessity of using pipeline architecture over non pipeline architecture.
- **Compare** between different page replacement algorithms.
- **Design** memory unit with the help of decoder, multiplexer, and register.
- **Construct** ALU considering basic arithmetical problems (addition, subtraction, multiplication, division) and logical problems.
- **Design** 4 bit ripple carry adder and carry look ahead adder.
- **Formulate** different solution strategy for different type of instructions.

3(g) **Analyze** the difference between Von Neuman architecture and Havard architecture.
3(h) **Demonstrate** different mapping techniques (Associative, direct, set associative).
3(i) **Define** stored program concept.

Detailed Syllabus:

Module-I: [8L]
Introduction to Computers:
Basic of Computer, Von Neumann and Harvard Architecture, Computer Organization Vs. Computer Architecture.
Instruction format, Addressing Modes.

Module-II: [12L]
Computer Arithmetic:
Addition & Subtraction with Signed-Magnitude, Half Adder, Full Adder Ripple carry adder, Carry look-ahead adder, Multiplication Algorithm, Division Algorithm, Floating point number representation, IEEE 754 standard, ALU design.

Module-III: [10L]
Memory Organization:
Memory Hierarchy, Main Memory, Auxiliary Memory, Cache Memory, Virtual Memory, Data path design for read/write access, Address Space and Memory Space, Associative Memory, Page Table, Page Replacement.

Module-IV: [6L]
Input Output Organization:
Modes of transfer, Concept of handshaking, interrupt.
Pipelining:
Basic concept, Different types of pipeline, and Different types of Hazards.

References:

1. Mano, M.M., “Computer System Architecture”, PHI.
2. Hayes J. P., “Computer Architecture &Organisation”, McGraw Hill,
3. Hamacher, “Computer Organisation”, McGraw Hill,
4. Chaudhuri P. Pal, “Computer Organisation & Design”, PHI,

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Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : DATA STRUCTURES LABORATORY					
Course Code: CSEN2011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Corse Outcome:

Ideally this course should act as a primer/pre-requisite for CS 503 (Design and Analysis of Algorithms). On completion of this course, students are expected to be capable of understanding the data structures, their advantages and drawbacks, how to implement them in C, how their drawbacks can be overcome and what the applications are and where they can be used. Students should be able to learn about the data structures/ methods/algorithms mentioned in the course with a comparative perspective so as to make use of the most appropriate data structure/ method/algorithm in a program to enhance the efficiency (i.e. reduce the running time) or for better memory utilization, based on the priority of the implementation. Detailed time analysis of the graph algorithms and sorting methods are expected to be covered in CS503 but it is expected that the students will be able to understand at least the efficiency aspects of the graph and sorting algorithms covered in this course. The students should be able to convert an inefficient program into an efficient one using the knowledge gathered from this course.

Detailed Syllabus:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem.
3. Evaluation of expressions operations on Multiple stacks & queues.
4. Implementation of linked lists: inserting, deleting, inverting a linked list.
5. Implementation of stacks & queues using linked lists:
6. Polynomial addition, Polynomial multiplication.
7. Sparse Matrices: Multiplication, addition.
8. Recursive and Non-recursive traversal of Trees.
9. Threaded binary tree traversal.
10. DFS and BFS.
11. Application of sorting and searching algorithms.

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Course Name : DIGITAL ELECTRONICS & COMPUTER ORGANIZATION LABORATORY					
Course Code: INFO2112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

- **Analyze** the utility of vertical expansion of RAM and Horizontal expansion of RAM.
- A**pply** their knowledge of basic gates, Multiplexer to **design** adder, subtractor, Flip Flop, encoder, decoder.
- **Design** and **explain** the use of 16 bit odd even parity checker/generator using IC74180.

Detailed Syllabus:

1. Realization of AND, OR, NOT, NAND, XOR gates using respective chips. Design AND, OR gates using basic design elements (Diod, Resistance, Transistor etc.)
2. Implementation of AND, OR, NOT, XOR gates using NAND Gate as a Universal Gate. Realize the following equation using only minimum number of NAND gates.
Y= AB’C’+A’BC
3. Design Half Adder & Full Adder Circuits using basic Gates.
4. Design Half Subtractor & Full Subtractor Circuits using basic Gates.
5. Design Adder-Subtractor Composite unit using 1 bit Full Adder Chip (LS 7483).
6. Design and implementation of 16 bit odd/even parity checker / generator using IC74180.
7. Design and implementation of encoder and decoder using logic gates and study of IC7445 and IC74147
8. Realization of 4:1 & 2:1 MUX Chips. Implement a 8:1 MUX using 4:1 MUXs.
9. Design S-R, D, J-K Flipflop.
10. Design and implementation of 3-bit synchronous up/down counter
11. Horizontal expansion of RAM.
12. Vertical expansion of RAM.

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Head, Dept. of Information Technology
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Course Name : SWITCHING THEORY & AUTOMATA					
Course Code: INFO2201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

After successfully completing this course the students will be able to:

3(a) **Define** a system and recognize the behavior of a system as well as will be able to minimize a system and compare different systems.
3(b) **Convert** Finite Automata to regular expression and check equivalence between regular linear grammar and FA.
3(c)Minimize context free grammar and to check equivalence of CFL and PDA
3(d) **Design** Turing Machine

Detailed Syllabus:

Module-I: [11L]
Fundamentals:
Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram (Relating of Automata concept to sequential circuit concept) Design of sequence detector, Introduction to finite state mode 2L
Finite state machine:
Definitions, capability & state equivalent, kth- equivalent concept 2L
Minimization of FSM, Equivalence between two FSM's , Limitations of FSM 1L
Merger graph, Merger table, Compatibility graph 2L
Finite memory definiteness, testing table & testing graph. 2L
Information lossless and Inverse machine 2L

Module-II: [13L]
Deterministic finite automaton and non deterministic finite automaton. 1L
Transition diagrams and Language recognizers. 1L
Finite Automata:
NFA with Î transitions - Significance, acceptance of languages. 1L
Conversions and Equivalence:
Equivalence between NFA with and without λ-transitions. NFA to DFA conversion. 4L
Application of finite automata, Finite Automata with output- Moore & Mealy machine. 2L
Regular Language :
Regular sets 1L
Regular expressions, identity rules. Arden's theorem state and prove 1L
Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA 1L
Pumping lemma of regular sets, Closure properties of regular sets (proofs not required). 1L

Module-III: [11L]
Grammar Formalism: Regular grammars-right linear and left linear grammars. 1L
Equivalence between regular linear grammar and FA. 1L
Inter conversion, Context free grammar. 1L
Derivation trees, sentential forms. Right most and leftmost derivation of strings. (Concept only) 1L
Context Free Grammars, Ambiguity in context free grammars. 1L
Normal forms for Context Free Grammars. 2L
Chomsky normal form and Greibach normal form. 2L
Pumping Lemma for Context Free Languages. 1L
Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications 1L

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Module-IV: [8L]

Push Down Automata:

Push down automata, definition.	1L
Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence.	1L
Equivalence of CFL and PDA, interconversion. (Proofs not required).	1L
Introduction to DCFL and DPDA.	1L
Turing Machine :	
Turing Machine, definition, model	1L
Design of TM, Computable functions	1L
Universal Turing Machine, Halting problem (proofs not required)	2L

References:

1. "Introduction to Automata Theory Language and Computation", Hopcroft H.E. and Ullman J. D., Pearson education.
2. "Theory of Computer Science ", Automata Languages and computation", Mishra and Chandrashekaran, 2nd edition, PHI.
3. "Formal Languages and Automata Theory", C.K.Nagpal, Oxford
4. "Switching & Finite Automata", ZVI Kohavi, 2nd Edn., Tata McGraw Hill
5. "Introduction to Computer Theory", Daniel I.A. Cohen, John Wiley
6. "Introduction to languages and the Theory of Computation", John C Martin, TMH
7. "Elements of Theory of Computation", Lewis H.P. & Papadimitrou C.H. Pearson, PHI.
8. "An Introduction to Formal Languages and Automata", Peter Linz, Jones & Bartlett Learning

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : DESIGN & ANALYSIS OF ALGORITHMS					
Course Code: INFO2202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

<u>After successfully completing this course the students will be able to:</u>

1. **Demonstrate** how the worst-case time complexity of an algorithm is defined and compare the efficiency of algorithms using asymptotic complexity;
2. **Argue** the correctness of algorithms using inductive proofs and invariants.
3. **Explain** the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate. Synthesize new graph algorithms and algorithms that employ graph computations as key components, and analyze them.
4. **Describe** the (divide-and-conquer, Dynamic programming and Greedy) paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize the above algorithms and analyze them.
5. **Explain** what amortized running time is and what it is good for. Explain what an approximation algorithm is, and the benefit of using approximation algorithms.

<u>Detailed Syllabus:</u>

Module-I: [9L]

Introduction: 3L

Properties of an algorithm, Patterns in algorithm, Time and Space Complexity, Different Asymptotic notations – their mathematical significance, The Master theorem, Generating Functions.

Divide and Conquer: 2L

Basic method, Binary Search, Merge Sort, Quick Sort and their complexity

Matrix Manipulation Algorithm: 1L

Strassen's matrix manipulation algorithm

Heapsort: 2L

Heaps, Maintaining the heap property, Building a heap, The heapsort algorithm, Priority queues

Lower Bound Theory: 1L

O(nlgn) bound for comparison sort. Set manipulation algorithm like UNION-FIND.

Module-II: [12L]

Graph traversal algorithm: 5L

Introduction of Graph, Breadth First Search(BFS), Depth First Search(DFS), Best First Search, Bidirectional Search

Network Flow: 3L

Ford Fulkerson algorithm, Max-Flow Min-Cut theorem (Statement and Illustration)

Backtracking: 4L

Basic method, 8 queens problem, Graph coloring problem.

Module-III: [12L]

Greedy Method: 4L

Basic method, Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning tree by Prim's and Kruskal's algorithm.

Dynamic Programming: 8L

Basic method, All pair shortest paths, Single source shortest path, Matrix Chain Manipulation, Travelling salesperson problem

Module-IV: [8L]

Branch and Bound: 2L

Basic method, 15 puzzles problem

Notion of NP-completeness: 3L

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P class, NP class, NP hard class, NP complete class – their interrelationship, Cook's theorem (Statement only), Satisfiability problem, Clique decision problem, Non-deterministic Algorithm

Approximation Algorithms: 3L

Necessity of approximation scheme, Polynomial time approximation schemes, Travelling salesman problem.

Reference:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, "Introduction to Algorithms"
2. A. Aho, J.Hopcroft and J.Ullman "The Design and Analysis of Algorithms"
3. D.E.Knuth "The Art of Computer Programming"
4. Jon Kleiberg and Eva Tardos, "Algorithm Design"
5. K.Mehlhorn , "Data Structures and Algorithms" - Vol. I & Vol. 2.
6. S.Baase "Computer Algorithms"
7. E.Horowitz and Shani "Fundamentals of Computer Algorithms"
8. E.M.Reingold, J.Nievergelt and N.Deo- "Combinatorial Algorithms- Theory and Practice", Prentice Hall, 1997

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : INFORMATION THEORY & CODING					
Course Code: INFO2203					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

Detailed Syllabus:

Module I: [14 L]

*Source Coding:*Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes.
*Channel Capacity and Coding:*Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.

Module II: [15 L]

*Linear And Block Codes For Error Correction:*Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes.
Cyclic Codes: Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes.

Module III : [8 L]

*BCH Codes:*Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.

Module IV : [8 L]

*Convolutional Codes :*Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding.

References:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.
3. Introduction to Information Theory - M Mansurpur; McGraw Hill.
4. Information Theory - R B Ash; Prentice Hall.
5. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : OBJECT ORIENTED PROGRAMMING					
Course Code: INFO2204					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

After successfully completing this course the students will be able to:

(1) Design an Object Oriented software system.

(2) Arrange real world entity to sketch (architecture) for real life problems (UML) and will be able to generalize the problems into number of objects. Finally test, debug and solve them separately.

(3) Reduce the complexity of procedural language by using package, Inheritance.

(4) Implement some user-friendly GUI interface support application.

Detailed Syllabus:

Module-I: [6L]

Properties of object oriented programming language, Major and minor elements, Object, Class, relationships among objects. Aggregation, Association, using, Generalization, meta-class. Difference between OOP and other conventional programming – advantages and disadvantages. Class, object, message passing, inheritance, encapsulation, polymorphism

Module-II: [16L]

Class & Object proprieties: 8L

Basic concepts of java programming – advantages of java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, garbage collection, nested & inner classes, basic string handling concepts, concept of mutable and immutable string, command line arguments, basics of I/O operations – keyboard input using BufferedReader & Scanner classes.

Reusability properties: 8L

Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages. Implementation of different relationships in OOPs.

Module-III: [6L]

Exception handling and I/O: 6L

Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes.

Input Output stream structure, Wrapper class, File copy programming using command line arguments.

Module-IV: [10L]

Multithreading and Applet Programming: 10L

Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads. Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets.

References:

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
4. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING
5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
6. Ivor Horton's Beginning Java 2 SDK – Wrox
7. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : DESIGN & ANALYSIS OF ALGORITHMS LABORATORY					
Course Code: INFO2212					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

After successfully completing this course the students will be able to:

(1) Analyze a problem and design a solution for the problem, following an algorithmic design paradigm.

(2) Reconstruct the solution to a problem to achieve optimum solution in terms of time complexity and memory utilization.

(3) Implement, empirically compare, and apply fundamental algorithms and data structures to real-world problems

Detailed Syllabus:

Programming Language used: C

Lab :1 : Divide and Conquer :

Implement Binary Search using Divide and Conquer approach

Implement Merge Sort using Divide and Conquer approach

Lab :2 : Divide and Conquer :

Implement Quick Sort using Divide and Conquer approach

Find Maximum and Minimum element from a array of integer using Divide and Conquer approach

Lab :3 : Dynamic Programming :

Find the minimum number of scalar multiplication needed for chain of matrix

Lab :4 : Dynamic Programming :

Implement all pair of Shortest path for a graph (Floyed- Warshall Algorithm)

Implement Traveling Salesman Problem

Lab :5 : Dynamic Programming :

Implement Single Source shortest Path for a graph (Dijkstra , Bellman Ford Algorithm)

Lab :6 : Brunch and Bound :

Implement 15 Puzzle Problem

Lab :7 : Backtracking :

Implement 8 Queen problem

Lab :8 : Backtracking (implement any one of the following problem):

Graph Coloring Problem

Hamiltonian Problem

Lab :9 : Greedy method(implement any one of the following problem) :

Knapsack Problem

Job sequencing with deadlines

Lab :10 : Greedy method (implement any one of the following problem) :

Minimum Cost Spanning Tree by Prim's Algorithm

Minimum Cost Spanning Tree by Kruskal's Algorithm

Lab :11 : Graph Traversal Algorithm :

Implement Breadth First Search (BFS)

Implement Depth First Search (DFS)

Prof. (Dr.) Siuli Roy
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Course Name : OBJECT ORIENTED PROGRAMMING LABORATORY					
Course Code: INFO2214					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

- **Analyze** a problem and design a solution for the problem, following an algorithmic design paradigm.
- **Reconstruct** the solution to a problem to achieve optimum solution in terms of time complexity and memory utilization.
- **Implement**, empirically compare, and apply fundamental algorithms and data structures to real-world problems.

Detailed Syllabus:

1. Assignments on class, constructor, overloading, inheritance, overriding
2. Assignments on wrapper class, arrays
3. Assignments on developing interfaces- multiple inheritances, extending interfaces
4. Assignments on creating and accessing packages
5. Assignments on multithreaded programming
6. Assignments on applet programming

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Syllabus for

Basic Environmental Engineering & Ecology **Code: CHEM 2001**

Contacts: 3L , Credits: 3

Module 1

Environment & Ecology (General discussion) **9L**

Basic ideas of environment and its component 1L

Mathematics of population growth: exponential and logistic and associated problems, definition of resource, types of resource, renewable, non-renewable, potentially renewable, Population pyramid and Sustainable Development. 2L

General idea of ecology, ecosystem – components, types and function. 1L

Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain [definition and one example of each food chain], Food web. 2L

Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphorus, Sulphur]. 2L

Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. 1L

Module 2 9L

Air pollution and control

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. 1L

Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Acid rain: causes, effects and control. Earth's heat budget, carbon capture, carbon footprint 2L

Lapse rate: Ambient lapse rate, adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion, Maximum mixing depth 2L

Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. 1L

Smog: Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification 1L

Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). 2L

Module 3 **9L**

Water Pollution and Control

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, 2L

River/Lake/ground water pollution: River: DO, 5 day BOD test, Unseeded and Seeded BOD test, BOD reaction rate constants, COD. 1L

Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) 1L

Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]

Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] 2L

Water pollution due to the toxic chemicals effects: Lead, Mercury, Cadmium, Arsenic 1L

Noise Pollution

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise]. Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L_{10} (18hr Index), effective perceived noise level.

Noise pollution control. 2L

Module 4 **9L**

Land Pollution

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes, electronic waste 2L

Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. 2L

Social Issues, Health and Environment

Environmental disasters: Bhopal gas tragedy, Chernobyl disaster, Three Mile Island disaster, cancer and environment: carcinogens, teratogens and mutagens (general aspect) 2L

Environmental impact assessment, Environmental audit, Environmental laws and protection act of India. 1L

Energy audit, Green building, Green sources of energy, Concept of Green Chemistry, Green catalyst, Green solvents (replacement of VOC) 2L

References/Books

1. Masters, G. M., “Introduction to Environmental Engineering and Science”, Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., “Environmental Chemistry”, New Age International.
3. Asim K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd
4. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
5. GourKrishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.

Subject Name: Mechanical Operations					
Paper Code: CHEN 2101					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcome:

1. Students will be able to apply the concepts of screen analysis to select suitable screening equipment and method for a given screening operation.

2. Given a mixture of unequal sized particles students will be able to calculate the averageparticle size of the mixture.

3. Students will be able to select appropriate size-reduction equipment for a given comminution operation and will be able to calculate the power requirements for the operation.

4. Students will be able to select appropriate equipment for gravity separation of solids and willbe able to calculate water/air flow rate for the operation.

5. Given a particular agitation and/or mixing problem, students will be able to apply the concepts of agitator design and scale-up to design appropriate agitation equipment to meet stipulated specifications.

6. Given an engineering problem involving filtration, students will be able to select suitable filtration equipment and estimate design parameters for the selected equipment.

Module I : 10 L

Particulate solids : Characterization of solid particles, particle shape, particle size, average particle size of particulate solids in terms of mean diameters like arithmetic mean diameter, mass-mean diameter, volume-mean diameter, volume-surface mean diameter. Mixed particle sizes and size analysis, specific surface of mixture.

Screen analysis : Types and Standards of screens, ideal screen, real screen, screen effective ness,differential and cumulative analysis, screen capacity, relation of screen capacity to screeneffectiveness.

Screening equipment: stationary screens and grizzlies, gyrating screens, vibrating screens and other industrial screens like trammels.

Transportation and storage of solids : Concepts of Conveyor and Elevator, Studies on performance and operation of different conveyor systems like Belt, Screw, Apron, Flight,pneumatic conveyor, pipe conveyor and bucket elevators; Storage of solids and dischargepattern from storage bin, theory and measurement of granular solid flow through orifice.

Module II : 10 L

Comminution of solids (Size Reduction) : Factors affecting comminution, comminution laws :

Kick's law, Rittinger's law and Bond's law and their limitations. Crushing efficiency & power consumption. Size reduction equipment : Primary crusher – Jaw crusher, Gyratory crusher, Secondary crusher – Roll crusher (both smooth roll & toothed roll) its selection and capacity, Angle of Nip of Smooth Roll crusher. Grinder – Construction and operation of Hammer mill, Ball mill for dry and wet grinding, Rod mill, Attrition mill, Vertical Roller Mill for dry grinding, Agitated mill and their materials suitability, Ultra-fine grinder – Fluid energy mill, Close circuit and Open circuit operation.

Module III : 10 L

Separation based on particle Mechanics through liquids :
Free settling and Hindered settling: Stoke's law & Newton's law regimes of settling,
Expression for Settling rate in hindered settling.

Gravity settling processes, gravity classifiers, sorting classifiers (Spizkasten, Elutriator, Rake classifier), differential settling methods. Clarifiers and thickeners e.g. Lamelar clarifiers, Hirate thickeners, flocculation, batch sedimentation, rate of sedimentation. Equipment for sedimentation: thickeners. Clarifier and thickener design, sedimentation zones in continuous thickeners, Concepts of Kynch's theory. Cyclones, hydrocyclones, centrifugal decanters.

Mixing : Principles and utilities of agitation, agitation equipment, flow patterns: prevention of swirling/vortex, draft tubes, Standard turbine design, power consumption, power correlation, significance of dimensionless groups, effect of system geometry, calculation of power consumption in Newtonian liquids. Solid-solid mixing equipment, Mixing effectiveness and Mixing index. Agitator scaleup.

Froth Flotation : Theory, operation, types, Flotation agents, Flotation cells.

Module IV : 10 L

Theory and principle of solid liquid filtration, cake filters, discontinuous pressure filter: principle and working of filter press, filter press with horizontal plates, compressible and incompressible filter cakes, filter-medium resistance, constant pressure filtration, constant rate filtration, principles of cake filtration, pressure drop through filter cake, cake washing and filtration cycle, continuous vacuum filter: principle and working of rotary drum filters, continuous vacuum belt filter, centrifugal filter: theory & working principle of centrifugalfilters, filter media, filter aids, Filtration of solid from gas – bag filter.

Text books:

1. Unit Operations in Chemical Engineering - W.L.McCabe, J.C.Smith and P.Harriot, McGraw-Hill, 4th Edition, 1984.
2. Chemical Engineering - J.M.Coulson, Richardson, Volume 2, 3rd Edition, PergamonPress,

1977.

3. Mechanical Operations - R.S.Hiremath & A.Kulkarni, Volume1.

References:

1. Introduction to Chemical Engineering - Badger and Bencharo, McGraw Hill.
2. Mechanical Operations for Chemical Engineers - C.M.Narayanan & B.C.Bhattacharya, Khanna.

Subject Name: Energy Engineering

Paper Code: CHEN 2103

Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcome:

After completion of the course the students will be able to:

1. Knowledge of the various energy sources and their operating characteristics.
2. Acquire knowledge of different crude oil extraction process.
3. Acquire knowledge on the processing of crude oil along with an estimation of various value-added products.
4. Knowledge of various characterization techniques of fossil fuels.
5. Acquire knowledge on the non-conventional energy resources and their utilization.
6. Acquire knowledge on the photovoltaic and solar thermal energy

Module I: 10L

Introduction: Conventional (fossil energy) and non-conventional (alternative energy) resources & reserves. Global Energy production & consumption pattern. Production &consumption pattern in India.

Solid Fuels: Biomass, Wood and Charcoal. Classification & Rank of Coal, Peat ,Lignite, Sub-Bituminous coal, Bituminous coal, Anthracite coal, Cannel &Bog head coal.

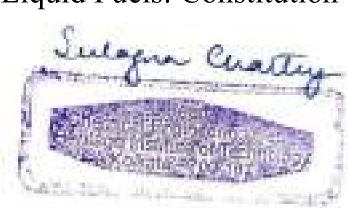
Coal Reserves in India

Physical Properties of coal, Proximate & Ultimate Analysis of Coal, Cleaning, washing &Storage of coal.

Theory of coal pyrolysis and Carbonization: Low Temperature Carbonization (LTC), High Temperature Carbonization (HTC), Horizontal & Vertical Gas Retorts, Coke Ovens-Beehive& Byproduct Slot type. Recovery of byproducts. Details of Structural configuration and Operatingprinciples.of Coke ovens including Charging and Discharging Mechanism.

Module II: 10L

Liquid Fuels: Constitution of petroleum, theory of formation of crude petroleum oil. Characterization of crude



oil & petroleum fuels, on shore and off-shore oil exploration. Parameters and testing logistics of petroleum products—Octane no., Cetane no., Pour point,Smoke point, Cloud point, Flash point, Fire point, Aniline point and Diesel index.
Processes of a typical Indian refinery involving Operation and flow-sheet of crude distillation plant; Thermal & catalytic cracking and reforming processes; coking, visbreaking, Fluid catalytic cracking and Hydrocracking. Concept of Modern Refinery integrated with downstream petrochemicals units which manufacture naphtha-based aromatics as well as propylene-based polymers.
Liquid fuel from coal: Fischer Tropsch process.

Module III: 10L
Gaseous Fuels: Classification of gaseous fuel; Physico-chemical principles, Calorific Value, Wobbes index, and flame speed.
Producer gas, Water gas with Carburetion, oil gas, coke-oven gas, blast furnace gas, Flow sheet & operation of Natural Gas and LPG. Coal Bed Methane. Integrated Gasification Combined Cycle.
Bio Gas: Principles and Operation of Aerobic & Anaerobic digestors, Biogas generation and management& flow sheet with special reference to waste utilization.

Module IV: 10 L
Solar Energy: Devices for measurement of solar flux. Solar thermal and solar PV, Differenttypes of Solar collectors (Flatplate, parabolic, concentric & heliostat), Solar Pond, Photovoltaic cells, Chemical storage, Efficiency of Solar devices – Tracking .
Geothermal Energy & Wind Energy: Utilization of Geo thermal Energy; Ocean Thermal Energy Conversion (OTEC).
Nuclear energy: Sources of Nuclear fuels, Indian scenario; Nuclear reactions and powergeneration by Nuclear reactors- Breeder reactor- reaction &operation.
Fuel Cells – Types, Construction, Principle of Operation, Applications.Fuels from Renewable Sources – Bio Fuels
Preliminary concepts of Illumination Engineering—CFL and LED lights.

Text Books:
1. Fuels and Combustion (3rd Edition) – Dr. Samir Sarkar, Universities Press.
2. Elements of Fuels, Furnaces and Refractories – Prof. O.P. Gupta, Khanna publishers
3. Understanding Renewable Energy Systems - Volker Quaschning - Earthscan Ltd

Reference Books:

1. Solar energy – S.P.Sukhatme – Tata McGraw Hill
2. Fuel Cells: From Fundamentals to Applications - Supramaniam Srinivasan - Springer

Subject Name: Industrial Stoichiometry

Paper Code: CHEN 2104

Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcome:

The students will able to:

1. Apply knowledge base to identify dimensionless numbers given several correlated variables.
2. Acquire ability to handle elementary flow-sheeting given a specific process.
3. Acquire skills to develop equations for energy and mass balance given a specific process.
4. Acquire ability to perform material and energy balance calculations without and with chemical reactions.
5. Develop skills to identify recycle, bypass and purge points in a chemical process and perform calculations with them.
6. Be familiar with equations of state and properties of gases and liquids, including phase transition

Module I: **10L**

Units and Dimensions:, Conversion of Equations, Systems of Units, Dimensional Homogeneity and Dimensionless Quantities, Buckingham Pi-theorem for Dimensional Analysis, , Concentration of different forms, Conversion from one form to another, Raoult's Law, Henry's law, Antoine's Equation. Clausius Clapeyron Equation.

Mathematical Requisites: Use of log-log and semi-log graph paper, Triangular Diagram, Graphical Differentiation and Graphical Integration, Least Square Method, Curve Fitting, Method of Regression.

Module II: 10L

Introduction to Chemical Engineering Calculations: Basis, Mole Fraction and Mole Percent, Mass Fraction and Mass Percent, Material Balance without Chemical Reaction: Material Balance during Mixing, Humidity and Application of Psychrometric Chart, Material balance calculation of the following unit operations: Crystallization, Evaporator, Distillation Column, Absorption Column, Drier, Liquid - Liquid and Solid - Liquid Extraction Units

Module III: 10L

Material Balance with Chemical Reaction: Single Reaction, Multiple Reactions, Reactions with Recycle, Purge and By pass, Combustion Reaction, Calculation of Excess Air, Material Balance of Unsteady State Reaction systems.

Module IV: 10L

Energy Balance: Enthalpy calculation for systems (single component and multi components) without Chemical Reaction with Mean and Temperature dependent Heat Capacity, Enthalpy calculation for systems with Chemical Reactions. Heat of Reaction from Heat of Formation and Heat of Combustion Data, Effect of Temperature and Pressure on Heat of Reaction, Hess's Law, Adiabatic Reaction Temperature, Theoretical Flame Temperature Energy calculation in transient condition Case Studies: Combined Material and Energy Balances of Industrial Process.

Text Books :

1. Chemical Process Principles (Part I), 2nd. Ed., O. A. Hougen, K. M. Watson, and R. A. Ragatz. John Wiley (Asian Edn.).
2. Basic Principles and Calculations in Chemical Engineering, 6th. Ed., D.M. Himmelblau: Prentice Hall,

References :

1. Stoichiometry, 4th. Ed., B.I.Bhat and S.M.Vora, McGraw Hill,.
2. Elementary Principles of Chemical Processes, 3rd.Ed., R.M. Felder and R. W. Rousseau, Wiley India Edition.

<table>
<tr><td colspan="6">Subject Name: Energy Laboratory</td></tr>
<tr><td colspan="6">Paper Code: CHEN 2111</td></tr>
<tr><td rowspan="2">Contact
Hours PerWeek</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>2</td></tr>
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Course Outcome:

1. The students will be able to understand the importance of quality control of the properties of different fuels during manufacturing and in applications and execution of the activities for implementing concept of Quality in the Refineries and fuel dealers' premises or R&D projects including the commercial operations in any business or industry operations of diverse nature.

2. The students will be able to estimate or calculate or determine the quality parameters and their upper & lower limits through quality control tools & process control techniques for the acceptance of products or services rendered by any organizations.

3. The students will be set the norms of testing and characterizing different grades of fuels and lubricants in their working places in future.

4. The students will be able to make quality control measurements and apply statistical tools to identify the problems or shortcomings in the operations processes involved in the industries or business operations.

5. The students will be able to evaluate the properties of various fuels (solid, liquid or gaseous) developed in the laboratories of the institutes/industries from other non-conventional sources like biomass/plastic to fuel conversion process.

6. The students will be able to apply the working knowledge of the energy laboratory fordisaster control and management in the organization or society and natural domains duringfire hazards and formulate the health, safety and occupational hazards in any such areas of operations.

At least eight experiments are to be performed

1. Proximate analysis of Coal.
2. Determination of carbon residue of fuel oil.
3. Determination of aniline point of a fuel oil.
4. Determination of moisture content of fuel oil by Dean & Stark apparatus.
5. Atmospheric Distillation of a petroleum product.
6. Determination of Flash Point & Fire Point of an oil by Abel apparatus.
7. Determination of Flash Point & Fire Point of oil by closed-cup Pensky Marten apparatus.
8. Determination of kinematic viscosity of oil by Redwood Viscometer.
9. Determination of calorific value of gaseous fuel by Junker's apparatus.
10. Determination of calorific value of solid and liquid fuel by Bomb Calorimeter.
11. Determination of vapour pressure of petroleum product using Reid apparatus.
12. Experiments on Non-conventional Energy Source using Solar Cooker/Flat Plate
13. Analysis of a gaseous mixture by Orsat apparatus.
14. Calibration of Pyrometer

Subject Name: Fluid Mechanics Lab					
Paper Code: CHEN 2112					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcome

The objective of this course is to impart working knowledge and develop skills of the students in fluid mechanics through bridging between the theoretical concepts and working practices for attaining the competency in practical applications or for working in the industry and conducting research & development activities. After completion of the course students will be able to:

1. Predict the energy losses, economic factors and maintenance aspects in the design, installation and operations of fluid flow systems for efficient transportation of mass & energy by studying the flow characteristics namely, turbulent, laminar and transition flow of different fluids.
2. Identify the requirements of various types of devices for quantitative measurement of fluidflow in open channel (rivers,/dams etc) and in closed channel(pipe flow etc) efficiently and economically.
3. Analyze the pump characteristics relating to best efficiency of the pump, power consumption, head developed by the pump for a given flow rate.
4. Design and install pumping system to demonstrate occurrence of cavitation in the system and also to take a practical measure to avoid cavitation during fluid flow and ultimately develop skills and expertise in designing the most efficient fluid transportation system including pump & the piping.

5. Construct and design packed bed and fluidized bed chemical reactors for various types of chemical processes and unit operations with a given pressure drop and various flow rates of the fluid or vice-versa.

6. Describe the concept of packed bed or fluidized bed operations practically for physical processes such as coating granular metal surfaces with various other desirable materials by normal fluidisation technique and separation of oil from water by reverse fluidisation technique etc.

At least eight experiments are to be performed

1. Determination of coefficient of discharge at various Reynold's number during fullydeveloped fluid flow through orificemeter.

2. Determination of coefficient of discharge at various Reynold's number during fullydeveloped fluid flow through venturimeter.

3. Determination of loss coefficient of pitot tube and construction of fully developed velocity profile through pipe in laminar and turbulent flow regime.

4. Measurement of open channel flow and determination of coefficient of discharge V-notch andrectangular notch.

5. Determination of pressure drop for flow through packed bed and verification of Ergun equation.

6. Determination of characteristic curve of a centrifugal pump.

7. Experiments on Reynold's apparatus for determination of flow regime and construction of fanning's friction factor vs Reynold's number plot.

8. Determination of pressure drop and bed height profile with varying modified Reynold's numberduring flow through a fluidized bed. Determination of incipient fluidization.

9. Calibration of rotameter.

10. Determination of viscosity of Newtonian and non-Newtonian fluid.

11. Assembling of pipe line and fitting according to a given layout.

Subject Name: Mechanical Operations Laboratory					
Paper Code: CHEN 2113					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcome

The objective of this course is to provide a hands-on idea on the mechanical devices that are essential in handling the material and it's processing in different chemical engineering related downstream applications. After completion of this course students will be able to:

1. Demonstrate mechanical instruments required for particles processing before downstream applications.
2. Illustrate the working principle of the mechanical instruments required for particles processing.
3. Solve the experimental problems related to particles' processing applications.
4. Analyze the outcome of the experiment on the basis of theoretical knowledge they had acquired.
5. Estimate the efficiency of the process through analysis of the experimental outcome.
6. Propose on the troubleshooting required after estimating the experimental outcomes.

At least eight experiments are to be performed

1. Sieve Analysis: To analyze a given powder for its particle size distribution. / Cumulativeand Differential methods of particle size distributions.

2. Overall Screen Effectiveness: To find out screen efficiency through a suitable material balance with respect to a single screen.

3. Jaw Crusher: To find out the reduction ratio and capacity and to verify Rittinger's Law.

4. Ball Mill: To determine the reduction ratio, capacity and the critical speed of theballmill.

5. Rod Mill: To determine the reduction ratio and capacity and compare the reduction atiofor the same feed sample to that in a ball mill.

6. Hammer Mill: To find out the reduction ratio and capacity.

7. Batch sedimentation: To determine the settling and sedimentation characteristics ofgiven slurry.

8. Elutriator: To study the sorting of a given mixture in an elutriator.

9. Filtration: To determine the specific cake resistance and filter medium resistance in thegiven plate and frame filtration.

10. Mixing: To determine the power number and power consumption for a given liquid in an agitated vessel.

11. Cyclone Separator: Demonstration of the operation of a cyclone separator anddetermination of its overall collection efficiency.

12. Hard Grooved Instrument: To determine the work index of a given brick sample.

Subject Name: Chemical Engineering Drawing Lab					
Paper Code: CHEN 2114					
Contact Hours PerWeek	L	T	P	Total	Credit Points
	0	0	3	3	2

Course Outcome:

The objective of the course is to provide an elaborated concept of engineering drawing and idea on therelevant software for engineering drawing. After completion of the course students will be able to:

1. Understand basics of engineering drawing
2. Draw different angular projection view of engineering equipment
3. Draw isometric projection view of engineering equipment
4. Draw cut-section view of engineering equipment
5. Use AutoCAD software for developing engineering drawing layouts.
6. Prepare a virtual 3-D representation of an engineering equipment.

1. Introduction to AUTOCAD software for drawing in 2D: Drawing and editing commands. Knowledge of setting up layers, dimensioning, hatching, making block, plotting and printing, working with external reference file.

2. Drawing any three of the following item using AUTOCAD software.

a) Flange coupling for shaft and vessel or pipe.

b) Pipe joints and fittings, single line and double line pipe line assembly

c) Stuffing box.

d) Detailed cut section drawing of Globe valve and Stop valve.

e) Piping and instrumentation diagram of any given chemical process.

3. Assembly drawing of a single stirred jacketed pressure vessel with all its accessories using AUTOCAD software**.**

4. Introduction to AUTOCAD software for drawing in 3D: Working in 3-dimensions, Drawing and editing commands, viewing 3D objects, basic solid and wireframe models, extruding, simple revolved objects. Generation of orthographic projections from 3D drawing.

Subject Name: Process Heat Transfer					
Paper Code: CHEN 2201					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:

1. Acquire basic knowledge of the heat transfer.

2. To review the practical importance and relevance of energy transfer and its conservation in chemical industry.
3. To utilize the technological methods related to heat transfer in process plant.
4. To study a detailed overview of heat transfer equipment and problems associated at preliminary stage of design.
5. To build a bridge between theoretical and practical concept used in industry.
6. To model basic heat transfer processes and identify modes.

Module I : 10L
Introduction to basic modes of heat transfer and their application in chemical process, heat transfer by conduction: Fourier law, thermal conductivity, thermal resistance; general heat conduction equation, thermal diffusivity; steady state heat conduction with heat generation for plane wall, cylindrical body and spherical body; conduction-convection system: critical insulation thickness of curved surface, steady state heat conduction through fin, fin efficiency, unsteady state heat conduction in solid with large thermal conductivity, significance of Biot no and Fourier no, transient heat conduction in solid.

Module II : 10L
Convective heat transfer without phase change: Newton-Rikhman law, local and average heat transfer coefficient, Reynold-Colburn analogy, concept of individual heat transfer coefficient and overall heat transfer coefficient, LMTD, empirical correlation for heat transfer coefficient in forced convection; elementary concept of thermal boundary layer, temperature distribution in laminar flow, analysis of free convection and correlation of free convection, Grashof number.

Module III : 10L
Heat transfer with phase change: filmwise and dropwise condensation, laminar film condensation on vertical plate, Nusselt equation; analysis of heat transfer during boiling, different boiling regimes during pool boiling.
Characteristics of radiation, properties of radiating surface, black body radiation: Plank's distribution law, Total emissive power: Stefan-Boltzman law, use of radiation function table; Wien's displacement law; Kirchoff's law; emissivity of black body, gray body and real body; radiation between

surfaces: view factor, Electrical network approach for radiation heat exchange, radiation shields and their application, radiation heat exchange for three radiating surfaces; radiation heat transfer through absorbing emitting medium.

Module IV : 10L

Heat exchangers and their classification, performance analysis of heat exchanger: fouling factor, LMTD correction factor, effectiveness and NTU of heat exchangers, sizing and rating problems of heat exchangers, construction details of shell and tube heat exchanger, Shell and Tube heat exchanger design, elementary note on heat exchanger network.

Evaporators and their classification, capacity and steam economy, BPE, material and energy balance of single effect evaporator, classification of multiple effect evaporator, design of single effect and multiple effect evaporator.

Text Books:

1. Process Heat Transfer - D. Q. Kern, MGH.
2. Heat Transfer Principles and Application - B. K. Dutta, PHI.
3. Units Operations of Chemical Engineering - McCabe & Smith and Harriot, MGH.

References:

1. Heat Transfer - A Basic Approach: M. Necati Ozisik, McGraw-Hill InternationalEdition, Singapore.

Subject Name: Chemical Engineering Thermodynamics					
Paper Code: CHEN 2203					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcome:
After completion of the course students will be able to

1. understand the terminology associated with engineering thermodynamics and have knowledge of contemporary issues related to chemical engineering thermodynamics
2. solve problems involving liquefaction, refrigeration and different power cycles
3. calculate thermodynamic efficiency of a process.
4. understand of phase equilibria in two-component and multi-component systems
5. estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture
6. predict excess property behavior of multi-component systems

Module I :10L
Introduction-Macroscopic and microscopic approaches; Units; Basic concepts of system, property, force, temperature, pressure, work, energy, heat and equilibrium from thermodynamic aspect.

Application of 1st law of thermodynamics to chemical process: open and closed system energy balance equations, SFEE, compressible flow through a nozzle, working principle of single stageand multistage compressor.

P.V.T behaviour of pure substances, equation of state: virial equation of state, cubic equationof state, law of corresponding states, generalised correlations for gases and liquids, acentric factor, compressibility factor.

Module II : 10L
Application of second law of thermodynamics to chemical process, entropy generation andirreversibility, clausius inequality.

Ideal power cycle, Rankine cycle, reheat cycle, regenerative cycle, and working principle ofIC engine: Otto cycle, diesel cycle, brayton cycle.

Ideal refrigeration cycle, vapour compression cycle, Bell-Coleman cycle, absorption refrigeration cycle, isenthalpic expansion: Linde and Claude liquefaction cycle.

Module III : 10L

Thermodynamic property relations of pure fluid: Maxwell relations. The Jacobian Method,residual property, physical significance of Gibb's free energy and work function, concept of fugacity.

Solution thermodynamics: partial molar properties, chemical potential, Gibbs-Duhem equation, effect of temperature and pressure on chemical potential, fugacity in solution, Lewis-Randall rule and Henry's law, Raoult's law, excess property, activity and activity coefficient, property change on mixing, Excess Gibbs free energy models – Margules, Redlick – Kister, Whol's, Van Laar, Wilson & NRTL, UNIQUAC, Group Contribution methods, modified Raoult's law, P-x-y and T- x-y diagram of binary liquid solution, azeotrope calculation, thermodynamic consistency checking of data.

Module IV : 10L

Chemical reaction equilibria: Reaction Stoichiometry, reaction coordinate, criteria of reaction equilibrium, equilibrium constant, standard Gibbs energy change and equilibrium constant, effect of temperature on equilibrium constant, effect of pressure on equilibrium constant, effect of inert material, excess reactant and product on equilibrium constant, heterogeneous reaction equilibria, phase rule and Duhem theorem for reacting syst

Text Books:

1. Introduction to Chemical Engineering Thermodynamics: Smith, J.M., Van ness, H.C. and Abbot, M.M., 6th Edn. MGH., 2001.
2. A Text Book of Chemical Engineering Thermodynamics, Narayanan, PHIReferences:

3. Chemical Engineering Thermodynamics: Y.V.C. Rao.
4. Chemical Process Principles (Vol-2): O.A.Hougen, K.M. Watson and R.A.Ragatz.
5. Chemical and Process Thermodynamics: Kyle PHI.

Subject Name: Heat Transfer lab					
Paper Code: CHEN 2211					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcome

The objective of this course is to provide the practical exposure to the students regarding the application of various heat transfer phenomenon and correlations in various engineering processes. Hands on experience will enable them to analyze working principles of various heat transfer devices including heat exchangers, condensers. After completion of this course students will be able to:

1. Identify different modes of heat transfer and basic laws of heat transfer.
2. Analyze problems involving steady state heat conduction and develop solutions for transientheat conduction in simple geometries.
3. Identify the fundamentals of convective heat transfer process.
4. Evaluate the heat transfer coefficients for forced convection inside duct.
5. Analyze radiation heat transfer between black body surfaces.
6. Analyze heat exchanger/ condenser performance.

At least eight experiments are to be performed

1. Determination of thermal conductivity of a metal bar using Fourier's heat conduction equation.
2. Estimation of heat loss through a lagged pipe and determination of thermal conductivity of insulating material.
3. Determination of thermal conductivity of insulating powder during heat transfer in a spherical vessel.
4. Determination of heat transfer coefficient of air during forced convection heat transfer and to study the effect of air velocities on heat transfer coefficient.
5. Determination of overall heat transfer coefficient in a Counter current & Parallel flow double pipe heat exchanger and to study the effect of fluid flow rate on overall heat transfer coefficient.
6. Determination of overall heat transfer coefficient and efficiency of a Shell and Tube heat exchanger and to study the effect of fluid flow rate on overall heat transfer coefficient.

7. Determination of emissivity of a given radiating surface applying Kirchhoff's law of thermalradiation.
8. Determination of Stefan's Boltzman constant experimentally.
9. Determination of economy, capacity and overall heat transfer coefficient of a single effectevaporator.
10. Determination of Biot number for a conductive convective system and validation of lumped system assumption.
11. Determination of heat transfer co-efficient in film-wise & drop-wise condensation.

B.Tech in Electrical Engineering
2nd Year, 1st Semester

Subject Code: MATH 2001

Subject : MATHEMATICAL METHODS

Course Outcome:- After completing the course the student will be able to:

1. **Synthesize components of a physical phenomenon and consequently construct a mathematical model of the system.**
2. **Classify engineering problems like forced oscillations, RLC Circuits etc.**
3. **Apply suitable analytic methods to solve wave equations , heat conduction equation.**
4. **Evaluate the efficiency of a method to solve ordinary and partial differential equations.**

Module I : Functions of Complex Variables (12L)

Complex numbers and its geometrical representation .

Functions of a complex variable – Limits, Continuity , Differentiability .

Analytic Functions . Cauchy- Riemann equations . Necessary and sufficient conditions for analyticity of complex functions(Statement only) , Harmonic functions.

Line Integral on complex plane . Cauchy-Goursat theorem , Cauchy's Integral Formula. Taylor's and Laurent's series expansion .

Zeros, Different types of Singularities. Definitions of poles and residues , Residue Theorem , Evaluation of real integrals using residue theorem.

Module II: Fourier Series , Integrals and Transforms (12L)

Definite Integral , Orthogonality of Trigonometric Functions , Power Series and its convergence .

Periodic Functions , Even and Odd Functions , Dirichlet's Conditions , Euler Formulas for Fourier coefficients , Fourier series representation of a function, e.g. Periodic square wave, Half wave rectifier, Unit step function.

Half Range series , Parseval's Identity.

Fourier Integral theorem , Fourier transform , Fourier sine and cosine transform, Linearity, Scaling , Frequency Shifting and Time shifting properties, Convolution Theorem.

Discussion of some physical problems : e.g Forced oscillations.

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Module III : Series solutions to Ordinary Differential equations and Special Functions (12L)

Series solution of ODE: Ordinary point , Singular point and Regular Singular point, series solution when $x = a$ is an ordinary point. Frobenius method.

Legendre's Equation , Legendre's polynomials and its graphical representation.

Bessel's equation , Bessel's function of first kind and its graphical representation.

Finite Difference Method and its application to Boundary Value Problem.

Module IV: Partial Differential Equations (12L)

Introduction to partial differential equations, Formation of partial differential equations, Linear and Nonlinear pde of first order, Lagrange's and Charpit's method of solution .

Second order partial differential equations with constant coefficients , Illustration of wave equation, one dimensional heat equation, Laplace's equation, Boundary value problems and their solution by the method of separation of variables.

Solution of Boundary value problems by Laplace and Fourier transforms.

Suggested Books:

1. Complex Variables and Applications
   Brown Churchill
   MC Graw Hill

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2. Complex Variable
   Murrey R. Spiegel
   Schaum's Outline Series

3. Theory of Functions of a Complex Variable
   Shanti Narayan, P. K. Mittal
   S. Chand

4. Larry C. Andrew, B. K. Shivamoggi
   Integral Transforms for Engineers and Applied Mathematicians
   Macmillan

5. Fourier Analysis with Boundary Value Problem
   Murrey R. Spiegel
   Schaum's Outline Series

6. Mathematical Methods
Potter, Merle C., Goldberg, Jack.
PHI Learning

7. Ordinary and Partial Differential Equations
M. D. Raisinghania
S. Chand

8. Elements of Partial Differential Equation
Ian Naismith Sneddon
Dover Publications

9. Advanced Engineering Mathematics
Kreyszig
Willey

10. Higher Engineering Mathematics
B. V. Ramana
Tata McGraw-Hill

ANALOG & DIGITAL ELECTRONIC CIRCUITS
CODE: ELEC2101

CONTACT: 4L
Credit : 4

COURSE OUTCOME

- Able to design amplifiers, integrators, differentiator, adder, subtractor, zero crossing detector, Schmitt trigger using Operational amplifiers
- Able to design Astable, Bistable and Monostable multivibrator using Op Amp and 555
- Able to design oscillators and regulated power supply
- To learn different number systems and representation of negative numbers
- Design of digital system to solve logical problem
- Design of decoder, encoder, MUX, DEMUX, counters and shift registers and their applications
- To be familiar with different semiconductor memories
- To be familiar with A/D, D/A converters , S/H
- To be familiar with different logic families

Module-I
Operational Amplifiers: Differential amplifiers using BJT & FET, OPAMP as high gain diff. amplifier- its internal structure. Specification of an OPAMP, OPAMP as voltage amplifiers (inverting and non-inverting), its advantages with respect to feedback amplifiers. Realization of integrator, differentiator, adder (inverting & non-inverting), subtractor (using single OPAMP and more than one OPAMP). Effect of input offset current and input offset voltage on integrator using OPAMP and the required compensation. Use of OPAMP to realize linear differential equations. [10L]

Module-II
Oscillators : Barkhausen criteria, Colpitts, Hartley, Phase shift oscillator, Wien Bridge oscillator, crystal oscillators
Comparators: Design of comparators, ZCD, comparator with hysteresis and its application.

Multivibrators: Design of Astable, Monostable and Bistable multivibrator. Functional diagram of 555, design of Astable, Monostable and Bistable multivibrator using 555.

Voltage regulators: Design of regulated power supply. Use of voltage regulator ICs like 78XX and 79XX. [10L]

Module-III
Number systems & Codes: Decimal, Binary, Octal and Hexadecimal representation and their conversion

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Negative Number Representation: Signed magnitude, 9's complement, 10's complement, 1's complement & 2's complement.
Introduction to floating point number representation
Codes: Weighted and non-weighted codes.
Boolean Algebra : Introduction, representation of logical statement into Boolean expression and its realization using Boolean functions(AND, OR, NOT gates) , Boolean Laws and its applications to minimize the Boolean expressions. Universal gates and realization of logical expression (POS & SOP), K-map and minimization of logical expression up to four variables.
Combinational circuits: Design of Adder, Subtractor, Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer, parity Generator and its application. [10L]

Module-IV
Sequential circuits: Latch and Flip-Flop, SR, JK, D and T Flip-Flop, realization of asynchronous and synchronous counters using Flip-Flop, non-sequential counters, shift registers.
Converters: DAC (weighted resistor and R-2R ladder type), S/H, ADC (dual slope and Successive Approximation type)
Memory systems: RAM, ROM, EPROM, EEROM and Flash ROM
Logic families: TTL, ECL, CMOS, their operation and specification, interfacing of different families. Introduction to PLD. [10L]

Total=40L

Text books

1. Op-amps and Linear IC's, R.A. Gayakwad, PHI.
2. D. Roy Choudhury, S. Jain, "Linear Integrated Circuits", New Age International (P) Ltd.
3. H. Taub, D. Schilling, "Digital Integrated Electronics", McGraw-Hill Kogakusha Ltd.
4. Fundamental of Digital Circuits, A. Anand Kumar, PHI.
5. A. Mottershead, "Electronic Devices and Circuits", Prentice-Hall of India Pvt. Ltd.
6. A.P. Malvino, D.P. Leach, "Digital Principles and Applications", Tata McGraw-Hill Publishing Co.Ltd.
7. Digital Electronics - Floyd

Reference Books

8. Millman & Halkias, "Integrated Electronics Analog and Digital Circuits and Systems " , Tata McGraw-Hill

HOD, EE

CIRCUIT THEORY

CODE: ELEC2102 **Contact: 3L+1T**

Credit : 4

COURSE OUTCOMES OF CIRCUIT THEORY

The students will be

- To solve electric circuits containing AC and DC sources applying network theorems
- To analyze magnetically coupled circuits
- Able to solve the transient analysis of electrical circuits applying Laplace transform for
- Able to Solve electric circuits applying the concept of graph theory
- Able to calculate open circuit impedance parameter, short circuit admittance parameter, transmission parameter and hybrid parameter applying the analysis of two port network
- Able to analyze and synthesize filters
- Able to simulate the circuits using SPICE software

Module-I

Network equations: Formulation of Node & Mesh equations. Loop and node variable analysis of transformed circuits. Network Theorems: Thevenin, Norton, Superposition and Reciprocity theorem applied to circuits containing dependent sources. [8L]

Coupled Circuits: Coefficient of coupling, Dot convention, Analysis of coupled circuits [3L]

Module-II

Laplace Transform: Concept of complex frequency. Properties of Laplace transform linearity, differentiation, integration, initial value theorem and final value theorem. Transform of standard periodic and non periodic waveforms. Circuit elements and their transformed equivalents. Independent and dependent sources and equivalence of sources, treatment of mutual couplings in t & s domain. Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Concept of natural frequency and damping. Sketching transient response, determination of time domain specifications. Concept of Convolution theorem and its application. [10L]

Module-III

Graph theory: Graph of network: Concept of path, tree, tree branch, tree link, loop, tie set and cut set. Incidence Matrix, tie-set Matrix and f-cut set matrix and their properties. Loop currents and node-pair potentials, formulation of loop and node equilibrium equations in view of graph theory. [5L]

Two port networks: Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and inverse hybrid parameters. Inter relation between parameters. Inter connection between two port networks. Driving point & transfer impedance & admittance. [5L]

Module-IV

Filter Circuits: Concept of filters, Classification of filters. Analysis and synthesis of Low pass, High pass, Band pass and Band reject filters using operational amplifier. Filter approximations: Butterworth, Chebyshev filters. [6L]

SPICE: Structure of a SPICE program, active and passive device/element statements, different study like DC analysis, transient analysis and ac analysis statement in SPICE. Plotting and printing statement, input and output Impedance calculation using SPICE, voltage and current controlled components in SPICE. [3L]

Total: 40L

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
2. Network Analysis, M.E. Valkenburg, Pearson Education
3. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
4. Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand

Reference Books:

1. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin,The Mc Graw Hill Company.
2. Modern Network Analysis, F.M.Reza & S.Seely, McGraw Hill.

HOD, EE

FIELD THEORY
CODE: ELEC-2103

CONTACT: 3L+1T

Credit : 4

Outcome of the Course

After completion of the course students will be able to

1. Apply knowledge of different co-ordinate systems for field analysis problems.
2. Apply different techniques of vector calculus to analyze electromagnetic fields to reach substantiated conclusions.
3. Compute electric potential, field intensity and electrical energy in electrostatic fields problems.
4. Compute magnetic fields and potentials to solve the electromagnetic problems
5. Analyze the problems of time-varying magnetic fields to compute field quantities for electromagnetic devices.
6. Design and develop solutions to complex problems related to transmission lines for benefits to society in terms of more efficient transmission of power and signals (in case of RF transmission lines).

Module 1:

Introduction: Curvilinear coordinate system, Cartesian coordinates, Cylindrical coordinates, Spherical coordinates & their transformation. Differential length, area and volume in different coordinate systems. **5L**

Introduction to Vector calculus: DEL operator, Gradient of a scalar, Divergence of a vector & Divergence theorem, Curl of a vector & Stoke's theorem, Laplacian operator on scalar and vector, Classification of vector fields, Statement of Helmholtz's theorem, Uniqueness theorem. **4L**

Module 2:

Electrostatic field: Coulomb's law, Electric field intensity E & Potential Φ, Gauss's law, Polarization and Dipole moment, Energy density in electrostatic field. Electric boundary conditions between dielectrics, Conductor–dielectric. Application of Poisson's and Laplace's equation for solving Electrostatic problems. Ohm's law and law of conservation of charge and continuity equation. General procedure for solving Poisson's and Laplace's equation. **6L**

Magneto static fields: Biot-Savart's law, Ampere's circuital law both differential and Integral form, Magnetic flux density, Magnetic scalar and Vector potential, Derivation of vector potential from Biot-Savart's law, Derivation of Poisson's equation in a magnetic field. Application of magnetic vector potential concept for solving field problem. Force on a current carrying conductor due to magnetic field and torque developed in current carrying coil in a magnetic field, magnetic moments, Magnetization in material, boundary conditions between two magnetic media, Inductor and Inductance of solenoid, Magnetic energy, Methods of Images. **6L**

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Module 3:

Electromagnetic fields: Faraday's law, Transformer and motional emf, Displacement current, Loss tangent, Maxwell's equations for time varying fields, Time varying Potential, Lorentz condition for potentials, Time harmonic fields. **4L**

Electromagnetic wave propagation: Wave equation, Electromagnetic wave equation in loss-less dielectric medium and conducting medium, Plane and polarized waves and their propagation, Intrinsic Impedance, solution of wave equation, Skin effect, Skin depth, Polarization, Reflection of a plane wave at normal incidence, Poynting Theorem and Poynting vector, application of its for power flows through a cable. **6L**

Module 4:

Transmission line: Concept of lump & distributed parameters, Line parameters, Transmission line equation & solutions: lossy and lossless, Physical significance of solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation, Distortion of Transmission line, Reflection and Transmission Coefficients, Input impedance, Standing waves, Standing wave ratio. **8L**

Total Classes=40

Text Books:

1. Engineering Electromagnetics by W.H.Hayt
2. Electromagnetics by Kraus & Carver
3. Electromagnetic Theory and application by P.Mukhopadhyay
4. Electromagnetics by A.Pramanik
5. Electromagnetics by Joseph Edminister
6. Electromagnetic fields by Griffiths.

HOD, EE

ANALOG & DIGITAL ELECTRONIC CIRCUIT LABORATORY
CODE: ELEC2111

Contact: 3P
Credit : 2

Experiments on Analog Electronic Circuit

1. Transfer characteristics of an inverting and non-inverting amplifier using op-amp
2. Realization of Adder and Subtractor using operational amplifier.
3. Realization of integrator and differentiator using operational amplifier.
4. Transfer characteristics of Zero Crossing Detector, comparator with hysteresis using op-amp.
5. Realization of astable and monostable multivibrator using op-amp.
6. Design of astable with 50% duty cycle and monostable multivibrator using 555.
7. Design of bistable and VCO using 555.

Experiments on Digital Electronic Circuit

8. Realization of logic statement using universal logic gates.
9. Construction of decoder and encoder using logic gates.
10. Realization of MUX and DMUX using logic gates
11. Realization of SR, D, JK and T Flip-Flop
12. Realization of binary, BCD counters (synchronous and asynchronous).
13. Construction of shift registers using Flip-Flops
14. Familiarization experiments on DAC0808 & ADC0808

HOD, EE

CIRCUIT THEORY LABORATORY
CODE: ELEC2112
Contact: 3P
Credit: 2

List of Experiments:

1. Determination of Laplace transform and Inverse Laplace transform using MATLAB.
2. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB in both discrete and analog form.
3. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion in s-domain and cascade connection of second-order systems using MATLAB.
4. Find the transfer function and pole-zeros of an electrical network containing RL, RC & RLC.
5. Transient response of R-L and R-C network using SPICE and hardware verification
6. Transient response of R-L-C series and parallel circuit using SPICE and hardware verification
7. Verification of Network theorems (Reciprocity, Compensation theorem) using SPICE software
8. Determination of Impedance (Z) and Admittance (Y) parameter of a two port network using SPICE/circuit maker.
9. Design of Butterworth Low Pass and High Pass filters: Simulation and Hardware implementation
10. Design of Band Pass and Band Reject filters using Butterworth Low Pass and High Pass filters: Simulation and Hardware implementation

HOD, EE

ELECTRICAL MACHINE I
CODE: ELEC2201

CONTACT: 3L+1T
Credit : 4
COURSE OUTCOME
At the end of this course students will be able to

1. Apply the knowledge of energy conversion principle to solve complex electrical engineering problem related to fundamental processes involved in electric machinery.
2. Identify and analyze the problems of two major ways of estimating electromagnetic forces reaching substantiated conclusions.
3. Apply the knowledge of behavior of DC machines to solve complex electrical engineering problems related to different types of DC generator and motor
4. Identify and analyze the problems related to performance analysis of DC machines reaching substantiated conclusions.
5. Identify and analyze the problems related to performance analysis of single phase transformer reaching substantiated conclusion.
6. Apply the knowledge of operating principle of 3-phase transformer in the practical field of installation, testing and commissioning of transformers.
7. To identify and analyze complex electrical engineering problems in presence of harmonics in three phase transformer reaching substantiated conclusions.

MODULE I
Generalized theory: Electromechanical Energy Conversion Principle, Singly Excited Magnetic System and Doubly Excited Magnetic system. Electromagnetic torque and Reluctance torque. Electrical & Mechanical degree. Pole pitch. Coil, Generated EMF in full pitched coil, Generated EMF in a short pitched coil, EMF polygon, Distribution factor, Pitch factor. MMF produced by Distributed Windings, MMF of a coil, MMF of single phase distributed Winding, MMF waveform of Commutator machines. Voltage developed in a conductor rotating in a pulsating field. Rotating magnetic field. [10L]

MODULE II
D.C machine: Construction, operating principle & classification. Armature & field winding. EMF equation from fundamental principle. Voltage buildup of dc generator. Armature reaction & its improvement. Commutation process, its classification & improvement. External & internal Characteristics of DC generators. Parallel operation of DC generator. Operating principle of DC motor, its classification. Torque equation of dc motor. Load characteristics of dc motors. Starting & Speed control of DC motor. Losses and efficiency of DC machines. Hopkinson's and Swinburne's test. Application of DC generators and motors. Different methods of breaking of DC Motors [12L]

MODULE III
Single Phase Transformer : Construction, Type, Basic principle of operation. EMF equation. Resistance and leakage reactance drop in transformer. Electrical equivalent circuit of transformer. Phasor diagram. Determination of equivalent circuit parameters, open circuit & short circuit test. Voltage regulation & Effiesency of transformer. Polarity test & Parallel operation. Cooling of transformer. Auto transformer & its application. [12L]

MODULE IV
Polyphase Transformer : Construction, type & rating of 3-ph Transformer. Different connections, vector groups, Parallel operation of Transformers. Effect of unbalanced loading. Production of Harmonics in Transformer and its suppression. tertiary winding. Open Delta connection. Scott connection. 3 phase to 6 phase connections, neutral shifting. Double star and Double delta, 3 winding transformer. Parameter estimation Tap changing: On load & Off load. Grounding transformer[10L]

Text Books :	Reference Books :
1. Electrical Machinery by Dr. P.S. Bimbra 2. Generalized Theory of Electrical Machines by Dr. P.S. Bimbra 3. Electrical Machines by P. K. Mukherjee & S. Chakravorty 4. Electrical Machinery by S.K.Sen 5. Theory of Alternating Current Machinery by Alexander S Langsdorf	1. The Performance And Design Of Direct Current Machines by Clayton & Hancock. 2. The Performance And Design Of Alternating Current Machines by M.G.Say.

HOD, EE

ELECTRICAL & ELECTRONIC MEASUREMENT
CODE: ELEC2202
CONTACT: 4L

The students will be able

- To learn the mechanism of torque production in various deflecting type of measuring instruments, their construction and the method of extension of the range of instruments
- To calculate the error of measurement using the statistical method
- To know the principle of measurement of power and energy and use of CT and PT
- To measure different types of resistance; to measure inductance and capacitance using different bridges; to locate the fault in a cable
- To know the principles of analogue electronic and digital voltmeters;
- To know the principle and operation of cathode ray oscilloscope

Module-I

Electrical Instruments:

Introduction, Classification of electrical measuring instruments. Construction, Principle of operation, torque equation, advantage and disadvantage of Moving coil, rectifier type instrument, Moving iron, Electrodynamometer type and induction type instruments. Extension of instrument ranges and multipliers, Principle of operation of the Electrostatic Instruments. [7L]

Errors in Measurement:

Definition of accuracy, precision, speed of response, non-linearity, techniques of linearization, classification of errors. Statistical error analysis, mean, median, mode, average, estimates, distribution, probable error, standard deviation, test of normal distribution, curve fitting using least squares methods. [5L]

Module-II

Measurement of Power:

Power measurement by Electrodynamometer Wattmeter, construction, principle of operation, shape of scale, wattmeter connections and errors. [3L]

Measurement of Energy:

Induction type energy meter: Principle of operation, errors and their compensation. [3L]

Instrument transformer:

Disadvantage of shunt and multipliers, Advantage of Instrument transformers, Construction, Principle of operation, Equivalent circuit and Vector diagram of Current & Potential transformer, Errors in Current Transformer and Potential Transformer. [4L]

Module-III

Measurement of Resistance:

Wheatstone bridge, Low resistance measurement by Kelvin double bridge, High resistance measurement, Megger. [2L]

Measurement of Inductances, Capacitances and Frequency:

Maxwell's Bridge, Anderson Bridge, Hay's Bridge, De Sauty's Bridge, Schering Bridge and Wien bridge. [2L]

Potentiometer:

Principle of operation and application of Crompton's DC potentiometer, Polar and Co-ordinate type AC potentiometer & Application. [4L]

Location of cable fault: Murray loop test, Varley loop test. [2L]

HOD, EE

Module-IV

Electronic Instruments:

Direct coupled DC volt meter, chopper type DC voltmeter, average reading AC voltmeters, peak reading AC voltmeters, true RMS voltmeter, Electronic multi-meter, [6L]

Digital Voltmeter: Integrating type and Successive approximation type. [2L]

Cathode ray oscilloscope (CRO):

Concept of digital storage oscilloscope. [1L]

TOTAL-41L

Text Books:

1. A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat, Rai & sons.
2. Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing.
3. Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition.
4. Modern Electronic instrumentation & Measuring instruments, A.D. Heltric & W.C. Copper, Wheeler Publication.
5. Electrical and Electronic Measurement, N.K.Dutta

HOD, EE

Thermal Power Engineering
(B.Tech.-Electrical-2nd year)
Subject Code: ELEC 2203

Credit: 4 Lectures/Week: 4

Course Objectives: After attending the course, the students will be able to:

1. Understand the various methods of generating shaft power.
2. Identify and learn the basic components of a simple thermal power plant and their working.
3. Identify and learn the basic components of IC engine and their working.
4. Explain engine test procedure and finding various engine efficiencies.

Module No	Syllabus	No. of Lectures
1	1.1 Basic components of Power Plant, Analysis of Steam Power Cycles: Vapour Power Cycles, Rankine Cycle, Rankine versus Carnot Cycle, limitations of Carnot cycle, Reheat Cycle, Regenerative Cycle. 1.2 Steam Generators and Water Treatment: Essentials, Classifications, Basic boiler mountings, Accessories and Mountings, Sub-critical and Super-critical steam generation, Rating of boilers and boiler efficiency 1.3 Superheaters, Economisers and Feedwater Heaters: Description and working principle	5 4 3
2	2.1 Condensers: Functions, Types, Vacuum Efficiency, Effects of Vacuum and Air leakage, Condenser efficiency 2.2 Cooling ponds and Cooling Towers: Cooling ponds and Towers, Types, Dry Cooling systems 2.3 Fuels, Fuel Handling, Combustion: Fuel classification, Methods of Coal handling, Fuel combustion, Fluidized Bed Combustion System 2.4 Ash handling and Dust Collection: Principal requirements, Systems of ash handling, Uses of ash, Dust collection (Cyclone Separator, ESP, Fabric Filters)	3 3 3 3
3	3.1 Types of nozzles, Flow through Nozzles under dry saturated and superheated condition ,condition for maximum mass flow rate , Nozzle Efficiency, Relationship between Area, Velocity and Pressure in nozzle. 3.2 Steam Turbines, Classification , Impulse and Reaction Steam Turbine Velocity diagram, Power Developed, Blade Efficiency, Stage Efficiency, Overall efficiency, Axial Thrust ,Condition for maximum efficiency , Degree of Reaction in Reaction Turbine, Velocity and Pressure compounding ,Losses in Turbines 3.3 Governing of Steam Turbines	4 6 2
4	4.1 Basics of I C Engines 4.2 Analysis of Otto Cycle, Diesel Cycle and Dual Cycle and their comparison under different conditions 4.3 Fuel characteristics of SI engine & CI engine , Detonation in SI/CI engines, Octane Number, Cetane Number 4.4 Engine Performance & Testing- Measurement of IP, Measurement of BP , Indicated thermal efficiency, Brake thermal efficiency, Mechanical efficiency , Volumetric efficiency , Brake specific fuel consumption , Heat balance sheet . 4.5 Exhaust gas emission and control	1 4 2 4 1

Recommended Books:
1. Domkundwar- Thermal Engineering-Dhanpat Rai &co.
2. Ballaney-Thermal Engineering- Khanna Publishers
3. R.K.Rajput- Thermal Engineering – Laxmi Publications

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HOD, EE

Electrical Machine Laboratory-I

[ELEC 2211]

Contact Hour-3P

Credit-2

1. Study of the characteristics of a separately excited DC generator.
2. Study of the characteristics of a DC motor
3. Study of methods of speed control of DC motor
4. Study of the characteristics of a compound DC generator.
5. Measurement of speed of DC series motor as a function of load torque.
6. Swinburne's test of a D.C. Machine .
7. Hopkinson's test
8. Study of equivalent circuit of a single phase transformer.
9. Polarity test on a single phase transformer & study of different connections of 3-phase transformer
10. Parallel operation of single phase transformer

HOD, EE

ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS LABORATORY
CODE: ELEC2212
CONTACT: 3P
Credit : 2

List of Experiments:

1. Familiarization of instruments: - Identification of the different parts of PMMC, Dynamometer, Electro-thermal and Rectifier type of instruments, Oscilloscope and Digital multi-meter.
2. Calibration of moving iron and electrodynamometer type ammeter/voltmeter/ wattmeter by potentiometer.
3. Calibration of dynamometer type wattmeter by potentiometer.
4. Calibration of AC energy meter.
5. Measurement of resistance using Kelvin double bridge.
6. Measurement of power and use of Instrument transformer to extending range of power measuring instruments.
7. Measurement of power in Three-phase circuits.
8. Measurement of frequency by Wien Bridge.
9. Measurement of Inductance by Anderson bridge
10. Measurement of capacitance by De-Sauty Bridge.
11. Measurement of capacitance by Schering Bridge.

HOD, EE

Thermal Power Engineering Lab

Sub Code: ELEC 2213

B.Tech.-Electrical-2nd year.

Credit:2 **Periods/Week: 3**

Expt.No.	Title of the Experiment	Periods
1.	Study of Two-stroke petrol ,Four-stroke Petrol and Diesel Engine with the help of cut models.	3
2.	Study of various water tube and fire tube boilers with the help of cut models.	3
3.	To Find out the Calorific Value of Petrol and Coal with the help of Bomb Calorimeter.	3
4.	To Find Out the Flash Point and Fire Point of Petrol and Diesel Fuel with the help of Pensky Martins Test Apparatus.	3
4.	To find out the quality of steam by measuring enthalpy and Dryness fraction.	3
5.	To Find Out the cloud Point and Pour Point of Petrol and Diesel Fuel.	3
6.	To study valve timing diagram of 4-stroke diesel engine .	3
7.	Load Test of 4-stroke Diesel Engine by Electrical Load –Box.	3
8.	Load Test of 4-stroke multicylinder petrol engine by Rope Brake dynamometer (Morse Test)	3
9.	Exhaust Gas Emission Test.	3

HOD, EE

Course Name : ANALOG ELECTRONIC CIRCUITS					
Course Code : ECEN2101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After completing the course the student will be able to:

1. Apply the previous knowledge gathered from Basic Electrical and Basic Electronics papers.
2. Understand the concepts of BJT and biasing techniques of BJT based amplifier circuits.
3. Analyze frequency response of amplifier circuits.
4. Design different type's sinusoidal oscillators and multivibrator circuits.
5. Construct algebraic equations based amplifier and analog computers using OP-AMP.
6. Design different types of Power Amplifier Circuits.

MODULE 1: Analog Signals and Devices

Introduction to Analog Signal [1L]:
Basic concepts on analog, discrete and digital signals, simple signal processing circuits (clippers, clampers)

Bipolar Junction Transistors (BJT)[2L]:
DC operating point, BJT characteristics & parameters, emitter bias with and without emitter resistance, operating point (Q point) and its stability.

Small Signal BJT Amplifiers[6L]:
AC equivalent circuit; Hybrid and re model.Applications of AC equivalent circuits in amplifier design; input impedance, output impedance,voltage gain, current gain for CE, CB and CC configurations.

MODULE 2: Amplifiers and Oscillators

Feedback & Oscillator Circuits [6L]:
Concept of feedback. Analysis of practical feedback amplifiers; Input and output impedance of different topologies, Sinusoidal Oscillators; Phase-shift, Wien-Bridge, Hartley, colpitt and crystal Oscillators.

Frequency Responses and Multistage Amplifiers [6L]:
Frequency response of CE, RC-coupled amplifiers; effect of external, parasitic and wiring capacitors on cut-off frequencies, Miller capacitance, effect of frequency dependent h_{fe} , Giacoletto (hybrid π) model of BJT, gain band-width product, unity-gain frequency

MODULE 3: Operational Amplifiers (OPAMPs)

Fundamentals of OPAMP [4L]:
Basic building blocks of OPAMP. Current source and current mirror circuits. Types of differential amplifier, AC and DC analysis of differential amplifiers; dual-input, balanced-output and dual-input, unbalanced-output. Frequency response of OPAMP.

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Applications of OPAMP [6L]:
Log-antilog amplifier, realization of basic algebraic equations using OPAMPs, designing of analog computers. Instrumentation amplifier. Precision rectifier.

MODULE 4: Analog Circuit Design and Applications

Power Amplifiers [3L]:
Class A; Calculation of DC power, AC power and efficiency of RC-coupled and transformer coupled class A amplifiers. , Class B amplifiers; Calculation of DC power, AC power and efficiency, push-pull configurations. Class AB; concept and cross-over distortion, Class C amplifier.

Applications Analog IC [2L]:
555 Timer IC; Astable, Mono-stable operations

Text Books:

1. Adel S. Sedra & Kenneth Carless Smith, Microelectronic Circuits, Oxford University Press
2. Robert L. Boylestad, Electronic Devices and Circuit Theory, Prentice Hall
3. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Prentice Hall of India Private Limited

Reference:

1. Behzad Razavi, Fundamentals of Microelectonics, Wiley India Pvt Ltd
2. Millman & Halkias, Integrated Electronics, Tata McGraw-Hill Education
3. Salivahanan, Linear Integrated Circuits, Tata McGraw-Hill Education
4. D. Roy Choudhury, Linear Integrated Circuits, New Age International
5. Anant Agarwal & Jeffrey H. Lang, Foundations of Analog and Digital Electronic Circuits, Elsevier

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Course Name : ANALOG ELECTRONIC CIRCUITS LABORATORY					
Course Code : ECEN2111					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

After completing the following experiments, students will be able to:

1. Identify the various circuit arrangements pertaining to this lab
2. Understand the functioning of equipments like Function Generators.
3. List the components required for conducting the experiments
4. Design various analog circuits and study their outputs.

List of Experiments:

1. Design and study of clipper and clamper circuits using diodes
2. Design a RC-coupled CE amplifier and study its frequency response, input impedance, output impedance.
3. Design an astable multivibrator using 555 Timer IC
4. Design a mono-stable multivibrator using Timer IC
5. Precision rectifier; full wave, half wave
6. Design a RC phase shift oscillator
7. Design Wien-Bridge oscillator
8. Triangular wave form generator
9. Square wave generator
10. Schmitt trigger oscillator

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Course Name	**: DATA STRUCTURE & ALGORITHM**				
Course Code	**: ECEN2102**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcome:
After completing the course the student will be able to:

1. Apply the previous knowledge gathered from the courses on programming language and discrete mathematical structures.
2. Solve problems related to linear data structures, algorithms and time complexities.
3. Understand the concepts of stack, queue and recursion and apply them for problem solving.
4. Design advanced data structures using non-linear data structures applying the knowledge and concepts of trees and graphs.
5. Evaluate operations like searching, sorting, hashing, traversing and collision resolution techniques.
6. Construct solutions to real life scenarios and explore the wide range of applications.

Module –I: [8L] Linear Data StructureI

Introduction (2L):
Why we need data structure?
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.
Algorithms and programs, Basic idea of pseudo-code.Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.

Array (2L):
Different representations – row major, column major. Sparse matrix - its implementation and usage.

Linked List (4L):
Singly linked list, circular linked list, doubly linked list.

Module -II: [7L] Linear Data Structure II

Stack and Queue (5L):
Stack and its implementations (using array, using linked list), applications.
Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications. Basic concept of deque.

Recursion (2L):
Principles of recursion – use of stack, differences between recursion and iteration, tail recursion.

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Module –III: [11L] Nonlinear Data structures

Trees (7L):
Basic terminologies, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (only basic concept, insertion, deletion with examples only).

Graphs (4L):
Graph representations/storage implementations – adjacency matrix, adjacency list,
Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS)

Module – IV: [10L] Searching, Sorting,Hashing:

Sorting Algorithms (6L):
Bubble sort, insertion sort, selection sort, merge sort, quicksort, heap sort, radix sort.

Searching (2L):
Sequential search, binary search

Hashing (2L):
Hashing functions, collision resolution techniques (Open and closed hashing).

Reference:

1. "Data Structures And Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Data Structures in C" by Aaron M. Tenenbaum.
3. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
4. "Data Structures" by S. Lipschutz.

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Course Name : DATA STRUCTURE LAB					
Course Code : ECEN2112					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

List of Experiments:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem.
3. Evaluation of expressions operations on Multiple stacks & queues.
4. Implementation of linked lists: inserting, deleting, inverting a linked list.
5. Implementation of stacks & queues using linked lists.
6. Sparse Matrices : Multiplication, addition.
7. Recursive and Nonrecursive traversal of Trees.
8. DFS and BFS.
9. Application of sorting and searching algorithms.

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Course Name : SIGNALS AND SYSTEMS					
Course Code : ECEN2103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcome:
After completing the course the student will be able to :

1. Apply the previous knowledge of mathematics of differential calculus.
2. Categorize and identify different types of signals and systems.
3. Analyze frequency domain characteristics of signals using Fourier series, Fourier transforms and Laplace Transform.
4. Implement the concepts of transformation tools to design of communication systems and filters.
5. Analyze random signals and its properties, hence extending the concept towards in communications systems.
6. Evaluate the response of different systems using different mathematical tools.

Module 1: Introduction to Signal and Systems: (10 L)

1.1. **Classification of Signals**:– Discrete and continuous signal, Periodic aperiodic, even – odd, energy and power signals, Deterministic and random signals, complex exponential and sinusoidal signals, periodicity, unit impulse, unit step, Transformation of independent variable of signals, time scaling, time shifting.

1.2. **Properties of Systems**:- Linearity, Causality, time invariance and stability. Dirichlet's conditions, Distortionless systems, Invertible systems- Frequency response of LTI discrete time system, discrete time invariant system describe by constant coefficient linear difference equation, Impulse response of an LTI recursive system.

Module 2: Analysis of continuous time and discrete time signals: (10 L)

2.1 Convolution in continuous time, , Continuous time Fourier Series, Fourier transformation of continuous time signals and their properties.

2.2. Laplace transformation- analysis and characterization of LTI systems with examples and properties. Computation of impulse response and transfer function using Laplace transform. Parseval's theorem.

2.3. Convolution in discrete time, Correlation of discrete time signals, Discrete time Fourier Series, Fourier transformation of discrete time signals and their properties.

Module 3: Application of Signal and Systems theory: (8 L)

3.1 Sampling Theorem, Types of sampling, Aliasing, Pre-alias filter, Reconstruction of a signal from its samples, Modulation for communication, Sampling of Band-pass signals, Filtering, Hilbert Transform.

3.2 Concept of digital low pass, high pass, band pass and band stop filters with ideal magnitude response, All pass transfer function, zero phase transfer function, Minimum and Maximum phase transfer function.

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Module 4: Random Signal And System, Noise (8 L)

Definitions, distribution & density function, mean values &moments, function of two random variables, concept of correlation, random processes, spectral densities, response of LTI system to random inputs, Noise sources in circuits, noise in communication circuits and systems, noise voltage.

Text Book:

1 A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals &Systems, Pearson
2 S.Haykin & B.V.Veen, Signals and Systems- John Wiley
3 P.Ramesh Babu & R.Anandanatarajan- Signals and Systems 4/e- Scitech

References:

1 J.G.Proakis & D.G.Manolakis- Digital Signal ProcessingPrinciples, Algorithms and Applications.
2 B.P.Lathi- Signal Processing & Linear Systems- Oxford
3 A.Nagoor Kani- Signals and Systems- McGraw Hill
4 Digital signal Processing by S.K. Mitra-Tata McGraw Hill

Course Name : SIGNALS AND SYSTEMS LABORATORY					
Course Code : ECEN2113					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

COURSE OUTCOME:
After completing the following experiments, students will be able to:

1. Understand the concepts of signal synthesis, Sampling techniques using Sampling theorem
2. Describe the process of generating various continuous and discrete signals.
3. Understand the concepts of convolution theorem in its different domains.
4.Analyze the auto and cross correlation of signals

List of Experiments:

<u>Hardware Experiments-:</u>

1. To Study Signal Synthesis via sum of harmonics using spectrum analyzer.

2. Study of sampling theorem.

<u>Software Experiments-:</u>

1. To study the generation of different type of continuous and discrete signals.

2. To study the different operation of signals.

3. To study convolution theorem in time and frequency domain.

4. To study the autocorrelation and crosscorrelation of signal.

5. To study the Fourier transform and Laplace transform.

6. Magnitude and phase response of the filters.

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Course Name	: CIRCUIT THEORY AND FILTERS				
Course Code	: ECEN2105				
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course outcome:
After completing the course the student will be able to:

1. Apply the previous knowledge gathered from Basic Electrical Engineering for understanding the basic concepts of this subject.
2. Solve problems in various electric circuits using Network Theorems.
3. Analyze complex circuits in Laplace domain.
4. Understand the application of Graph theory to solve various network behaviour.
5. Evaluate the output of various Two port network without going through the detailed configuration.
6. Design various types of filters using SPICE software.

Module-I:
Network equations: Formulation of Node & Mesh equations. Loop and node variable analysis of transformed circuits. Network Theorems: Thevenin's, Norton's, Superposition and Reciprocity theorem applied to circuits containing dependent sources. [8L]
Coupled Circuits: Coefficient of coupling, Dot convention, Analysis of coupled circuits. [3L]

Module-II:
Laplace Transform: Concept of complex frequency. Properties of Laplace transform linearity, differentiation, integration, initial value theorem and final value theorem. Transform of standard periodic and non periodic waveforms. Circuit elements and their transformed equivalents, Independent and dependent sources and equivalence of sources, treatment of mutual couplings in t & s domain. Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Concept of natural frequency and damping. Sketching transient response, determination of time domain specifications. Concept of Convolution theorem and its application. [10L]

Module-III:
Graph theory: Graph of network: Concept of path, tree, tree branch, tree link, loop, tie set and cut set. Incidence Matrix, tie-set Matrix and f-cut set matrix and their properties. Loop currents and node-pair potentials, formulation of loop and node equilibrium equations in view of graph theory. [5L]

Two port networks: Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and inverse hybrid parameters. Inter relation between parameters. Inter connection between two port networks. Driving point & transfer impedance & admittance. [5L]

Module-IV:
Filter Circuits: Concept of filters, Classification of filters. Analysis and synthesis of Low pass, High pass, Band pass and Band reject filters using operational amplifier. Filter approximations: Butterworth, Chebyshev filters. [6L]

SPICE: Structure of a SPICE program, active and passive device/element statements, different study like DC analysis, transient analysis and ac analysis statement in SPICE.

Plotting and printing statement, input and output Impedance calculation using SPICE, voltage and current controlled components in SPICE. [3L]

Total: 40L

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
2. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
3. Network Analysis, M.E. Valkenburg, Pearson Education .
4. Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand.

Reference Books:

1. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin,The Mc Graw Hill Company.
2. Modern Network Analysis, F.M.Reza & S.Seely, McGraw Hill.

Course Name : EM THEORY & TRANSMISSION LINE					
Course Code : ECEN2201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcome:

After completing the course the student will be able to:

1. Calculate gradient, divergence and curl respectively for scalars and vectors in different coordinate systems.
2. Calculate electric and magnetic fields for given boundary conditions.
3. Solve one-dimensional electromagnetic wave (EMW) equations in order to find power transmissions and reflections.
4. Compare transmission lines by estimating transmission coefficient, reflection coefficient, standing wave, VSWR, input impedance of lossless and distortion-less transmission line terminating at matched and unmatched load.
5. Do experiment with half-wave dipole antenna and analyze radiation pattern of the antenna.
6. Develop skills to formulate equations for estimating and/or calculating chracteristics of the medium and nature of the wave propagating through some special mediums.

Electromagnetic Theory

1. Vector calculus - orthogonal Coordinate System, Transformations of coordinate systems; Del operator; Gradient, Divergence, Curl - their physical interpretations; Laplacian operator. **[3]**

2. Coulomb's law, electric field intensity, charge distribution; Gauss' law, flux density and electric field intensity. Divergence theorem. Current Densities, Conductors, Poisson's & Laplace's equations. Uniqueness theorem, Biot-Savart law, Ampere's law, Relation between J & H, Vector magnetic Potential, Stokes' theorem. **[5]**

3. Faraday's law & Lenz's law. Displacement Current, J_c- JD Relation, Maxwell's equations, Time-harmonic fields, Wave Equation, Boundary Conditions between media interface; Uniform Plane wave; Plane Wave Propagation in Lossy Dielectric, Loss-less Dielectric, Good Conductor, Free space; Poynting Theorem, Power flow, Poynting vector, Skin Depth, Surface Resistance; Reflection and Transmission for normal incidence**. [10]**

Transmission Lines

4. Transmission Lines; Concept of Lumped parameters and Distributed parameters. Line Parameters, Transmission line equations and solutions, Physical significance of the solutions, Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Distortion-less Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart -Applications; Load Matching Techniques / Quarter wave Matching, Bandwidth problem; Low loss RF transmission lines, line as circuit elements. **[10]**

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Radiation of E M Waves

5. Antenna Concepts, Antenna Characteristic; Hertzian dipole (Radiation Fields, Radiation Resistance, Radiation patterns, Directive Gain); Properties and typical applications of Half-wave dipole, Loop antenna, Yagi-Uda array, Array Antennas. **[6]**

Text Books:

1. Principles of Electromagnetics, 4th Edition, Matthew O H Sadiku, Oxford University Press.
2. Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education.
3. Electromagnetic Waves Shevgaonkar, Tata-McGaw-Hillr –R K.
4. Antenna Theory: Analysis and Design, 3rd edition, C.A. Balanis, Wiley India.

Reference Books:

1. Engineering Electromagnetics, 2ed Edition - Nathan Ida, Springer India.
2. Fields & Waves in Communication Electronics, S. Ramo, J. R. Whinnery & T. Van Duzer, John Wiley
3. Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
4. Engineering Electromagnetics, 7thEdition-W.H.Hayt & J.A.Buck, Tata-McGraw-Hill
5. Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy-Scitech.

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Course Name : E.M THEORY & TRANSMISSION LINE LABORATORY					
Course Code : ECEN2211					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

After completing the following experiments, students will be able to:

1. Understand the behavior of Transmission Lines and study standing wave patterns.
2. Describe the use of Smith chart using MATLAB
3. Generate radiation patterns of various antennas
4. Evaluate parameters like Gain, directivity etc of antennas like Yagi Uda.

List of Experiments:

[At least THREE experiments from Module I and FOUR experiments from Module II]

Module I:

1. Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited and terminated by a resistive load at the load end.
2. Measurement of Input Impedance of a terminated coaxial line using shift in minima technique.

3. Study of Smith chart on MATLAB platform.

4. Simulation study of Smith chart - Single and double stub matching.

Module II:

5. Radiation Pattern study of dipole antenna.

6. Radiation Pattern study of a folded-dipole antenna.

7. Radiation pattern study of Helical Antenna.

8. Parametric study (Gain, Directivity, HPBW and FNBW) of three, five and seven element Yagi Uda configurations.

9. Radiation pattern study of a Pyramidal Horn Antenna.

10. Spectrum analysis of different analog signals (sine, triangular, square) using spectrum analyzer.

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Course Name : DIGITAL ELECTRONICS					
Course Code : ECEN2002					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcome:
After completing the course the student will be able to:

1. Apply the concept of Boolean algebra to minimize logic expressions by algebraic method, K-map method, and Tabular method.
2. Construct different Combinational circuits like Adder, Subtractor, Multiplexer, De-Multiplexer, Decoder, Encoder, etc.
3. Design various types of Registers and Counters Circuits using various Flip-Flops.
4. Understand the concept of different types of A/D and D/A conversion techniques.
5. Construct basic gates using RTL, DTL, TTL, ECL and CMOS logic families.
6. Use the concept of Flip flops to analyze different memory systems like RAM, ROM, EPROM, EEROM, etc.

Module-1:
Data and number systems; Binary, Octal and Hexadecimal representation and their conversions; BCD,, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De- Morgan's theorem,Various Logic gates- their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K- map method, Tabular method. [8]

Module-2:
a) Combinational circuits- Adder and Subtractor, BCD adder, BCD subtractor, Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator. [7]
b) Memory Systems: Concepts and basic designs of RAM, ROM, EPROM, EEROM, Programming logic devices and gate arrays. (PLAs and PLDs) [5]

Module-3:
Sequential Circuits- Basic memory element-S-R, J-K, D and T Flip Flops,Interconversions of Flip-Flop, State table and state transition diagram, sequential circuits design methodology, FSM (Mealy and Moore machine), various types of Registers and counters (Synchronous, asynchrounous, Irregular , cascaded, ring, johnson) and their design, Lockout and its remedy. [8]

Module-4:
a) Different types of A/D(Flash, SAR, Counter type, Dual slope) and D/A(R-2R, weighted resistor) conversion techniques.[4]

b) Logic families- RTL , DTL, TTL, ECL, and CMOS, their operation and specifications. Realization of basic gates using above logic families.[4]

Total: 40 hours

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Textbooks:

1. Morries Mano- Digital Logic Design- PHI .
2. R.P.Jain-Modern Digital Electronics, 2/e , Mc Graw Hill
3. Virendra Kumar-Digital technology, New Age Publication
4. S.Salivahanan, S.Arivazhagan- Digital Circuit & Design- Bikas Publishing

Reference:

1. H.Taub & D.Shilling, Digital Integrated Electronics- Mc
2. Tocci, Widmer, Moss- Digital Systems,9/e- Pearson 7.
3. Leach & Malvino—Digital Principles & Application, 5/e, Mc Graw Hill
4. Floyed & Jain- Digital Fundamentals-Pearson. 11.

Course Name : DIGITAL ELECTRONICS LAB					
Course Code : ECEN2012					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

After completing the following experiments, students will be able to:

1. Identify various digital circuit configurations like BCD t to Excess-3, Four-bit parity generator etc.
2. Design simple mathematical circuits and study the outputs.
3. Construct various Flip flops and see the outputs.
4. Experiment with construction of various types of counters.

List of Experiments:

1. Code conversion circuits- BCD to Excess-3 and vice-versa.
2. Four-bit parity generator and comparator circuits.
3. Construction of simple arithmetic circuits-Adder, Subtractor.
4. Construction of simple Multiplexer circuits using logic gates.
5. Realization of different combinational circuits using Multiplexers.
6. Design of 4-bit Priority Encoder using logic gates.
7. Realization of RS-JK and D flip-flops using Universal logic gates.
8. Realization of Asynchronous Up/Down counter.
9. Realization of Synchronous Up/Down counter.
10. Design of Sequential Counter with irregular sequences.
11. Realization of Ring counter and Johnson's counter.

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Course Name : ANALOG COMMUNICATION					
Course Code : ECEN2203					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcome:
After completing the course the student will be able to:

1. Understand & apply the concepts of various types of signals, techniques for signal transmission and signal modulation from the knowledge gathered earlier.
2. Identify various parameters associated with Amplitude Modulation, time and frequency domain representations, side band frequencies etc and apply these knowledge to solve numerical problems.
3. Understand principles of various generation and detection techniques of Amplitude Modulation.
4. Identify and apply detailed knowledge of Angle modulation and demodulation techniques.
5. Analyze various multiplexing techniques and radio receivers.
6. Understand system noise and apply this knowledge to compare the noise performance of Analog Communication systems.

Module -1: [9L]

Introduction to Analog Communication: Introduction to basic elements of communication systems, signal transmission through linear systems, Condition for distortion less transmission of signals through networks. Different types of distortion and their effect on the quality of output signals. Concept of modulation, its needs.

Continuous Wave Linear Modulation:
a) Amplitude modulation(AM-DSB/TC): Time domain representation of AM signal (expression derived using a single tone message), modulation index, frequency domain (spectral) representations, illustration of the carrier and side band components; transmission bandwidth for AM; Phasor diagram of an AM signal; Calculation of Transmitted power & sideband power & Efficiency ; concept of under, over and critical modulation of AM-DSB-TC.
b) Other Amplitude Modulations: Double side band suppressed carrier (DSBSC) modulation: time and frequency domain expressions, bandwidth and transmission power for DSB. Single side band modulation (SSB) both TC & SC and only the basic concept of VSB, Spectra and band-width.

Module -2: [9L]

Generation & Detection of Amplitude Modulation:
a) Generation of AM: Gated, Square law modulators, Balanced Modulator.
b) Generation of SSB: Filter method, Phase shift method and the Third method
Demodulation for Linear Modulation:
Demodulation of AM signals: Detection of AM by envelope detector , Synchronous detection for AM-SC, Effects of Frequency & Phase mismatch, Corrections.

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Module -3: [8L]

Angle Modulation:

a) **Frequency Modulation (FM) and Phase Modulation (PM):** Time and Frequency domain representations, Spectral representation of FM and PM for a single tone message, Bessel's functions and Fourier series.; Phasor diagram;

b) **Generation of FM & PM:** Narrow and Wide-band angle modulation, Basic block diagram representation of generation of FM & PM, Concept of VCO & Reactance modulator

c) **Demodulation of FM and PM:** Concept of frequency discriminators and phase discriminators, Phase Locked Loop.

Module – 4: [10L]

a) **Multiplexing :** Frequency Division Multiplexing, Time Division Multiplexing,

b) **Radio Receivers** –Basic block diagram of TRF, Superhetrodyne principle.

Random Signals and Noise in Communication System:

i) Noise in Communication systems – Internal & External noise, Noise Temperature, Signal-to-Noise ratio, White noise, thermal noise, Figure of Merit.

iii)Noise performance in Analog Communication systems: SNR calculation for DSB/TC, DSB-SC, SSB-TC, SSBSC & FM.

Total 36 Hours

Text Books:

1. B.P.Lathi -Communication Systems- BS Publications
2. Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc-Graw Hill
3. Singh & Sapre—Communication Systems: 2/e, TMH
4. S Sharma, Analog Communication Systems- Katson Books

References:

1. Carlson—Communication System,4/e , Mc-Graw Hill
2. Proakis & Salehi Fundamentals of Communication Systems- Pearson
3. V Chandra Sekar – Analog Communication- Oxford University Press
4. P K Ghosh- Principles of Electrical Communications- University Press
5. L.W.Couch Ii, "Digital and Analog Communication Systems", 2/e, Macmillan Publishing
6. Blake, Electronic Communication Systems- Cengage Learning

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Course Name : SOLID STATE DEVICES					
Course Code : ECEN2204					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcome:

After completing the course the student will be able to:

1. Apply the previous knowledge of Basic electronics Engineering to appreciate the contents of this paper.
2. Understand both the particle and wave natures of electrons in Solid State Devices.
3. Identify unknown extrinsic semiconductor type using Hall Effect.
4. Describe working principles of different devices using mathematical models and energy band diagrams.
5. Justify different operations of solid state devices using relative position of Fermi energy levels across p-n junctions in devices.
6. Evaluate performance of different hetero junctions in semiconductor devices.

Module - 1: Semiconductor Physics **(12L)**

Recapitulation of Quantum Mechanics, Kronig Penny Model, Energy Band diagram, E-K diagram, Direct and Indirect Band-gap semiconductors, concept of effective mass, Carrier distribution in solid, concept of density of state (only expression), Fermi-Dirac distribution, Fermi level, Intrinsic and Extrinsic semiconductors, idea of Degeneracy and Non-Degeneracy, Fermi level shift with the changes in doping and temperature. (7L)

Semiconductor under equilibrium: Carrier Concentration in terms of effective Density of States, Mass-Action Law. (2L)

Semiconductor under non-equilibrium: Drift and Diffusion of carrier with expressions, Scattering Effect, Hall Effect, Piezo-electric effect, Excess Carrier Generation and recombination with expression, concept of quasi Fermi-level. (3L)

Module - 2: Diodes: **(12L)**

Basic concepts about Homo & Hetero junctions

Homo-junctions: p-n junction physics: derivations and plots of depletion charge, electric field, potential profiles; energy band diagram, depletion width, p-n junction capacitances, Varactor diode, Derivation of p-n junction current, junction resistances; concepts about linearly graded and abrupt junctions. (5L)

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Basic operations of different diodes: Breakdown diodes, Tunnel diode, Photo diodes (P-N, P-I-N, APD), Photoconductor, Solar cell; Basic concept about Spontaneous and Stimulated emissions, LED. (4L)

Hetero-junctions: Physics of Metal-Semiconductor & Semiconductor-Semiconductor hetero-junctions, Rectifying & Non-rectifying natures of Hetero-junctions, basic concept of potential-well & 2D electron gas. (3L)

Module - 3: Bipolar Junction Transistors (BJT): (8L)

Physic of BJT: Basic device operating principle, minority carrier distributions, Different modes of operations and respective band diagrams, input output characteristics of BJT in CB & CE modes, base width modulation, Early effect, punch through, thermal runaway; concepts about large and small signal modeling of the device, Eber's Moll model, Hybrid-π model. (6L)

Basic operations of different transistors: Photo-transistor, TRIAC, DIAC, UJT, SCR. (2L)

Module - 4: Field Effect Transistors (FET): (8L)

JFET: Device construction and physics, principle of operation, V-I characteristics. (2L)

MOSFET: Physics of 2-terminal MOS structures with proper band diagrams; MOSFET classifications: Enhancement and Depletion type MOSFETs, basic operations and V-I characteristics of both the devices; concepts of Threshold voltage and Flat-band voltage, small signal model of MOSFET, Introduction to CMOS technology. (6L)

Text Books :

1. Neamen- Semiconductor Physics and Devices- TMH
2. Bhattacharya & Sharma- Solid State Electronic Devices- Oxford
3. Streetman & Banerjee- Solid State Electronic Devices- PHI

Reference Books :

1. Milman, Halkias & Jit- Electronics Devices and Circuits- TMH
2. Bell-Electronics Devices and Circuits-Oxford
3. Bogart, Bisley & Rice- Electronics Devices and Circuits- Pearson
4. Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson

Course Name : Analog Electronics					
Course Code: AEIE2101					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I- [6L]

Diode and Diode circuits: Diode characteristics and Peak Inverse Voltage, Analysis of Ideal and Practical diode circuits, Rectifier circuits (half wave and full wave rectifier circuits),Bridge rectifier circuit, Voltage Regulator circuits, series and shunt voltage regulators, percentage regulation, Clippers and Clampers.

Module II – [16L]

Transistor Biasing, Amplifiers and Feedback Circuits: Operating-point, fixed bias, collector to emitter bias, voltage divider bias, variation of operating point and its stability, RC coupled amplifier, Effect of Emitter and coupling capacitors, Frequency Response of single-stage and multistage.

CE transistor amplifier, Transistor Hybrid model, Analysis (Voltage gain, Current gain, Input and Output Impedance, Trans-resistance & Trans-conductance) of a Transistor amplifier circuit by h-parameters, Bandwidth and concept of wide band amplifier, Principle of frequency translation, concept of heterodyne principle.

Power Amplifier (Class A, B, AB and C), Concepts of distortion in amplifier circuits, Feedback concept, Effect of positive and negative feedbacks, voltage/current, series/shunt feedback, Berkhausen criterion, Colpitts, Hartley, Phase shift, Wein bridge and crystal oscillators.

Module III-[8L]

Basics of Operational Amplifier: Basics of OPAMP, Differential (ac and dc analysis) and Common mode operation, Constant current source, level shifter, Open & Closed loop circuits, importance of feedback loop (positive & negative), inverting & non-inverting amplifiers, voltage follower/buffer circuit, Adder, Subtractor, Integrator & differentiator, Multiplier, Divider, comparator.

Module IV-[10L]

Applications of Operational Amplifier: Zero crossing detector, Schmitt Trigger, Generalised Impedence Converter, Instrumentation Amplifier, Log & Anti-log amplifiers, Trans-conductance multiplier, Precision Rectifier (Half & Full wave), voltage to current and current to voltage converter, Peak detector, Multivibrators: Monostable, Bistable, and Astable, Multivibrators (using the 555 timer): Monostable, Bistable, and Astable, VCO and PLL.

References:

1. Sedra & Smith-*Microelectronic Circuits*- Oxford UP
2. Franco—*Design with Operational Amplifiers & Analog Integrated Circuits* , 3/e, McGraw Hill
3. Boylested & Nashelsky- *Electronic Devices and Circuit Theory*- Pearson/PHI.
4. Coughlin and Driscol – *Operational Amplifier and Linear Integrated Circuits* – Pearson Education
5. Millman & Halkias – *Integrated El;ectronics*, McGraw Hill.
6. Rashid-*Microelectronic Circuits-Analysis and Design*- Thomson (Cenage Learning)
7. Schilling & Belove—*Electronic Circuit:Discrete & Integrated* , 3/e , McGraw Hill
8. Razavi- *Fundamentals of Microelectronics* - Wiley
9. Malvino—*Electronic Principles* , 6/e , McGraw Hill
10. Horowitz & Hill- *The Art of Electronics*; Cambridge University Press.
11. Bell- *Operational Amplifiers and Linear ICs*- Oxford UP
12. Gayakwad R.A -- *OpAmps and Linear IC's*, PHI.

13. Problems in Electrical Engineering (English) 9th Edition, N N Parker Smith.

Course Outcomes:

After completing the course the students will be able to

1. Apply the knowledge of semiconductor fundamentals to analyze simple electronic circuits based on diodes and transistors with special focus on designing different biasing methods of BJT.
2. Design and analyze BJT amplifiers for small and large signal.
3. Learn basic function of operational amplifier, ideal and practical characteristics and their mathematical applications.
4. Design and compare between different types of Oscillators to meet the specified needs with appropriate consideration.
5. Design, analyze and understand the application of different types of multivibrators with and without IC 555.
6. Analyze and design analog electronic circuits using discrete components with specified needs for the betterment of human living.

Course Name : Circuit Theory and Networks					
Course Code: AEIE2102					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [17L]

Analysis of DC & AC circuits: Analysis of circuits with and without controlled sources using mesh, node analysis, Superposition, Thevenin's, Norton's, Millman's, and Maximum Power Transfer Theorem.

Analysis of coupled circuits: Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit, solution using loop analysis.

Series and parallel resonance circuits: Condition of resonance, impedance curve, current curve, half power points, bandwidth, quality factor, selectivity, application to different combination of parallel circuits.

Module II – [8L]

Time domain analysis of R-L and R-C circuits: Forced and natural response, time constant, initial and final values.

Solution using first order equation for standard input signals: Transient and steady state time response, solution using universal formula.

Time domain analysis of R-L-C circuits: Forced and natural response, effect of damping.

Solution using second order equation for standard input signals: Transient and steady state time response.

Frequency domain analysis of RLC circuits: S-domain representation, applications of Laplace Transform in solving electrical networks, driving point and transfer function.

Module III – [9L]

Two Port Network: open circuit, short circuit, transmission and hybrid parameters, relationships among parameters, reciprocity and symmetry conditions.

Series/parallel connection: T and Pi representations, interconnection of two-port networks.

Graph Theory: Concept of graph, tree, branches, twigs, links, incidence matrix, reduced incidence matrix, tie-set matrix, cut-set matrix.

Module IV – [6L]

Basic filter circuit Design & Synthesis: Low pass, high pass, band pass and band reject filters, transfer function, frequency response, cutoff frequency, bandwidth, quality factor, attenuation constant, phase shift, Butterworth filter 2nd, 3rd and 4th order design (RC).

Network function, driving point impedance& admittance function. Synthesis tools: Foster form-I, form-II, Cauer form-I and form-II.

References:

1. Franklin F Kuo, *Network Analysis and Synthesis*, Wiley India Edition.
2. M E Van Valkenburg, *Network Analysis*", Prentice-Hall of India Pvt Ltd, New Delhi.
3. K V V Murty and M S Kamth, *Basic Circuit Analysis*, Jaico Publishing house, London.
4. Reinhold Ludwig and Pavel Bretchko, *RF Circuit Design*, Pearson Education, Asia.
5. Joseph J. Carr, *Secrets of RF Circuit Design*, Tata McGraw-Hill, New Delhi.
6. William H. Hayt, Jack E. Kemmerly, *Engineering Circuit Analysis*, McGraw-Hill Higher Education.
7. K.M.Soni, *Circuit Analysis & Synthesis*, S. K. Kataria & Sons.

Course outcome:

After completing the course the students will be able to

1. Apply knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits.
2. Identify, formulate, and solve engineering problems in the area circuits and systems.
3. Acquire skills in analyzing electrical measuring devices, analog electronic circuits, power electronic circuits.
4. Analyze and synthesize RL, RC and RLC networks.
5. Obtain circuit matrices of linear graphs and analyze networks using graph theory.
6. Design an electric system, components or process to meet desired needs within realistic constraints.

Course Name : Analog Electronics Lab					
Course Code: AEIE2111					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Introduction: Study of characteristics curves of B.J.T.
2. Study the effect of different parameters on frequency response of a two-stage R-C coupled amplifier and verify phase difference between input and output voltage.
3. Study of Integrator and Differentiator circuits with different types of input waveforms.
4. Study of class C & Push-Pull amplifiers.
5. Realization of Zero crossing detector & level shifter circuit using Operational Amplifiers.
6. Study of timer circuit using NE555 & configuration for monostable & astable multivibrator.
7. Construction & study of Bistable multivibrator using NE555.
8. Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip.
9. Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).
10. Design of an Oscillator circuit (Phase shift/ Wien Bridge).

Course Outcome:

Students will be able to

1. Analyze and identify different components of electronic circuits.
2. Set up testing strategies and select proper instruments to evaluate the performance characteristics of electronic circuits.
3. Design different kind of electronic circuits appropriately to obtain the best possible circuits that can be applied to any electronic systems.
4. Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.
5. Practice different types of wiring and instruments connections keeping in mind technical, economical, safety issues.
6. Evaluate the use of computer based analysis tools to review the performance of electronic circuit.

Course Name : Circuits and Networks Lab					
Course Code: AEIE2112					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

A. Hardware Based Experiment:

1. Verification of Thevenin's and Norton's theorem.
2. Transient response in RC, RL & RLC network.
3. Frequency response of Passive and active (LP, HP, BP, BR) filters of 1^{st} & 2^{nd} order

B. Software Based Experiment

1. PSPICE Based:
   i. Transient analysis of RC and RL circuits.
   ii. Leading and lagging analysis for RC and RL circuits
   iii. Over damped, under damped, critically damped analysis of a 2nd order system by Appling different inputs
   iv. Frequency response of 2^{nd} order system
2. MATLAB Based:
   i. Different types of signal generation
   ii. Laplace and inverse Laplace transform

Course outcome:

After completing the course the students will be able to

1. Apply network theorems to analyze the experimental result using hardware circuits.
2. Analyze RL, RC, and RLC circuits in time domain using hardware components.
3. Design and analyze the frequency response of passive and active (LP, HP, BP, BR) filters of 1st & 2nd order.
4. Carry out time & frequency domain measurements on elementary RL, & RC circuits using simulation software.
5. Design the RLC circuits to study the performance characteristics.
6. Become proficient with computer skills (e.g., PSPICE and MATLAB) for the analysis and design of circuits.

Course Name : Digital Electronic Circuits					
Course Code: AEIE2201					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I - [10L]

Data and number systems: Binary, Octal and Hexadecimal representation and their conversions, BCD,ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic.
Boolean algebra: Various Logic gates- their truth tables and circuits, Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method and Quine-McClauskey method.

Module II - [08L]

Combinational circuits: Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator and Checkers.

Module III - [12L]

Sequential Circuits: Basic Concepts, Flip-Flop, RS, JK, Master Slave, T and D Flip-Flops, Shift Registers and their applications, Synchronous and asynchronous counters, Up/Down counters, Ring counter. State table and state transition diagram, sequential circuits design methodology.

Module IV - [10L]

A/D (Ramp-compare, Successive - approximation and Flash type) and D/A (Binary weighted and R-2R Ladder type) conversion techniques.
Introduction to Various Logic Families: TTL, ECL, MOS and CMOS, their operation and specifications.
Memories and Programmable Logic Devices: RAM, ROM, EPROM, EEROM, PLA and PAL.

References:

1. Malvino & Brown, *Digital Computer Electronics*, TMH
2. H.Taub & D.Shilling, *Digital Integrated Electronics*, Mc Graw Hill
3. M. Mano, *Digital Logic and Design*, PHI
4. A. Anand Kumar, *Fundamentals of Digital Circuits*, PHI
5. Kharate, *Digital Electronics*, Oxford
6. Floyed & Jain, *Digital Fundamentals*, Pearson.
7. S Salivahanan & S Arivazhagan, *Digital Circuits and Design*, Vikas Publication

Course outcome:

After the completion of the course the students will be able to:

1. Understand the fundamentals of converting from one number system to another.
2. Explain the basic logic operations of NOT, AND, OR, NAND, NOR, and XOR.
3. Analyze, design and implement combinational logic circuits.
4. Analyze, design and implement sequential logic circuits.
5. Describe the nomenclature and technology in the area of memory devices: ROM, RAM, PROM, PLD etc. and different kind of ADCs and DACs.
6. Understand the basic electronics of logic circuits and be able to use integrated circuit packages.

Course Name : Sensors and Transducers					
Course Code: AEIE2202					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [13L]

Definition, principles of sensing and transduction, classification; concept of signal conditioning.
Mechanical and Electromechanical sensors
Resistive (potentiometric) type: Forms, materials, resolution, accuracy, sensitivity
Strain Gauges: theory, types, materials, design consideration, sensitivity, gauge factor, temperature dependance, adhesives, rosettes, applications-force, velocity and torque measurements
Inductive sensors: common types- reluctance change type, mutual inductance change type, LVDT: Construction, materials, output-input relationship, discussion
Capacitive sensors: Variable distance- parallel plate type, Variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type: calculation of sensitivities; proximity measurement, Stretched Diaphragm type: microphones, response characteristics

Module II – [10L]

Magnetic sensors: Sensors based on Villari effect for assessment of force, torque, rpm meters, proximity measurement
Hall Effect and Hall drive, performance characteristics
Piezoelectric elements: piezoelectric effects, charge and voltage coefficients, crystal model, materials, natural and synthetic types – their comparison, force and stress sensing, piezoelectric accelerometer
Tachometers – Stroboscopes, Encoders, seismic accelerometer, Measurement of vibration.

Module III – [9L]

Industrial weighing systems : Link–lever mechanism, Load cells – pneumatic, piezo-electric, elastic and magneto-elastic types - their mounting, connections & circuits, pressductor, different designs of weighing systems, conveyors type, weighfeeder type.
Thermal sensors: RTD – materials, construction, types, working principle, 2-wire, 3-wire and 4-wire configuration and circuit arrangement.
Thermistor – materials, construction, types, working principle
Thermo-emf sensors: Thermocouple – Thermoelectric Laws, types, working principle, Thermopile, series and Parallel configuration of thermocouple, Wien's displacement Law, Pyrometer (total radiation and optical types)

Module IV – [8L]

Optical Sensors: Introduction to optical fibres, LDR, Photodiode, Photovoltaic cell, Photomultiplier Tube.
Geiger counters, Scintillation detectors, Ultrasonic sensors: working principle, medical & industrial applications. Introduction to Smart sensors, Advantages of Smart sensor over conventional sensors.

References:

1. D Patranabis, *Sensors and Transducers*, PHI, 2nd ed.
2. E. A. Doebelin, *Measurement Systems: Application and Design*, Mc Graw Hill, New York
3. H. K. P. Neubert, *Instrument Transducers*, Oxford University Press, London and Calcutta.
4. S. Renganathan, *Transducer engineering*, Allied Publishers Limited, 2003.
5. D. V. S. Murty, *Transducer and instrumentation*, PHI, second edition, 2008.

Course Name : Electrical Measurement and Instruments					
Course Code: AEIE2203					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [10L]

Static characteristics of instruments: Accuracy, Sensitivity, Repeatability, Precision, Significant figures, Drift, Hysteresis, Threshold, Resolution, Dynamic characteristics of instruments: Fidelity, Speed of response.

Classification of analog instruments, Types of torques in indicating instruments, Ballistic galvanometer, Construction and principle of operation of Permanent Magnet Moving coil, Moving iron, Dynamometer and Electrostatic type instruments, Extension of instrument ranges using shunts and multipliers.

Module II – [7L]

Instrument transformer: Current transformer & Potential Transformer

D.C. Potentiometer: Basic slide wire potentiometer, Crompton's potentiometer,

A.C. Potentiometer: Drysdale polar potentiometer, Gall-Tinsley potentiometer; Measurement of energy by single phase induction type meter.

Module III – [11L]

Measurement of medium resistance: Ammeter-voltmeter methods, Substitution method, Wheatstone bridge method; Measurement of low resistance by Kelvin Double bridge; Measurement of high resistance: Direct deflection method, Loss of charge method, Megger ; Measurement of self inductance: Maxwell's Inductance bridge, Maxwell's inductance-capacitance bridge, Hay's bridge, Anderson's bridge; Measurement of capacitance: De Sauty's bridge, Schering bridge, Carey Foster bridge (in terms of standard mutual inductance), Measurement of mutual inductance: Heaviside mutual inductance bridge, Heaviside Campbell bridge; Measurement of frequency by Wien's bridge, Wagner Earthing device.

Module IV – [8L]

Localization of cable faults using Murray and Varley loop methods;

Static calibration of instruments & Curve fitting methods (sequential differences, extended differences and least squares method); Errors; Combination of limiting errors; Statistical treatment of Errors: Measures of Central Tendency and Dispersion; Error estimation from Normal Distribution, Chi-Square test; Reliability Principles: Reliability, Un-reliability, MFR, MTTF, MTBF, MDT, MTTR, Bath Tub curve.

References:

1. Golding & Widdis, *Electrical Measurements & Measuring Instruments* ; Wheeler
2. W. D. Cooper, *Electronic Instrument & Measurement Technique*; Prentice Hall of India
3. Forest K. Harris, *Electrical Measurement*; Willey Eastern Pvt. Ltd. Indi
4. M.B. Stout, Basic *Electrical Measurement*; Prentice Hall of India
5. A. K. Ghosh, *Introduction to Measurements & Instrumentation*, Prentice Hall, India

Course Outcome:

The students will be able to

1. Explain the static and dynamic characteristics of measuring instruments
2. Compare among the operation of measuring instruments and Select the suitable one for measurement of electrical quantities
3. Select appropriate devices for extension of range for measuring instruments

4. Apply the knowledge about the instruments to use them more effectively
5. Choose appropriate bridge for measurement of impedance
6. Estimate & analyze the errors associated with static calibration

Course Name : **Digital Electronic Circuits Lab**					
Course Code: **AEIE2211**					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

Design and Implementation of:

1. Basic gates using Universal logic gates.
2. Adder/Subtractor.
3. BCD to Excess-3 and Excess-3 to BCD Code Converters.
4. Binary to Gray and Gray to Binary Code Converters.
5. Simple Decoder & Multiplexer circuits using logic gates.
6. 4-bit parity generator & comparator circuits.
5. RS, JK & D flip-flops using Universal logic gates.
7. Synchronous Up/Down counter.
8. Asynchronous Up/Down counter.
9. Shift register (Right and Left) using flip-flops.
10. Ring counter.
11. Johnson's counter.

Course outcome:

After the completion of the course the students will be able to:

1. Analyze and identify different components of digital electronic circuits.
2. Set up testing strategies and select proper instruments to evaluate the performance characteristics of digital electronic circuits.
3. Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.
4. Analyze, design and implement combinational logic circuits.
5. Analyze, design and implement sequential logic circuits.
6. Develop necessary digital logic and apply it to solve real life problems keeping in mind technical, economical, safety issues.

Course Name : Electrical Measurement Lab					
Course Code: AEIE2212					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Calibration of Single Phase A.C. energy meter.
2. Calibration of moving iron and electrodynamometer type ammeter/voltmeter by potentiometer.
3. Calibration of dynamometer type wattmeter by potentiometer.
4. Measurement of low resistance using Kelvin Double Bridge.
5. Measurement of Power using Instrument Transformer.
6. Measurement of Inductance by Anderson's Bridge.
7. Measurement of Capacitance by De Sauty's Bridge.
8. Measurement of unknown frequency of an A.C. supply using Wien Bridge.

Course Outcome:

The students will be able to

1. Demonstrate the calibration process of Ammeter, Voltmeter and Wattmeter
2. Estimate the value of unknown impedance using bridge circuits
3. Measure energy using Single Phase A.C. energy meter
4. Evaluate the unknown frequency of an A.C. supply using Wien Bridge
5. Determine the power using Instrument Transformer
6. Apply the knowledge about the instruments to use them more effectively

    - Types of Exception Classes, Use of Try & Catch with Throw, User-defined Exceptions Classes
- Threads, Communication and Synchronization of Threads: **[3L]**
    - Multithreading, Thread Lifecycle, Thread Priorities, Inter-thread Communication
- Applet Programming (using Swing): **[4L]**
    - Applet Lifecycle, Application & Applet, Parameter Passing, Event Model & Listener, I/O

References:

1. The C++ Programming Language by Stroustrup, Adisson Wesley
2. Object Oriented Programming in C++ by R. Lafore, SAMS
3. Java 2.0 Complete Reference by H. Schildt, McGrawHill
4. JAVA How to Program by Deitel and Deitel, Prentice Hall
5. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH
6. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Outcome:

Students who complete the course will demonstrate the ability to do the following:

1. *Learn* the features of C++ and Java supporting object oriented programming
2. *Understand* the relative merits of C++ and Java as object oriented programming language
3. *Apply* the features learned to design object-oriented software template using C++ and Java
4. *Estimate* the performance of the software written in C++ and Java
5. *Evaluate* the performance of the software and compare the effectiveness of two different language (C++ and Java)
6. *Develop* the object oriented software using C++ and Java.

Subject Name:	**Digital Logic**				
Paper Code:	**ECEN 2104**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

1. Students will learn Binary Number system
2. Student should be able to do logic design using combinational gates
3. Student should be able to design Sequential Circuits
4. Student should be able to do design of Finite State Machine
5. Students will learn Memory classifications
6. Students will learn basic CMOS logic
7. Students will prepare to learn various digital component design as used in VLSI applications.

Lecture hours: 40

Module 1: Binary System, Boolean Algebra and Logic Gates [10L]:

Data and number systems; Binary, Octal and Hexadecimal representation and their conversions, BCD, Gray codes, excess 3 codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De-Morgan's theorem, Various Logic gates - their truth tables and circuits, universal logic gates, Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, Karnaugh-map method, Quine-McCluskey method.

Module 2: Combinational Logic [12L]:

2.1 **Arithmetic Circuits**: Adder circuit – Ripple Carry Adder, CLA Adder, CSA, and BCD adder, subtractor circuit, Fixed point multiplication - Booth's algorithm, Fixed point division – Restoring and non-restoring algorithms.

2.2 **Combinational Circuit:** Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and parity Generator. Shannon's Expansion Theorem, Realization of logic using Mux, Parity Generators.

Module 3: Sequential Logic [10L]:

Basic memory elements, S-R, J-K, D and T Flip Flops, Sequential circuits design methodology: State table and state diagram, State Reduction Method, Circuit Excitation and Output tables, Derivation of Boolean functions; Finite State Machine Design using Sequential circuit design methodology (Mealy and Moore machine), various types of Registers (with Parallel load, shift Registers) and Counters (asynchronous ripple counters, synchronous counters: binary, BCD, Johnson)

Dr. Subhashis Majumdar
Professor and HOD

Module 4: Memory Design and Logic Families [8L]:

4.1 **Memory Systems:** Concepts and basic designs of RAM (SRAM & DRAM), ROM, EPROM, EEPROM, Programmable logic devices and gate arrays (PLAs and PLDs)

4.2 **Logic families:** TTL, ECL, NMOS and CMOS, their operation and specifications. Realization of basic gates using above logic families, Open collector & Tristate gates, wired-AND and bus operations. 4.3 Analog digital interfacing: Different A/D and D/A conversion techniques, sample-hold units and analog multiplexers in multichannel data acquisition.

Text Books:

1. Digital Logic and Computer Design, Morris M. Mano, PHI.
2. Digital Principles & Applications, 5th Edition, Leach & Malvino, Mc Graw Hill Company
3. Modern Digital Electronics, 2nd Edition, R.P. Jain. Tata Mc Graw Hill Company Limited
4. Digital Logic Design, Fourth Edition - Brian Holdsworth & Clive Woods (free download)
5. H.Taub & D.Shilling, Digital Integrated Electronics- Mc Graw Hill Company Limited

Reference Books:

1. **Digital Design: Principles and Practices: John F. Wakerly.**
2. Fundamental of Digital Circuits, A. Anand Kumar, PHI

Subject Name:	**Human Values and Professional Ethics**				
Paper Code:	**HMTS 2001**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**2**

Module I

Human society and the Value System
Values: Definition, Importance and application.
Formation of Values: The process of Socialization,
Self and the integrated personality
Morality, courage, integrity
Types of Values:
Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism
Aesthetic Values: Perception and appreciation of beauty
Organizational Values: Employee: Employer--- rights, relationships, obligations
Psychological Values: Integrated personality and mental health
Spiritual Values &their role in our everyday life
Value Spectrum for a Good Life, meaning of Good Life
Value Crisis in Contemporary Society

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name:	**Object Oriented Programming Lab**				
Paper Code:	**CSEN 2113**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

- Assignments on C++: [based on Lectures]
  1. Basic Programming
  2. Class
  3. Overloading
  4. Inheritance
  5. Polymorphism
  6. Templates
- Assignments on Java: [based on Lectures]
  1. Basic Programming
  2. Class
  3. Overloading
  4. Inheritance
  5. Interfaces and Packages
  6. Exception Handling
  7. Threads
  8. Applets

Course Outcomes:

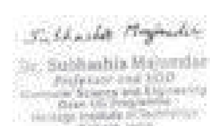
Students who complete the course will demonstrate the ability to do the following:

1. *Learn* the characteristics and the behaviors of object oriented programming and implement them in C++ and Java.
2. *Understand* any given code written in C++ and Java and also write programs in these languages.
3. *Explain and analyze* the building blocks of OOPs (Encapsulation, Overloading, Inheritance and Abstraction) in any real world problem and *design* the solution accordingly.
4. *Defend and argue* the application of the specific tool to solve a given problem.

Subject Name:	**Digital Logic Lab**				
Paper Code:	**ECEN 2114**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Choose any Ten

1. Realization of basic gates using Universal logic gates.
2. Four-bit parity generator and comparator circuits.
3. Code conversion circuits BCD to Excess-3 & vice-versa.
4. Construction of simple 3 to 8 Decoder circuit by 2 to 4 Decoders using logic gates.
5. Design a 4 to 1 Multiplexer using logic gates and use it as a Universal logic module.
6. Realization of RS-JK and D flip-flops using Universal logic gates.
7. Construction of simple arithmetic logic circuits-Adder, Subtractor.
8. Realization of Asynchronous Up/Down Counter (Count up to 7) using logic gates.
9. Realization of Synchronous Up/Down Counter (Count up to 7) using logic gates.
10. Realization of Shift Registers using logic gates (Serial in Serial out and Parallel in Serial out)
11. Construction of Serial adder circuit using a D Flip-Flop and a Full adder.
12. Design a combinational circuit for BCD to Decimal conversion to drive 7-Segment display using logic gates.



Course Name : ANALOG COMMUNICATION LAB					
Course Code : ECEN 2213					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

COURSE OUTCOME:
After completing the following experiments, students will be able to:

1. The students will learn to analyze AM and FM signals using spectrum analyzer.
2. They will be able to design AM demodulator.
3. The students will be in a position to design VCO and FM demodulator.
4. They will be able to design pre-emphasis and de-emphasis circuits.

List of Experiments:

1. Measurement of modulation index varying modulating signal amplitude of an AM signal.
2. Design of an AM demodulator (Envelope detector).
3. Study of the spectral analysis of AM Signal.
4. Design of a voltage controlled oscillator (VCO).
5. Measurement of modulation index varying modulating signal amplitude of a FM signal.
6. Design of a FM demodulator using PLL.
7. Study of the spectral analysis of FM signal.
8. Study of Pre-Emphasis and De-Emphasis circuits

HOD, ECE Department
Heritage Institute of Technology
Kolkata

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcome:

After successfully completing this course the students will be able to:

1 Describe the basic foundation of computer related concepts like sets, POsets, lattice and Boolean Algebra.
2.Analyze sets with binary operations and identify their structures of algebraic nature such as groups, rings and fields.
3. Give examples of groups, rings, subgroups, cyclic groups, homomorphism and isomorphism, integral domains, skew-fields and fields.
4. Compare even permutations and odd permutations, abelian and non-abelian groups, normal and non-normal subgroups and units and zero divisors in rings.
5. Adapt algebraic thinking to design programming languages.
6. Identify the application of finite group theory in cryptography and coding theory.

<table>
<tr><td colspan="6">Subject Name: Probability and Numerical Methods</td></tr>
<tr><td colspan="6">Paper Code: MATH 2202</td></tr>
<tr><td rowspan="2">Contact Hours per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
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MODULE-I – NUMERICAL METHODS (16L)
SOLUTION OF NON-LINEAR ALGEBRAIC EQUATIONS AND TRANSCENDENTAL EQUATIONS:
Bisection Method, Newton-Raphson Method, Regula-Falsi Method.
SOLUTION OF LINEAR SYSTEM OF EQUATIONS:
Gauss elimination method, Gauss-Seidel Method, LU Factorization Method.
INTERPOLATION AND INTEGRATION:
Newton's Forward and Backward Interpolation Method, Lagrange's Interpolation, Trapezoidal and Simpson's 1/3rd Rule.

SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:
Euler's and Modified Euler's Method , Runge-Kutta Method of 4th order.

MODULE-II – FUNDAMENTALS OF PROBABILITY (5L)
Prerequisites- Set Theory.
Random experiment, Sample space , Events .
Definition of Probability ,
Addition law of probability, Multiplication law and Conditional Probability.
Bayes' Theorem (Statement only)

MODULE-III – PROBABILITY DISTRIBUTIONS AND STATISTICS (15L)
Random Variables – Discrete and Continuous, Probability Mass Function, Probability Density and Cumulative Distribution Functions, Mathematical Expectation and Variance.
Special Distributions: Binomial, Poisson, Uniform, Exponential and Normal
Measures of Central Tendency and Dispersion – Mean, Median, Mode and Standard Deviation for grouped and ungrouped frequency distribution.
Simple Correlation and Regression

MODULE –IV- MARKOV CHAINS AND JOINT PROBABILITY DISTRIBUTION (12L)
Definition of Discrete Time Markov Chain. Examples Including Random Walk, Ehrenfest Chain and Birth-Death Chain, Transition Matrix, Chapman-Kolmogorov Equation and its application.

Joint distribution using joint probability mass/density function. Finding marginal pmf/pdf from joint. Multiplicative property of joint pmf/pdf in case of independent random variables.

References:

1. Miller & Freund's Probability and Statistics for Engineers, R.A.Johnson, Prentice Hall of India
2. Numerical Mathematical Analysis, J.B.Scarborough, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Numerical Methods (Problems and Solution), Jain, Iyengar , & Jain, New Age International Publishers
4. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons
5. A First course in Probability, Sheldon Ross, Pearson
1. Introduction to Stochastic Processes, Paul G. Hoel, Sidney C. Port & Charles J. Stone University Bookstall, New Delhi (Houghton Pliffin Company, 1972)
6. Introduction to Probability Models, Sheldon Ross, Elsevier India

Course Outcome:

After successfully completing this course the students will be able to:

1. Articulate the axioms (laws) of probability.
2. Compare and contrast different interpretations of probability theory and take a stance on which might be preferred.
3. Formulate predictive models to tackle situations where deterministic algorithms are intractable.
4. Summarize data visually and numerically
5. Assess data-based models.
6. Apply tools of formal inference.

Subject Name: Design & Analysis of Algorithms					
Paper Code: CSEN 2201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module I

1. Algorithm Analysis (7 Lectures)

Time and space complexity. Asymptotic Notations and their significance.
Asymptotic Analysis. Finding time complexity of well known algorithms like-mergesort, heapsort, quicksort. Randomized Quicksort. Average Case Analysis. Asymptotic solution to recurrences. Master Theorem.

2. Medians and Order Statistics. (3 Lectures)

Module II

3. Dynamic Programming (6 Lectures)

Basic method, use, Examples: Matrix-chain multiplication, All pair shortest paths, LCS Problem. Optimal Binary Search Trees: Algorithm and speedup using quadrangle inequality.

4. Greedy Method (6 Lectures)

Elements of the greedy strategy. Huffman codes. Matroids and the greedy methods. Minimum cost spanning trees: Prim's and Kruskal's algorithms and their correctness proofs.

Module III

5. Amortized Analysis (2 Lectures)

Aggregate, Accounting and Potential methods.

6. Disjoint Set Manipulation (2 Lectures)

UNION-FIND with union by rank, Path compression.

7. Graphs Algorithms (6 Lectures)

Topological Sorting. Strongly Connected Components. Shortest Path Algorithms: Dijkstra’s and Bellman Ford with correctness proofs.

Group 1: Experiments on Electricity and Magnetism
1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
3. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
4. Determination of specific charge (e/m) of electron.

Group 2: Quantum Physics
5. Determination of Planck's constant.
6. Determination of Stefan's radiation constant.
7. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
8. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum

Group 3: Modern Physics
9. Determination of Hall co-efficient of semiconductors.
10. Determination of band gap of semiconductors.
11. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Note: A candidate is required to perform at least 5 experiments taking one from each group.
Emphasis should be given on the estimation of error in the data taken.

Recommended Text Book:
Quantum Physics
- Atomic Physics – S.N. Ghoshal – S Chand
- Quantum Physics– Eisberg and Resnick – Wiley
- Quantum Mechanics – A.K. Ghatak and S. Lokenathan –Springer

Classical Mechanics
- Introduction to Classical Mechanics – R.G Takwale & P S Puranik –Tata MaGraw Hill
- Classical Mechanics – N C Rana & P S Joag – Tata MaGraw Hill

Solid State Physics
- Atomic Physics – S.N Ghoshal
- Elementary Solid State Physics – M.Ali Omar – Pearson Education
- Solid State Physics – A.J Dekkar – Macmillan
- Introduction to Solid state Physics – C.Kittel

Statistical Mechanics
- Thermodynamics, Kinetic Theory, and Statistical Mechanics–Sears and Salinger–Narosa

Subject Name: Numerical Methods & Programming Lab					
Paper Code: MATH 2212					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Development of computer programs in C for the following problems:
1. Regula-Falsi Method
2. Newton-Raphson Method
3. Gauss-elimination Method
4. Gauss-Seidel Method
5. Newton's Forward Interpolation
6. Lagrange's Interpolation
7. Trapezoidal and Simpson's 1/3rd rule
8. Euler's and Modified Euler's Method
9. Runge-Kutta method of 4th order

10. Computation of Mean , Median , Mode and Standard Deviation for grouped and ungrouped frequency distribution
11. Computation of Correlation coefficient and Regression equation for Bivariate data.

Subject Name:	**Language Practice Lab (Level 2)**				
Paper Code:	**HMTS 2011**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Module 1
Formal verbal communication:

- Introduction to formal verbal communication, Interpersonal Skills & Public Speaking: Building Positive Relationships, Focusing on Solving Problems, Time Management, Dealing with Criticism: Offering Constructive Criticism, Responding to Criticism – Managing Conflict: Approaches to Conflict, Resolving Conflict
- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module II
Presentation skills

- Speech Purposes - General: Informative Speeches, Persuasive Speeches, Entertaining Speeches; Methods of Speaking: Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation
- Organising the Presentation: the Message Statement, Organising the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium, Post- presentation Discussion

Module III
Group Discussion

- Introduction to Group Communication
  Factors in Group Communication, Status – Group Decision Making: Reflective Thinking, Brainstorming, Body Language, Logical Argument, The Planning Process, Strategies for Successful GDs, Role of Social Awareness (Newspapers, Magazines, Journals, TV News, Social Media), Practice GDs

Module IV
Job Application and Personal Interview

- **Job Application** Letter: Responding to Advertisements and Forced Applications, Qualities of Well-Written Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section

- **Resume and CV:** Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination Chronological and Functional Resume – Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honours and Achievements, Personal Profile, Special Interests, References

Course Name : APPLIED THERMODYNAMICS					
Course Code: MECH 2101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	To understand and analyze a thermodynamic system and calculate work transfer in various quasi-static processes
CO 2	To apply the knowledge of the values of properties of water/steam from steam table.
CO 3	To evaluate heat transfer and work transfer in processes involving steam.
CO 4	To quantify irreversibility in a process by evaluating entropy generation.
CO 5	To evaluate thermal efficiency of Otto, Diesel and Rankine cycle.
CO 6	To understand the basics of a refrigeration system and to evaluate the COP using table of refrigerants.

Sl. No.	Syllabus	Contact Hrs.
Module 1	**Review of fundamentals:** Introduction; Macroscopic and microscopic concept; Thermodynamic systems; Control mass and control volume; Thermodynamic properties; Thermodynamic equilibrium; Thermodynamic processes and cycles; Quasi-static processes; Reversible processes; Zeroth law of Thermodynamics.	1
	Heat & Work: Thermodynamic work; Work transfer-displacement work for a simple compressible system; Pdv work for various processes; Path function and point function; Heat transfer.	1
	First law of Thermodynamics: First law for closed system; First law for steady and unsteady flow processes;	2
	Pure substance: Definition, properties of pure substance; Phases of pure substance — Gibbs phase rule; Phase change processes of pure substances — critical point, triple point; Property (phase) diagrams — P- v, P- T, T- s, h-s diagrams; P v T surface for water; Property tables of pure substances — compressed liquid, saturated, wet and superheated vapour, use of saturated and superheated steam table and Mollier diagram.	5

Module 2	**Second law of Thermodynamics:** Qualitative difference between heat and work; Cyclic heat engine, heat pump and refrigerator, thermal efficiency of heat engine, C.O.P of heat pump and refrigerator; Kelvin-Plank and Clausius statements of second law. Reversible process; Carnot cycle and Carnot efficiency; Carnot theorem, corollaries; Thermodynamic temperature scale; Reversible heat engine and heat pump; **Entropy:** Clausius Inequality: Entropy as a property; Tds equation and calculation of entropy change of ideal gases for various processes; entropy change of solids; Concept and uses of entropy, Entropy principle; Entropy generation, entropy transfer; 2^{nd} law applied to control volume. **Joule Thomson Effect:** Isenthalpic plots, inversion curve, Joule Thomson coefficient	3 4 2
Module 3	**I C Engines and Gas Power Cycles:** Air standard cycles — Otto cycle, Diesel cycle, Dual combustion cycle; P-v, T-s plots; Efficiency, net work done, mean effective pressure; Principles of 4-stroke S I engine and C I engine; Engine nomenclature. **Reciprocating air compressor:** Compression process, work of compression, Single stage reciprocating compressor, volumetric efficiency, efficiency of a compressor; Multistage compression, advantages, ideal intermediate pressure.	5 4
Module 4	**Vapour power Cycle:** Carnot cycle and its practical difficulties; Basic Rankine cycle with steam; Mean temperature of heat addition, steam rate, heat rate; Reheat cycle; Regenerative cycle. **Introduction to refrigeration systems:** Reversed heat engine cycle; Vapour compression refrigeration cycle; Absorption refrigeration cycle; Refrigerants.	5 4
	Total Classes	**36**

Text Books:

1. Engineering Thermodynamics- 5e, Nag, P.K. – TMH.
2. Fundamentals of Thermodynamics- 6e, Sonntag, Borgnakke & Van Wylen, Wiley India

Reference Books:

1. Thermodynamics- an Engineering approach - 6e, Cengel & Boles, TMH
2. Principles of Engineering Thermodynamics -7e, Moran, Shapiro, Boettner, Bailey. Wiley India

09/08/2022

Course Name : STRENGTH OF MATERIALS					
Course Code: MECH 2102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After going through the course, the students will be able to:
CO1: **Define** different types of stresses / strains and **analyze** relationships among them. (level 1, 4)
CO2: **Classify** and **analyze** statically determinate and indeterminate problems. (level 2, 4)
CO3: **Determine** the stresses and strains in axially-loaded members, circular torsion members, and members subject to flexural loadings. (level 5)
CO4: **Determine** the principal stresses and orientations of principal planes for structural members. (level 5)
CO5: **Formulate** the governing differential equation for elastic curve and **solve** problems on beam deflection. (level 6, 3)
CO6: **Interpret** the concept of buckling as being a kind of instability and **analyze** slender, long columns subjected to axial loads. (level 2, 4)

Sl. No.	Syllabus	Contact Hrs.
Module 1	**Stress**: General Concepts, Method of Sections, Definition of Stress, Normal and shear stresses, Definition of strain, Normal and Shear Strains. Stress Analysis of Axially Loaded Bars: Statically Determinate and Indeterminate Problems, Thermal Stresses. Stress-Strain Relationships, Generalized Hooke's Law for isotropic materials, Poisson's ratio, relationships between Young's modulus, shear modulus and bulk modulus. Strain energy in tension, compression.	8
Module 2	Transformation of stresses in two-dimensional problems, principal stresses, maximum and minimum shear stresses, Mohr's circle of stress. Thin-walled pressure vessels. Deflections: deflections by simple integration, Beam method of superposition, energy methods, Castigliano's theorems. Statically determinate and indeterminate problems on beam deflections.	9
Module 3	**Beam Statics**: axial force, shear force & bending moment diagrams, differential equations of equilibrium for a beam element, symmetric beam bending, strain energy in bending, beams of composite cross section and shear stresses in bending.	9
Module 4	**Torsion** of circular shafts, strain energy in torsion, stresses and deflections of open and closely coiled helical springs,	10

	combined bending and torsion. **Columns:** Buckling of columns, Euler loads for columns with pinned ends and with other different end restraints, eccentric loading of short struts, Euler's curve, empirical column formulae- (i) straight line (ii) parabolic (iii) Rankine Gordon.	
	Total Classes	36

Text Books:

1. Elements of Strength of Materials- S.P. Timoshenko & D.H. Young, East West press, 5e, 2011
2. Strength of Materials- D. Nag & A. Chanda, Wiley India, 2e
3. Strength of Materials- R. Subramanian, Oxford University press, 2e, 2010

Reference Books:

1. Engineering Mechanics of Solids- E.P. Popov & T.A. Balan, Pearson Education Asia, 2e, 2010
2. Mechanics of Materials- R.C. Hibbeler, Prentice Hall, 16e, 2013
3. Introduction to Solid Mechanics by I. H. Shames, JM Pitarresi, Prentice Hall, 3e.

09/08/2022

Course Name : FLUID MECHANICS					
Course Code: MECH 2103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Examine and use different properties of fluid.
CO 2	Apply the fundamental laws to solve problems in fluid statics.
CO 3	Analyze fluid flow problems with application of fluid kinematics and fluid dynamics principles in engineering systems.
CO 4	Develop concept of boundary layer growth and boundary layer separation.
CO 5	Examine different flow parameters for viscous flow through pipe and evaluate different losses in pipe flow.
CO 6	Perform the dimensional analysis for fluid flow problems.

Sl. No.	**Syllabus**	**Contact Hrs.**
Module 1	Review of fluid properties and fluid statics- variation of pressure within a static fluid – equation of hydrostatic pressure distribution.	1
	Hydrostatic thrust on submerged plane and curved surfaces; buoyancy, stability of submerged and floating bodies.	4
	Kinematics of Fluid Flow: Continuity Equation, Deformation of fluid particle- Translation and Rotation; Circulation and Vorticity; Irrotational and Rotational flow; Stream function, Velocity Potential.	4
Module 2	Review of fluid dynamics (Euler's equation of motion and Bernoulli's equation); Bernoulli's Equation for a real fluid with applications (Venturi meter, Orifice meter, Pitot tube).	3
	Application of linear momentum to control volume-linear momentum equation, analysis of force exerted by a fluid stream on a solid boundary- thrust on pipe bends etc.	3
	Flow through notches and weirs (rectangular and triangular cross section)	3

Module 3	Characteristics of Laminar and Turbulent flow; Reynolds experiment, critical Reynolds number; Laminar flow through pipe- Hagen-Poiseuille equation Flow through closed conduits: Darcy Weisbach equation, concept of friction factor in a pipe flow, Variation of friction factor, Moody's diagram and its use; minor losses- at sudden expansion, at sudden contraction, at bends, at valves, and fittings etc.	4 5
Module 4	Boundary layer theory: concept of boundary layer; boundary layer thickness, displacement thickness, momentum thickness, growth of boundary layer, momentum integral equation; Boundary layer separation. Flow of fluid around submerged bodies; basic concepts of drag and lift, aerofoils. Dimensional analysis and Buckingham Pi theorem, similarity and model study.	4 2 3
	Total Classes	36

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines- Som, Biswas and Chakraborty, TMH, 3e
2. Fluid Mechanics and Machinery-C.S.P Ojha, R. Berndtsson, P.N. Chandramouli, OUP, 1e
3. Fluid Mechanics – Fox, Mcdonald & Pritchard, Wiley, 8e
4. Mechanics of Fluids- B Massey, Taylor & Francis, 8e

Reference books:

1. Fluid Mechanics – Dr. A.K. Jain, Khanna Publishers, 11e
2. Engineering Fluid Mechanics – Graebel. W. P, Taylor & Francis (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint, 2013

09/08/2022

Course Name : ENGINEERING MATERIALS					
Course Code: MECH 2104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Classify different materials like metals, polymers, ceramics, composites and advanced material like semiconductors, smart materials and nano-materials.
CO 2	Analyze different crystal structure of materials and Identify different types of defects in the material structure.
CO 3	Construct the phase diagram of multi-phase system of alloy. Analyze the Iron –Iron Carbide equilibrium diagram.
CO 4	Discuss the composition, properties and applications of ferrous and nonferrous alloy and understand during different heat treatment processes.
CO 5	Explain mechanical, thermal, electrical and magnetic properties of material and implement the concept in design of mechanical components.
CO 6	Discuss the properties, applications and making processes of different polymers, ceramics and composites materials

Sl. No.	Syllabus	Contact Hrs.
Module 1	**Introduction:** Material Science –its importance in engineering: Classification of Materials--metals, polymers, ceramics, composites; Advanced materials –semiconductors, smart materials, nano-materials; Atomic structure, Atomic bonding in solids — bonding forces and energies; Ionic/covalent/metallic bonding. **Crystal structure**: Fundamental concepts; unit cells; seven crystal systems; single crystal, polycrystalline and non-crystalline materials; Metallic crystal structures—FCC, BCC, & HCP structures, atomic packing factor; Anisotropy & Isotropy. **Imperfections in Metals:** Point defects due to vacancy & impurities, alloys, solid solutions; Dislocations—linear defects, interfacial defects, grain boundaries, grain growth, grain structure. **Phase Diagrams:** Definition and basic concepts; solubility limit; phase Equilibrium, one component phase diagram, binary phase diagram, interpretation of phase diagrams.	**2** **2** **2** **3**
Module 2	**Iron-carbon system:** Allotropy of iron, iron-iron-carbide phase diagram, Properties and uses of plain carbon steel. **Classification of Metals and Alloys- compositions, general properties and uses:** **Ferrous alloys:** Classification –low carbon steels, medium carbon steels, high carbon steels, stainless steels, alloy steels, tool and die steel, cast irons **Non-ferrous alloys :** Copper and copper alloys, Aluminum alloys; zinc Alloys; Nickel alloys; Lead and Tin alloys. **Heat Treatment :**Definition and purposes, Heat treatment processes of steels—	**3** **2**

	Hardening, structural change during heating and cooling, factors affecting hardening; Tempering; Austempering; Normalizing; Annealing—full annealing, spheroidising annealing, stress –relieving, recrystallization annealing; Precipitation or Age Hardening of non-ferrous alloys, Martempering. T-T-T diagram Heat treatment cycles for a tool steel.	**2** **4**
Module 3	**Properties of Materials:** **Mechanical Properties:** Elastic properties of materials-tensile and compressive stress and strain, stress-strain behavior, modulus of elasticity(Young's modulus), yield strength, tensile strength, plastic deformation, true stress and strain, Ductility; Resilience; Toughness, impact tests, Hardness- Brinnel, Rockwell and Vickers hardness and their testing procedures, correlation between hardness and tensile strength; Strain hardening; Fatigue strength; Effect of temperature on tensile strength and impact properties, creep failure, slip, twining. **Thermal Properties:** High temperature materials, thermally insulating materials, specific heat, thermal conductivity, thermal expansion **Electrical Properties :**Dielectric Materials, Factors affecting dielectric constant, Polarization, mechanism of polarization. **Magnetic Properties:** Magnetism, diamagnetism, paramagnetism ferromagnetism, magnetic energy.	**7**
4.	**Polymers & Elastomers:** Definition; How polymers are made-polymer molecular structures, Thermoplastics & Thermosets; Special characteristics like low specific gravity, optical, electrical & thermal property, decorative color, easy formability, low corrosion etc. Uses of polymers and elastomers. **Ceramic Materials :** What is ceramics common ceramic materials and their characteristics; How ceramics are made-sintering and vitrification process; Ceramic structures , Properties and applications. **Composite Materials :** What is composites; Polymers matrix and their applications; Metal matrix and ceramic matrix composites and their applications; How composites are made. **Corrosion and Degradation of Engineering Materials:** Definition; Types of corrosion -uniform, pitting, crevice, galvanic, stress corrosion cracking and erosion, Corrosion Control - material selection, environment control, proper design.	**2** **2** **2** **2** **1**

	Materials selection methodology: Selection of material based on required properties, availability and cost of material, environmental issues.	
	Total Classes	**36**

Text Books:

1. Materials Science and Engineering by W.D.Callister and adapted by R.Balasubraniam, Wiley India, 9e, 2010.
2. Engineering Materials and Metallurgy by R.Srinivasan ,2e, Tata McGraw Hill
3. Materials Science and Engineering by V.Raghavan, 5e, Prentice Hall India

Reference books:

4. Engineering Materials Properties & Selection by Budinski & Budinski, 9e, Prentice Hall India
5. A Textbook of Material Science and Engineering by R.K.Rajput, S.K.Kataria & Sons, 4e, 2013
6. Mechanical Metallurgy by George E Dieter , McGraw Hill, 3e

09/08/2022

Course Name : METROLOGY AND MEASUREMENT					
Course Code: MECH 2105					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Remember various measuring techniques.
CO 2	Understand the precision and accuracy of various measuring instruments.
CO 3	Demonstrate the importance of interchangeability and concept of fits and tolerance.
CO 4	Understand the structure and characteristics of a measuring instrument.
CO 5	Select the type of instruments to be used given the specification of the measurand.
CO 6	Use various measuring instruments according to requirement.

Sl. No.	Syllabus	Contact Hrs.
Module 1	Introduction: Definition and importance of Metrology & Measurement; Methods of measurements – direct, indirect,comparison, substitution, transposition, deflection and null measurement; Errors in measurement – absolute, relative,parallax, alignment, loading, dynamic and calibration error; Units of measurements – SI base and derived units, SI prefixes of units.	**3**
	Linear Metrology: Vernier scale; use of Vernier calliper, Vernier height and depth gauge, micrometer;slip gauge.	**2**
	Angular Metrology: Use of protractor, Vernier bevel protractor, angle gauges, sine bar and slip gauges.	**2**
	Measurements of: (i) Level using spirit-level; (ii) Flatness using straight edge, interferrometry (Newton's rings) and surface plate; Parallelism, cylindricity and concentricity using dial indicator. Alignment & testing methods. Gear tooth measurement.	**4**

Module 2	Interchangeability of components; concept of limits, tolerances and fits; Hole basis and shaft basis system of fits; Go and No Go limit gauges; plug, ring, snap, thread, radius and feeler gauges.	**5**
	Definition, use and essential features of Comparators; working principle and application of (i) dial gauge, (ii) Cook optical comparator, (iii) back pressure Bourdon gauge pneumatic comparator, (iv) optical comparator-profile projector.	**4**
Module 3	Measuring Instruments: Functional elements of an instrument – sensing, conversion & manipulation, data transmission and presentation element;	**5**
	Characteristics – accuracy, precision, repeatability, sensitivity, reproducibility, linearity, threshold, response, dynamic or measurement error; Transducers – definition, primary and secondary, active and passive. Tolerance analysis in manufacturing and assembly. Calibration methods of thermocouple, vernier caliper, pressure gauge	
	Measurement of Surface Finish: Definition; Terminologies – geometrical surface, effective surface, surface roughness, roughness (primary texture), waviness (secondary texture), form, lay, sampling length; Numerical evaluation of surface roughness: peak-to-valley height (Rmax), centre line average (CLA, Ra), average depth (Rm), smoothness value (G); Principle of operation of a Talysurf.	**4**
Module 4	Principle of operation of a few measuring instruments: displacement by LVDT; force by strain – gauge load cell and piezoelectric load cell; pressure by Bourdon – tube gauge; temperature by liquid-in-glass thermometer, thermocouples, optical pyrometer; liquid velocity by pitot tube; water flow by orifice meter. Level measurement.	**7**
	Total Classes	**36**

Text Books:

1. R. Rajendra, Principles of Engineering Metrology, Jaico Pub. House. 2e
2. Bewoor and Kulkarni, Metrology & Measurement, TMH. 1e

Reference books:

1. E.O. Doebelin and D.N. Manik, Measurement Systems– Application and Design, Tata McGraw Hill. 5e
2. Beckwith, Lienhard and Marangoni, Mechanical Measurements, Pearson. 6e
3. R.K. Jain, Metrology, Khanna Publication, New Delhi. 20e

09/08/2022

Course Name : MACHINE DRAWING-I					
Course Code: MECH 2111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

On completion of the course students will be able to

1. Identify **and** recognize **different types of lines and materials representation.**

2. Repeat **the basic concepts of dimension placing and** Understand **dimensioning of common features like chamfers, tapers, undercut, countersunk repetitive features.**

3. Understand **the concept of conversion of Isometric view to Orthographic projection and vice-versa and** Implement **the same for various practice problems.**

4. Classify **nuts and** Understand **the terminologies used in drawing of nuts & bolts.** Implement **the concepts of projection to draw orthographic projection of bolts and** Remember **Imperical relations of dimensions of nut and bolt with respect to bolt head diameter.**

5. Understand **the concepts of orthogonal Sectional view and** Implement **the same for shaft couplings.**

6. Identify **the various parts of Plummer Block and draw the assembly with Bill of Material(BOM).**

Module	**Topics**	**Contact Hrs. / No. of sheets**
1A	***Introduction:-*** Representation of different types of lines, Representation of different materials, like - ferrous, non-ferrous, bricks, wood, concrete etc.	1 class/ Theory
1B	**Dimensioning:-** Placing of dimensions, Functional and Non-functional dimensions, Dimensioning common features like: Circular Arcs, Diameters, Holes, Angles, Chamfers, Tapers, Undercut, Repetitive features, Countersunk, Square, Sphere, Across flat, Threads.	2 classes/ 2 sheets
2	***Conversion of Projection:-*** ***a)*** Conversion of Isometric Views into Orthographic Projection. ***b)*** Conversion of Orthographic Views into Isometric Projection.	3 classes/ 2 sheets
3	***Nuts and Bolts:-*** Classification of nuts, terminology used in the drawing of nuts and bolts, studs. Drawing of orthographic projections (top view, front view and side view) of a bolt, Imperical relations of dimensions of nut and bolt with respect to bolt head diameter.	2 classes/ 2 sheets
4A	***Orthographic Sectional View of*** a) Shaft Coupling	2 classes/ 2 sheets
4B	***Assembling of*** Shaft with antifriction bearing mounted on a Plummer Block.	2 Class/ 1 Sheet

N.B: *Each class comprises of 3 periods*

Text Books:

1. Text Book of Machine Drawing, K. C. John, PHI Learning, 1e, 2009
2. Machine Drawing, K. L. Narayana, New Age International, 4e, 2012
3. Machine Drawing, N. Sidheswar, McGraw Hill Education, 1e,
4. Machine Drawing, Basudeb Bhattacharya, Oxford University Press, 1e, 2011
5. SP 46-2003 (Detailed procedure of engineering drawing)

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Course Name : APPLIED MECHANICS LAB					
Course Code: MECH 2112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	**Relate** the behavior of material experimentally under different loading conditions with theoretical knowledge gained.
CO 2	**Examine** and **demonstrate** the strain-rate and load-deformation behavior of material under tensile and torsional loadings.
CO 3	**Determine** the modulus of elasticity of beam material by **utilizing** deflection of a cantilever beam using strain gauge.
CO 4	**Distinguish** among Rockwell, Brinnel and Vicker's hardness tests and **learn** the procedures to carry them on and calculate the values for different materials in engineering field.
CO 5	**Measure** the co-efficient of friction between two selected surfaces.
CO 6	**Explain** the method deployed in determining the stiffness of leaf spring by operating specific machines and necessary attachments.

List of Experiments:

1. Tension Test of Mild Steel
2. Torsion Test of Mild Steel
3. Deflection of Cantilever Beam using a strain gauge
4. Rockwell Hardness Test
5. Brinell Hardness Test
6. Vickers Hardness Test
7. Determination of Stiffness of Leaf Spring
8. Determination of Coefficient of Friction.

N.B. A minimum of six jobs / experiments must be performed in the semester.

09/08/2022

Course Name : WORKSHOP PRACTICE –II					
Course Code: MECH 2113					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	**Understand** various manufacturing processes that are used in a typical workshop, be **aware** of various safety precautions that needs to be observed while working.
CO 2	**Understand** the mechanics of material removal in a lathe machine, **Identify** various metal cutting operations that are possible in lathe, Select speed, feed and depth of cut depending on the material to be processed, List and **Sequence** various operations and **Manufacture** and **Inspect** a Job from a given drawing.
CO 3	**Define** the key parameters of spur gear, be **Conversant** with the cutting of spur gear in a milling machine, **Calculate** the blank diameter of a spur gear given its module and no of teeth, **Manufacture** and **Inspect** the spur gear.
CO 4	**Differentiate** between the TIG and MIG welding, **Select** TIG and MIG welding parameters, **Operate** the TIG and MIG welding machines, **Perform** a simple job and **Assess** its defects.
CO 5	**Understand** and **Explain** various allowances given to a product drawing , **Prepare and Inspect** a wooden pattern from given a product drawing, **Demonstrate** the purpose and use of core in a mould , **Cast** a component and **Inspect** the component for any casting defects .
CO 6	**Differentiate** between hot working and cold working of metals, **Prepare** a sheet metal component and a forged component from a given drawing, **Calculate** the blank size of sheet metal from a manufacturing drawing, **Appreciate** the various safety measures needs to be taken while forging.

1. Pattern making: Pattern material, pattern allowances and types of patterns- Making a wooden pattern. (6P)

2. Mould making Practice: Uses of moulding tools: green sand moulding, gating system, risering system, use of core. (6P)

3. Making a typical product using sheet metal; Brazing/Gas Welding. (3P)

4. Basic Forging processes like upsetting, drawing down and forge welding. (3P)

5. Practicing Resistance Spot Welding, Shielded Metal Arc Welding. (6P)

6. Machining of typical products involving lathe, milling/shaping /drilling operations and finishing process. (9P)

7. Machining of gears. (6P)

N.B. A minimum of six jobs / experiments must be performed in the semester.

09/08/2022

Course Name : FLUID MACHINERY					
Course Code: MECH 2201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of the course, the students will be able to

- Classify different types of fluid machines and list their components.
- Apply the working principle of rotodynamic machines for evaluating different flow parameters.
- Identify losses in fluid machines and relate different efficiencies.
- Analyze performance characteristics of various fluid machines.
- Examine different components and working principle of positive displacement machine.
- Describe different processes and phenomena involving operation of fluid machines.

Sl. No.	Syllabus	Contact Hrs.
Module 1	Introduction: Definition, Classification and Application of fluid machinery. Rotodynamic Machines: Classification, Incompressible and compressible flow machines, Pump, Turbines and Compressor. Radial, Axial and Mixed flow type machines, Basic equation of energy transfer in Rotodynamic machines.	2
	Centrifugal Pump: Classification, Main components and their functions- Casing, Inlet Guide Vane, Impeller, diffuser. Principles of Energy Transfer, Euler one-dimensional equation, Euler head, Rotor work, Velocity diagram; Different heads and efficiencies for centrifugal pump. Priming in centrifugal pump.	8
Module 2	Hydraulic Turbines: Classification; Impulse Turbine: Pelton Turbine- Main components and their functions, velocity triangle and work done . Wheel efficiency. Reaction turbine: Radial flow reaction turbine-Francis Turbine- main components and their functions; inward and outward radial flow turbine, velocity diagram; Some Definitions (Speed ratio, flow ratio, discharge, head). Theory & different types of draft tube. Axial flow reaction turbine: Propeller and Kaplan turbines, component parts: construction and operation; Difference between Francis and Kaplan Turbine	8
Module 3	Performance characteristics curves: System resistance curve; Pumps- Radial, Mixed flow and Axial flow. Turbines-Francis, Kaplan and Pelton wheel- Main, Operating characteristics and Muschel curves, Dimensional analysis for fluid machinery: Dimensionless quantities and their use in design, selection and testing. Series and parallel operation of pump.	7
	Cavitation: NPSH, Thoma's cavitation parameter and methods to avoid cavitation.Specific speed of a pump and turbine. Unit quantities	3

Module 4	Positive Displacement Pumps: Reciprocating and Rotary Pumps, Main components of reciprocating pump. Working principle- variation of velocity and acceleration in the suction and delivery pipes due to acceleration of the piston; Effect of variation of velocity on friction in the suction and delivery pipes; Indicator diagram for reciprocating pump; Air vessel.	8
	Total Class	**36**

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines-Som, Biswas and Chakraborty, TMH, 3e
2. Hydraulic Machines – Dr. Jagdish Lal, Metropolitan Book Co. Pvt. Ltd, Reprint 2011.
3. Mechanics of Fluids- B Massey, Taylor & Francis, 8e

Reference Books:

1. Fluid Mechanics and Machinery-C.S.P Ojha, R. Berndtsson, P.N. Chandramouli, OUP, 1e
2. Turbomachinery- Designed and theory – Gorla, Taylor & Francis (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011
3. Incompressible Flow Turbomachines –Rowal, Elsevier (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011
4. Principle of Turbomachinery- Turton R. K, Springer (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011
5. Turbomachines by B.U.Pai; WILEY, 1e, 2013

09/08/2022

Course Name : KINEMATICS OF MACHINES					
Course Code: MECH 2202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	**Classify** and **describe** a mechanism based on its technical parameters.
CO 2	**Recognize** different straight line generating mechanisms, offset slider crank mechanisms, steering mechanism.
CO 3	**Analyze** velocity and acceleration of different components in a mechanism by graphical method.
CO 4	**Implement** their technical knowledge to **analyze** a belt drive to transmit motion and power.
CO 5	**Characterize, analyze** and **design** a gear train system.
CO 6	**Analyze** and **design** of a cam drive for specified follower motion.

Module	**Syllabus**	**Contact Hrs.**
1	Introduction to mechanisms, Difference between Machine and Mechanism; Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion. Four bar chain and its inversions, Grashoff's law, Slider crank chain and its	8

	inversions, Double slider crank chain and its inversions.	
2A	**Velocity Analysis of mechanisms (mechanisms up to 6 links).** Velocity analysis by instantaneous center of rotation method (Graphical approach) Velocity analysis by relative velocity method (Graphical approach)	5
2B	**Acceleration analysis of Mechanism** Acceleration Images, Klein's construction, Coriolis acceleration. Analytical expression of velocity & acceleration.	4
3A	**Belt-drive** – introduction; Law of belting, Length of flat belt for open and cross belt connections;Stepped pulley for open flat belt; Tension in flat belt and V-belts; Power transmitted in belt drive.	3
3B	**Gear and Gear trains :** Types of Gears, Gear terminologies, Simple, compound, Epicyclic gear train; Speed-torque analysis of geartrains.	5
4A	**Cam Mechanisms:** Cam and its Classifications. Followers and its Classification. Motion analysis and plotting of displacement-time, velocity-time, acceleration- time, jerk-time graphs for SHM motion, uniform velocity motion, Constant acceleration motion and Cycloid motions of cams with knife-edge, roller and flat face follower (along with concept of offset follower). Pressure angle and method to control pressure angle Layout of cam profiles.	7

4B	**Lower Pair Mechanisms:** **Straight line generating Mechanisms:** Exact Straight Line Generating Mechanisms – Peaucellier's and Hart's Approximate Straight Line Generating Mechanisms – Watt's, Grasshopper and Tchebicheff's. **Offset slider crank mechanisms-** Pantograph. Hook joint- single and double **Steering gear mechanisms –** Ackerman, Davis	4
	Total Classes	**36**

Text Books:

1. Theory of Machines ‐ S S Rattan, Tata McGraw Hill, 4e, 2014
2. Theory of Machines – R. S. Khurmi and J. K. Gupta, S. Chand Technical, 14e, 2005

Reference Books:

1. Theory of Machines and Mechanisms – Uicker, Pennock and Shigley, Oxford University Press, 3e, 2009
2. Kinematics and Dynamics of Machinery – R. L. Norton, McGraw Hill Education, 1e, 2009
3. The Theory of Machines through Solved Problems – J. S. Rao, New Age International Publication, 1e, 2012
4. Mechanism and Machine Theory – Ashok G. Ambekar, PHI Learning, 1e, 2007
5. Theory of Mechanisms & Machines (3rd edition) By Ghosh and Mallik; East West Press, 3e, 2006

Course Name : PRIMARY MANUFACTURING PROCESSES					
Course Code: MECH 2203					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Form basic idea of different mechanical manufacturing processes (except machining) & related equipment along with type of products manufactured through such processes.
CO 2	Acquire working knowledge of sand casting process.
CO 3	Know about different arc welding processes, resistance welding process, friction welding process and hot forge welding process.
CO 4	Familiarization with different forming processes like rolling, forging, extrusion & their specific applications.
CO 5	Learn about powder metallurgy process & different plastic moulding processes.
CO 6	Acquire working knowledge of press working process.

Sl. No.	Syllabus	Contact Hrs.
Module 1	**Introduction& casting process:** Engineering materials (metals & plastics); classification of manufacturing processes. Casting: Definition; Ferrous & non ferrous casting materials; Example of cast products. Types of casting & their application: (1) Sand casting, (2) Sodium silicate-CO_2 moulding, (3) Shell moulding, (4) Expendable mould, (5) Investment casting, (6) Full mould & lost foam casting, (7) Die casting, (8) Centrifugal casting. Sand mould making procedure;definition & meaning of different terms, gating system. Properties of moulding sand; moulding sand composition; effect of grain size, clay & water content on moulding sand properties. Testing of sand properties: moisture content, clay content, grain size, calculation of GFN, permeability, mould strength & hardness. Pattern: materials, allowance; type of patterns: single piece, split, gated, matchplate, cope & drag, loose piece, sweep. Core: Definition & use; Core making with oven/no baking, properties	11

	& constituents; core prints & chaplets. Basic idea of gating system & riser design. Process & utility of die casting & centrifugal casting. Defects in sand casting & remedies.	
Module 2	**Welding process:** Different joining (fabrication) processes; metal welding process; types of joints. Gas welding: oxy-acetylene flame; gas welding equipment; welding process. Electric arc welding: principle of arc; arc welding equipment- Ac & Dc m/c.; electrodes. Manual metal arc welding procedure: edge preparation, current & voltage setting, electrode movement; down hand, horizontal & overhead welding. TIG & MIG welding: process & application. Resistance welding- Spot welding & Butt welding. Hot forge welding & Friction welding process. Causes & remedy of welding defects: under cut, incomplete fusion, porosity, slag inclusion, hot cracking, cold cracking. NDT methods.	8
Module 3	**Forming process:** Elastic & plastic deformation of perfect crystal; effect of mechanical working on mechanical properties; hot & cold working; recrystalization process. **Forging:** Definition; forging operation; application; hot & cold forging. Forging methods: smith forging, drop forging, press forging & m/c forging. Design features of forging dies; forging defects. **Rolling:** definition; hot & cold rolling; rolled products- sections & flats. Rolling stand: 2 Hi, 3Hi, 4Hi & cluster mill; different parts & mechanisms of a mill stand. Rolling load & torque; roll pass sequence. **Extrusion:** process & product; hot & cold extrusion; forward & backward extrusion; impact extrusion. Tooling for solid sections & tubes. **Wire drawing:** process & products; drawing dies, drawing machine.	10
Module 4	**Press work, Powder metallurgy & Plastic processing:** **Press work:** definition of process & different operations like shearing, blanking, piercing, notching, drawing(cupping), coining & embossing. Press tools (die & punch); effect of tool clearance; simple, compound & combination die. Basic components of a press; electro mechanical & hydraulic press.	7

	Powder metallurgy: Definition & products; metal powder making processes. Processing methods: blending, compacting, sintering, secondary operations(heat treatment, coating). Definitions of polymer; thermo-plastics & thermo-sets; popular plastics & their use. Processes: extrusion; injection moulding; blow moulding; thermo-forming(vacuum & pressure).	
	Total Class	**36**

Text Books:

1. Manufacturing technology, Foundry, Forming & Welding-P.N Rao. Vol. 1, 3e, 2012
2. Manufacturing Science-A Ghosh & A Mallick, 2e, 2010
3. Manufacturing Engineering & Technology-S Kalpakjian; Pub:Addison Wesley. 5e, 2013
4. Fundamentals of Metal forming processes by B. L. Juneja, New age International publishers, 2e, 2010

Reference Books:

1. Materials & processes in manufacturing-E.P Degarmo, Black & Kohser, Pub: Wiley, 10e
2. Processes & materials of manufacturing-R.A Lindberg, 2e, 1978

09/08/2022

Course Name : METROLOGY AND MEASUREMENT LAB					
Course Code: MECH 2212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Select and use the appropriate measuring instrument available for linear, angular and roughness measurements.
CO 2	Understand the precision, accuracy, structure and characteristics of various measuring instruments.
CO 3	Measure the threads, radius, -gap between two surfaces, parallelism, cylindricity and concentricity by appropriate instruments and analyze the data.
CO 4	Measure the various parameters like length, height, depth by using various instruments like vernier calipers, micrometer, Vernier height & depth gauge.
CO 5	Measure angle of a component using Vernier bevel protractor, angle gauges and Sine-bar.
CO 6	Measure surface finish by a Talysurf instrument and profile of an object by profile projector.

Taking measurements using following instruments:

1. Group A: (i) Vernier height & depth gauge, (ii) Dial micrometer, (iii) Slip gauge (2P)
2. Group B: (iv) Thread gauge, (v) Radius gauge, (v) Feeler gauge. (2P)
3. Measurement of angle of a component using :(i) Vernier bevel protractor, (ii) angle gauges , (iii) Sine-bar and slip gauges. (2P)
4. Checking / measuring parallelism, cylindricity and concentricity of components using dial indicator. (2P)
5. Measurement of a specific dimension for a lot of components, and prepare a histogram from the data obtained. (2P)
6. Measurement of surface finish by a Talysurf instrument. (2P)
7. Measurement of micro feature of a product (e.g. Thread of a bolt or saw etc.) in a profile projector. (2P)
8. Determine natural cooling characteristics of a heated object by using a thermocouple. (2P)
9. Measurement of air velocity across an air duct using anemometer. (2P)
10. Gear Measurement (2P)

N.B. A minimum of six experiments must be performed in the semester.

09/08/2022

Course Name : MANUFACTURING TECHNOLOGY LAB					
Course Code: MECH 2213					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Familiarise with different components of moulding sand and their effect on properties of mould.
CO 2	Analyze moulding sand for its grain size distribution.
CO 3	Observe the capability of moulding sand for escapement of entrapped gases produced during casting under varying components of moulding sand.
CO 4	Evaluate strength of moulding sand in wet and dry condition in compression and shear mode.
CO 5	Analyse moulding sand for its green hardness property.
CO 6	Understand the amount of moisture present and its effect on moulding sand.

FIELD	**EXPERIMENTS**
A. CASTING	1. To Find grain fineness number (GFN) of sand specimen. 2. To Determine permeability of moulding sand. 3. To determine clay content of moulding sand. 4. To determine green compression strength of moulding sand. 5. To determine hardness of green sand mould. 6. To find out the moisture content of moulding sand.
B. FORGING	1. Compare the hardnesses of a aluminium annealed sample after reducing thickness by 15% and 30% by cold hammering (surface grinding before hardness testing). 2. Study micro structure of MS sample after annealing and after 30% deformation by both hot and cold process.
C. PLASTICS & POWDER METALLERGY	1. Tensile strength testing of Plastic. 2. Compaction and Sintering of Powder Metallurgical samples (Demonstration).

D.WELDING	1. Welding efficiency testing on MS samples (Demonstration).

N.B. A minimum of six experiments must be performed in the semester.

09/08/2022

Course Name : MATERIAL TESTING LAB					
Course Code: MECH 2214					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course Outcomes :

At the end of the course, a student will be able to	
CO 1	Analyze the level of deformation on sheets when they are subjected to an amount of applied force(ANALYSING)
CO 2	Develop a magnetic field to detect flaws in components by the presence of a flux leakage field (CREATION)
CO 3	Provide visual reference of surface discontinuities in solid non-porous materials (UNDERSTANDING)
CO 4	Evaluate the amount of energy by a material during fracture (EVALUATION)
CO 5	Ability to apply knowledge of mathematics and engineering in calculating the mechanical properties of structural materials (APPLYING)
CO 6	Identify the rates at which subcritical cracks grow under cyclic loadings prior to reaching a size critical for fracture (REMEMBERING)

1. Impact Test –Charpy.
2. Impact Test – Izod.
3. Drawability test of sheet metal by cupping.
4. Fatigue test of a typical sample.
5. Sample preparation and etching of ferrous and non-ferrous metals and alloys and metallographic observations.
6. Observations of presence of surface cracks by Dye Penetration Test.
7. Observations of presence of surface and sub-surface cracks by Magnaflux Test.
8. Experiments on heat treatment of carbon steels under different rates of cooling and testing for the change of hardness.
9. Experiments on heat treatment of carbon steels under different rates of cooling and observing the change of microstructure.

N.B. A minimum of six experiments must be performed in the semester.

09/08/2022

Course Name : MACHINE DRAWING-II					
Course Code: MECH 2211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

On successful completion of the course, the student will be able to,

1. Identify **the industrial standards pertaining to machine drawing.**
2. Understand **and** Apply **limits and tolerances (both dimensional and geometrical) to assemblies and choose appropriate fits.**
3. Recognize **machining and surface finish symbols.**
4. Understand **the basic concepts of Setting , Drawing and Editing Tools of Auto-CAD software through various practice problems.**
5. Select **detail dimensioning of Machine components along with Tolerances(both dimensional and geometrical) in Auto-CAD software.**
6. Identify **the various parts of Machine Elements and Draw it's assembly along with BOM in Auto-CAD software.**

Module	Topics	Contact Hrs. / No. of sheets
1A	**I S Conventions:-** Need and Types, I S conventions of Threads, Nuts, Bolts, Gears, Bearings, Springs, Washers, Knurling, array of holes, Ratchet & Pawl,	1 class/ Theory
1B	***Limits, Fits & Dimensional Tolerances:-*** Terminology, Necessity of Limit system, Unilateral and Bilateral Tolerances, Relation between Tolerances and Manufacturing Processes, Methods of indicating tolerances on drawings, IT grades, Systems of fits, Types fits, Selection of fits, Selection of tolerances based on fits.	1 class/ Theory
1C	***Geometrical Tolerances:-*** Need of Geometrical Tolerances, Terminology, Tolerances for Single Features such as Straightness, Flatness, Circularity, Cylindricity. Tolerances for Related Features such as Parallelism, Perpendicularity, Angularity, Concentricity, Tolerance Symbol and Value, Indicating Geometrical Tolerances on drawings.	1 class/ Theory
1D	***Surface Finish:-*** Surface Texture, Surface Roughness Number, Roughness Symbols, Range of Roughness obtainable with different manufacturing processes.	1 class/ Theory
2	***A detailed discussion on Drafting software*** Drawing format setting tools, like LIMITS Command, UNITS command, LAYER command, tool for line type setting from GUI, tool for text height-n-width setting etc. Different Drawing tools, like LINE command, PLINE command, MLINE Command, ELLIPSE Command, RECTANGLE Command, POLYGON Command etc. Different transformation and drawing editing tools, like ZOOM Command, SCALE Command, ERRASE Command, TRIM Command, OFFSET Command, MOVE Command, COPY Command, ARRAY Command etc.	4 classes/ Practical
3	***Assembling of:-*** a) Cotter Joint. b) Cross head of steam engine.	2 Class/ Practical

4	***Disassembling of:-*** a) Lathe Tail Stock.	2 Classes/ Practical

N.B: *Each class comprises of 3 periods*

Recommended Books

1. Machine Drawing, Basudeb Bhattacharya, Oxford University Press, 1e, 2011
2. IS 2079 (Guide for selection of fits), IS-919 (Recommendations for limits and fits in engineering), IS-10719 (To indicate surface texture and finish), IS-8000 (Geometrical tolerance on technical drawing)
3. AutoCAD 2013 for Engineers and Designers, Sham Tickoo, Dreamtech Press, 1e, 2013

09/08/2022

Course Name : Chemistry of Biomolecules					
Course Code: BIOT2101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:
After completion of this course, the students will be able to:

1. Calculate the pH of a buffer system, identify different stereoisomer's of carbohydrate and lipids and understood the chemistry of carbohydrate and lipids.
2. Explain the different structural components and physiochemical properties of amino acids, proteins.
3. Analyses and explain the different structural components and physiochemical properties of DNA and RNA.
4. Select and apply suitable spectroscopic techniques for estimation biomolecules.
5. Select and apply suitable techniques for and structure determination of of biomolecules.
6. Able to solve mathematical problems related to estimation and structural features of biomolecules.

Module –I: Introduction and Chemistry of Carbohydrates [10L]

Introduction: Structure of water molecules, Weak inter-molecular interactions in biomacromolecules, Basic concepts of pH, buffer, pKa**.** Chemistry of Carbohydrates: Definition, classification, structure and chemical properties of: Monosaccarides; Sucrose, Lactose, Maltose; Glucosamine, Muramic Acid; Starch, Glycogen, Cellulose, Chitin, Agar, Proteoglycans; Sialic acids and blood group polysaccharides. Stereochemistry of Carbohydrates: Projection formula (Fischer, flying-wedge, Sawhorse, Newman & Howarth), Configuration, conformation, Optical isomerism (d/l, D/L and R/S nomenclature), Anomer, Epimer, Mutarotation.

Module-II: Chemistry of Lipids [10L]

Lipids: Definition, classification. Structure, Reactions and characterization of: fatty acids, Triacyl glycerols. Structure of Prostaglandins, Oil, Wax. Geometrical isomerism (cis/trans, syn/anti, E/Z) of Fatty acids. Hydrolysis, saponification value, iodine number, rancidity and Biological significance of fats. Phospholipids: Introduction and importance. Glycerophospholipids, lecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens, sphingomyelines. Glycolipids: cerbrosides, gangliosides. Steroids and carotenoids: Introduction, and importance, cholesterol, modifications of sterols, bile acids, steroid hormones, carotenes.

Module-III: Chemistry of Amino Acids, Proteins and Nucleic acids [10L]

Classification, Structure, pH titration curve and Important Chemical reactions. Structure of Amino Acids. Peptide bond, Solid phase peptide synthesis, peptide sequencing. Four levels structures, Conformation (Ramachandran plot, domains, motif and folds), Separation Methods based on structure and chemical properties; denaturation and renaturation of proteins. Example: RNaseA, keratins, collagen, Lectins, myoglobin, hemoglobin. Stability of protein. Chemistry of Nucleic Acids: Structure, nomenclature of Nucleoside, Nucleotides. Four levels structures, Functions, Conformations, Nucleotide sequence composition of DNA and RNA. Supercoiled structure, Denaturation and renaturation kinetics of DNA. Stability of Nucleic acids

Module-IV: Techniques for estimation and structure determination of Biomolecules [10L]

Introduction to absorption and emission spectroscopy and Lambert–Beer law. Estimation of biomolecules by spectroscopic, colorimetric, phosphorescence, and luminescence method. Basic concepts and principles for structure determination techniques: X-ray diffraction, crystallography; spectroscopy: UV and visible, fluorescence, Infrared, Nuclear Magnetic Resonance, circular dichroism, Optical Rotatory Dispersion, Surface plasmon resonance, Electron Spin Resonance Spetroscopy, Microscopy: atomic force (AFM) and cryoelectron. Radioisotopic techniques.

Textbooks:

1. Lehninger Principles of Biochemistry by Nelson and Cox, McMillan publishers
2. Van Holde, Principles of Physical Biochemistry, Pearson
3. Biochemistry,by 4th Edn. (2011) Voet, D. and Voet JG. (Wiley)
4. Biochemical Calculations by Irwin H. Segel, John Wiley & Sons

Reference books:

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY
2. Biochemistry by Zubey. Wm. C. Brown publishers
3. Organic Chemistry, Finar, IL. Part II.
4. Biochemistry, 5th edition (2002) by Berg, Tymoczko, and Stryer. (W H Freeman)
5. David Friefelder, Physical Biochemistry
6. Practical Biochemistry Principles and techniques :Ed Wilson and Walker, Cambridge University Press
7. Physical Chemistry, Principles and Applications in Biological Sciences (2001) by Tinoco, Sauer and Wang,, Prentice Hall, 4th Edition
8. Physical Chemistry for the Life Sciences (2005) by Atkins,, W.H. Freeman
9. Physical Chemistry with Applications to the Life Sciences(1979) by Eisenberg & Crothers, Benjamin/Cummings Publishing Co.
10. Principles of Physical Biochemistry (1998) by K. E. van Holde, W. C. Johnson, and P.S. Ho.
11. Biophysical Chemistry (1981), Part I: The Conformation of Biological Macromolecules, Part II: Techniques for the Study of Biological Structure and Function by C.R. Cantor and P.R.Schimmel.

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Course Name : Industrial Stoichiometry					
Course Code: BIOT2102					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course Outcomes:

After completion of this course, the students will be able to:

1. Solve problems related to units and conversions and fit the given data using the methodologies.
2. Able to make material balances on unit operations and processes.
3. Understand stoichiometry of microbial growth and product formation.
4. Solve problems related to energy balance for steady state processes.
5. Determine the heat of reaction for processes with biomass and secondary metabolite production.
6. Design simultaneous material and energy balances in biochemical processes

Module-I: Units and Dimensions [10L]

Small units and dimensions, dimensionless groups, dimensional analysis. Conversion of equations. Use of log-log and semi-log graph paper, graphical differentiation and graphical integration, treatment and interpretation of data by least square analysis.

Module II: Material balance [10L]

Introductory Concepts- simplification of the general mass balance equation for steady and unsteady state processes, procedure for material balance calculations, material balance without chemical reactions: application of humidification, distillation column. Material balance with chemical reaction: combustion.

Stoichiometry of growth and product formation- growth stoichiometry and elemental balances. Material Balance with recycle, bypass and purge streams in bioprocess.

Module-III: Energy Balance [10L]

General energy balance equation for steady state processes - without and with chemical reaction. Enthalpy calculation procedures: enthalpy change due to reaction, heat of combustion, heat of reaction for chemical processes.

Energy-balance equation for cell culture -heat of reaction for processes with biomass and secondary metabolites production in fermentation processes.

Module-IV: Combined material and energy balance in bioprocesses [10L]

Simultaneous material and energy balances in biochemical processes: growth associated, non-growth associated and mixed growth associated product production process.

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Textbook:

1. Bhatt & Vora, Stoichiometry, 4th Ed., Tata McGraw Hill

Reference books:

1. Hougen and Watson, Chemical Process Principles (Part one): 2nd ed, John Wiley.
2. Basic Principles and Calculations in Chemical Engineering: Himmelblau, 6th Ed. Prentice Hall India.
3. Bioprocess Engineering: 2nd edition, Michael L. Shuler, Filkert Kargi. Prentice Hall India.

Course Name : Biochemistry					
Course Code: BIOT2103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes

After completion of this course, the students will be able to:

1) Explain the basic concepts of enzymes.
2) Understand and apply mathematical knowledge to solve Enzymatic Kinetics particularly related to Michaelis-Menton Equation.
3) Understand and grasp knowledge about main principles behind how various cell signalling works.
4) Explain the basic concepts of how extracellular matrix works.
5) Explain the basis behind lipid synthesis and lipid β oxidation pathways.
6) Understand how Cholesterol synthesis happens.

Module-I: Introduction to Enzyme & Carbohydrate Metabolism [10L]

Enzymes: Basic concept of enzyme-substrate reaction, Classification and nomenclature, active site, allosteric regulation. **Metabolism of carbohydrates and their regulation:** glycolysis, TCA cycle, pentose phosphate pathway, Glyoxalate cycle, Cori cycle, glucuronate pathway**,** glycogenolysis, gluconeogenesis glycogenesis. **Oxidative phosphorylation:** electron transport chain, ATP synthesis, and its regulation. **Photosynthesis:** Photophosrylation, Calvin cycle. Disorder/ diseases of carbohydrate metabolism.

Module-II: Metabolism of lipids and vitamins [10L]

Oxidation of Fatty acid and its regulation: Beta oxidation, Alpha oxidation and omega oxidation of fatty acids - saturated and unsaturated fatty acids - even and odd numbered. Catabolism of phospholipids. Biosynthesis of fatty acids, phospholipids, cholesterol, steroids and Ketone bodies and their regulation. Disorder/ diseases of lipid metabolism. Vitamins and hormones: classification, Structure and Function; Micronutrients.

Module-III: Metabolism of Amino acid and nucleic acid [10L]
Oxidation of amino acids: Transamination, oxidative deamination. Urea cycle and its regulation. Overview of amino acid degradation. Biosynthesis of amino acids and its regulation; Protein turnover. Disorder/ diseases of amino acids metabolism.
Nucleic acid metabolism: nucleotide metabolism, Overview of purine and pyrimidine biosynthesis and degradation, De Novo and Salvage Pathways. Disorder of purines and pyrimidines metabolism.

Module-IV: Cell Signaling [10L]
Cell signaling and signal transduction pathways: Ligands and their receptors, cell surface receptor, signaling through G-protein coupled receptors, second messengers, regulation of signaling pathways, general principles of cell communication, cell adhesion and different adhesion molecules, gap junctions, extracellular matrix, integrins.

Textbook: 1. Lehninger's Principles of Biochemistry by Nelson & Cox, W.H. Freeman Pub.

Reference books:
1. Molecular Biology of the Cell by Bruce Alberts, 4th ed, Garland Science Publishers, 2002
2. Lubert Stryer, Bio chemistry, Freeman & Co, NY
3. Voet & Voet, Fundamentals of Biochemistry, John Willey & Sons
4. Harper's Illustrated Biochemistry - R.K.Murray et al. (McGraw Hill)
5. Outline of Biochemistry - Conn & Stump (John Willey & Sons)

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Course Name : Microbiology					
Course Code: BIOT2104					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course Outcomes:

After completing this course, students will be able to:

1. Describe different cell structures with subcellular functional organelles.
2. Describe the working principles of different types of microscopes.
3. Isolate pure culture from different environmental sources.
4. Preserve and maintain pure culture.
5. Understand various microbial identification processes.
6. Apply their knowledge of microbes in different environmental aspects.

Module-I: Introduction to Microbiology [10L]

Development of microbiology: rejection of abiogenesis theory- major contributions by different scientists: diversification of basic microbiology into different application domains.
Bacteria: morphology, cell structure with subcelluar functional organelles,
Archaebacteria and actinomyces: General morphology, growth characteristics.
Yeast: General morphology and subcellular structure, growth and reproduction.
Fungi: General morphology, sexual and asexual reproduction.
Algae: Classes of algae, cyanobacteria.
Virus: General morphology, virulence, types.
Applications of microbes and Algae in Biotechnology.
Biochemical & Molecular Taxonomical identification of microorganisms.

Module-II: Basic principles and methods in microbiology [10L]

Microscopy: Human visibility and microorganisms, history of development of Microscope, description optical complex microscope. Resolving power, numerical aperture and chromatic aberration Microscopy II: Optical microscope with special utility (phase contrast, fluorescence and inverted microscope), Electron microscope TEM & SEM.
Cultivation of microbes – General media for the growth of bacteria, yeast and fungi, Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture). Anaerobic (thioglycolate, anaerobic chamber, Robertson's media, microaerophilic), liquid shake culture of aerobic bacteria. Control of microbes: Sterilization, tyndallisation, pasteurization; Physical agents: dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter; Chemical agents: antibiotics and antiseptics, disinfectants.

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Module-III: Microbial Growth and Metabolism [10L]

Growth of bacteria- Definition, growth phases, kinetics of growth, direct and indirect measurement of growth, The mathematical nature and expression of growth. growth principles of nutrition, influence of environmental factors-pH, temperature, oxygen, Heavy metals and Other compounds. Bacterial growth, fermentation and putrification, Aerobic and anaerobic respiration (definition, examples), fermentation (alcoholic, mixed acid, acetic acid, lactic acid), Entner Duodruffs pathway, bacterial photosynthesis (green and purple bacteria), biochemical nitrogen fixation – non-symbiotic, symbiotic (definition and examples), basic concept of nif-genes. Mod genes, nitrogenase complex, legheamoglobin.

Module-IV: Environmental microbiology [10L]

Air microbiology- Microorganisms in the air, sampling techniques, air borne pathogens. Microbiology of fresh water and wastewater (sewage), water borne diseases (name of pathogen, pathogenicity and preventive measures). Outlines of method for determination of microbial safety of drinking water (presumptive, confirmatory and completed tests). Soil microbiology: soil microbes, different kinds of associations, importance of soil microbes in agriculture.

Textbook:

1. R.C Dubey and D. K Maheshwari -A Text Book of Microbiology, 3rd ed, S. Chand and Company.
2. C.B Powar and H.F Daginawala- General Microbiology (Vol I & II) 3rd ed, Himalaya Publishing House.

Reference books:

1. Stanier R. –General Microbiology, 5thed, Macmilan Press ltd.
2. M. Pelczar, E.Chan, N.Kreig, Microbiology, 5thed, MGH
3. Salle.A.J- Fundamental Principles of Bacteriology, Tata Mcgraw Hill.
4. Hans G. Schlegel, General Microbiology, 7thed, Cambridge Low Price Edition.
5. A.H. Rose, Chemical Microbiology, 3rded, Butterworth World Student Reprints

Course Name : Thermodynamics and Kinetics					
Course Code: BIOT2201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

After completion of this course, the students will be able to:

1. Comprehend the thermodynamic properties and functions of different systems and processes.
2. Apply the thermodynamic laws in practical problems.
3. Relate the thermodynamic properties and functions to biological systems.
4. Explain effect of temperature on rate of reaction.
5. Determine the order of a reaction using different suitable analytical methods.
6. Understand the kinetic mechanism of enzyme-substrate reactions with/without the presence of inhibitor and solve related problems.

Module-I: Basic concept of thermodynamics [10L]

Concept of Enthalpy and Entropy; Phase Rule; PVT behavior of pure substances; Equation of states: Van der Waal's Equation, Virial Equation and its Application; Low temperature processes: Refrigeration and Liquefaction; Residual properties; Chemical Potential and Phase Equilibrium; Fugacity and Fugacity Coefficient; Vapour/Liquid Equilibrium, Roult's Law, Modified Raoult's Law, Henry's law.

Module-II: Bioenergetics and Thermodynamics [10L]

Importance of thermodynamic laws and free energy in Biological system; Thermodynamic properties to understand: Enzymes, ATP synthesis and hydrolysis within cell, metabolism and ATP yield; Protein folding and free energy funnel. Transport across membrane: active transport; activation energy; gradient of chemical potential as driving force in biological process.

Module-III: Kinetics [10L]

Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrehnius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction, Elementary Reactions, First, Second and Third order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half life method, Fractional order reactions.

Module-IV: Applications of Kinetics [10L]

Interpretation of batch reactor data for simple and complex reactions. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes–derivation of Michaelis-Menten equation, Briggs-Haldane relationship, the determination and significance of kinetic constants, Lineweaver-Burk, Hanes–Woolf plot and Eadie-Hofstee plot, Principles of enzyme inhibition: competitive, noncompetitive and uncompetitive.

Textbook:

1. Smith & Vanness, Thermodynamics for Chemical Engineers, McGraw Hill & Co.
2. Levenspiel. O. Chemical Reaction Engineering, Wiley Eastern Ltd.

Reference books:

1. Richardson, J.F., Peacock, D.G. Coulson & Richardson's Chemical Engineering, Volume 3rd ed., First Indian ed. Asian Books Pvt. Ltd. 1998
2. Bailey & Olis, Biochemical Eng. Fundamentals, McGraw Hill & Co., 1990
3. Gordon G. Hammes, Thermodynamics and Kinetics for the Biological Sciences; John Wiley & Sons, Inc., Publication; 2000
4. Michael L. Shuler, Filkert Kargi, Bioprocess engineering: 2nd edition, Prentice Hall India.

<table>
<tr><td colspan="6">Course Name : Transfer Operation-I</td></tr>
<tr><td colspan="6">Course Code: BIOT2202</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
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Course Outcomes:

After completion of this course, the students will be able to:

1. Understand thy physical properties of fluid, flow behavior and their consequence on fluid flow.
2. Apply the basic laws and equations to analyze fluid dynamics and solve numerical problems related to them.
3. Understand the importance of fluid flow measurement by various devices in industries.
4. Analyze and calculate various parameters involved in heat transfer by conduction, convection and thermal radiation.
5. Develop and design various equipment's associated with heat transfer and evaluate heat exchanger performance.
6. Develop the knowledge of principles of communition, mechanical separation aspects, working of equipments used in mechanical operation and calculate various parameters for energy requirement related to size reduction of solid.

Module-I: Basic concepts of Fluid Mechanics [10L]

Fluid – rheological properties – compressible, incompressible fluids. Newtonian and non Newtonian fluids. Basic equations of fluid flow, fluid flow phenomena – through pipes and other devices – pressure drop calculations. Fluid friction- friction in flow through packed beds. Fundamentals of fluidization and inverse fluidization, gravity settling, terminal settling velocity. Basic concept of multiphase flow-flow regime, pressure drop measurement.

Module-II: Flow measurements and machineries [10L]

Flow measuring devices- orifice and venturi meters, pitot tube, weirs, rotameters and other types of meters. Pipe fittings and valves. Pumps – classification, centrifugal and positive displacement type, peristaltic pump. Principle of compressor and blower.

Module-III: Heat transfer [10L]

Classification of heat flow processes- conduction, convection, radiation. Conduction- Steady state and unsteady state heat conduction. Heat flow in fluids by convection (natural and forced). Heat exchanger- double pipe and shell and tube heat exchanger. Basic concept of radiation.

Module-IV: Mechanical Operations [10L]

Principles of comminution, types of comminuting equipment, energy and power requirement. Crushing, grinding, mixing and agitation, power consumption in mixing. Mechanical separation-screening, filtration (constant pressure and constant rate), centrifugation.

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Textbook:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition

Reference books:

1. Geankopolis, Transport Processes & Unit operations: 3rd edition, PHI.
2. Coulson & Richardson, Chemical Engineering, Vol-I & II:, Butterworth Heinemann

Course Name : Molecular Biology					
Course Code: BIOT2203					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

After completion of this course, the students will be able to:

1. Identify and analyze the different components and mechanism of replication.
2. Describe different types of DNA damage and repair systems and recombination process.
3. Comment on various components and detailed process of transcription.
4. Comment on various components and mechanism of translation.
5. Understood the rational of genetic code.
6. Comprehend on models of gene regulation and apply the knowledge of gene regulation as genetic switch.

Module-I: Replication and DNA repair in Prokaryotes & Eukaryotes [10L]

The biochemical basis of inheritance, DNA as the genetic material, Central Dogma of molecular biology. Organization of Genome. DNA Replication: Mechanism, Models; Initiation, Elongation & Termination; Enzymes and accessory proteins; Inhibitors of DNA replication; extrachromosomal replicons. Replication in DNA and RNA virus. Mechanisms of different types of DNA Repairs, SOS repair. Repair defects and human diseases. Recombination: Mechanism of general, site specific, recombination.

Module-II: Transcription in Prokaryotes & Eukaryotes [10L]

Structure of and function of different types of RNA, promoter, RNA polymerases: structure and assembly; RNA polymerase I, II, III, transcription factors, terminators. Process of transcription: Initiation, Elongation & Termination of transcription. Post Transcriptional Modifications: Processing of hnRNA, tRNA, rRNA, siRNA, miRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing (different types); RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA, RNA transport, localization and function. Inhibitors of transcription; Reverse transcription; Ribozyme.

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Module-III: Genetic code & Translation in Prokaryotes & Eukaryotes [10 L]

Concept of genetic code: Universal genetic code; Degeneracy of codons; Termination codons; Isoaccepting tRNA; Wobble hypothesis. Components translationa: structure and function of ORF, tRNA, rRNA, Ribosomes, RBS, aminoacyl synthetases. Process of Translation: Initiation, Elongation, Termination, Proof-reading, Translational inhibitors. Post translational modifications of protein, Protein folding, Protein trafficking, Protein transport and degradation.

Module-IV: Regulation of Gene Expressions in Prokaryotes & Eukaryotes [10 L]

Molecular structure of gene and its nomenclature. Principle of gene regulation: Negative and Positive Regulation, Structure and function of gene regulatory protein. Regulatory elements: Promoter, Operator, Inducer, Repressor, Activators, Silencers, Insulators, Enhancers. Gene regulation in Prokaryote: concept of Operon Model (*lac, gal, trp* and *ara* operon), Attenuation; antitermination in lambda virus. Gene regulation in Eukaryotes: DNA looping model, hormonal control of gene expression (steroid and non steroid), Role of chromatin, Chromatin remodeling, Gene silencing and Epigenetic regulation. Regulations at level of translation, Riboswitch.

Text books:

1. Molecular Biology of the Gene, 6th Edition, - by J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner.
2. Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007.
3. Essentials of molecular Biology, by Malacinski and Freifelder Jones and Bartlelt Publishers.

Reference books:

1. Molecular and Cellular Biology- by Stefen Wolfe, Wordsworth Publishing Co.
2. Genomes, by T. A. Brown, John Wiley and Sons PTE Ltd.
3. Cell and molecular Biology, Concepts and experiments by Gerald Karp, John Wiley & Sons.
4. The Cell - A molecular approach, by G. M. Cooper, ASM Press.
5. Molecular biology of cell 4thed Alberts, Bruce; Watson, J D(2002) Garland Science Publishing,
6. Molecular cell biology 4th ed Lodish, Harvey and. Baltimore,D(2000) W.H. Freeman and Co.
7. Cell and Molecular Biology 8th ed, Robertis, EDP De & Robertis, EMF De(2002) lippincott, Williams & Wilkins international student edition.

Srabanti Basu

Course Name : Industrial Microbiology and Enzyme Technology					
Course Code: BIOT2204					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**1**

Course Outcomes:

After completing this course, students will be able to:

1. Describe different methods for immobilization of enzymes.
2. apply enzymes in various industries that can benefit human life
3. Produce different useful secondary metabolites by microbes.
4. Modify the enzymes for better stability.
5. Design different biosensors for applications in biotechnology.
6. Develop the fermentation techniques and downstream processes.

Module-I: Fermentation process and high-yielding microbes [10L]

Definition and scope, Basic idea on fermentation process, submerged, stationary, solid and semi-solid – with their merits and demerits, Microbial Culture systems; Media for Industrial fermentations; Media optimization; Sterilization of Industrial Media, Cellular control regulating production of microbial metabolites – Primary and Secondary metabolite – Induced mutation technique – Analogue resistant mutant – Catabolic derepressed mutants – Genetically engineered strain – Protoplast fusion technique.

Module-II: Fermentation processes [10L]

Microbial production: Production of organic acids and solvents, microbial polysaccharides, amino acids, enzymes, vitamins, growth factors and hormones, antibiotics and vaccines, alcoholic beverages and other microbial food products.

Downstream processing and fermentation economics. Postproduction techniques and future.

Module III: Enzyme Technology [10L]

Enzyme : brief overview, classification and nomenclature , general characteristics ,Units of enzyme activity, physical and chemical factors affecting enzyme activity, outlines of extraction and purification of commercial enzymes from plant, animal and microbial sources, formulation and stabilization of commercial enzymes. Commercial enzymes: Industrial application Food processing Enzymes of Analytical, diagnostic and medicinal applications Stable enzyme : selection of extremophilic producer Stable enzymes by protein engineering Enzyme electrode & Enzyme sensor Use of Enzymes in non aqueous media.

Module IV: Enzyme applications [10L]

Chemical Modification of enzymes for better stability Enzyme immobilization –Physical and chemical methods for enzyme immobilization. Adsorption, matrix entrapment. Covalent binding, cross linking – advantages and disadvantages of different immobilization techniques. Immobilized enzyme kinetics

General overview on the use of enzymes in different industrial processes

Enzyme electrode and application as biosensor in biotechnology and environmental monitoring. Different bioreactors for processes using immobilized enzymes.

Text books:

1. L.E. Cassida.Jr, Industrial Microbiology, New Age International Publisher.
2. W. Crueger, Annelise Crueger, Biotechnology: A Textbook of Industrial Microbiology, Sinauer Assoc. Inc.
3. Fundamentals of Enzymology by Nicolas C. price and Lewis Stevens. Oxford University Press.
4. Enzymes by Trevor palmer, East west Press 3. Enzyme Technology by Messing

Reference books:

1. Prescott's and Dunn's, A. Industrial Microbiology, 4th edition. CBS Publishers, New Delhi, India, 1987.
2. Atkinson.B and Marituna.F, Biochemical Engineering and Biotechnology Handbok, The Nature Press, Macmillan Publ. Ltd.
3. Enzymes : Dixon and Webb.(IRL Press) Enzyme technology by Chaplin and Bucke. Cambridge University Press.
4. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition.

Subject Name: SURVEYING
Subject Code: CIVL 2101
Contacts: 3 L + 1 T
Credits: 4

Course Outcome:

After going through this course, the students will be able to:

1. Demonstrate the basics of linear/angular measurement methods like chain surveying, compass surveying and the significance of plane table surveying in plan making.
2. Analyze and interpret the data of leveling and theodolite survey in elevation and angular measurements.
3. Illustrate the theory and data of tacheometric surveying in distance and height measurements.
4. Estimate the area and volume by different methods.
5. Construct simple circular curves by using linear and angular method and to know the basics of transition curve.
6. Explain the basic concepts of the modern instrument like EDMs, GPS instrument, Total Station etc. and demonstrate the concepts of Triangulation, Hydrographic Survey and Aerial Photogrammetry.

SL. No	Module	Details of Course Contents	Hours	Total
1	I	**BASICS OF SURVEYING** Introduction to Surveying efinition, principles of surveying, types of scales (numerical problems), basic concepts of plans and maps. Chain Surveying ypes of chains, accessories for chain surveying with their use, methods of ranging and methods of offsets, obstacles in chain surveying. Compass Surveying Definition, instrument and terminology, local attraction and its elimination, Open and closed traverse, adjustment of traverse. Plane Table Surveying inciple, equipment and methods, two and three point problems.	2 2 4 2	44
2	II	**METHODS OF MEASUREMENT** Levelling and Contouring Definitions and terminology, types and methods of leveling, use of leveling instruments and supporting accessories, different terms used in contouring, characteristics of contour and contour interval. Theodolite Surveying and Tacheometry Components of Theodolite, adjustments, measurement of vertical and horizontal angels, concepts of trigonometric leveling, definitions and principles of tachometry and stadia system, fixed hair stadia method, calculation of horizontal and vertical distance using tachometer.	6 8	

3	III	**COMPUTATION PROCEDURE AND SETTING OUT WORKS** Computation of Area And Volume mputation of area using trapezoidal rule and Simpson's $^1/_3$ rule. mputation of volume of different cross sections. Setting Out Of Horizontal Curves Elements of simple circular curves and methods of setting out simple circular curve by linear and angular method. equirements, types and elements of transition curve. Setting Out Of Vertical Curves Introduction to vertical curves.	 2 4 1	
4	IV	**INTRODUCTION TO HIGHER SURVEYING** Measurement Procedure Using Advanced Instruments Basic concepts of EDMs and GPS instrument (relating to land surveying), Total Station and its different parts. Practical application of Total Station. Triangulation Concepts of triangulation and triangulation systems in brief. Hydrographic Survey Shoreline survey, soundings, locating soundings and reduction of soundings. Basic concept of Mean sea level, bathymetry. Aerial Photogrammetry Terminology, equipments and phototheodolite.	 4 2 4 3	

RECOMMENDED BOOKS:

TEXT BOOKS	
Sl. No.	Name of the Books
1.	Duggal S. K. *Surveying (Vol-1 and 2)*. 4th edition, McGraw Hill Education (India) Pvt Ltd.
2.	Roy S.K. *Fundamentals of Surveying*. 2nd edition, PHI Learning Pvt. Ltd-New Delhi.
3.	Punmia B.C., Jain A.K. and Jain A.K. *Surveying (Vol-1 and 2)*. 15th edition, Laxmi Publications (P) Ltd.

REFERENCE BOOKS	
Sl. No.	Name of the books
1.	Subramanian R. *Surveying and Levelling*. 2nd editon, Oxford university Press.
2.	Venkatramaiah C. *Textbook of Surveying*. 2nd edition, Orient Blackswan Pvt. Ltd. – New Delhi.
3.	Bannister A., Raymond S. and Baker R. *Surveying*. 1st edition, Pearson India.

Subject Name: STRENGTH OF MATERIALS

Subject Code: CIVL 2102

Contact: 3L + 1T = 4

Credit: 4

Course Outcome:

1. To identify the equilibrium conditions and elastic properties of axially loaded bars through stress-strain and force-displacement curves.
2. To identify the principal plane and principal stresses through Mohr circle.
3. To calculate the hoop and meridional stresses in thin cylinders and spherical shells.
4. To identify different degrees of freedoms for support conditions like hinge, roller and fixed constraints.
5. To calculate the bending moment, shear force and deflection of beams for uniformly distributed, concentrated, linearly varying and external concentrated moment.
6. To calculate the member forces in a plane truss using Method of Joint and Method of Section.
7. To identify torsional moment and twist on a circular shaft and calculate the shear stress.
8. To know the concepts of strain energy due to axial load, bending and shear.
9. To calculate the buckling load of columns using Euler's theory for different support constraints.

<table>
<tr><th>Sl.No.</th><th>Module</th><th>Details of course content</th><th>Hours</th><th>Total</th></tr>
<tr><td>1.</td><td>I</td><td>i. Condition of equilibrium, Degrees of freedom, Relation between different Elastic moduli, Composite section, thermal stress.
ii. Principal stresses, principal plane, and Mohr's circle.
iii. Hoop and meridonial stresses in thin cylindrical, conical and spherical shells.</td><td>8</td><td rowspan="4">44</td></tr>
<tr><td>2.</td><td>II</td><td>i. Shear force and bending moment diagrams for statically determinate beams subjected to concentrated, uniformly distributed, and linearly varying loads, relationship between load, shear force and bending moment.
ii. Bending of beams, elastic flexure formulae, Bending and shear stress, shear centre and shear flow</td><td>14</td></tr>
<tr><td>3.</td><td>III</td><td>i. Analysis of determinate two dimensional truss by Method of joints and Method of section and graphical method.
ii. Torsion in circular solid and hollow shafts</td><td>8</td></tr>
<tr><td>4.</td><td>IV</td><td>i. Slope and deflection analysis of determinate beams using Double integration method, Area-Moment theorem and Conjugate beam theory.
ii. Strain energy: Strain energy and complementary strain energy, Strain energy due to axial load, bending and shear.
iii. Columns: Fundamentals, criteria for stability in equilibrium, column buckling theory, Euler's load for columns with different end conditions – limitations and problems, eccentric load and secant formula.</td><td>14</td></tr>
</table>

Reference books

Sl. No.	Name of the book	Name of author/authors	Publisher
1	Elements of Strength of Material	S. P. Timoshenko and D. H. Young	EWP Pvt. Ltd
2	Engineering Mechanics of Solids	E. P. Popov	Pearson Education
3	Strength of Materials	R. Subramanian	OXFORD University Press
4	Strength of Materials	S S Bhavikatti	Vikas Publishing House Ltd
5	Strength of Material	A. Pytel & F. L. Singer	AWL Inc
6	Engineering Mechanics	J. L. Mariam	John Willey
7	Engineering Mechanics	I. H. Shames	PHI
8	Strength of Materials	S. S Rattan	McGraw Hill Education Pvt. Ltd.

Subject Name: BUILDING MATERIALS AND CONSTRUCTION
Subject Code: CIVL 2103
Contacts: 3 L + 1 T
Credits: 4

Course Outcome:

After going through this course, the students will be able to:

1. Impart knowledge regarding the various building and general construction products and their quality, durability and availability.
2. Impart knowledge regarding the various types of properties, uses and variety of materials used in the construction industry.
3. Study the behavior of concrete at its fresh and hardened state
4. Study about the concrete design mix.
5. Expose themselves to various quality control aspects of the civil engineering materials.
6. Learn and use the terms common in the building industry.

SL. No	Module	Details of Course Contents	Hours	Total
1	I	**Building Materials -I** Bricks Introduction, Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick earth, Different forms of bricks, Testing of bricks, Defects of bricks, Fly ash brick. Cement Introduction, Chemical Composition of Cement, Hydration of Cement. Tests on Cement and Cement Paste – specific gravity, fineness, consistency, setting time, soundness, strength. Types of Portland Cement – Ordinary, Rapid hardening, Low-heat, Sulphate resisting, Portland slag, Portland pozzolana, Super sulphated cement, White cement. Aggregates Introduction, Classification, Mechanical and Physical Properties, Deleterious Substances, Alkali-Aggregate Reaction. Testing of Aggregates – Particle size distribution, Flakiness, Elongation Tests, Aggregate Crushing Value, Ten Percent Fines Value, Impact Value, Abrasion Value Lime Introduction, Classification, Slaking and hydration, Hardening, Lime putty, Storage, Handling.	2 5 5 1	42
2	II	**Building Materials -II** Ferrous Metals Introduction, Pig Iron- composition, properties, uses. Cast Iron-Properties, Manufacturing, uses. Wrought iron- properties, uses. Steel- composition, properties, manufacturing, uses. Rolled steel sections, Reinforcing steel bars, Rusting and corrosion of steel, Tensile testing of steel, Alloy steel. Mortars Introduction, Classification, Uses, Characteristics of good mortar,	5 1	

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		Ingredients. Wood and Wood Products Classification of Timber, Structure, Characteristics of good timber, Seasoning of timber, Defects in Timber, Diseases of timber, Decay of Timber, Veneers , Plywood, Applications of wood and wood products. Paints, Enamels and Varnishes Composition of oil paint, characteristic of an ideal paint, preparation of paint, covering power of paints, Painting: Plastered surfaces, painting wood surfaces, painting metal Surfaces. Defects, Effect of weather, enamels, distemper, water wash and colour wash, Varnish, French Polish, Wax Polish. Miscellaneous Materials Gypsum- Classification, Plaster of Paris, Gypsum wall Plasters, Gypsum Plaster Boards, Adhesives, Heat and sound insulating materials, Anticorrosive, Waterproofing.	1 1 3	
3	III	**Building Construction -I** undations nction of Foundations, Essential requirement of good foundation, Different types of shallow and deep Foundations. Brick masonry Definitions, Rules for bonding, Type of bonds – stretcher bond, Header bond, English bond, Flemish Bond, Comparison of English Bond and Flemish Bond (one and one and half brick thick wall) Wall, Doors and Windows Load bearing wall, Partition wall, Reinforced brick wall Common types of doors and windows of timber and metal.	4 4 2	
4	IV	**Building Construction -II** Stairs Technical Terms, Requirements of good stair, Dimension of steps, Classification, Geometric design of a dog legged stair case. Flooring Components of a floor, selection of flooring materials, Brick flooring, Cement concrete flooring, mosaic, marble, Terrazzo flooring, Tiled roofing. Centering and Shuttering, Plastering and Pointing: Centering and Shuttering, Plastering with cement mortar, Defects in plastering, pointing, white washing, colour washing, Distempering. Roofs Types, Pitched roofs and their sketches, Lean – to roof, King Post – Truss, Queen post truss and Simple steel Truss, Roof Covering materials: AC sheets GI sheet.	2 2 2 2	

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RECOMMENDED BOOKS:

TEXT BOOKS	
Sl. No.	Name of the books
4.	Duggal S.K. *Building Materials* , New Age International
5.	Varghese P.C. *Building Materials*, PHI Learning Pvt. Ltd-New Delhi.
6.	Punmia B.C. *Building Construction*, Laxmi Publications.

REFERENCE BOOKS

Sl. No.	Name of the books
4.	M. S. Shetty R. *Concrete Technology*, S. Chand.
5.	Nevile A.M. & Brooks J.J. *Concrete Technology*, Pearson Education.
6.	S.C. Rangwala *Engineering Materials*, Charotar Publishing

Subject Name: ENGINEERING GEOLOGY
Subject Code: CIVL 2104
Contact: 3L
Credits-4

After going through this course, the students will be able to:

1. Characterize a site with respect to physical and chemical properties of foundation rocks and minerals.
2. Assess physical and chemical longevity of the earth material (rocks and minerals) with respect to dynamic and chemical activities of natural agencies.
3. Identify the main and most common igneous, sedimentary and metamorphic rocks encountered by foundations and construction.
4. To understand issues concerning the geological basement and structure of a region.
5. To distinguish the characteristics of the most important geological formations and problems that may arise in the various public works.
6. To describe and interpret the geological structures in the geological maps and cross sections.
7. To assess and appropriately adjust the results of geological study in order to secure construction and operation of a technical project.
8. To receive, analyze and evaluate data and appropriately solve problems both technical and environmental.

Sl. No.	Module	Details of Course Contents	Hours	Total
1	I	Geology and its importance in Civil Engineering. Mineralogy: Definition, internal and external structure of minerals, study of crystals, Classification and physical properties of minerals. Classification of rocks Igneous Rocks: Origin, mode of occurrence, forms & texture, classification and engineering importance. Sedimentary Rocks: Process of sedimentation, classification and engineering importance. Metamorphic Rocks Agents and types of metamorphism, classification and engineering importance.	9	36
2	II	Weathering and Erosion of rocks: Agents and kinds of weathering, soil formation & classification based on origin. Geological work of rivers: Origin and stages in the system, erosion, transportation and deposition. Structural Geology Introduction to structural elements of rocks, dip & strike, definition, description, classification of folds, faults and joints, importance of geological structures in Civil Engineering.	9	
3	III	Earthquakes and seismic hazards: Causes and effects, seismic waves and seismographs, Mercelli's intensity scale and Richter's scale of magnitude. Engineering properties of rocks: Porosity, permeability, compressive strength, tensile strength and abrasive	9	

		resistance. Rocks as construction materials: Qualities required for building and ornamental stones, foundations, concrete aggregate, railway ballast, road metal, pavement, flooring and roofing.		
4	IV	Geophysical exploration: Methods of Geophysical Exploration, electrical resistivity method: field procedure – sounding and profiling, electrode configuration, and interpretation of resistivity data. Geophysical surveys in ground water and other Civil Engg. Projects. Applied Geology: Surface and subsurface geological and geophysical investigations in major Civil Engg. Projects. Geological studies of Dams and reservoir sites, Geological studies for selection of tunnels and underground excavations. Landslides: Types of landslides, causes, effects and prevention of landslides.	9	

Text & Reference Books:

Sl. No.	Title	Author(s)	Publisher
1.	Engineering and General Geology	Parvin Singh	Katson Publishing House Delhi
2.	Engineering Geology for Civil Engineers	D. Venkat Reddy	Oxford, IBH, 1995.
3.	Principles of Petrology	Tyrell	Asia, Bombay
4.	Structural Geology	Marland P. Billings	Wiley Eastern Prentice-Hall, U.S.A.
5.	Ground Water Hydrology	Todd D.K.	John Wiley & Sons

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Subject Name: STRENGTH OF MATERIALS LAB
Subject Code: CIVL 2111
Contact-3P
Credits-2

Course Outcome:

After going through this course, the students will be able to:

1. Demonstrate the method and findings of tension and compression tests on ductile and brittle materials.
2. Explain the method of bending tests on mild steel beam and concrete beam.
3. Demonstrate the method and findings of Torsion test on mild steel circular bar and concrete beam.
4. Illustrate the concept of hardness and explain the procedure and findings of Brinnel and Rockwell tests.
5. Demonstrate the concept and procedure of calculation of spring constant and elaborate its use in Civil Engineering.
6. Demonstrate the method and findings of Izod and Charpy impact tests.
7. Understand the concepts of fatigue test.

List of Experiments:

1. Tension test on structural materials: Mild steel and TMT bar.
2. Compression test on structural materials: Timber, bricks and concrete cubes.
3. Bending test on mild steel beam and concrete beam.
4. Torsion test on mild steel circular bar.
5. Hardness tests on ferrous and non-ferrous metals: Brinnel and Rockwell tests.
6. Test on closely coiled helical spring / leaf spring.
7. Impact tests: Izod and Charpy.
8. Demonstration of Fatigue test.

Subject Name: ENGINEERING GEOLOGY LAB

Subject Code: CIVL 2112

Contact: 3P

Credits-2

List of Experiments:

1. Study of crystals with the help of crystal models
2. Identification of Rocks and Minerals [Hand Specimens]
3. Microscopic study of Rocks and Minerals
4. Study of Geological maps, Interpretation of geological structures, Thickness problems, Bore-hole problems

Subject Name: BUILDING PLANNING & DRAWING

Subject Code: CIVL 2121

Contact: 3P

Credits: 2

FOUNDATIONS

- Footing for a RCC column and Brick wall.
- Combined footing.
- Strip footing.
- Raft foundation.
- RCC Pile Foundation.

DOORS, WINDOWS AND STAIRS

- Glazed and paneled doors of standard sizes.
- Glazed and paneled windows of standard sizes.
- Special windows and ventilators.
- Proportioning and planning of dog-legged and open well staircase.

ROOFS AND TRUSSES

- Types of sloping roof, lean-to-roofs, RCC roof.
- King post and Queen post trusses.

FUNCTIONAL DRAWING OF BUILDINGS

- To draw the line diagram, plan, elevation and section of Residential Buildings (flat, pitched and combined roofs), Office Buildings (flat roof) showing positions of various components including lift well and their sizes, load bearing wall and column.
- Details of plumbing and sanitary lines, septic tank.

References:

Sl No.	Title	Author
1	Principles of Building Drawing	Shah & Kale
2	Text Book of Building Construction	Sharma & Kaul
3	Building Construction	BC Punmia
4	Civil Engineering Drawing	M. Chakraborti

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Subject Name: CAD LAB

Subject Code: CIVL 2122

Contact: 3P

Credits: 2

1) Study of capabilities of software for drafting and modeling - Coordinate systems, simple figures like polygon and multiline figures.
2) Drawing of Title Block with necessary text and projection symbol.
3) Drawing of curves like circular, parabolic, spiral using polylines and Bspline.
4) Drawing of front and top views of simple solids like prism, pyramid, cylinder, cone and dimensioning.
5) Drawing of architectural plan, sectional elevation, front elevation, side elevation and foundation plan of a residential building (two bedroom, kitchen, toilet, dining hall and verandah).
6) Drawing of a simple steel truss.

Textbooks recommended:

Sl. No	Name	Author	Publishers
1.	Engineering Graphics with Auto Cad 2015	James D. Bethune	Pearson publication house.
2.	AutoCAD 2016 Beginning and Intermediate	Mercury Learning	BPB Publications.
3.	AutoCAD 2016 and AutoCAD LT 2016	Donnie Gladfelter	Sybex

References: National building code, KMC rules.

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Subject Name: ANALYSIS OF STRUCTURES - I

Subject Code: CIVL 2201

Contact hours: 3L+1T

Credits: 4

Course Outcome:

After going through this course, the students will be able to:

1. Distinguish between stable and unstable and statically determinate and indeterminate structures.
2. Apply equations of equilibrium to structures and compute the reactions.
3. Calculate the internal forces in cable and arch type structures.
4. Evaluate and draw the influence lines for reactions, shears and bending moments in beams due to moving loads.
5. Use approximate methods for analysis of statically indeterminate structures.
6. Calculate the deflections of truss structures and beams.

Sl.No.	Module	Details of course contents	Hours	Total
1.	I	**BASICS OF STRUCTURAL ANALYSIS** (i) Concept of static and kinematic indeterminacy, Determination of degree of indeterminacy for different types of structures. (ii) Theorem of minimum potential energy, law of conservation energy, principle of virtual work, the first and second theorems of Castigilano, Betti's law, Clark Maxwell's theorem of reciprocal deflection. **ANALYSIS OF DETERMINATE STRUCTURES:** Portal Frames, Three hinged arches, Cables **DEFLECTION OF DETERMINATE STRUCTURES:** Energy methods. Unit Load method for beams, Deflection of trusses and Simple Portal Frames.	4 6 6	42
2.	II	**INFLUENCE LINE DIAGRAM** Statically determinate beams and trusses under series of concentrated and uniformly distributed rolling loads, criteria for maximum and absolute maximum moments and shear.	9	
3.	III	**ANALYSIS OF STATICALLY INDETERMINATE BEAMS:** Theorem of three moments, Energy methods, Force method (Method of consistent deformation) [For analysis of propped cantilever, fixed beams and continuous beams (maximum two degree of indeterminacy) for simple loading case], Analysis of two hinged arch.	12	
4.	IV	**INFLUENCE LINE DIAGRAM FOR INDETERMINATE STRUCTURES:** Müller – Breslau principle.	5	

Text & References:

Sl. No.	Name	Author	Publishers
1.	Basic Structural Analysis	C.S.Reddy	Tata Mc Graw Hill
2.	Statically Indeterminate Structures	C.K.Wang	Mc Graw Hill
3.	Structural Analysis-A unified Classical and Matrix Approach.	A. Ghali and A.M.Neville	E & FN SPON
4.	Theory of Structures	Timoshenko and Wang	Tata Mc Graw Hill
5.	Engineering Mechanics of Solids	E.P.Popov	Pearson Education

Subject Name: SOIL MECHANICS I
Subject Code: CIVL 2202
Contact: 3L+1T
Credits-4

Course Outcome:

After going through this course, the students will be able to:

1. Classify soil as per grain size distribution curve and understand the index properties of soil.
2. Apply the concept of total stress, effective stress and pore water pressure for solving geotechnical problems.
3. Assess the permeability of different types of soil and solve flow problems.
4. Estimate the seepage loss, factor of safety against piping failure using flow net related to any hydraulic structure.
5. Determine vertical stress on a horizontal plane within a soil mass subjected to different types of loading on the ground surface and also the maximum stressed zone or isobar below a loaded area.
6. Apply the concept of shear strength to analyze different geotechnical problems and determine the shear strength parameters from lab and field tests.

Sl. No.	Module	Details of Course Contents	Hours	Total
1	I	**PHYSICAL PROPERTIES OF SOILS** Soil Formation Introduction, Origin of Soil, Formation and Types of soil, Formative classification, Typical Indian Soil, Some Special Types of Soils, Structure and Composition, Clay Mineralogy.	3	40
		Soil as a Three Phase System Basic Definitions, Weight - Volume Relationship, Measurement of Physical Properties of Soil: Insitu Density, Moisture Content, Specific Gravity, Relative density, Functional Relationships.	4	
		Index Properties of Soil Introduction, Particle Size Distribution, Mechanical Analysis - Sieve Analysis, Sedimentation Analysis – Hydrometer and Pipette Methods. Consistency of Soil – Atterberg Limits, Different Indices, Discussion on Limits and Indices.	4	
		Classification of Soil Classification by Structure, Particle Size Classification, Textural System, PRA System (AASHTO Classification), Unified Classification System, As per IS Code Recommendation, Field Identification of Soil, Classification by Casagrande's Plasticity Chart.	4	

2	II	**SOIL WATER SYSTEM** Soil Hydraulics Modes of Occurrence of Water in Soil – Free Water, Held Water, Structural Water, Capillary Water, Gravitational Water, Adsorbed Water, Pore Water, Pore Water Pressure, Effective Pressure, Total Pressure, Effective Pressure under Different Conditions and in Different Cases of Flow through Soils, Critical Hydraulic Gradient, Quick Sand Condition. Permeability Introduction, Darcy's Law, Coefficient of Permeability, Discharge Velocity, Seepage Velocity, Factors Affecting Permeability. Determination of Coefficient of Permeability – Constant Head and Falling Head Methods, Permeability of Stratified Soil Deposits, Field Determination of Permeability – Unconfined and Confined Aquifers. Seepage Analysis Introduction, Seepage, Seepage Pressure, Two Dimensional Flow, Laplace's Equations, Continuity equation, Flow Nets, Flow through Earthen Dam, Estimation of Seepage, Construction, Properties and Use of Flow Nets, Piping and Heaving, Uplift due to Seepage, Design of Fillers.	4 4 4	
3	III	**STRESS DISTRIBUTION IN SOILS** Introduction, Geostatic Stress, Boussinesq's Equation, Determination of Stress due to Point Load, Vertical Stress Distribution on a Horizontal Plane, Isobar and Pressure Bulb, Vertical Stress Distribution on a Vertical Plane, Vertical Stress under Uniformly Loaded Circular Area, Vertical Stress Beneath a Corner of a Rectangular Area, Equivalent Point Load Method, 2:1 Method, Newmark's Influence Chart, Vertical Stress Beneath Line and Strip Loads. Westergaard Analysis, Comparison of Boussinesq and Westergaard Theories, Contact Pressure.	6	`
4	IV	**SHEARING CHARACTERISTICS OF SOILS** Shear Strength of Soil Introduction, Basic Concept of Shear Resistance and Shear Strength of Soil, Mohr Circle of Stress, Sign Conventions, Mohr - Coulomb Theory, Relationship between Principal Stresses and Cohesion. **Determination of Shear Parameters of Soil** Stress Controlled and Strain Controlled Tests, Laboratory Determination of Soil Shear Parameters- Direct Shear Test, Triaxial Test, Classification of Shear Tests Based on Drainage Conditions, Unconfined Compression Test, Vane Shear Test as per Relevant IS Codes. Stress- Strain Relationship of Clays and Sands, Concept of Critical Void Ratio. Skempton's Pore Pressure Parameters. Sensitivity and Thixotropy of clay. Concept of Stress path.	3 4	

Note: Sufficient numbers of problems are to be solved in class and also given as assignments.

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RECOMMENDED BOOKS:

TEXT BOOKS	
Sl. No.	Name of the books
7.	Murthy, V.N.S., *Textbook of Soil Mechanics and Foundation Engineering (Geotechnical Engineering Series)*, Reprint 2011, CBS Publishers and Distributors Pvt. Ltd.
8.	Punmia, B.C. and Jain A. K., *Soil Mechanics and Foundations*. 16th edition, Laxmi Publications (P) Ltd.
9.	Das, B. M., *Principles of Geotechnical Engineering*. 5th edition, Thomson Brooks / Cole

REFERENCE BOOKS	
Sl. No.	Name of the books
7.	Lambe T. W. and Whitman, R.V. *Soil Mechanics*. 2nd editon, Wiley Eastern Ltd.
8.	Rao, A.V. and Venkatramaiah, R.C., *Numerical Problems – Geotechnical Engineering,* 1st edition, University Press.
9.	Terzaghi, Peck and Mesri, *Soil Mechanics in Engineering Practice,* 3rd edition, Wiley-Interscience.
10.	Alam Singh, *Soil Engineering in Theory & Practice (Vol.1, 2 & 3)*, 2nd edition Jain Book Agency Publishers.

Subject Name: CONCRETE TECHNOLOGY
Subject Code: CIVL 2203
Contact hours: 3L+1T
Credits: 3

Course Outcome:

After going through this course, the students will be able to:

1. Understand the properties of ingredients of concrete
2. Study the behavior of concrete at its fresh and hardened state
3. Study about the concrete design mix
4. Know about the procedures in concreting
5. Understand special concrete and their use
6. Understand the various Non-Destructive tests.

Sl.No.	Module	Details of Course Contents	Hours	Total
1.	I	**QUALITY OF WATER** Mixing water, Curing Water, Harmful Contents. **PROPERTIES OF FRESH CONCRETE** Workability, Factors Affecting Workability, Slump test, Compacting Factor Test, Flow Table Test, Segregation, Bleeding, Setting time, Mixing and Vibration of Concrete, Mixers and Vibrators, Curing Methods, Maturity.	3 6	36
2.	II	**STRENGTH OF CONCRETE** Water/Cement ratio, Gel/Space ratio, Strength in Tension, Compression, Effect of Age on Strength, Relation between Compressive and Tensile Strength, Fatigue Strength, Stress-Strain Relation and Modulus of Elasticity, Poisson's Ratio, Shrinkage and Creep, Compression Test on Cubes, Cylinders.	9	
3.	III	**ADMIXTURES** Different types, Effects, Uses, Retarders and Admixtures. **MIX DESIGN BY I.S. 10262(2009)**	9	
4.	IV	**SPECIAL CONCRETE & CONCRETING TECHNIQUES** Light- weight Concrete, High performance Concrete. Polymer Concrete, Fibre-reinforced Concrete, Waste Material Based Concrete, Shotcrete, Ferrocement, Self Compacting Concrete, Foam Concrete Modification in the Microstructure. Deterioration of reinforced Concrete and its Prevention. Repair Technology and its restoration and health monitoring. **INTRODUCTION TO NON-DESTRUCTIVE TESTS** (rebound hammer & ultrasonic pulse velocity).	6 3	

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Text & References:

Sl.No	Name	Author	Publishers
1.	Concrete Technology	Neville	Pearson Education
2.	Concrete Technology	M.S. Shetty	S.Chand
3.	Concrete Technology	A.R.Santakumar	Oxford University Press
4.	Concrete Technology	M.L.Gambhir	Tata McGraw Hill
5.	Text Book of Concrete Technology	P.D. Kulkarni	Tata McGraw Hill

Codes:
IS: 10262-2009, IS 456-2000, IS: 383-1970.

Subject Name: Fluid Mechanics

Subject Code: CIVL 2204

Contacts: 3 L + 1 T

Credits: 4

Course Outcome:

The course will assist the students to:

1. Introduce themselves to the fundamental aspects of fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
2. Learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.
3. Develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
4. Imbibe basic laws and equations used for analysis of static and dynamic fluids.
5. Inculcate the importance of fluid flow measurement and its applications in Industries.
6. Determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

SL. No	Module	Details of Course Contents	Hours	Total
1	I	**FLUID STATICS** Fluid pressure at a point, Variation of pressure within a static fluid, measurement of pressure, total fluid pressure on plane and curved areas, Center of pressure, buoyancy, stability of submerged and floating bodies, meta-centre. **FUNDAMENTALS OF OPEN CHANNEL FLOW** Scope and importance, characteristics of open channel flow, distinction between pipe flow and open channel flow, types of flow: Steady, Unsteady; Uniform, Non uniform, Gradually varied flow, Rapidly varied flow (definition only). **STEADY UNIFORM FLOW IN OPEN CHANNEL** Characteristics, Chezy's, Manning's formulae, Hydraulically efficient Rectangular and trapezoidal sections. Design features of rigid boundary channels.	4 4 4	44
2	II	**WEIRS AND NOTCHES** Rectangular, triangular, trapezoidal and cippoletti notch, sharp crested and broad crested weirs, submerged weirs. **FLOW IN PIPES** Laminar and turbulent flow through pipes, Reynold's number, fluid friction in pipes, head loss due to friction. Darcy- Weisbach equation, Friction factors for commercial pipes, use of Mody's diagram, minor losses in pipes, basic concept of boundary layer, drag, lift, concept of water hammer and surge tank.	4 6	

3	III	**SPECIFIC ENERGY / NON-UNIFORM FLOW IN OPEN CHANNEL** Definition, Diagram. Critical, Sub-critical and Super-critical flows. Establishment of critical flow, Specific force: Definition and diagram, Hydraulic Jump.	4	
		DIMENSIONAL ANALYSIS AND MODEL STUDIES Dimensions and dimensional homogeneity, Importance and use of dimensional analysis.	2	
		Buckingham Pi Theorem**:** Statement and application, Geometric, Kinematic and Dynamic similarity. Non Dimensional Numbers, Froude and Reynold model laws and applications.	4	
4	IV	**MACHINERIES IN FLUID MECHANICS** Turbines, Classification and types, power and efficiency, Working Principles of Pelton, Francis and Kaplan turbines, draft tube, Cavitations in pumps and turbines.	6	
		Application of principles of similarity of hydraulic machines, specific speed of pumps and turbines, centrifugal and reciprocating pumps, performance characteristics graph for head, discharge and efficiency, hydraulic machines in parallel and series, hydraulic Ram.	6	

RECOMMENDED BOOKS:

TEXT BOOKS

Sl. No.	Name of the books
1.	Bansal R.K., *A textbook of Fluid Mechanics and Hydraulic Machines,* 9th edition, Laxmi Publications (P) Ltd
2.	Pati S., *A textbook of Fluid mechanics and Hydraulic machines,* 1st edition, McGraw Hill Education (India) Pvt Ltd
3.	Som S.K., Biswas G. and Chakraborty S., *Introduction to fluid mechanics and fluid machines,* 3rd edition, McGraw Hill Education (India) Pvt Ltd
4.	Ojha C.S.P., Berndtsson R. and Chandramouli P.N., *Fluid Machines and Machinery,* 1st edition, Oxford University Press

REFERENCE BOOKS

Sl. No.	Name of the books
11.	Cengel Y. A. and Cimbala J. M., *Fluid Mechanics: Fundamentals and Applications,* 2nd edition, Tata McGraw Hill Education Private Limited
12.	Pritchard P.J. and Leylegian J.C., *Fox and McDonald's Introduction to Fluid Mechanics,* 8th edition, John Wiley & Sons
13.	Massey B.S. and Ward-Smith John., *Mechanics of Fluids*, 9th edition, Taylor & Francis.
14.	Modi P.N. and Seth S.M., *Hydraulics and Fluid Mechanics including hydraulics machines,* 19th edition, Standard Book House

Subject Name: Fluid Mechanics Lab
Subject Code: CIVL 2211
Contacts: 3P
Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Be acquainted with the fundamentals of fluid mechanics.
2. Practice in the analytical formulation of fluid mechanics problems using Newton's Laws of motion and thermodynamics.
3. Be acquainted with the introduction to experimental methods.
4. Get exposure to practical applications, work on a small design project, and writing of a technical report related to the designed project.
5. Discuss and practice standard measurement techniques of fluid mechanics and their applications.
6. Impart knowledge in measuring pressure, discharge and velocity of fluid flow.

List of Experiments:

1. To determine the coefficient of discharge for an Orifice meter
2. Calibration of V- Notch
3. Determination of Co-efficient of Discharge for Venturimeter
4. Measurement of velocity of fluid in pipe using a pitot tube
5. Measurement of water surface profile for flow over Broad crested weir
6. To verify Bernoulli's equation experimentally
7. Measurement of water surface profile for a hydraulic jump
8. Determination of efficiency of a Centrifugal pump
9. Determination of efficiency of a Pelton wheel Turbine
10. Determination of efficiency of a Francis Turbine

REFERENCE BOOKS:

Sl. No.	Name of the Books
1	Laboratory Manual: Hydraulics and Hydraulic Machines by R. V. Raikar, PHI Learning.
2	Laboratory manual for Civil Engineering second edition by H S Moondra and R Gupta, CBS Publishers, New Delhi.
3	Fluid Mechanics by Modi & Seth Standard Book House, New Delhi.
4	Fluid Mechanics by A.K.Jain, Khanna Publishers, Nath Market, Nai Sarak, New Delhi.
5	Fluid Mechanics & Machinery by H. M. Raghunath – CBS Publishers, New Delhi.

Tapas Sadhu

Subject Name: SURVEYING PRACTICE
Subject Code: CIVL 2212
Contacts: 3P
Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Prepare maps by chain and compass traverse.
2. Perform temporary adjustment of Dumpy level, Differential leveling, Profile leveling and plot long and cross sections.
3. Construct traverse plot using theodolite with the help of Gales traverse table.
4. Set out circular curve and transition curve and estimate the error in setting out method.
5. Instruct the procedure of setting out of building layout.
6. Demonstrate different parts of a Total station and can perform simple operations of the instrument.

1. **Chain and Compass survey:** Preparation of maps, method of ranging-method of taking offsets, measurement of bearings, chain and compass traverse.
2. **Plane Table survey:** Temporary adjustments of plane table and Radiation method, Intersection, Traversing and Resection methods of plane tabling, Three-point problem.
3. **Levelling:** Temporary adjustment of Dumpy level, Differential leveling, Profile leveling and plotting of long and cross sections.
4. **Theodolite survey:** Traversing using theodolite, preparation of gales traverse table using the field data, tacheometry in theodolite.
5. **Total station:** Demonstration of the instrument and perform Leveling using it.
6. **Curve setting:** Setting out of simple circular curve and transition curve.
7. **Setting out of building:** Setting out procedure of building layout.

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Subject Name: QUANTITY SURVEY, SPECIFICATION AND VALUATION
Subject Code: CIVL 2221
Contacts: 1L+3P
Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Apply different types of estimates in different situations.
2. Prepare quantity estimates for buildings, roads, rails and canal works.
3. Calculate the quantity of materials required for civil engineering works as per specifications.
4. Demonstrate the concepts of specification writing.
5. Evaluate contracts and tenders in construction practices.
6. Prepare cost estimates.

1. Introduction of Estimation in Civil Engineering:

Introduction-Principles of estimating, Types of estimates, approximate estimates, items of work, unit of measurement, unit rate of payment.

2. Preparation of Bill of Quantities:

Measurements and calculations of quantities of Civil engineering works, Preparation of abstracts of bill of quantities.

3. Analysis of Rates of different items with specifications:

Specifications for materials and construction of a building.

Rate analysis for Earthwork, PCC, Shuttering, Reinforcement, RCC, brick work, plastering, flooring and finishing, Use of standard schedules such as PWD schedules of rates. Specifications.

4. Quantity Estimation of infrastructures:

Quantity estimates of road, Underground reservoir, Surface drain, Septic tank

5. Valuation:

Concept of price, value and cost. Purpose of valuation; free hold and lease hold properties; market value, present value; sinking fund; year's purchase. Different methods of land valuation. Different methods of valuation of real properties. Outgoing, appreciation, depreciation, different methods for fixation of rents. Valuation of plant and machineries.

References:

1. Estimating, costing, Specification and Valuation in Civil Engineering by M. Chakroborty
2. Estimating and Costing in Civil Engineering" by B.N. Dutta, USB Publishers & Distributers
3. IS CODE SP34

Data Structure & Database Concept

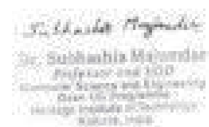
CSEN2206

Syllabus of Data Structure:

Module I: 10L
Linear Data structures: Sequential Representation, Arrays, Lists, Stacks, Queues, Circular Queue, De-queue
Linked List Representations: Linear Linked List, Circular Linked List, Doubly Linked List and their Application.
Implementation of Stack, Queue and its variations using linked list
Recursion: Design of Recursive algorithm, Tail Recursion
Module II: 10L
Non-Linear Data Structures:
Trees : Binary Trees, Traversals, Binary Search Trees- Insertion and Deletion algorithms, AVL Tree, Heap (Definition and basic concepts)
Graphs: Breadth First Search (BFS) and Depth First Search (DFS).
Sorting and Searching:
Sorting Algorithms: Bubble sort, Insertion sort, Selection sort, Quick sort.
Searching Algorithms: Linear search, Binary search.

Syllabus of DBMS
Module I: (10L)
Introduction to Database Concepts, File Processing System and Database Management System , DBMS Architecture and Data Independence,.
Data Model: Basic Concepts, Entity-Relationship Diagram, Keys, Cardinality, Weak Entity Set.
Introduction to relational algebra & SQL: Operators like select, project, rename, Cartesian product, join, union, intersect, minus, DDL, DML.

Module II:(7L)
Relational Database Design: Functional Dependencies, Normalization: Different anomalies in database designing 1NF, 2NF, 3NF and BCNF, Lossless-Join Decomposition and Dependency Preservation,



Module III: (3L)
Introduction to Transaction Processing Concepts: ACID properties, Serializability and Recoverability

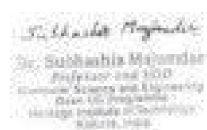
Syllabus of Data Structure & DBMS lab
(CSEN 2216)

DBMS Lab for Chemical Engineering.

Experiments on Database on RDBMS Platform (Oracle):
DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check.
Altering Table Structure like adding and modifying constraints, adding column, modifying column data types, etc.
DML: Inserting rows, Updating rows, Deleting rows
SQL Query: Cartesian Product, Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause, Nested Sub-Queries
Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc. Programming using Cursors, Creating different types of Triggers.

Data Structure Lab for Chemical Engineering

Implement a singly linked list.
Implement stack, queue - using array.
Implement stack, queue - using Linked List.
Implement Binary Search Tree.
Implement i) Linear Search, ii) Binary Search.
Implement Bubble sort, Insertion sort, Selection sort, and Quick sort.



Department of Humanities

Syllabus

Paper Name: Human Values and Professional Ethics
Paper Code: HMTS-2001
3L/week/3credit

Course Outcome:

The student will

i) be aware of the value system and the importance of following such values at workplace
ii) learn to apply ethical theories in the decision making process
iii) follow the ethical code of conduct as formulated by institutions and organizations
iv) Implement the principles governing work ethics
v) Develop strategies to implement the principles of sustainable model of development
vi) Implement ecological ethics wherever relevant and also develop eco-friendly technology

Detailed Syllabus
Module I (10 L)
Human society and the Value System
Values: Definition, Importance and application.
Formation of Values: The process of Socialization
Self and the integrated personality
Morality, courage, integrity
Types of Values:
Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism
Aesthetic Values: Perception and appreciation of beauty
Organizational Values: Employee: Employer--- rights, relationships, obligations
Psychological Values: Integrated personality and mental health impact of social media on mental health, games, addiction
Spiritual Values &their role in our everyday life Value Spectrum for a Good Life, meaning of Good Life
Value Crisis in Contemporary Society
Value crisis at----
Individual Level
Societal Level
Cultural Level
Value Crisis management --- Strategies and Case Studies
Materialism, existentialism
Module II (10L)
Ethics and Ethical Values
Principles and theories of ethics
Consequential and non-consequential ethics
Egotism, Utilitarianism, Kant's theory and other non-consequential perspectives
Ethics of care, justice and fairness, rights and duties
Ethics-- Standardization
Codification
Acceptance
Application
Types of Ethics--- Ethics of rights and Duties

Ethics of Responsibility
Ethics and Moral judgment
Ethics of care
Ethics of justice and fairness
Work ethics and quality of life at work

Professional Ethics
Ethics in Engineering Profession
moral issues and dilemmas, moral autonomy(types of inquiry)
Kohlberg's theory, Gilligan's theory (consensus and controversy)
Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEE Institute of Engineers, Indian Institute of materials management, Institute of Electronics and telecommunication engineers
Violation of Code of Ethics---conflict, causes and consequences
Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development)
Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, **moral** leadership (leaders as role models) violation-
Conflict between business demands and professional ideals
social and ethical responsibilities of technologies.
Whistle Blowing: Facts, contexts, justifications and case studies
Ethics and Industrial Law
Institutionalizing Ethics: Relevance, Application, Digression and Consequences

Module III (10L)
Science, Technology and Engineering
Science, Technology and Engineering as knowledge and profession
----Definition, Nature, Social Function and Practical application of science
Rapid Industrial Growth and its Consequences
Renewable and Non- renewable Resources: Definition and varieties
Energy Crisis
Industry and Industrialization
Man and Machine interaction
Impact of assembly line and automation
Technology assessment and Impact analysis
Industrial hazards and safety
Safety regulations and safety engineering
Safety responsibilities and rights
Safety and risk, risk benefit analysis and reducing risk
Technology Transfer: Definition and Types Specific industry related to the discipline of engineering, The Indian Context
Module IV (6L)
Environment and Eco- friendly Technology
Human Development and Environment
Ecological Ethics/Environment ethics
Depletion of Natural Resources: Environmental degradation
Pollution and Pollution Control
Eco-friendly Technology: Implementation, impact and assessment

Sustainable Development: Definition and Concept
Strategies for sustainable development
Sustainable Development--- The Modern Trends
Appropriate technology movement by Schumacher and later development
Reports of Club of Rome.

Suggested Readings:

1) Tripathi,A.N., Human Values, New Age International, New Delhi,2006
2) Ritzer, G., Classical Sociological Theory, The McGraw Hill Companies, New York,1996.
3) Doshi,S.L., Postmodern Perspectives on Indian Society, Rawat Publications, New Delhi,2008.
4) Bhatnagar, D.K., Sustainable Development, Cyber Tech Publications, New Delhi, 2008.
5) Kurzwell,R., The age of Spiritual Machines, Penguin Books, New Delhi,1999.
6) Weinberg, S.K., Social Problems in Modern Urban Society, Prentice Hall,Inc.,USA, 1970.
7) Giddens, Anthony 2009. Sociology. London: Polity Press (reprint 13th Edition).

Department of Humanities

Syllabus

Paper Name: Indian Culture and Heritage

Paper Code: HMTS-2002

Contact hours-2L/week

Credit-1

Course Outcome

The student will -

- be able to apply the basic philosophical tenets in day-to-day life.
- be aware of the diverse cultural heritage of our country.
- gain knowledge about the ancient Vedic mathematical tradition and apply it in modern day perspectives.
- attempt to use foundational Ayurvedic concepts in his daily life.
- use the fundamental approach of the universal message of Bhagwad Gita.
- be an ambassador of Indian ethos in his workplace.

Detailed Syllabus

Module I:

Indian Philosophical Thought

Basic features of Indian Philosophy

Different Schools of Indian Philosophy (Brief Introduction)

Module II

Modern Indian Thinkers

Brief biographical introduction and importance of their contribution

Raja Rammohan Roy

Swami Vivekananda

Rabindranath Tagore

Mohandas Karam Chand Gandhi,

Suparna Chakraborti

Dr. B.R. Ambedkar

Module III

Ancient Indian Science & Technology

Mathematics: Vedic Mathematics, geometry and geometric algebra, arithmetic.

Post-Vedic-discovery of zero and decimal, value of pi, trigonometry and algebra, quadric equation, binomial theorem, area of triangle.

Works of mathematicians: Baudhayana, Aryabhatta, Brahmagupta, Bhaskaracharya.

Astronomy: Vedic astronomy-concept of solstices, months, year,time.

Post –vedic- solar system, planets and their motions, earth as a sphere.

Works of Aryabhatta 1,Varahamihira, Brahmagupta, Bhaskara I and Bhaskara II

Medicine: Ayurveda and its scope,

Medicines and medicinal plants, Diagnosis and treatment,

Ayurvedic texts-SusrutaSamhita, CharakaSamhita, MadhavasNidan Sutra.

Architecture: Civil works of Indus Valley period, Town planning in Kautilya'sArthasastra, Buddhist Stupas and Viharas, Ajanta and Ellora.

Temple and Monument architecture- Mahabalipuram, Lingaraj temple, Khajuraho, FatehpurSikrI and TajMahal.

Technology: Knowledge of agriculture in Vedic and post-vedic period, crops, tillage and irrigation

Mining in Indus Civilization, literature in mining and geology.

Shipbuilding in ancient India, ships and their categories, sea going vessels and international trade.

Module IV

Art and Literature

Overview of Indian Art and Literature (Dance, music, natyashastra)

Iconic Texts of Ancient India

Gita and its Relevance

Vedas and Upanishads

Puranas

Mahabharata, Ramayana

Suparna Chakraborti.

Suggested Readings

1). *Outlines of Indian Philosophy* Chatterjee, S. &Datta, D. Calcutta: Calcutta University Press, 1939.

2) *Spiritual Values to Live By* Prabhananda, Swami.. Calcutta: Ramakrishna Mission Institute of Culture, 2010.

3) *The Essential Writings of B.R. Ambedkar* Valerian, Rodrigues.. New Delhi: OUP, 2004.

4) *The Complete Works of Swami Vivekananda* (Volumes 4, 5, 6). Calcutta: Sri Ramakrishna Math.

5) *The Cultural Heritage of India*. Vol 6. Calcutta: The Ramkrishna Mission Institute of Culture.

6) *Eternally Talented India-108 Facts*. Hyderabad: Vivekananda Institute of Human Excellence.

Suparna Chakraborti.

Department of Humanities

Syllabus

Paper Name: Language Practice Lab Level II

Paper Code: HMTS 2011

Contact: 3/week

Credit: 2

Course Outcome

The student will be able to

- acquire conversational skills in business scenario
- deliver both impromptu and prepared speeches
- organize information, data, point of views in a logical sequence and present them convincingly
- participate actively in group discussions and brainstorming sessions
- apply various techniques and strategies to successfully appear at job interviews
- apply language competence for various communication purposes at workplace

Detailed Syllabus

Module 1

Formal verbal communication:

- Introduction to formal verbal communication, Interpersonal Skills & Public Speaking: Building Positive Relationships, Focusing on Solving Problems, Time Management, Dealing with Criticism: Offering Constructive Criticism, Responding to Criticism – Managing Conflict: Approaches to Conflict, Resolving Conflict
- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module II

Presentation skills

- Speech Purposes - General: Informative Speeches, Persuasive Speeches, Entertaining Speeches, Methods of Speaking: Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation
- Organising the Presentation: the Message Statement, Organising the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium, Post- presentation Discussion

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Module III

Group Discussion

- Introduction to Group Communication Factors in Group Communication, Status – Group Decision Making: Reflective Thinking, Brainstorming, The Planning Process, Strategies for Successful GDs, Role of Social Awareness (Newspapers, Magazines, Journals, TV News, Social Media), Body Language, Logical Argument, Practice GDs

Module IV

Job Application and Personal Interview

- Job Application Letter: Responding to Advertisements and Forced Applications, Qualities of Well-Written Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section
- Resume and CV: Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination Chronological and Functional Resume – Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honors and Achievements, Personal Profile, Special Interests, References
- Interviewing
  Types of Interviews, Format for Interviews: One-to-one and Panel Interviews, Employment Interviews, Frequently Asked Questions, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
4. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Suparna Chakraborti.

Course Name : NUMERICAL AND STATISTICAL METHODS					
Course Code : MATH2002					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing the course students will be able to

1. Apply numerical methods to obtain approximate solutions to mathematical problems where analytic solutions are not possible.
2. Develop algorithmic solutions for problems like system of linear equations, integration, ordinary differential equations which are pertinent to many physical and engineering problems.
3. Apply probabilistic methods to engineering problems where deterministic solutions are not possible. Analyze probability distributions required to quantify phenomenon whose true value is uncertain.
4. Find numerical solutions to algebraic and transcendental equations appearing in a vast range of engineering problems e.g in the study of Ideal and non ideal gas laws, pipe friction , design of electric circuits.
5. Apply numerical methods to find solutions to linear system of equations appearing in spring-mass systems , resistor circuits, steady state analysis of a system of reactors.
6. Solve problems in data analysis , least-cast treatment of wastewater where the knowledge of interpolation will be required. Compute numerical solution to integrals to find root mean square current.

MODULE-I : NUMERICAL SOLUTION TO LINEAR AND NON-LINEAR EQUATIONS (8L)

SOLUTION OF NON-LINEAR ALGEBRAIC EQUATIONS AND TRANSCENDENTAL EQUATIONS:
Bisection Method, Newton-Raphson Method, Regula-Falsi Method.

SOLUTION OF LINEAR SYSTEM OF EQUATIONS:
Gauss elimination method, Gauss-Seidel Method, LU Factorization Method.

MODULE-II : NUMERICAL SOLUTION TO INTEGRATION AND ORDINARY DIFFERENTIAL EQUATIONS (8L)

INTERPOLATION AND INTEGRATION:
Newton's Forward and Backward Interpolation Method, Lagrange's Interpolation, Trapezoidal and Simpson's 1/3rd Rule.

SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:
Euler's and Modified Euler's Method , Runge-Kutta Method of 4th order.

MODULE-III : FUNDAMENTALS OF PROBABILITY (5L)

Prerequisites- Set Theory.
Random experiment, Sample space , Events .
Definition of Probability ,
Addition law of probability, Multiplication law and Conditional Probability.
Bayes' Theorem (Statement only)

MODULE-IV : PROBABILITY DISTRIBUTIONS AND STATISTICS (15L)

Random Variables – Discrete and Continuous, Probability Mass Function, Probability Density and Cumulative Distribution Functions, Mathematical Expectation and Variance.
Special Distributions: Binomial, Poisson, Uniform, Exponential and Normal.
Measures of Central Tendency and Dispersion – Mean, Median, Mode and Standard Deviation for grouped and ungrouped frequency distribution.
Simple Correlation and Regression.

Sandip Chatterjee

The highlighted topics are having direct correlation with the skill development in case of B.Tech. in Information Technology, Bio-Technology, Electronics and Communication Engineering.

References:

1. Miller & Freund's Probability and Statistics for Engineers, R.A.Johnson, Prentice Hall of India
2. Numerical Mathematical Analysis, J.B.Scarborough, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Numerical Methods (Problems and Solution), Jain, Iyengar , & Jain New Age International Publishers
4. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons
5. A First course in Probability, Sheldon Ross, Pearson

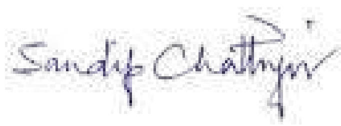
Course Name : NUMERICAL AND STATISTICAL METHODS LAB					
Course Code : MATH2012					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course outcome:
After completing the course the student will be able to:

1. Reproduce customized programs to solve problems based on Numerical Methods.
2. Develop algorithms to handle large systems of equations appearing in physical and engineering problems.

Development of computer programs in C for the following problems:

1. Regula-Falsi Method
2. Newton-Raphson Method
3. Gauss-elimination Method
4. Gauss-Seidel Method
5. Newton's Forward Interpolation
6. Lagrange's Interpolation
7. Trapezoidal and Simpson's 1/3rd rule
8. Euler's and Modified Euler's Method
9. Runge-Kutta method of 4th order
10. Computation of Mean , Median , Mode and Standard Deviation for grouped and ungrouped frequency distribution
11. Computation of Correlation coefficient and Regression equation for Bivariate data.



Course Name : Physics II					
Course Code: PHYS2001					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I:

***Lagrange and Hamiltonian* (4L)**
Generalised coordinates, constrains, Lagrange's Equation of motion and Lagrangian, generalised force potential, momenta and energy. Hamiltonian formulation, Hamilton's Equation of motion.
Course should be discussed along with physical problems of 1-D motion
***Quantum Mechanics* (6L)**
Concept of probability and probability density, operator, Commutator, Formulation of quantum mechanics and Basic postulates, Operator correspondence, Time dependent Schrödinger's equation, formulation of time independent Schrödinger's equation by method of separation of variables, Physical interpretation of wave function Ψ(normalization and probability interpretation), Expectation values, Application of Schrödinger equation-Particle in an infinite square well potential (1-D and 3-D potential well), Discussion on degenerate levels.

Module II:

***Statistical Mechanics* (6L)**
Concept of energy levels and energy states. Microstates, Macrostates and thermodynamic probability, equilibrium macrostate. MB, FD, BE statistics (no deduction necessary), fermions, bosons (definitions in terms of spin, examples), physical significance and application, classical limits of quantum statistics. Fermi distribution at zero and non –zero temperature.
***Applications of Statistical Mechanics* (4L)**

Planck's Black body radiation, Fermi Level in Intrinsic and Extrinsic Semiconductors, Intrinsic Semiconductors and Carrier Concentration, Extrinsic Semiconductors and Carrier Concentration, Equation of Continuity, Direct & Indirect Band Gap Semiconductors

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Module III:

***Dielectric Properties* (5L)**
Electric Dipole Moment, Dielectric Constant, Polarizability, Electric Susceptibility, Displacement Vector, Electronic, Ionic and Orientation Polarizations and Calculation of Polarizabilities - Internal Fields in Solids, Piezo-electricity, Pyro-electricity and Ferro-electricity.
***Magnetic Properties* (5L)**
Permeability, Field Intensity, Magnetic Field Induction, Magnetization, Magnetic Susceptibility, Origin of Magnetic Moment, Bohr Magneton, Classification of Dia, Para and Ferro Magnetic Materials on the basis of Magnetic Moment, Domain Theory of Ferro Magnetism on the basis of Hysteresis Curve, Soft and Hard Magnetic Materials, Properties of Anti-Ferro and Ferri Magnetic Materials, Ferrites and their Applications, Concept of Perfect Diamagnetism

Module IV:

***Band Theory of Solids* (6L)**
Electron in a periodic Potential, Bloch Theorem, Kronig-Penny Model (Qualitative Treatment), Origin of Energy Band Formation in Solids, Classification of Materials into Conductors, Semi Conductors & Insulators, Concept of Effective Mass of an Electron and Hole.
***Super Conductivity* (4L)**

Introduction (Experimental survey), General Properties of SC, Effect of Magnetic field, Meissner effect , Explanation in view of wave mechanical property, , Hard and Soft superconductors, Thermal properties of SC, London equations, penetration depth.

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Recommended Text Book:

Quantum Physics

- Atomic Physics – S.N. Ghoshal – S Chand
- Quantum Physics– Eisberg and Resnick – Wiley
- Quantum Mechanics – A.K. Ghatak and S. Lokenathan –Springer

Classical Mechanics

- Introduction to Classical Mechanics – R.G Takwale & P S Puranik –Tata MaGraw Hill
- Classical Mechanics – N C Rana & P S Joag – Tata MaGraw Hill

Solid State Physics

- Atomic Physics – S.N Ghoshal
- Elementary Solid State Physics – M.Ali Omar – Pearson Education
- Solid State Physics – A.J Dekkar – Macmillan
- Introduction to Solid state Physics – C.Kittel

Statistical Mechanics

- Thermodynamics, Kinetic Theory, and Statistical Mechanics–Sears and Salinger–Narosa

Course Outcomes:

After completing the course the student will be able to:

1. Develop a basic understanding of quantum mechanics with thorough knowledge of operator functions and solution and applications of Schrodinger equation;
2. Acquire the concepts of basic solid state physics and classification of solids;
3. Develop an idea of the different types of statistical distributions and be able to understand semiconductor behavior by application of statistical methods.
4. Understand different dielectric materials, physical interpretation of magnetic properties of matter, and basic understanding of superconductivity. In all cases they must build an ability of addressing related problems and explore the applications of the different theories.

Course Name : Physics II Lab					
Course Code: PHYS2011					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

Group 1: Experiments on Electricity and Magnetism

1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
3. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
4. Determination of specific charge (e/m) of electron.

Group 2: Quantum Physics

5. Determination of Planck's constant.
6. Determination of Stefan's radiation constant.
7. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
8. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum

Group 3: Modern Physics

9. Determination of Hall co-efficient of semiconductors
10. Determination of band gap of semiconductors.
11. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Note: A candidate is required to perform at least 5 experiments taking one from each group. Emphasis should be given on the estimation of error in the data taken.

Course Outcome:

After taking this course, which is a laboratory paper students will be able to

1. Apply theoretical knowledge of electricity and magnetism, quantum physics and semiconductor physics to perform various experiments that will help them determine some very important material constants viz. dielectric constant, Hall coefficient, band gap of semiconductors etc., as well as some universal constants of great importance like Stefan's constant, Planck's constant etc.
2. Develop skills of result analysis and graph plotting along with operational skills of the different experimental apparatus.

Frayak 10/8/2022

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Detailed syllabus of 5th semester:

Course Name : Formal Language & Automata Theory					
Course Code: CSEN3101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module-1: [9L]

Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram, Design of sequence detector (Application of concept of Automata to sequential circuit design), Introduction to finite state model [2L]

Finite state machine: Definitions, capability & state equivalence, kth- equivalence concept[1L]
Deterministic finite automaton and non deterministic finite automaton. Transition diagrams and Language recognizers. [1L]

Finite Automata: NFA with ε transitions - Significance, acceptance of languages. [1L]

Conversions and Equivalence: Equivalence between NFA with and without ε transitions. NFA to DFA conversion. [1L]

Minimization of FSM, Equivalence between two FSM's , Limitations of FSM [1L]

Application of finite automata, Finite Automata with output- Moore & Mealy machine. [2L]

Module-2: [10L]

Introduction to Formal Languages and Grammars [1L]

Chomsky Classification of grammar: unrestricted, context sensitive, context free grammar [1L]

Grammar Formalism: Right linear and left linear grammars, Regular grammar, Regular Languages, Regular sets [1L]

Regular expressions, identity rules. [1L]

Arden's theorem statement, proof and applications [1L]

Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA [1L]

Pumping lemma of regular sets.[1L]

Closure properties of regular sets (proofs not required). [2L]

Equivalence between regular grammar and FA. [1L]

Module-3: [10L]

Context free grammar: Introduction to Context free grammars, Derivation trees, Sentential forms, Right most and leftmost derivation of strings, basic applications of the concept of CFG [1L]

Ambiguity in context free grammars. [1L]

Minimization of Context Free Grammars : Removal of useless, null and unit productions [1L]

Chomsky normal form and Greibach normal form. [1L]

Pumping Lemma for Context Free Languages. [1L]

Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications [1L]

Push Down Automata: Push down automata, Definition and design of PDA [1L]

Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. [1L]

Equivalence of CFL and PDA, interconversion. (Proofs not required). [1L]

Introduction to DCFL and DPDA. [1L]

Module-4: [11L]

Turing Machine : Introduction to Turing Machine, Definition, Model [1L]

Design of TM, TM as language accepter[1L]

TM as transducers [1L]

Computable functions [1L]

Languages accepted by a TM, recursively enumerable and recursive languages [1L]

Church's hypothesis, counter machine [1L]
Types of Turing machines (proofs not required) [1 L]
Universal Turing Machine [1L]
Decidability, Undecidability, Various Undecidable problems like Post's Correspondence Problem (PCP), Turing Machine Halting Problem, Ambiguity of Context Free Grammars etc. [3L]

Course Outcome:

1. Students will be able to design Turing machine as language accepter as well as a transducer.
2. Students will be able to classify a grammar and a language, design a Finite Automata for a regular expression and derive the regular expression for a FA. Students will be able to check equivalence between regular grammar and FA.
3. Students will be able to minimize context free grammar, derive it's normal forms and recognize a CFG. They will be able to design a PDA for a given CFL. Student will be able to check equivalence of CFL and PDA.
4. The student will be able to define a system and recognize the behavior of a system. They will be able to minimize a system and compare different systems.

TEXT BOOKS:

1."Introduction to Automata Theory Language and Computation", Hopcroft H.E. and Ullman J. D., Pearson Education.
2."Theory of Computer Science ", Automata Languages and computation", Mishra and Chandrashekaran, 2nd edition, PHI.
3."Formal Languages and Automata Theory", C.K.Nagpal, Oxford.
4. "Introduction to the Theory of Computation", Sipser Michael. Cengage Learning.

REFERENCES:

1 "Switching & Finite Automata", ZVI Kohavi, 2nd Edn., Tata McGraw Hill
2 "Introduction to Computer Theory", Daniel I.A. Cohen, John Wiley
3 "Introduction to languages and the Theory of Computation", John C Martin, TMH
4 "Elements of Theory of Computation", Lewis H.P. & Papadimitrou C.H. Pearson, PHI.

Course Name : Database Management Systems					
Course Code: CSEN3102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

MODULE-I

Introduction [4L]
Concept & Overview of DBMS, Data Models, Database Languages, Role of database administrator and database Users, Three Tier architecture of DBMS.

Entity-Relationship Model [6L]
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

MODULE-II

Relational Model [5L]
Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.

Relational Database Design [9L]
Functional Dependency, Different anamolies in designing a Database., Normalization using funtional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued depedencies, 4NF, 5NF.

Church's hypothesis, counter machine [1L]
Types of Turing machines (proofs not required) [1 L]
Universal Turing Machine [1L]
Decidability, Undecidability, Various Undecidable problems like Post's Correspondence Problem (PCP), Turing Machine Halting Problem, Ambiguity of Context Free Grammars etc. [3L]

Course Outcome:

1. Students will be able to design Turing machine as language accepter as well as a transducer.
2. Students will be able to classify a grammar and a language, design a Finite Automata for a regular expression and derive the regular expression for a FA. Students will be able to check equivalence between regular grammar and FA.
3. Students will be able to minimize context free grammar, derive it's normal forms and recognize a CFG. They will be able to design a PDA for a given CFL. Student will be able to check equivalence of CFL and PDA.
4. The student will be able to define a system and recognize the behavior of a system. They will be able to minimize a system and compare different systems.

TEXT BOOKS:

1.“Introduction to Automata Theory Language and Computation”, Hopcroft H.E. and Ullman J. D., Pearson Education.
2.“Theory of Computer Science “, Automata Languages and computation”, Mishra and Chandrashekaran, 2nd edition, PHI.
3.“Formal Languages and Automata Theory”, C.K.Nagpal, Oxford.
4. “Introduction to the Theory of Computation”, Sipser Michael. Cengage Learning.

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1 “Switching & Finite Automata”, ZVI Kohavi, 2nd Edn., Tata McGraw Hill
2 “Introduction to Computer Theory”, Daniel I.A. Cohen, John Wiley
3 “Introduction to languages and the Theory of Computation”, John C Martin, TMH
4 “Elements of Theory of Computation”, Lewis H.P. & Papadimitrou C.H. Pearson, PHI.

Course Name : Database Management Systems					
Course Code: CSEN3102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

MODULE-I
Introduction [4L]
Concept & Overview of DBMS, Data Models, Database Languages, Role of database administrator and database Users, Three Tier architecture of DBMS.
Entity-Relationship Model [6L]
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

MODULE-II
Relational Model [5L]
Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.
Relational Database Design [9L]
Functional Dependency, Different anamolies in designing a Database., Normalization using funtional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued depedencies, 4NF, 5NF

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

MODULE-III

SQL and Integrity Constraints [8L]

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

MODULE-IV

Internals of RDBMS [7L]

Physical data structures, Query optimization: join algorithm, statistics and cost based optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking.

File Organization & Index Structures [6L]

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree.

Course outcomes:

1. Differentiate database systems from file systems by enumerating the features provided by database systems and describe each in both function and benefit.
2. Define the terminology, features, classifications, and characteristics embodied in database systems.
3. Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.
4. Demonstrate an understanding of the relational data model.
5. Transform an information model into a relational database schema and to use a data definition language and/or utilities to implement the schema using a DBMS.
6. Formulate, using relational algebra, solutions to a broad range of query problems.
7. Formulate, using SQL, solutions to a broad range of query and data update problems.
8. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
9. Use an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.
10. Use a desktop database package to create, populate, maintain, and query a database.
11. Demonstrate a rudimentary understanding of programmatic interfaces to a database and be able to use the basic functions of one such interface.

Text Books:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing Company.
3. Ramakrishnan: Database Management System , McGraw-Hill.
4. Gray Jim and Reuter Address, "Transaction Processing: Concepts and Techniques", Moragan Kauffman Publishers.
5. Jain: Advanced Database Management System CyberTech.
6. Date C. J., "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
7. Ullman JD., "Principles of Database Systems", Galgottia Publication.

References:

1. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
2. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition.
3. "Database Management Systems", Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill.

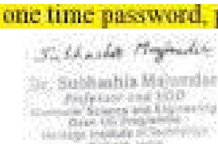
COURSE STRUCTURE OF B. TECH IN
COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : OPERATING SYSTEMS					
Course Code: CSEN3103					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module I:
Introduction [4L]
Introduction to Operating System. Operating system functions, OS Architecture (Monolithic, Microkernel, Layered, Hybrid) , evaluation of O.S., Different types of O.S.: batch, multi-programmed, time-sharing, real-time, distributed, parallel.
System Structure [3L]
Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, System calls.

Module II:
Process Management [17L]
Processes [3L]: Concept of processes, process scheduling, operations on processes, co-operating processes, inter-process communication.
Threads [2L]: overview, benefits of threads, user and kernel threads.
CPU scheduling [3L]: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.
Process Synchronization [5L]: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.
Deadlocks [4L]: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Module III:
Storage Management [19L]
Memory Management [5L]: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.
Virtual Memory [3L]: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.
File Systems [4L]: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.
I/O Management [4L]: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and non-blocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.
Disk Management [3L]: disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN) , disk reliability, disk formatting, boot block, bad blocks.
Module IV:
Protection & Security [4L]
Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.



Course Outcomes:
1. Master functions, structures and history of operating systems.
2. Master understanding of design issues associated with operating systems.
3. Master various process management concepts including scheduling, synchronization, deadlocks.
4. Be familiar with multithreading.
5. Master concepts of memory management including virtual memory.
6. Be familiar with issues related to file system interface and implementation, disk management, protection and security.

References :

1. Milenkovie M., "Operating System : Concept & Design", McGraw Hill.
2. Tanenbaum A.S., "Operating System Design & Implementation", Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., "Operating System Concepts", Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, "Operating Systems", Maxwell McMillan International Editions, 1992.
6. Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.

Course Name : Computer Architecture					
Course Code: CSEN3104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module 1:
Introduction: (2L)
Review of basic computer architecture;
Pipelining: (9L)
Basic concepts, Instruction and arithmetic pipeline, Scheduling in Pipeline; Data hazards, control hazards and structural hazards, techniques for handling hazards.

Module 2:
Instruction-level parallelism: (6L)
Basic concepts, Array and vector processors. Superscalar, Superpipelined and VLIW processor architectures.
Interconnection networks: (4L)
Crossbar, Delta, Omega, Shuffle-Exchange, Banyan , Hypercube, Butterfly Networks.

Module 3:
Measuring and reporting performance: (2L)
CPI,MIPS etc**.** Amdahl's Law & Gustafson's Law.
Hierarchical memory technology: (4L)
Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.
Multiprocessor architecture: (6L)
Taxonomy of parallel architectures; Centralized shared- memory architecture; Distributed shared-memory architecture. Cluster computers.

Module 4:
Issues with Multiprocessor Architectures: (4L)
Synchronization, memory consistency; Cache Coherence protocols (brief discussion only);
Non von Neumann architectures: (3L)
Data flow computers, RISC architectures, Systolic architectures.

References:

1. **Kai Hwang:** Advanced Computer Architecture – Parallelism, etc.
2. **Hennessey & Patterson :** Computer Architecture – A Quantitative Approach
3. **Hamacher et el:** Computer Organization (5th Ed) & above
4. Kai Hwang & Briggs: Computer Architecture & Parallel Processing

Course Outcome:
CO1: Analyze the concept of pipelining, segment registers and pin diagram of CPU.
CO2: Understand and analyze various issues related to memory hierarchy.
CO3: Examine various inter connection structures of multi processor.
CO4. Design architecture with all the required properties to solve state-of-the-art problems

References :

1. Milenkovie M., "Operating System : Concept & Design", McGraw Hill.
2. Tanenbaum A.S., "Operating System Design & Implementation", Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., "Operating System Concepts", Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, "Operating Systems", Maxwell McMillan International Editions, 1992.
6. Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.

Course Name : Computer Architecture					
Course Code: CSEN3104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module 1:
Introduction: (2L)
Review of basic computer architecture;
Pipelining: (9L)
Basic concepts, Instruction and arithmetic pipeline, Scheduling in Pipeline; Data hazards, control hazards and structural hazards, techniques for handling hazards.

Module 2:
Instruction-level parallelism: (6L)
Basic concepts, Array and vector processors, Superscalar, Superpipelined and VLIW processor architectures.
Interconnection networks: (4L)
Crossbar, Delta, Omega, Shuffle-Exchange, Banyan , Hypercube, Butterfly Networks.

Module 3:
Measuring and reporting performance: (2L)
CPI,MIPS etc**.** Amdahl's Law & Gustafson's Law.
Hierarchical memory technology: (4L)
Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.
Multiprocessor architecture: (6L)
Taxonomy of parallel architectures; Centralized shared- memory architecture; Distributed shared-memory architecture. Cluster computers.

Module 4:
Issues with Multiprocessor Architectures: (4L)
Synchronization, memory consistency; Cache Coherence protocols (brief discussion only);
Non von Neumann architectures: (3L)
Data flow computers, RISC architectures, Systolic architectures.

References:

1. **Kai Hwang:** Advanced Computer Architecture – Parallelism, etc.
2. **Hennessey & Patterson :** Computer Architecture – A Quantitative Approach
3. **Hamacher et el:** Computer Organization (5th Ed) & above
4. Kai Hwang & Briggs: Computer Architecture & Parallel Processing

Course Outcome:
CO1: Analyze the concept of pipelining, segment registers and pin diagram of CPU.
CO2: Understand and analyze various issues related to memory hierarchy.
CO3: Examine various inter connection structures of multi processor.
CO4. Design architecture with all the required properties to solve state-of-the-art problems

<table>
<tr><td colspan="6">Course Name : Data Structure & Algorithm</td></tr>
<tr><td colspan="6">Course Code: CSEN3106</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
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Course Outcomes:
Upon successful completion of this course students should be able to:
1. Identify and select appropriate data structures as applied to specified problem definition.
2. Implement operations like searching, insertion, deletion, traversal etc. on linear data structures like array, stack and queue.
3. Implement operations like searching, insertion, deletion, traversal etc. on nonlinear data structures like tree and graph.
4. Apply appropriate sorting/searching technique for given problem.
5. Analyze and compare the different sorting algorithms.
6. Design advanced data structure using Nonlinear data structures.

Module -I. Linear Data Structure I [8L]
Introduction (2L):
Why we need data structure?
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.
Algorithms and programs, basic idea of pseudo-code.Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.
Array (2L):
Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.
Linked List (4L):
Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module -II: Linear Data Structure II [6L]
Stack and Queue (4L):
Stack and its implementations (using array, using linked list), applications.
Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list)
Recursion (2L):
Principles of recursion – use of stack, differences between recursion and iteration, tail recursion.

Module -III. Nonlinear Data structures [13L]
Trees (9L):
Basic terminologies, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only).

Graphs (4L):
Graph representations/storage implementations – adjacency matrix, adjacency list,
Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS)

Module - IV Searching, Sorting, Hashing. [9L]
Sorting Algorithms (5L):
Bubble sort, insertion sort, selection sort, merge sort, quicksort, heap sort, radix sort.
Searching (1L):
Sequential search, binary search
Hashing (3L):
Hashing functions, collision resolution techniques (Open and closed hashing).

Recommended books:
1. “Data Structures And Program Design In C”, 2/E by Robert L. Kruse, Bruce P. Leung.
2. “Fundamentals of Data Structures of C” by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. “Data Structures in C” by Aaron M. Tenenbaum.
4. “Data Structures” by S. Lipschutz.
5. “Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

Course Name: Electronic Design Automation Lab					
Course Code: ECEN3156					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

1. Course Outcomes

After completion of the course, students will be able to:

ECEN3156.1. Learning Industry Standard Frontend and Synthesis CAD Tool (Xilinx Vivado).
ECEN3256.1. Learning Industry Standard Verilog RTL Behavioral and Structural Design.
ECEN3356.1. Learning Logic Synthesis and Place and Route using FPGA Flow.
ECEN3456.1. Learning Industry Standard Backend CAD Tool (Mentor Graphics).
ECEN3556.1. Designing CMOS Combinational Digital Gates
ECEN3656.1. Designing CMOS/TG Sequential Digital Gates.

2. Detailed Syllabus

List of Experiments:

1. Familiarities with Xilinx Vivado Front end and Synthesis CAD Tool
2. Verilog RTL Design and Testing of Digital Gates (INV, NAND, NOR, MUX, AOI, OAI …)
3. Verilog RTL Design and Testing of Functional Blocks (Adder, Decoder, ALU …)
4. Verilog RTL Design and Testing of Sequential Gates (Latch, Flop …)
5. Verilog RTL Structural Design and Testing of Functional Blocks
6. Verilog RTL Design and Testing for Finite State Machine (Mealy, Moore)
7. Logic Synthesis and P & R using Vivado for FPGA
8. Familiarity with Mentor Graphics Back end CAD Tool
9. CMOS Inverter, NAND, NOR Delay, VTC, Noise Analysis
10. CMOS/TG Sequential Design and Analysis

3. Textbooks

1. Principles of CMOS VLSI Design, A Systems Perspective, Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition.
2. Algorithms for VLSI Physical Design Automation, N. Sherwani, Kluwer Academic Publishers (3rd edition).

4. Reference Books

1. CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition).
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition), Neil Weste, David Harris, Ayan Banerjee. Pearson.
3. Digital Integrated Circuit, Design Perspective, M. Rabaey, Prentice-Hall.
4. VLSI Design and EDA TOOLS, Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, Scitech Publications (India) Pvt. Ltd., 2011.
5. Algorithms for VLSI Design Automation, Gerez, Wiley, 2011.

C. HONORS COURSES

Course Name: Artificial Intelligence					
Course Code: CSEN3111					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN3111.1. Remember and understand the basic principles of state-space representation of any given problem, various searching and learning algorithms, game playing techniques, logic theorem proving etc.
CSEN3111.2. Comprehend the importance of knowledge as far as intelligence is concerned and the fundamentals of knowledge representation and inference techniques.
CSEN3111.3. Apply this knowledge so that it can be used to infer new knowledge in both certain and uncertain environment
CSEN3111.4. Apply various AI searching algorithms, like state-space search algorithm, adversarial search algorithm, constraint satisfaction search algorithm as and when required.
CSEN3111.5. Understand the working knowledge of Prolog/ Lisp in order to write simple Prolog/ Lisp programs and explore more sophisticated Prolog/ Lisp code on their own.
CSEN3111.6. Design and evaluate the performance of a heuristic applied to a real-world situation.

2. Detailed Syllabus

Module 1 [9L]

Introduction: Definition of AI, Intelligent Behavior, Turing Test, Typical AI Problems, Various AI Approaches, Limits of AI.
Introduction to Intelligent Agents: Agents & environment, Agent Architecture, Agent Performance, Rational Agent, Nature of Environment, Simple Reflex Agent, Goal Based Agent, Utility Based Agent.
Knowledge Representation & Propositional Logic: Knowledge representation issues, Approaches to knowledge representation, Propositional Logic – its syntax & semantics, Inference rules, Resolution for propositions, Limitation of Propositional Logic.
Problem Solving using Single Agent Search: Introduction to State-space search, state-space search notation, search problem, Formulation of some classical AI problems as a state space search problem, Explicit Vs. Implicit State space.
Uninformed Search Techniques: Basic Principles, Evaluating parameters, BFS, DFS, Depth Limited Search, Iterative Deepening DFS, Uniform Cost Search & Bidirectional Search, Properties of various search methods & their comparative studies.

Module 2 [9L]

Informed Search Methods: Basic Principles, Heuristics, A* Search and its properties, Admissible & Consistent heuristic, Iterative deepening A* (IDA*) and AO* search, Local Search Techniques – Hill climbing & Simulated Annealing, Comparison with other methods
Problem Solving using Two Agent Search: Adversarial Search – Game Tree, MINIMAX Algorithm, Alpha-Beta Pruning, Performance Analysis.
Constraint Satisfaction Problem: Definition of CSP, Representation of CSP, Formulation of Various popular problems as CSP, Solution methods of CSP – Backtracking & Forward Checking.

Module 3 [9L]

Knowledge Representation & Predicate Logic: Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default & Non-Monotonic reasoning.
Knowledge Representation using Rules: Rule based system, Horn clauses, Procedural vs. declarative knowledge, forward & backward reasoning, Introduction of logic programming using PROLOG/ LISP.
Probabilistic reasoning: Representing knowledge in an uncertain domain, probabilistic inference rules, Bayesian networks – representation & syntax, semantics of Bayesian net, Brief discussion on Fuzzy sets & fuzzy logic.
Other Representational Formalism: Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects.

Module 4 [9L]

Planning: Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning.
Learning: Overview, Taxonomy of learning system, various learning models, learning rules, Naïve Bayes classifier and Decision tree based learning, Brief idea about learning using Neural Network & Genetic Algorithm.
Natural Language Processing: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.
Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

3. Textbooks

1. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education. Type text here
2. Artificial Intelligence, Rich & Knight, TMH.

4. Reference Books

1. Artificial Intelligence & Intelligent Systems, N.P Padhy, Oxford University Press.
2. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI.
3. Artificial Intelligence: A new Synthesis, Nils J. Nilsson, Morgan Kaufmann Publishers, Inc.
4. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

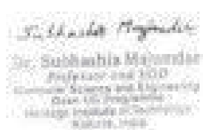
Course Name : Database Management Systems Lab					
Course Code: CSEN3112					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	0	3	3

Creating Database
1. Creating a Database
2. Creating a Table
3. Specifying Relational Data Types
4. Specifying Constraints
5. Creating Indexes

Table and Record Handling
1. INSERT statement
2. Using SELECT and INSERT together
3. DELETE, UPDATE, TRUNCATE statements
4. DROP, ALTER statements

Retrieving Data from a Database
1. The SELECT statement
2. Using the WHERE clause
3. Using Logical Operators in the WHERE clause
4. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause
5. Using Aggregate Functions
6. Combining Tables Using JOINS
7. Subqueries

Database Management



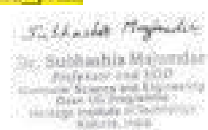
1. Creating Views
2. Creating Column Aliases
3. Creating Database Users
4. Using GRANT and REVOKE
5. Cursors in Oracle PL / SQL
6. Writing Oracle PL / SQL Stored Procedures.

Course outcomes:
1. To provide a sound introduction to the discipline of database management as a subject in its own right, rather than as a compendium of techniques and product-specific tools.
2. To familiarize the participant with the nuances of database environments towards an information-oriented data-processing oriented framework.
3. To give a good formal foundation on the relational model of data.
4. To present SQL and procedural interfaces to SQL comprehensively
5. To give an introduction to systematic database design approaches covering conceptual design, logical design and an overview of physical design.
6. To motivate the participants to relate all these to one or more commercial product environments as they relate to the developer tasks.
7. To present the concepts and techniques relating to query processing by SQL engines.
8. To present the concepts and techniques relating to ODBC and its implementations.
9. To introduce the concepts of transactions and transaction processing.
10. To present the issues and techniques relating to concurrency and recovery in multi-user database environments.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

<table>
<tr><td colspan="6">Course Name : Operating Systems Lab</td></tr>
<tr><td colspan="6">Course Code: CSEN3113</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>2</td></tr>
</table>

1. Shell programming [6P]: Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions and commands).
2. Process [6P]: starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. Signal [9P]: signal handling, sending signals, signal interface, signal sets.
4. Semaphore [6P]: programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v.
5. POSIX Threads [9P]: programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
6. Inter-process communication [9P]: pipes(use functions pipe, popen, pclose), named
7. pipes (FIFOs, accessing FIFO).



Learning Outcomes/Course Outcomes:
Upon the completion of Operating Systems practical course, the student will be able to:
1. Understand and implement basic services and functionalities of the operating system using system calls.
2. Will be able to describe and write shell scripts in order to perform basic shell programming.
3. Will be able to describe and create user defined processes.
4. Understand the benefits of thread over process and implement them.
5. Synchronization programs using multithreading concepts.
6. Use modern operating system calls and synchronization libraries in software to implement process synchronization.
7. Implementation of Inter-process communication using PIPE.

References:
1. Sumitabha Das. Your Unix The Ultimate Guide, MH.
2. Neil Matthew, Richard Stones, Beginning Linux Programming, Wrox.

<table>
<tr><td colspan="6">Subject Name: Computer Architecture Lab</td></tr>
<tr><td colspan="6">Paper Code: CSEN 3114</td></tr>
<tr><td rowspan="2">Contact Hours per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>2</td></tr>
</table>

VHDL introduction
1. Design digital logic gate (OR, AND, XOR,NOT, NAND, NOR) simulation
2. Implement basic gates using Universal gates.
3. Implement 2's Complement of a binary number.
4. Implement Binary to Excess-3 Code conversion using Array.
5. Implement Gray Code to Binary Code Conversion & vice versa .
6. Implement Half adder and Half subtractor.
7. Design a BCD adder and carry-look ahead Adder.
8. Design an Adder/Subtracter composite unit .
9. Implement Full adder and Full subtractor.
10. Implement MUX, Decoder, Encoder.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Operating Systems Lab					
Course Code: CSEN3113					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

1. Shell programming [6P]: Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions and commands).
2. Process [6P]: starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. Signal [9P]: signal handling, sending signals, signal interface, signal sets.
4. Semaphore [6P]: programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v.
5. POSIX Threads [9P]: programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
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7. pipes (FIFOs, accessing FIFO).

Learning Outcomes/Course Outcomes:
Upon the completion of Operating Systems practical course, the student will be able to:
1. Understand and implement basic services and functionalities of the operating system using system calls.
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6. Use modern operating system calls and synchronization libraries in software to implement process synchronization.
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1. Sumitabha Das. Your Unix The Ultimate Guide, MH.
2. Neil Matthew, Richard Stones, Beginning Linux Programming, Wrox.

Subject Name: Computer Architecture Lab					
Paper Code: CSEN 3114					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

VHDL introduction
1. Design digital logic gate (OR, AND, XOR,NOT, NAND, NOR) simulation
2. Implement basic gates using Universal gates.
3. Implement 2's Complement of a binary number.
4. Implement Binary to Excess-3 Code conversion using Array.
5. Implement Gray Code to Binary Code Conversion & vice versa .
6. Implement Half adder and Half subtractor.
7. Design a BCD adder and carry-look ahead Adder.
8. Design an Adder/Subtracter composite unit .
9. Implement Full adder and Full subtractor.
10. Implement MUX, Decoder, Encoder.

11. Implement Flip/Flop(RS, JK, D, T), b)Register,(4/8 bit Synchronized Data Transfer).
12. Design a ripple counter and comparator.
13. Use a multiplexer unit to design a composite ALU.
14. Design a Control Unit.
15. Design a simplified communication protocol.

Course Outcome:

1. After completion of this, students would be able to have adequate knowledge of basics of computer architecture.
2. Students would be able to understand detailed implementation of machine instructions, their classifications and their relevance to programming paradigms.
3. Students would have sufficient knowledge of design implementations of various arithmetic operations such as adder, multiplier etc.
4. Students would be able to design and simulate various combinatorial and sequential logic circuits using Vivado/Xilinx.
5. Students would be able to understand various memory functions.
6. Students would be able to design a formal testbench from informal system requirements.

Course Name : Microprocessors & Microcontrollers Lab					
Course Code: AEIE3115					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above all using 8085A Simulator.
2. Study of prewritten programs using basic instruction set (data transfer, load/store, arithmetic, logical) on the simulator. Assignments based on above.
3. Programming using kit/simulator for:
   a) Addition/Subtraction of two 8-bit Hex numbers
   b) Packing and unpacking of BCD numbers
   c) Copying and Shifting block of memory
   d) Addition of two 16-bit Hex numbers.
   e) BCD Addition
   f) Multiplication of two 8-bit unsigned numbers using sequential Shift - Add Method
   g) Binary to ASCII conversion
4. Familiarization of 8086 microprocessor kit/simulator and assembly language programming using 8086 microprocessor/simulator for :
   a) Addition of two 32-bit Hex numbers.
   b) String matching
   c) Shifting a block of data from one memory location to another
   d) Finding the largest/ smallest number from an array
5. Interfacing with switches and LEDs and glowing LEDs according to read switch status and scrolling-
blinking using delay subroutines through
   a) PPI 8255A with 8085A trainer kit
   b) 8051 microcontroller
6. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using- a) 8085A trainer kit, b)8086A trainer kit and 8255A PPI employing absolute and partial decoding concept as a peripheral mapped output port with absolute address decoding.

Dr. Subhashis Majumder

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Detailed Syllabus of 6th Semester:

Course Name : COMPUTER NETWORKS					
Course Code: CSEN3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module I: Data Communication Fundamentals and Physical Layer [10L]

(A) **Introduction:** Direction of data flow (simplex, half duplex, full duplex), Network topology, categories of network (LAN, MAN,WAN); [1L]

(B) **Protocols and standards:** Reference models: OSI reference model, TCP/IP reference model, their comparative study [2L]

(C) **Physical Layer:** Digital signal coding, Modulation(Digital and Analog), Multiplexing [1L]

(D) Switching, Telephone Networks [4L]

(E) Transmission Media and its properties; [2L]

Module II: Data Link Layer and MAC Sublayer [13L]

(A) Data link layer Framing / Stuffing, Error detection and correction; [4L]

(B) Flow Control Protocols: Stop-and-Wait / Go-Back-N / Selective Repeat; [3L]

(C) HDLC, PPP [1L]

(D) MAC sub-layer: Ethernet (IEEE 802.3) ALOHA / CSMA-CD / Collision Resolution, Controlled Access and Channelization methods; [3L]

(E) Devices: Transparent Bridges / Source-Route Bridges / Ethernet Switches ; Backward Learning Algo; Construction of Spanning Trees; Routers. [2L]

Module III: Network layer and Internetworking: [10L]

(A) IPv4: Packet format ; Classful addressing / subnetting / subnet mask; CIDR / supernetting / masks; [3L]

(B) IPv6: address format / packet format / differences with IP (v4); [1L]

(C) Protocols: IP, ICMP, ARP [2L]

(D) Routing algorithm: concept of static and dynamic routing, Distance vector / Link state algo; [2.5L]

(E) Protocols: OSPF, BGP [1.5L]

Module IV: Transport and Application layer [10L]

(A) Transport Layer: Process to process delivery / multiplexing and other services of transport layer [1L]

(B) Transport Layer protocols: TCP: Three way handshaking, Window management, Flow and congestion control with slow start, additive increase, multiplicative decrease; UDP; Difference between UDP and TCP [4L]

(C) General Congestion control algorithm: open and closed loop; Techniques to improve: QoS Leaky bucket / Token bucket. [2L]

(D) Modern Topics: Introduction to wireless LAN and Bluetooth, Mobile IP, Mobile TCP [3L]

Dr. Subhashis Majumder

Text Books:

1. Andrew S. Tanenbaum: Computer Networks, Pearson Education , fourth edition.
2. William Stallings: Data and Computer Communication, Prentice hall, Seventh edition.
3. William Stallings: High speed Networks and Internets, Pearson education, second edition.

References:

1. William Stallings: Cryptography and Network security PHI, Third edition.
2. William Stallings: ISDN and Broadband ISDN with Frame Relay and ATM.
3. Kurose & Ross: Computer Networking: A Top Down Approach, 5^{th} Ed.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcomes/Learning Outcomes:

Upon completion of their academic and internship requirements, graduates of Champlain College's undergraduate Computer Networking Program will:

- Describe and analyze the hardware, software, components of a network and the interrelations.
- Explain networking protocols and their hierarchical relationship hardware and software. Compare protocol models and select appropriate protocols for a particular design.
- Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.
- Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols and security. Analyze performance of enterprise network systems.
- Use appropriate resources to stay abreast of the latest industry tools and techniques analyzing the impact on existing systems and applying to future situations.

Course Name : Software Engineering					
Course Code: CSEN3202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**3**

Module-1[10L]:

1. Introduction to Software Engineering (3L)
- Software Engineering – objectives and definitions
- Software Life Cycle – different phases
- Lifecycle Models - Waterfall, Relaxed Waterfall, RAD, Prototyping, Incremental, Spiral, Agile

2. Requirements Phase (3L)
- Requirements Collection and Analysis
- Requirement Specifications – General Structure of Software Requirement Specifications (SRS)
- Functional and Non-functional Requirements
- Representing Requirements as Use Cases with examples

3. Structured Analysis Modeling Techniques (4L)
- Process Model using Context Diagrams (CD) and Data Flow Diagram (DFD) with examples
- Data Dictionary, Decision Tree, Decision Table with examples
- Data Model using Entity Relationship Diagram (ERD) with examples

Module-2: [10L]

4. Design Phase (4L)
- Overview – Comparison between Requirement Analysis and Design, Attributes of Good Design
- Define Approaches – Functional and Object Oriented
- Design Aspects – Top-Down and Bottom-Up
- Structured Design – Module Design (or High Level Design), Detail Design (or Low Level Design)
- Functional Decomposition – Abstraction, Cohesion, Coupling, Structure Chart, Structured English

5. Object Oriented Analysis and Design (6L)
- OOAD Basic Concepts
- Unified Modeling Language (UML) – different types of diagrams for different views of system
- User View – Use Case Diagram with examples
- Structural Views – Class Diagram with examples
- Behavioral View – Sequence, Collaboration, Activity and State Chart Diagrams with examples

Module-3: [10L]

6. Coding or Programming (2L)
- Programming Principles and Guidelines – Structured Programming, Code Re-use, Coding Standards / Guidelines
- Coding Process – Incremental Coding, Test Driven Development, Pair Programming / Extreme Programming

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcomes/Learning Outcomes:

Upon completion of their academic and internship requirements, graduates of Champlain College's undergraduate Computer Networking Program will:

- Describe and analyze the hardware, software, components of a network and the interrelations.
- Explain networking protocols and their hierarchical relationship hardware and software. Compare protocol models and select appropriate protocols for a particular design.
- Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.
- Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols and security. Analyze performance of enterprise network systems.
- Use appropriate resources to stay abreast of the latest industry tools and techniques analyzing the impact on existing systems and applying to future situations.

Course Name : Software Engineering					
Course Code: CSEN3202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**3**

Module-1[10L]:

1. Introduction to Software Engineering (3L)
- Software Engineering – objectives and definitions
- Software Life Cycle – different phases
- Lifecycle Models - Waterfall, Relaxed Waterfall, RAD, Prototyping, Incremental, Spiral, Agile

2. Requirements Phase (3L)
- Requirements Collection and Analysis
- Requirement Specifications – General Structure of Software Requirement Specifications (SRS)
- Functional and Non-functional Requirements
- Representing Requirements as Use Cases with examples

3. Structured Analysis Modeling Techniques (4L)
- Process Model using Context Diagrams (CD) and Data Flow Diagram (DFD) with examples
- Data Dictionary, Decision Tree, Decision Table with examples
- Data Model using Entity Relationship Diagram (ERD) with examples

Module-2: [10L]

4. Design Phase (4L)
- Overview – Comparison between Requirement Analysis and Design, Attributes of Good Design
- Define Approaches – Functional and Object Oriented
- Design Aspects – Top-Down and Bottom-Up
- Structured Design – Module Design (or High Level Design), Detail Design (or Low Level Design)
- Functional Decomposition – Abstraction, Cohesion, Coupling, Structure Chart, Structured English

5. Object Oriented Analysis and Design (6L)
- OOAD Basic Concepts
- Unified Modeling Language (UML) – different types of diagrams for different views of system
- User View – Use Case Diagram with examples
- Structural Views – Class Diagram with examples
- Behavioral View – Sequence, Collaboration, Activity and State Chart Diagrams with examples

Module-3: [10L]

6. Coding or Programming (2L)
- Programming Principles and Guidelines – Structured Programming, Code Re-use, Coding Standards / Guidelines
- Coding Process – Incremental Coding, Test Driven Development, Pair Programming / Extreme Programming

- Source Code Version Control, Build, Code Refactoring

7. Review and Testing (8L)

- Self Review / Peer Review
- Testing Overview -- Objective, Definition, Static and Dynamic Testing, Functional vs. Non-functional Testing
- Testing Artifacts – Test Cases and Test Suites, Traceability Matrix , Test Data , Stub and Driver
- Testing Process – Test Case Design, Test Case Execution, Test Result, Defect Logging and Tracking
- Testing Methods -- White Box Testing with Test Coverage using Control Flow Graph (CFG) and Cyclomatic Complexity, Black Box Testing with Equivalence Class Partitioning and Boundary Value Analysis,
- Testing Level – Unit Testing, Integration Testing, System Testing, (User) Acceptance Testing, Regression Testing, Performance Testing, Usability Testing, Non-functional Testing

<u>Module-4</u>:[10L]

8. Software Maintenance (2L)

- Types of Maintenance – Corrective, Preventive, Adaptive Change Management and Maintenance Process Software Estimation (3L)

9. Software Estimation (3L)

- Overview of Software Estimation – Size, Effort, Duration and Cost
- Size Estimation Methods – Lines of Code (LOC) and Function Points (FP)
- Estimation of Effort and Duration based on Size and Productivity
- Constructive Cost Model (COCOMO) – Basic COCOMO, Intermediate COCOMO (COCOMO 81), Detailed COCOMO (COCOMO II)

10. Project Management (3L)

- Project Management Overview -- Planning, Staffing, Execution, Monitoring and Control
- Responsibilities of Project Manager
- Project Scheduling – Work Breakdown Structure (WBS) and Gantt Charts

11. Configuration Management (2L)

- Overview of Configuration Management - Identification, Control, Status Accounting, Audits
- Concept of Baseline, Versioning of Configurable Items (CI)

<u>Learning Objectives/Course Outcomes</u>:

1) Knowledge and Understanding of:
   a) the system development lifecycle and associated models;
   b) the software-development process, including requirements analysis, design, coding, testing and maintenance;
   c) the basic principles of function-oriented and object-oriented software development with modular approach
   d) the essentials of software estimation and project planning
   e) the basics of software configuration management
   f) the fundamentals of software project risk management.
2) Ability to:
   a) prepare software requirement specifications as per IEEE guidelines
   b) model function-oriented and object-oriented software systems using industry-standard techniques (e.g., DFD, ERD, UML);
   c) approach testing of software systems in a methodical manner
   d) estimate software size using industry-standard methods (e.g., FPA)
   e) work out software project schedule and staffing plan
   f) identify software project risks and their mitigation approach.

Course Name : Database Management System & Computer Networking					
Course Code: CSEN 3205					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: [10L]
Introduction to Database Concepts, File Processing System and Database Management System, DBMS Architecture and Data Independence.
Data Model: Basic Concepts, Entity-Relationship Diagram, Keys, Cardinality, Weak Entity Set.
Introduction to relational algebra & SQL: Operators like select, project, rename, Cartesian product, join, union, intersect, minus, DDL, DML.

Module II: [12L]
Relational Database Design: Functional Dependencies, Normalization: Different anomalies in database designing,1NF, 2NF, 3NF and BCNF, Lossless-Join Decomposition and Dependency Preservation.
Introduction to Transaction Processing Concepts: ACID properties, Serializability and Recoverability.

Module III: [10L] Computer Networking: Introduction, topology, transmission mode, LAN/MAN/WAN, OSI 7 layer Model, Communication Techniques, TCP/IP Protocol Stacks.

Module IV: [10L] Inter Networking, WWW, URLs, search engines, electronic mails, Distributed System, Distributed Database System Concepts.

Text books:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts, 4th Ed., McGraw Hill, Computer Science Series.
2. Behrouz A. Forouzan, Data Communications and Networking, 4th Ed., McGraw Hill.

Reference books:

3. Elmasri Ramez and Novathe Shamkant,"Fundamentals of Database Systems", Pearson.
4. Ramakrishnan: Database Management System, McGraw-Hill.
5. Gray Jim and Reuter Address, "Transaction Processing: Concepts and Techniques", Moragan Kauffman Publishers.
6. Jain: Advanced Database Management System, CyberTech.
7. Date C. J., "Introduction to Database Management", Vol. I, II, IIIPearson.
8. Ullman J. D., "Principles of Database Systems", Galgottia Publication.
9. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi.
10. Ramez Elmasri, Shamkant B.Navathe "Fundamentals of Database Systems", Pearson.
11. Andrew S. Tanenbaum: Computer Networks, Pearson Education, fourth edition.

Module-III

SPICE: Structure of a SPICE program, active and passive device/element statements, different study like DC analysis, transient analysis and ac analysis statement in SPICE. Plotting and printing statement, input and output Impedance calculation using SPICE, voltage and current controlled components in SPICE. [5L]

Graph theory: Graph of network: Concept of path, tree, tree branch, tree link, loop, tie set and cut set. Incidence Matrix, tie-set Matrix and f-cut set matrix and their properties. Loop currents and node-pair potentials, formulation of loop and node equilibrium equations in view of graph theory. [5L]

Module-IV

Two port networks: Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters and Hybrid parameters. Inter relation between parameters. Inter connection between two port networks. Driving point & transfer impedance & admittance. [5L]

Filter Circuits: Concept of filters, Classification of filters. Analysis of Low pass, High pass, Band pass and Band reject filters using operational amplifier. [5L]

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
2. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
3. Network Analysis, Van Valkenburg, Pearson Education .
4. Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand.

References:

1. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin,The Mc Graw Hill Company.
2. Modern Network Analysis, F.M.Reza & S.Seely, McGraw Hill.

COURSE OUTCOMES OF CIRCUIT THEORY

- Solve electric circuits containing AC and DC sources applying network theorems
- Apply Laplace transform for transient analysis of electrical circuits
- Solve electric circuits applying concepts of graph theory.
- Apply two port network analysis to calculate open circuit impedance parameter, short circuit admittance parameter, transmission parameter and hybrid parameter
- Circuit Simulation using SPICE
- Familiarization with different filter networks.

Course Name : Computer Networks Lab					
Course Code: CSEN3211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

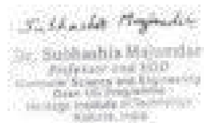
Network Programming Exercises: (To be implemented preferably in Java or C/C++):

1. Getting familiar with the Networking (Socket) API and associated data structures.
2. Implement Simple TCP Client Server Application.
3. Implement TCP Echo Server Client Application.
4. Implement TCP Chat Server Client Application.
5. Implement a File Server Client application.
6. Implement UDP Echo Server Client Application.
7. Implement UDP Time Server Client Application.

8. Implement multithreaded chat program.
9. Implement Web based protocol (looking up URLs, retrieving & examining content, posting a form etc.etc.).
10. Implement Multicasting / Broadcasting socket I/O.
11. Implement Sliding Window Protocol using Non-Blocking I/O (try the Selective Repeat).
12. Implement Secured TCP echo protocol.
13. Experimenting on cross-platform network based communication issues.

Network Hardware / Simulation Exercises:

14. Use of QualNet for Network Modeling. (Basic ideas / demonstration only)
15. Use of Wireshark for Network packet capturing.
16. Creating a small LAN by an Ethernet switch
17. Creating a Wireless LAN using an Access Point



Course Outcomes:

CO 1. Learn the terminology and concepts of network management in Linux platform by understanding shell commands and implementing the same.

CO 2. Understand the concepts of protocols, network interfaces, and design/performance issues through programs.

CO 3. Understanding the need of dividing stream of data into smaller units and implementing program to send such data units across a network.

CO 4. Demonstrate various types of protocols to transfer packets of data from a source to destination machine.

CO 5. Understand the need of different types of Transport Layer Protocols and implement them through socket programming.

CO 6. Learn how to synthesize the learning gathered from different network layers to build useful, relevant and user friendly applications with the objective to solve real life problems.

Course Name : Software Engineering Lab					
Course Code: CSEN3212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

Exercises and Assignments on:

1. Preparation of SRS for sample application system(s).
2. Preparation of UML Diagrams for sample application problems – Class Diagrams and Sequence Diagrams using tools.
3. Preparation of Test Cases for sample application module(s).
4. Estimation of Project Size for sample application system(s) – Function Point Analysis (FPA).
5. Preparation of Project Schedule and Staffing Plan for sample software project(s) using tools.

Course Outcomes:

a) Students will be able to prepare SRS document for sample application system as per IEEE guidelines.
b) Students will be able to design sample software application problem using various UML diagrams (e.g. Class Diagram, Sequence Diagram etc.) using tools like Microsoft Visio.
c) Students will be able to prepare test cases for sample application module(s).
d) Students will be able to estimate the project size, duration and cost for sample application system using industry standard method like FPA.
e) Students will be able to prepare project schedule and plan the staffing for sample application system.

8. Implement multithreaded chat program.
9. Implement Web based protocol (looking up URLs, retrieving & examining content, posting a form etc.etc.).
10. Implement Multicasting / Broadcasting socket I/O.
11. Implement Sliding Window Protocol using Non-Blocking I/O (try the Selective Repeat).
12. Implement Secured TCP echo protocol.
13. Experimenting on cross-platform network based communication issues.

Network Hardware / Simulation Exercises:

14. Use of QualNet for Network Modeling. (Basic ideas / demonstration only)
15. Use of Wireshark for Network packet capturing.
16. Creating a small LAN by an Ethernet switch
17. Creating a Wireless LAN using an Access Point

Course Outcomes:

CO 1. Learn the terminology and concepts of network management in Linux platform by understanding shell commands and implementing the same.
CO 2. Understand the concepts of protocols, network interfaces, and design/performance issues through programs.
CO 3. Understanding the need of dividing stream of data into smaller units and implementing program to send such data units across a network.
CO 4. Demonstrate various types of protocols to transfer packets of data from a source to destination machine.
CO 5. Understand the need of different types of Transport Layer Protocols and implement them through socket programming.
CO 6. Learn how to synthesize the learning gathered from different network layers to build useful, relevant and user friendly applications with the objective to solve real life problems.

Course Name : Software Engineering Lab					
Course Code: CSEN3212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

Exercises and Assignments on:

1. Preparation of SRS for sample application system(s).
2. Preparation of UML Diagrams for sample application problems – Class Diagrams and Sequence Diagrams using tools.
3. Preparation of Test Cases for sample application module(s).
4. Estimation of Project Size for sample application system(s) – Function Point Analysis (FPA).
5. Preparation of Project Schedule and Staffing Plan for sample software project(s) using tools.

Course Outcomes:

a) Students will be able to prepare SRS document for sample application system as per IEEE guidelines.
b) Students will be able to design sample software application problem using various UML diagrams (e.g. Class Diagram, Sequence Diagram etc.) using tools like Microsoft Visio.
c) Students will be able to prepare test cases for sample application module(s).
d) Students will be able to estimate the project size, duration and cost for sample application system using industry standard method like FPA.
e) Students will be able to prepare project schedule and plan the staffing for sample application system.

COURSE STRUCTURE OF B. TECH IN
COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : System Administration Lab					
Course Code: CSEN3213					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

- Introduction to the network environments and different configuration files
- System startup, runlevels and shutdown, file system
- User and group Creation and management with different option and permission
- Packet Monitoring software (tcpdump, ethereal)
- Trace route, Ping, Nmap , netstat
- NFS Configuration
- Firewall Configuration using iptables/ipchains
- Server configuration: FTP, telnet, SMTP, DHCP, HTTP/S, DNS

Course outcomes:

1. Students will demonstrate an understanding of basic knowledge about the installation and configuration of operating systems
2. Students will create different servers in Linux/ Unix System.
3. Students will configure firewall of the system

Course Name : Computer Graphics and Multimedia Lab					
Course Code: CSEN3285					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

- Point plotting, line & regular figure algorithms
- Raster scan line & circle drawing algorithms
- Clipping & Windowing algorithms for points, lines & polygons
- 2-D / 3-D transformations
- Filling algorithms.
- Photo Editing using Photoshop.
- Creating Animation using Flash.

Course Outcomes:

1. Students will demonstrate an understanding of contemporary graphics hardware.
2. Students will create interactive graphics applications in C using one or more graphics application programming interfaces.
3. Students will write programs that demonstrate computer graphics animation.
4. Students will write programs that demonstrate 2D image processing techniques
5. Students will do photo editing using photoshop.
6. Students will create animation in flash.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

List of Electives

OPTIONS FOR ELECTIVE I (Even Semester)
CSEN 3280 Computer Graphics & Multimedia
CSEN 3281 Artificial Intelligence
CSEN 3282 Web technologies
CSEN 3283 Advanced Java Programming

OPTIONS FOR ELECTIVE I Lab* (Even Semester)
CSEN 3285 Computer Graphics & Multimedia Lab
CSEN 3286 Artificial Intelligence Lab
CSEN 3287 Web technologies Lab
CSEN 3288 Advanced Java Programming Lab

Course Name : Computer graphics and multimedia					
Course Code: CSEN3280					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I:
Introduction to computer graphics & graphics systems [6L]: Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.
Scan conversion: [6L]: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Module II:
2D transformation & viewing [8L]: Basic transformations: translation , rotation, scaling ; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines , parallel lines, intersecting lines. Viewing pipeline, Window to viewport co-ordinate transformation, clipping operations, point clipping , line clipping, clipping circles , polygons & ellipse.
3D transformation & viewing [7L]: 3D transformations: translation, rotation, scaling & other transformations. rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, viewport clipping, 3D viewing.

Module III:
Curves [3L]: Curve representation, surfaces , designs , Bezier curves , B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.
Hidden surfaces [3L]: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Printer's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry.
Color & shading models [2L]: Light & color model; interpolative shading model; Texture.

Module IV:
Multimedia [10L]: Introduction to Multimedia: Concepts, uses of multimedia, hypertext and hypermedia.; Image, video and audio standards.
Audio: digital audio, MIDI, processing sound, sampling, compression.
Video: MPEG compression standards, compression through spatial and temporal redundancy, inter-frame and intra-frame compression .
Animation: types, techniques, key frame animation, utility, morphing. Virtual Reality concepts.

Learning Outcomes/Course Outcomes:

1. Ability to write program functions to implement graphics primitives.
2. Ability to write programs that demonstrate geometrical transformations.
3. Ability to write programs that demonstrate an understanding of the use of object hierarchy in graphics applications.
4. Ability to write program functions to implement visibility detection.

Text Books:

1. Hearn, Baker – " Computer Graphics (C version 2nd Ed.)" – Pearson education
2. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
3. D. F. Rogers, J. A. Adams – " Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
4. Foley, Vandam, Feiner, Hughes – "Computer Graphics principles (2nd Ed.)" – Pearson Education.
5. Ranjan Parekh-"Principles of Multimedia"-TMH

References:

1. Mukherjee, Fundamentals of Computer graphics & Multimedia, PHI
2. Sanhker, Multimedia –A Practical Approach, Jaico
3. Buford J. K. – "Multimedia Systems" – Pearson Education
4. Andleigh & Thakrar, Multimedia, PHI
5. Mukherjee Arup, Introduction to Computer Graphics, Vikas
6. Hill,Computer Graphics using open GL, Pearson Education
7. W. M. Newman, R. F. Sproull – "Principles of Interactive computer Graphics" – TMH.
8. Elsom Cook – "Principles of Interactive Multimedia" – McGraw Hill

<table>
<tr><td colspan="6">Course Name : Artificial Intelligence</td></tr>
<tr><td colspan="6">Course Code: CSEN3281</td></tr>
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<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
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Module I:

Introduction [1L]: Definition of AI, Intelligent Behavior, Turing Test, Typical AI Problems, Various AI Approaches, Limits of AI.

Introduction to Intelligent Agents [1L]: Agents & environment, Agent Architecture, Agent Performance, Rational Agent, Nature of Environment, Simple Reflex Agent, Goal Based Agent, Utility Based Agent.

Knowledge Representation & Propositional Logic [2L]: Knowledge representation issues, Approaches to knowledge representation, Propositional Logic – its syntax & semantics, Inference rules, Application of those rules, Limitation of Propositional Logic.

Problem Solving using Single Agent Search [2L]: Introduction to State-space search, state-space search notation, search problem, Formulation of some classical AI problems as a state space search problem, Explicit Vs. Implicit State space.

Uninformed Search Techniques [4L]: Basic Principles, Evaluating parameters, BFS, DFS, Depth Limited Search, Iterative Deepening DFS, Uniform Cost Search & Bidirectional Search, Properties of various search methods & their comparative studies.

Module II:

Informed Search Methods [6L]: Basic Principles, Heuristics, Best First Search – Greedy Best First, A* Search, their Properties, Admissible & Consistent heuristic, Local Search Techniques – Hill climbing & Simulated Annealing, Comparison with other methods

Problem Solving using Two Agent Search [2L]: Adversarial Search – Game Tree, MINIMAX Algorithm, Alpha-Beta Pruning, Performance Analysis.

Constraint Satisfaction Problem [2L]: Definition of CSP, Representation of CSP, Formulation of Various popular problems as CSP, Solution methods of CSP – Backtracking & Forward Checking.

Module III:

Knowledge Representation & Predicate Logic [3L]

Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default & Non-Monotonic reasoning.

Knowledge Representation using Rules [2L]

Rule based system, Horn clauses, Procedural vs. declarative knowledge, forward & backward reasoning, Introduction of logic programming using PROLOG/ LISP.

Other Representational Formalism [2L]

Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects.

Probabilistic reasoning [3L]

Representing knowledge in an uncertain domain, probabilistic inference rules, Bayesian networks – representation & syntax, semantics of Bayesian net, Fuzzy sets & fuzzy logic.

Module IV:

Planning [2L]: Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning.

Learning [4L]: Overview, Taxonomy of learning system, various learning models, learning rules, inductive learning framework, Decision tree based learning, Learning using Neural Network & Genetic Algorithm.

Natural Language Processing [2L]: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Expert Systems [2L]: Representing and using domain knowledge, expert system shells, knowledge acquisition.

Course Outcomes/Learning Objectives:

- At the end of this course the students are expected to be capable of understanding the basic features/ attributes that an intelligent system should have, how those attributes can be incorporated to the system.
- Beside this students should be able to know the importance of knowledge as far as intelligence is concerned and how this knowledge can be suitably represented so that it can be used to infer new knowledge.
- On completion of this course, the students also get an idea of the significance of efficient searching algorithms as far as intelligent decisions are concerned.
- Last but not the least, by the end of this course, students will be able to explore various problem solving paradigms, learning algorithms, game playing techniques, logic theorem proving etc.

References:

1. Artificial Intelligence A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education
2. Artificial Intelligence, Ritch & Knight, TMH
3. Artificial Intelligence & Intelligent Systems, N.P.Padhy, Oxford University Press
4. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI
5. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

Course Name : Web Technologies					
Course Code: CSEN3282					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

MODULE 1 [Types of Web pages and Web page front end design]

Dynamic Web Pages [1L]

The need of dynamic web pages; comparative studies of different technologies of dynamic page creation

Active Web Pages [1L]

Need of active web pages; java applet life cycle.

HTML (3L):

Module III:

Knowledge Representation & Predicate Logic [3L]

Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default & Non-Monotonic reasoning.

Knowledge Representation using Rules [2L]

Rule based system, Horn clauses, Procedural vs. declarative knowledge, forward & backward reasoning, Introduction of logic programming using PROLOG/ LISP.

Other Representational Formalism [2L]

Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects.

Probabilistic reasoning [3L]

Representing knowledge in an uncertain domain, probabilistic inference rules, Bayesian networks – representation & syntax, semantics of Bayesian net, Fuzzy sets & fuzzy logic.

Module IV:

Planning [2L]: Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning.

Learning [4L]: Overview, Taxonomy of learning system, various learning models, learning rules, inductive learning framework, Decision tree based learning, Learning using Neural Network & Genetic Algorithm.

Natural Language Processing [2L]: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Expert Systems [2L]: Representing and using domain knowledge, expert system shells, knowledge acquisition.

Course Outcomes/Learning Objectives:

- At the end of this course the students are expected to be capable of understanding the basic features/ attributes that an intelligent system should have, how those attributes can be incorporated to the system.
- Beside this students should be able to know the importance of knowledge as far as intelligence is concerned and how this knowledge can be suitably represented so that it can be used to infer new knowledge.
- On completion of this course, the students also get an idea of the significance of efficient searching algorithms as far as intelligent decisions are concerned.
- Last but not the least, by the end of this course, students will be able to explore various problem solving paradigms, learning algorithms, game playing techniques, logic theorem proving etc.

References:

1. Artificial Intelligence A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education
2. Artificial Intelligence, Ritch & Knight, TMH
3. Artificial Intelligence & Intelligent Systems, N.P.Padhy, Oxford University Press
4. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI
5. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

Course Name : Web Technologies					
Course Code: CSEN3282					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

MODULE 1 [Types of Web pages and Web page front end design]

Dynamic Web Pages [1L]

The need of dynamic web pages; comparative studies of different technologies of dynamic page creation

Active Web Pages [1L]

Need of active web pages; java applet life cycle.

HTML (3L):

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue.

Image Maps (1L): map, area, attributes of image area.

MODULE 2 [Web page scripting, server and client side**]**

HTTP[2L]: Message, Request, Response, Methods , Status Codes

Extensible Markup Language (XML) (4L): Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.

Java Script [3L]

Data types, variables, operators, conditional statements, array object, date object, string ob ject.

Java Servlet [2L]

Servlet environment and role, HTML support, Servlet API, The servlet life cycle, Cookies and Sessions.

MODULE 3 [Advanced Java Server Side Programming**]**

JSP [9L]: JSP architecture, JSP servers, JSP tags, understanding the layout in JSP, Declaring variables, methods in JSP, inserting java expression in JSP, processing request from user and generating dynamic response for the user, using include and forward action, Creating ODBC data source name, introduction to JDBC, prepared statement and callable statement.

J2EE[4L]: An overview of J2EE web services, basics of Enterprise Java Beans, EJB vs. Java Beans

MODULE 4 [Network Security**]**

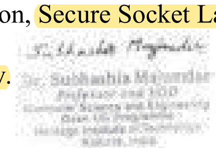
Threats (1L):

Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks.

Network security techniques (2L):

Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH).

Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy.



References:

1. Web Technology: A Developer's Perspective, N.P.Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Chapters 1-5,7,8,9).
2. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.(Chapters 5,6,12)
3. Murach's Java Servlets and JSP.
4. Java for the Web with Servlets, JSP, and EJB, Budi. Kurniawan
5. Cryptography and Network security by William Stallings

Course Outcome:

1. Students will be able to understand the basic tags of HTML, CSS, java script and DHTML.
2. Students will be able to connect a server side program using servlet and JSP to a DBMS and perform insert, update and delete operations on DBMS table.
3. Students will be able to write a server side programming using servlet and JSP to store the data sent from client, process it and store it on database.
4. 4. Students will be able to prepare a well formed / valid XML document , schema to store and transfer data.
5. 5. Students will be able to understand various types of attacks and their characteristics.
6. 6. Students will be able to get familiar with network security designs using available secure solutions (such as PGP, SSL, IPSec)

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Advanced Java Programming					
Course Code: CSEN3283					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I:
Client & server side programming.
Enterprise architecture styles: Single tier, 2-tier , 3-tier, n-tier; Relative comparison of the different layers of architectures.
MVC Architecture: Explanation, Need, Drawbacks, J2EE WEB SERVICES, Different components & containers. [4L].

Module II:
Servlet: Introduction, Advantages over CGI, How it works?, Servlet life cycle, Servlet API (Different interfaces & classes of generic servlet & HTTP servlet), Accessing user information by means of Request & Response, Servlet session management techniques and relative comparison. [4L]
JSP: Introduction, Comparison between JSP & servlet., Architecture/Life cycle, Different types of JSP architectures and relative comparison.; JSP tags ,Directives, Scripting elements, Actions; JSP implicit objects, Accessing user information using implicit objects. [5L]
EJB :Introduction, Comparison of EJB & Java Beans , Applications, Drawbacks, Different types of enterprise beans,Services provided by EJB container. [5L].

Module III:
RMI: Introduction and applications, Architecture ,Use of RMI Registry.
JNDI: Introduction and applications, Comparison between LDAP and JNDI
JDO (Java Data Objects): Introduction, Integration of EJB and JDO, JDO & RMI
JINI :Introduction, Applications [5L]
JDBC: Introduction, Database driver ,Different approaches to connect an application to a database server, Establishing a database connection and executing SQL statements, JDBC prepared statements, JDBC data sources. [5L].

Module IV:
XML: Java & XML, XML syntax, Document type definition., Parsers, SAX parsers, DOM parsers, SAX vs. Dom,
JAXP and JAXB. [8L].

Text Books:

1. "Professional JAVA Server Programming", Allamaraju and Buest ,SPD Publication
2. "Beginning J2EE 1.4" Ivor Horton, SPD Publication.
3. "Advanced Programming for JAVA 2 Platform" Austin and Pawlan, Pearson

References:

1. Internet & Java Programming by Krishnamoorthy & S. Prabhu(New Age Publication)

Course Outcome:
Students will be able to:
CO 1: Understand evolution of Client/Server Computing to access desktop vs web application.
CO 2 : Understand various Architecture patterns used for web application.
CO 3 : Understand the common problems faced in architecting large scale applications and analyze the requirement for applying Java EE components at various level.
CO 4 : Learn various Java EE components and apply them for developing multilayered web application.
CO 5: Learn and use various components (JNDI, EJB) used for distributed processing in Java EE.
CO 6 : Understand and use XML for data transfer
CO 7: Understand database handling in web application using Java EE components (servlets, JSP)
CO 8: Apply various Java EE components for developing a database driven web application using MVC pattern.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : System Administration Lab					
Course Code: CSEN3213					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

- Introduction to the network environments and different configuration files
- System startup, runlevels and shutdown, file system
- User and group Creation and management with different option and permission
- Packet Monitoring software (tcpdump, ethereal)
- Trace route, Ping, Nmap , netstat
- NFS Configuration
- Firewall Configuration using iptables/ipchains
- Server configuration: FTP, telnet, SMTP, DHCP, HTTP/S, DNS

Course outcomes:

1. Students will demonstrate an understanding of basic knowledge about the installation and configuration of operating systems
2. Students will create different servers in Linux/ Unix System.
3. Students will configure firewall of the system

Course Name : Computer Graphics and Multimedia Lab					
Course Code: CSEN3285					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

- Point plotting, line & regular figure algorithms
- Raster scan line & circle drawing algorithms
- Clipping & Windowing algorithms for points, lines & polygons
- 2-D / 3-D transformations
- Filling algorithms.
- Photo Editing using Photoshop.
- Creating Animation using Flash.

Course Outcomes:

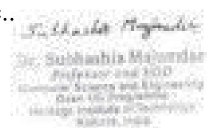
1. Students will demonstrate an understanding of contemporary graphics hardware.
2. Students will create interactive graphics applications in C using one or more graphics application programming interfaces.
3. Students will write programs that demonstrate computer graphics animation.
4. Students will write programs that demonstrate 2D image processing techniques
5. Students will do photo editing using photoshop.
6. Students will create animation in flash.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Artificial Intelligence Lab					
Course Code: CSEN3286					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

In this laboratory students will be familiarized with PROLOG/ LISP language. A tentative outline for this laboratory is given below:

- Introduction to PROLOG facts & rules with the help of a simple family tree; how the goals are given in PROLOG; some simple queries on the family tree
- Formation of recursive definition; how PROLOG executes the goals; simple assignments
- How PROLOG deals with problems with numbers – integers, real; with some examples
- Introduction to LIST structure; how PROLOG implements LIST; some simple assignments on LIST.
- Some more complex assignments on LIST; Introduction of Accumulators – simple assignments
- Introduction to CUT with simple assignments; implementation of Sorting algorithms
- PROLOG clauses for file operation – with simple assignments
- Implementation of Graph Search algorithms like DFS, BFS; Some application of DFS & BFS
- Implementation of some well known puzzles, like 8-queens problem, Towers-of-Hanoi problem, Missionaries & Cannibals problem etc..
- Introduction to LISP
- Some simple assignments on LISP.



Course Outcomes/Learning Objectives:
At the end of this course, students are expected to get a good flavor of logical programming by using PROLOG/ LISP. Students should be able to apply those knowledge to solve some intelligent puzzles.

Course Name : Web Technologies Lab					
Course Code: CSEN3287					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

HTML:

A) A) Designing a web page with HTML.
B) B) Designing HTML Form.
C) C) Designing with CSS

Java Script :

A) Data types, variables, operators, conditional statements, array object, date object, string object.
B) Validate the fields of a form using JavaScript

XML :

A) How to write a XML document.
B) How to validate XML document.

Java Servlet :

A) Servlet environment and role
B) HTML support
C) Cookies and Sessions.

JSP :

A) JSP tags, layout in JSP, Declaring variables, methods in JSP
B) Inserting java expression in JSP, processing request from user and generating dynamic response for the user, inserting applets and java beans into JSP, using include and forward action
C) Creating ODBC data source name.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Artificial Intelligence Lab					
Course Code: CSEN3286					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

In this laboratory students will be familiarized with PROLOG/ LISP language. A tentative outline for this laboratory is given below:

- Introduction to PROLOG facts & rules with the help of a simple family tree; how the goals are given in PROLOG; some simple queries on the family tree
- Formation of recursive definition; how PROLOG executes the goals; simple assignments
- How PROLOG deals with problems with numbers – integers, real; with some examples
- Introduction to LIST structure; how PROLOG implements LIST; some simple assignments on LIST.
- Some more complex assignments on LIST; Introduction of Accumulators – simple assignments
- Introduction to CUT with simple assignments; implementation of Sorting algorithms
- PROLOG clauses for file operation – with simple assignments
- Implementation of Graph Search algorithms like DFS, BFS; Some application of DFS & BFS
- Implementation of some well known puzzles, like 8-queens problem, Towers-of-Hanoi problem, Missionaries & Cannibals problem etc..
- Introduction to LISP
- Some simple assignments on LISP.

Course Outcomes/Learning Objectives:
At the end of this course, students are expected to get a good flavor of logical programming by using PROLOG/ LISP. Students should be able to apply those knowledge to solve some intelligent puzzles.

Course Name : Web Technologies Lab					
Course Code: CSEN3287					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

HTML:

A) A) Designing a web page with HTML.
B) B) Designing HTML Form.
C) C) Designing with CSS

Java Script :

A) Data types, variables, operators, conditional statements, array object, date object, string object.
B) Validate the fields of a form using JavaScript

XML :

A) How to write a XML document.
B) How to validate XML document.

Java Servlet :

A) Servlet environment and role
B) HTML support
C) Cookies and Sessions.

JSP :

A) JSP tags, layout in JSP, Declaring variables, methods in JSP
B) Inserting java expression in JSP, processing request from user and generating dynamic response for the user, inserting applets and java beans into JSP, using include and forward action
C) Creating ODBC data source name.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcome:

1. Students will be able to **understand** the basic tags and properties to write client side and server side programming.
2. Students will be able to **develop** static and dynamic webpage by the use of HTML/CSS, java script and DHTML.
3. Students will be able to **connect** a server side programs using servlet and JSP to a DBMS and **perform** insert, update and delete operations on DBMS table.
4. Students will be able to **write** a server side programming using servlet and JSP to store the data sent from client, process it and store it on database.
5. Students will be able to **select** required HTML tags and CSS properties and java scripts to design a particular web page.
6. Students will be able to **prepare** a well formed / valid XML document , schema to store and transfer data.

Course Name : Advanced Java Programming Lab					
Course Code: CSEN3288					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

Java Data Base Connectivity: A Data Base can be accessed from program.
Servlets: Development of web based components.
Java Beans: Using EJB , programmer should visually assemble components and dynamically change properties.
Java Server Pages: Programs to implement to dynamically generate HTML, XML or other types of documents in response to a Web client request.
Remote Method Invocation: Programs to provide the mechanism by which the server and the client communicate and pass information back and forth.

Course Outcome:
CO 1: Students will be able to develop dynamic web pages using servlet, JSP, EJB
CO 2: Students will be able to access Data using JDBC from dynamic web page
CO 3: Students will be able to process data using XML

Syllabus of Sessional Course

Course Name : Seminar I					
Course Code: CSEN3297					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**3**	**2**

Seminar on recent topics related to Computer Science & Engineering.
Course outcomes/Learning objectives:

- Students will demonstrate the ability to prepare appropriately to participate effectively in class discussion.
- Students will demonstrate the ability to follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments.
- Further, students will be able to challenge and offer substantive replies to others' arguments, comments, and questions, while remaining sensitive to the original speaker and the classroom audience.
- Students will learn to prepare materials on a topic relevant to the course and demonstrate critical faculties with the text discussed.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcome:

1. Students will be able to **understand** the basic tags and properties to write client side and server side programming.
2. Students will be able to **develop** static and dynamic webpage by the use of HTML/CSS, java script and DHTML.
3. Students will be able to **connect** a server side programs using servlet and JSP to a DBMS and **perform** insert, update and delete operations on DBMS table.
4. Students will be able to **write** a server side programming using servlet and JSP to store the data sent from client, process it and store it on database.
5. Students will be able to **select** required HTML tags and CSS properties and java scripts to design a particular web page.
6. Students will be able to **prepare** a well formed / valid XML document , schema to store and transfer data.

Course Name : Advanced Java Programming Lab					
Course Code: CSEN3288					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

Java Data Base Connectivity: A Data Base can be accessed from program.
Servlets: Development of web based components.
Java Beans: Using EJB , programmer should visually assemble components and dynamically change properties.
Java Server Pages: Programs to implement to dynamically generate HTML, XML or other types of documents in response to a Web client request.
Remote Method Invocation: Programs to provide the mechanism by which the server and the client communicate and pass information back and forth.

Course Outcome:
CO 1: Students will be able to develop dynamic web pages using servlet, JSP, EJB
CO 2: Students will be able to access Data using JDBC from dynamic web page
CO 3: Students will be able to process data using XML

Syllabus of Sessional Course

Course Name : Seminar I					
Course Code: CSEN3297					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**3**	**2**

Seminar on recent topics related to Computer Science & Engineering.
Course outcomes/Learning objectives:

- Students will demonstrate the ability to prepare appropriately to participate effectively in class discussion.
- Students will demonstrate the ability to follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments.
- Further, students will be able to challenge and offer substantive replies to others' arguments, comments, and questions, while remaining sensitive to the original speaker and the classroom audience.
- Students will learn to prepare materials on a topic relevant to the course and demonstrate critical faculties with the text discussed.

Dr. Subhashis Majumdar
Professor and HOD

Course Name : Operating Systems Concepts					
Course Code: INFO3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

After successfully completing this course the students will be able to:

(1) Analyze and differentiate between different types of operating systems (namely, batch, multi-programmed, time-sharing, real-time, distributed, parallel processing system) based on their application domains and evolution.

(2) Demonstrate and describe system operations, internal structure of computer system and operating system.

(3) Design multiprocessing and multithreading environments based on inter-process/thread communication and synchronization.

(4) Compare the different level of memory (Primary memory, cache, virtual memory, secondary storage) and how they are correlated to improve the performance of the system.

(5) Demonstrate the operations of IO devices and how they are governed by the operating system

(6) Discuss the activity and impact of threat, virus, worm and how the system could be protected from them.

Detailed Syllabus:

Module - I (10L)

Introduction [4L] : Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, timesharing, real-time, distributed, parallel.

System Structure[3L] : Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, and system calls.

Process and Threads (3L) :

Processes [1L]: Concept of processes, operations on processes.

Threads [2L]: overview, benefits of threads, user and kernel threads.

Module - II (14L)

Process Scheduling(2L): Process scheduling, co-operating processes, inter process communication.

CPU scheduling [3L]: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.

Process Synchronization [5L]: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.

Deadlocks [4L]: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Module III (11L)

Memory Management [5L]: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.

Virtual Memory [3L]: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.

Disk Management [3L]: disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN) , disk reliability, disk formatting, boot block, bad blocks.

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Module IV(12L)

File Systems [4L]: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.

I/O Management [4L]: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and non blocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.

Protection & Security [4L]

Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

References:

1. Milenkovie M., “Operating System : Concept & Design”, McGraw Hill.
2. Tanenbaum A.S., “Operating System Design & Implementation”, Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., “Operating System Concepts”, Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, “Operating Systems”, Maxwell McMillan International Editions, 1992.
6. Dietel H. N., “An Introduction to Operating Systems”, Addison Wesley.

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Course Name : Computer Architecture					
Course Code: INFO3102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

(1) Review of basic computer architecture, Quantitative techniques in computer design, measuring and reporting performance.

(2) Classify different kinds of pipeline, pipeline hazards and suggesting suitable remedial techniques to handle the hazards. Discussing different kinds of parallel architectures (Flynn's Classification), types of Multiprocessor architectures (UMA, NUMA, COMA and NORMA), types of Inter connection (Bus, Hypercube and Omega) network and Memory Consistency models. Explaining the concepts of Centralized shared memory architecture and Distributed shared memory architecture.

(3) Compute performance parameters of pipelines (Speed-up, Efficiency and Throughput) and deduce derivations to demonstrate the performance parameters when branching effect is introduced. Pipeline optimization techniques needs to be illustrated. Preparing numerical module based on pipeline concepts.

(4) Differentiate between different Memory technologies (Primary, Secondary and Cache) and helping students to compute different kinds of numerical based on the memory technologies.

(5) Collecting knowledge about Superscalar, Super pipelined and VLIW processor architectures, Array and vector processors. Constructing the concepts of ILP.

(6) Comparing different techniques of ILP (Loop Unrolling, Dynamic Scheduling and Software Pipelining) and concluding with concepts of Data Flow architecture, RISC, CISC and Systolic architecture

<u>Detailed Syllabus:</u>

Module – 1: [12 L]

Introduction: Review of basic computer architecture (Revisited), Quantitative techniques in computer design, measuring and reporting performance. (4L)

Pipelining: Basic concepts, Instruction pipeline, Arithmetic pipeline, processor pipeline, Data hazards, Control hazards and Structural hazards, Techniques for handling hazards, Static scheduling vs Dynamic scheduling, Pipeline optimization technique. (8L)

Module – 2: [8L]

Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, Mapping and management techniques, Memory replacement policies.

Module – 3: [8L]

Instruction-level parallelism: Basic concepts, techniques for increasing ILP, Superscalar, Super-pipelined and VLIW processor architectures. Array and vector processors. Design of Control Unit.

Module – 4: [12 L]

Multiprocessor architecture: Taxonomy of parallel architectures; Centralized shared- memory architecture, Memory consistency models, Interconnection networks. Distributed shared-memory architecture. Cluster computers. (8L)

Non von Neumann architectures: Data flow computers, RISC and CISC architecture, Systolic architectures. (4L)

References:

1) Advanced Computer Architecture by Kai Hwang.
2) Computer Architecture: A Quantitative approach- Patterson and Hennessy.
3) Computer Architecture and Parallel processing- Hwang and Briggs.
4) Computer Architecture by T.K.Ghosh.

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Head, Dept. of Information Technology
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Course Name : Software Engineering & Project Management					
Course Code: INFO3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

1. At the end of the course student should gather the knowledge of the system development lifecycle;
2. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, health and manufacturability.
3. Acquire Knowledge of the principles of object-oriented software construction.
4. Acquire knowledge to manage a project including planning, scheduling and risk assessment.

Detailed Syllabus:

Module-I: [10L]
Principles and Motivations:
Definitions and need for engineered approach to software development; software Development process models from the points of view of technical development and project management: waterfall, rapid prototyping, incremental development, spiral model.
Design of Software Systems: System Design: Context diagram and DFD, Cohesion, Coupling, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.

Module-II: [10L]
Software Testing:
Testing Levels of Testing, Black Box Testing ,White Box Testing ,Integration Testing ,System Testing, Validation Testing ,Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control ,Case Tools ,Classification ,Features ,Strengths And Weaknesses; Icase; CASE Standards.Formal Methods of Software Development.
Module-III: [10L]
Software Project Management:
Principles of software projects management; organizational and team structure; project planning; project scheduling, project initiation and project termination; technical, quality, and management plans; Software Quality Assurance, Software Configuration Management ,Risk analysis and Management ,project control; cost estimation methods - function points and COCOMO.

Module-IV: [10L]
Object Modeling and Design:
UML Fundamentals, Structural Diagram, Behavioral Diagram, Classes, objects, relationships, key abstractions, class diagrams, message, Sequence diagrams, use cases, use case diagrams, activity diagrams, States, Events, Actions, State Chart Diagram.

References:

1. Roger pressman; software engineering - a practitioner's approach, McGraw hill, New York.
2. Ian sommerville; software engineering, addison-wesley publishing company, England
3. Pankaj Jalote; an integrated approach to software engineering, Narosa publishing House, New Delhi.
4. Grady Booch, James Rumbaugh, Ivar Jacobson, the unified modeling language User guide, Pearson education, New York

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Contact hrs per week:	L	T	P	Total	Credit points
Course Name : DBMS					
Course Code: INFO3104					
	4	0	0	4	4

<u>After successfully completing this course the students will be able to:</u>

1.Evaluation:- Justify the need of DBMS over traditional file system and analyze the overall database description, at three levels, namely, internal, conceptual, and external levels.

2.Evaluation: Deduce the constraints , i.e., the candidate keys, superkeys, that exists in a given real world problem and design the entity relationship diagram to graphically represent entities and their relationships to each other, typically used in computing in regard to the organization of data within databases or information systems

3.Synthesis : Formulate a mathematical tool using relational algebra that operates on one or more relational tables and outputs a relational table as result, and design a normalized Database based on real-world situations, maintaining all constraints and manipulate database relations using SQL and PL/SQL

4.Evaluation: Prove if a schedule A is conflict serializable with schedule B then it is also view serializable with schedule B but vice versa is not true.

5.Evaluation : Compare the number of block access required for searching a particular record in a data file having (primary index , secondary index, multilevel index.).

<u>Detailed Syllabus:</u>

<u>Module 1:</u> Introduction and Conceptual Modeling [7L]

Database Model, Schema and architecture : [2L]

Concept & Overview of database and DBMS, Advantages of using DBMS approach, Database Users , Database Administrator, Database applications. Data Models and its categories, Schema, Instances, Database Languages, Three Schema architecture of DBMS, Data independence, Centralized and client server architecture for DBMS. Classification of DBMS. Introduction to big data.

Entity-Relationship Model : [5L]

Basic concepts, Design Issues, Cardinality, SuperKeys, Candidate keys, Entity types, Entity sets, attributes and keys. Relationship types, Relationship sets, Attributes of relationship types, Weak Entity Sets , ER diagram design issues, Extended E-R modeling: generalization, specialization, aggregation.

<u>Module 2 :</u>Relational Model: Languages and query processing [13L]

Introduction to relational model: [1L]

Concepts of domains, attributes, tuples, relations. Transformation of ERD model to relational model.

Relational Algebra and Calculus: [5L]

Operators in relational algebra: select, project, rename, cartesian product, different types of join, Division,Intersect, Union, Minus. Tuple relational calculus, Domain relational calculus.

Introduction to Database languages [4L]

SQL: Concept of DDL, DML, DCL,TCL,DQL. Query structure, concept of subquery, group functions. View. PL/SQL basic structure, Control structure, Cursor,Triggers.

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Module 3 : Relational Database Design **[13L]**

Database integrity : **[1L]**

Domain constraints, entity integrity, referential integrity constraints. Concept of null and not null constraint

Functional Dependencies: **[3L]**

Basic concept of functional dependency, Axioms, Closure, Attribute closure, Equivalent set of FD, Cover, Canonical cover.

Normalization : **[8L]**

Concept of Super keys, Candidate keys. Determining candidate keys from FD. Different anomalies in designing a Database. First, second and third normal form, Boyce-Codd Normal Form, Nomalization using multi-valued depedencies and join dependency. Dependency preservation, Lossless decomposition.

Module 4 : Transaction Processing , Data Storage **[13L]**

Transaction processing concepts **[8L]**

Transaction properties, states, serial vs. concurrent execution, Serializability, Concurrency control techniques, and Recovery Management

File Organization & Index Structures **[5L]**

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree .

References:

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc.Graw Hill.
2. Elmasri Ramez and Navathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Date C. J., “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
4. Ramakrishnan: Database Management System , McGraw-Hill
5. Gray Jim and Reuter Address, “Transaction Processing : Concepts and Techniques”, Moragan Kauffman Publishers.
6. Jain: Advanced Database Management System CyberTech
7. Ullman JD., “Principles of Database Systems”, Galgottia Publication.

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Head, Dept. of Information Technology
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Course Name : Communication Theory					
Course Code: INFO3131					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

(1) The students will have concepts about communication – wireless and line.

(2) Will be able to differentiate between AM, FM.

(3) Will form ideas about data rate, bandwidth, and channel.

(4) Will practically see and measure the key parameters like deviation, clock rate etc.

<u>Detailed Syllabus:</u>

Module1: [Elements of communication system] [12]

The elements of a communication system, origin of noise and its effect, Importance of SNR in system design. Basic principle of linear (AM) modulation, Generation of AM waves, Demodulation of AM wave. Basic principle of nonlinear (FM, PM) modulation. Generation of FM waves. Demodulation of FM waves. Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, Aliasing. Analog pulse modulation-PAM (natural & flat topped sampling), PWM, PPM. Basic concept of Pulse code modulation, Block diagram of PCM, Multiplexing-TDM, FDM.

Module2: [**Digital transmission] [7]**

Concept of Quantization & Quantization error, Uniform quantizer, Non-uniform quantizer, A-law and μ-law. Encoding, coding efficiency. Line coding & properties, NRZ & RZ, AMI, Manchester coding, PCM, DPCM. Base band pulse transmission, Matched filter, error rate due to noise, Nyquist criterion for distortion-less base band binary transmission, Signal power in binary and digital signal.

Module3: [**Digital carrier modulation & demodulation technique**] **[10]**

Bit rate, Baud rate, Information capacity, Shanon's limit, Introduction to the different digital modulation techniques-ASK, FSK, PSK, BPSK, QPSK. Introduction to QAM, Basic concept of Delta modulating, Adaptive delta modulation. Introduction to the concept DPCM. Basic concept of spread spectrum modulation.

Module4: [Introduction to coding theory] [6]

Introduction, News value & Information content, Entropy, Mutual information, Information rate, Shanon-Fano algorithm for encoding, Shanon's theorem- source coding theorem. Basic principle of Error control & coding.

References:

1. An Introduction to Analog and Digital communication, Simon Haykin, Wiely India.
2. Analog communication system, P. Chakrabarti, Dhanpat Rai & Co.
3. Principle of digital communication, P. Chakrabarti, Dhanpat Rai & Co.
4. Modern Digital and Analog Communication systems, B.P. Lathi, Oxford University press

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Head, Dept. of Information Technology
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Course Name : Compiler Design					
Course Code: INFO3132					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

(1) Describe the theory and practice of compilation, in particular the lexical analysis, syntax, and semantic analysis, code generation and optimization phases of compilation.
(2) Create lexical rules and grammars for a programming language.
(3) Use Flex or similar tools to create a lexical analyzer and Yacc/Bison tools to create a parser.
(4) Design a compiler for a concise programming language.
(5) Implement a lexer without using Flex or any other lexer generation tools.
(6) Implement a parser such as a bottom-up SLR parser without using Yacc/Bison or any other compiler-generation tools.
(7) Implement semantic rules into a parser that performs attribution while parsing.

<u>Detailed Syllabus:</u>

Module I: [9L]
Introduction to Compiling *[3L]*
Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.
Lexical Analysis *[6L]*
The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).

Module II: [14L]
Syntax Analysis *[9L]*
The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.
Syntax directed translation *[5L]*
Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.

Module III: [13L]
Type checking *[4L]*
Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions
Run time environments *[5L]*
Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.
Intermediate code generation *[4L]*
Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

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Module IV: [9L]

Code optimization *[5L]*

Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.

Code generations *[4L]*

Issues in the design of code generator, a simple code generator, Register allocation & assignment.

References:

1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" – Pearson Education.
2. Holub - "Compiler Design in C" - PHI.

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Head, Dept. of Information Technology
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Course Name : Discrete Mathematics					
Course Code: INFO3133					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

This course introduces the applications of discrete mathematics inthe field of computer science. It covers sets, logic, provingtechniques, combinatorics, functions, relations, graph theory and algebraic structures. These basic concepts of sets, logic functionsand graph theory are applied to Boolean Algebra and logicnetworks, while the advanced concepts of functions and algebraicstructures are applied to finite state machines and coding theory.

<u>Detailed Syllabus:</u>

Module I [10L]:
Introduction to Propositional Calculus: Propositions, Logical Connectives, Conjunction, Disjunction, Negation and their truth table. Conditional Connectives, Implication, Converse, Contrapositive, Inverse, Biconditional statements with truth table, Logical Equivalence, Tautology, Normal forms-CNF, DNF; Predicates and Logical Quantifications of propositions and related examples.

Module II [10L]:
Theory of Numbers: Well Ordering Principle, Divisibility theory and properties of divisibility; Fundamental theorem of Arithmetic; Euclidean Algorithm for finding G.C.D and some basic properties of G.C.D with simple examples; Congruences, Residue classes of integer modulo and its examples. Order, Relation and Lattices: POSET, Hasse Diagram, Minimal , Maximal, Greatest and Least elements in a POSET, Lattices and its properties, Principle of Duality, Distributive and Complemented Lattices.

Module III [10L]:
Counting Techniques: Permutations, Combinations, Multinomial Theorem, Binomial coefficients, Pigeon- hole Principle, Principles of inclusion and exclusions; Recurrence relations: Formulation/Modelling of different counting problems in terms of recurrence relations, Solution of linear recurrence relations with constant coefficients (upto second order) by (i) The iterative method (ii) Characteristic roots method (iii) Generating functions method.; Ramsey Problem on Counting techniques.

Module IV [6L]:
Dual Graph and its construction, Planar Graph & Testing for Planarity of a Graph, Cut Set & Cut Vertices; Graph Coloring: Chromatic Numbers and its bounds, Independence and Clique numbers, Perfect Graphs-Definition and examples, Chromatic polynomial and its determination, Applications of Graph Coloring Matchings: Definitions and Examples of Perfect Matching, Maximal and Maximum Matching, Hall's Marriage Theorem (Statement only) and related problems.

Siuli Ray

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

References:

1. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
2. J.L. Mott, A. kandel and T. P. Baker: Discrete Mathematics for Computer Scientist, reston, Virginia, 1983.
3. C. L. Liu: Elements of Discrete Mathematics, 2nd ed., McGraw Hill, New Delhi, 1985.
4. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI.
5. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
6. N. Deo :Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, Englewood Cliffs,1974.
7. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
8. J.K. Sharma, Discrete Mathematics, Macmillan
9. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.
10. R. A. Brualdi: Introductory Combinatorics, North Holland, New York, 1977.
11. F. S. Roberts: Applied Combinatorics, Prentice Hall, Englewood Cliffs, NJ, 1984.
12. Reingold et al.: Combinatorial Algorithms: Theory and Practice, Prentice Hall, Englewood Cliffs,1977.
13. S. K. Chakraborty and B. K. Sarkar, Discrete Mathematics, OXFORD University Press.
14. Douglas B. West, Introduction to graph Theory, PHI

Course Name : UNIX & Operating Systems Laboratory					
Course Code: INFO3111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

(1) Develop shell scripts to manage the system memory, user, files, and devices.

(2) Develop multi-processing and multi-threading environment capable of performing multiple tasks or sub-tasks simultaneously.

(3) Apply system calls and signals for user defined purposes

(4) Design a synchronized multi-threaded system capable of resource sharing

(5) Develop C programs to share information between two process using concepts of IPC.

Detailed Syllabus:

1. Managing Unix/Linux Operating System [8P]:
Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands). Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making file systems, Superblock, I-nodes, File system checker, Mounting file systems, Logical Volumes, Network File systems, Backup schedules and methods Kernel loading, init and the inittab file, Run-levels, Run level scripts. Password file management, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users & user groups.

2. **Process [4P]:** starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.

3. **Signal [4P]:** signal handling, sending signals, signal interface, signal sets.

4. **Semaphore [6P]:** programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).

5. **POSIX Threads [6P]:** programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)

6. **Inter-process communication [6P]:** pipes(use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO), message passing & shared memory(IPC version V).

References:

1. Behrouz A. Forouzan, Richard F. Gilberg, UNIX and Shell Programming, Thomson, 2003.
2. Brian W. Kernighan, Rob Pike, The UNIX Programming Environment, PHI, 1996.
3. K. Srirengan, Understanding UNIX, PHI, 2002.
4. Sumitabha Das, Your UNIX- The Ultimate Guide, TMGH, 2002.
5. Sumitabha Das, UNIX Concepts and Applications, Second Edition, TMGH, 2002.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Computer Architecture Laboratory					
Course Code: INFO3112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

(1) Discuss HDL introduction and explain the working of VHDL Simulator.

(2) Demonstration of the following Lab Assignments are undertaken in the lab:

Adder (Full & Half), Subtractor (Full & Half), Code Conversion (Binary to Gray & Gray to Binary), Decoder (3:8), Mux (4:1 & 8:1), Flip-flops (T, SR, JK & D), ALU design (8 bit), and Asynchronous Binary Up/Down Counter.

(3) Designing Truth table, KMap and Timing Diagram for all lab assignments.

Detailed Syllabus:

Lab 1: Data flow approach:

Write vhdl code for and, or, not, nand, xor, xnor, nor gates using data flow approach.

Lab 2: Behavioral flow approach:

Write vhdl code for and, or, not, nand, xor, nor, xnor gates using behavioral flow approach.

Lab 3: Adder and subtractor:

Write vhdl code for half adder, full adder, half subtractor and full subtractor using data flow approach & behavioral approach.

Lab 4: Structural approach:

Write vhdl code for half adder, full adder, half subtractor and full subtractor using structural approach.

Lab 5: Array:

Write vhdl code to implement 2's complement and excess three of a four bit number using array.

Lab 6: Binary-gray converter:

Write vhdl code for binary to gray code and vice-versa by data flow approach & behavioral approach.

Lab 7: Decoder and multiplexer:

Write vhdl code to implement 3-8 line decoder and 2:1 mux using data flow approach & behavioral approach.

Lab 8: Flipflop:

Write vhdl codes for d-flipflop, t-flipflop and sr-flipflop using data flow approach and behavioral approach.

Lab 9: ALU design:

Design and implement 4 bit alu and 8 bit alu using behavioral approach.

Lab 10: Counter and seven segment display:

Write vhdl code for asynchronous binary up/down counter.

Write vhdl code for bcd up/down counter

Write vhdl code for seven segment display.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Software Engineering & Project Management Laboratory					
Course Code: INFO3113					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>After successfully completing this course the students will be able to:</u>

1. Ability to design the document according to functionality
2. Ability to learn the object oriented design.
3. Develop software applications in a development environment that makes use of commonly supported tools.
4. Develop and apply testing strategies for software applications;

Pre-requisite: For Software Engineering Lab, design a project proposal which will be used throughout the lab for performing different experiments using CASE Tools.

<u>Detailed Syllabus:</u>

1. Preparation of requirement document for proposed project in standard format.

2. Project Schedule preparation using tools like MSProject.Generation of Gnatt chart from schedule.Prepare Project Management Plan in standard format.
3. Draw DFD and ERD and prepare Functional Design Document using LibreOffice.
4. Draw Class diagram,Use Case Diagram,Sequence diagram ,Activity Diagram and prepare Object Oriented Design Document using tools like Dia.
5. Design Test Script/Test Plan(both Black box and WhiteBox approach) for a small component of the proposed project.
6. Generate Test Result and perform defect root cause analysis using Pareto or Fishbone diagram.

Following projects can be used as dummy projects:

- Library Management System
- Railway Reservation System
- Employee Payroll System
- Online Banking System
- Online Shopping Cart
- Online Examination System

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Head, Dept. of Information Technology
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Course Name : DBMS Laboratory					
Course Code: INFO3114					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

After successfully completing this course the students will be able to:

1. Analyze. design and implement business problems as practiced in industry.
2. Familiarize with popular RDBMS software tools like Oracle.
3. Familiarize with administrative and security aspects of database.
4. Implement management principles / practices for handling projects under various business constraints.
5. To apply appropriate methodologies, techniques and software for designing and conducting experiments in order to analyze and interpret data using suitable data mining paradigms

Detailed Syllabus:

Structured Query Language

1.Introduction to server architecture

2.Creating database objects

- Creating a Table
- Specifying Relational Data Types
- Specifying Constraints
- Creating Column Aliases
- DROP, ALTER statements
- Creating an object structure from another existing structure

3. Table and Record Handling

- INSERT statement
- DELETE, UPDATE, TRUNCATE statements
- Populating data from other tables using insert and select together

4. Retrieving Data from a Database

The SELECT statement

- Using the WHERE clause
- Using Logical Operators in the WHERE clause
- Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING
- Clause
- Using Aggregate Functions
- Combining Tables Using JOINS
- Subqueries

5. Database Management

Creating Views
Creating Database Users
Granting and revoking Priviledges (GRANT, REVOKE)
Granting object priviledges

Basics of Programming Language/Structured Query Language (PL/SQL)

- Conditional /Iterative Statements
- Introduction to Functions and Stored procedures
- Exception Handling
- Cursor and its application
- Triggers

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Data Warehousing & Data Mining					
Course Code: INFO3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Discuss the role of data warehousing and enterprise intelligence in industry and government.

(2) Summaries the dominant data warehousing architectures and their support for quality attributes.

(3) Recognize and describe at least three computational approaches to data clustering, taking cognizance of the contribution of paradigms from the fields of Artificial Intelligence and Machine learning.

(4) Compare and contrast the dominant data mining algorithms.

(5) Construct a lightweight prototype or simulation that supports the concept of data mining.

(6) Analyze the results generated from the constructed artifact to determine if patterns of clusters were detected in the data sets.

(7) Demonstrate an appreciation of the importance of paradigms from the fields of Artificial Intelligence and Machine Learning to data mining.

Detailed Syllabus:

Module I [10]

Introduction: Data warehousing – definitions and characteristics, Multi-dimensional data model, Warehouse schema.

Data Marts: Data marts, types of data marts, loading a data mart, metadata, data model, maintenance, nature of data, software components; external data, reference data, performance issues, monitoring requirements and security in a data mart.

Online Analytical Processing: OLTP and OLAP systems, Data Modeling, LAP tools, State of the market, Arbor Essbase web, Microstrategy DSS web, Brio Technology, star schema for multi dimensional view, snowflake schema; OLAP tools.

Designing the Data Warehouse: Star Schemas, Dimensional Modeling, Metadata, Data Warehouse Design Examples.

Module II [8]

Data Mining: Definitions; KDD (Knowledge Discovery database) versus Data Mining; DBMS versus Data Mining, Data Mining Techniques; Issues and challenges; Applications of Data Warehousing & Data mining in industry.

Association Rules: A priori algorithm, Partition algorithm, Dynamic inset counting algorithm, FP – tree growth algorithm; Generalized association rule.

Module III [9]

Classification methods: Bayesian Classification, Neural Network, CBR, Genetic Algorithms.

Clustering Techniques: Clustering paradigm, Partition algorithms, K means, Fuzzy C menas CLARANS; Hierarchical clustering, DBSCAN; Categorical clustering, STIRR, ROCK.

Decision Trees: Tree construction principle, Best split, Splitting indices, Splitting criteria, Decision tree construction with presorting.

Module IV [9]

Web Mining: Web content Mining, Web structure Mining, Web usage Mining, Link Analysis Text Mining.

Big Data Handling: Introduction, Challenges, data storage (Hadoop), retrieval (Script languages) and computing for Big Data (Map reduces)

Dimensionality Reduction: PCA, Supervised Dimension Reduction.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

References:

1. Prabhu: Data Warehousing –Concepts, Techniques, products, application; PHI.
2. K. Pujari : Data Mining Techniques, Universities Press.
3. Alex Berson and Stephen J Smith: Data Warehousing, Data Mining and OLAP, TMH.
4. Anahory: Data Warehousing in the real world, Pearson Education.
5. Dunham: Data Mining Introductory & Advanced Topic, Pearson Education.
6. Foster Provost & Tom Fawcett: Data Science for Business: What you need to know about data mining and data-analytic thinking, O'Reilley.
7. Russell Jurney: Agile Data Science: Building Data Analytics Applications with Hadoop, O'Reilley.
8. Tom White: Hadoop: The Definitive Guide, O'Reilley.
9. Srinath Perera: Instant MapReduce Patterns - Hadoop Essentials How-to, Packt Publication

Course Name : Computer Network					
Course Code: INFO3202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Analyze the pieces of hardware (hub, bridge, switch, router) to make networks more efficient, faster, more secure, easier to use, able to transmit several simultaneous messages, and able to interconnect with other networks.

(2) Specify and identify importance of existing protocols (DNS, DHCP, FTP, WWW, HTTP) are running in application layer.

(3) Compare the various techniques (open loop and close loop) are used for congestion control and quality of service (traffic scheduling and shaping).

(4) Analyzing why network needs flow control and error control and how subneting is used to divide the large network.

(5) Evaluate the performance of the different routing protocol (RIP, OSPF) based on routing cost, convergence rate and complexity to find the shortest path.

Detailed Syllabus:

Module – I [10L]

Introduction: Data communications, Direction of data flow - Simplex, Half-duplex, Full-duplex, Topology – Bus, Ring, Mesh. Star & Hybrid, Types of Network - LAN, MAN 7 WAN, Protocols, Reference models – OSI & TCP/IP reference model & comparative study.

Physical Layer: Transmission media - Guided & Unguided, Switching – Circuit, Packet & Message, Telephone Network, Network Devices: Repeaters, Hubs, Bridges, Switches, Router and Gateway.

Data link Layer: Types of Errors, Error Detection – Parity, CRC & Checksum, Error Correction – Hamming Code,

Module – II [10L]

Data link Layer: Flow Control – Stop-n-Wait & Sliding Window Protocol, ARQ Techniques – Stop-n-Wait, Go-Back- N & Selective Repeat, Framing, Bit & Byte Oriented Protocol, HDLC, Point to Point Protocol (PPP), Token Ring, FDDI and Ethernet Protocols, Reservation, Polling, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA

Module – III [10L]

Network Layer: Internet Protocol (IP), IPv4 vs IPv6, ARP & RARP, IP Addressing – Classful & Classless, Subnetting, VLSM, CIDR. Routing - Techniques, Static, Dynamic & Default Routing, Unicast Routing Protocols - RIP, OSPF, BGP.

Module – IV [10L]

Transport Layer: Process to Process delivery; UDP; TCP; Congestion Control - Open Loop, Closed Loop, Quality of service, Techniques to improve QoS - Leaky bucket & Token bucket algorithm.

Application Layer Protocols: DNS, SMTP, FTP & DHCP.

References:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Kurose and Rose – " Computer Networking -A top down approach featuring the internet" – Pearson Education
5. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Advanced Java & Web Technology					
Course Code: INFO3203					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

1) Analyze and apply several kind of client side scripting (e.g : HTML, CSS and JavaScript).
2) Analyze and apply server side scripting using JSP..
3) Practice EJB, RMI and XML to implement J2EE at application level.

Detailed Syllabus:

Module-I: [8L]

*Static Web Pages:*Web Pages - types and issues, tiers; comparisons of Microsoft and java technologies, WWWBasic concepts, web client and web server, http protocol (frame format), universal resource locator (URL), HTML different tags, sections, image & pictures, listings, tables, frame, frameset, form.

*Dynamic Web Pages:*The need of dynamic web pages; an overview of DHTML, cascading style sheet (css), comparative studies of different technologies of dynamic page creation.

*Active Web Pages:*Need of active web pages; java applet life cycle, Java Swing.

Module-II: [7L]

*Java Script:*Data types, variables, operators, conditional statements, array object, date object, string object.

*Java Servlet:*Servlet environment and role, HTML support, Servlet API, The servlet life cycle, Cookies and Sessions.

Module-III: [12L]

*JSP:*JSP architecture, JSP servers, JSP tags, understanding the layout in JSP, Declaring variables, methods in JSP, inserting java expression in JSP, processing request from user and generating dynamic response for the user, inserting applets and java beans into JSP, using include and forward action, comparing JSP and CGI program, comparing JSP and ASP program; Creating ODBC data source name, introduction to JDBC, prepared statement and callable statement.

Module-IV: [13L]

*J2EE:*An overview of J2EE web services, basics of Enterprise Java Beans, EJB vs. Java Beans, basics of RMI, JNI.

XML: Extensible Markup Language (XML), basics of XML, elements and attributes, document type definition, XML parsers, sequential and tree approach.

References:

1. Web Technologies - Godbole A. S. & Kahate A., TMH.
2. Web Technology & Design - Xavier C., New Age Publication.
3. Java Server Programming, J2EE edition. (VOL I and VOL II); WROX publishers

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : E-Commerce & ERP					
Course Code: INFO3231					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Convert an e-commerce based business model into a live e-commerce system.

(2) Choose right kind of hardware and software platforms for the e-commerce system they are building.

(3) Evaluate and justify the system by testing it from different aspects.

(4) Understand the importance of 'integration' of different systems within an organization

(5) Understand the basic concepts of ERP systems for manufacturing or service companies, and the differences among MRP, MRP II, and ERP systems

(6) Employ the thinking in ERP systems: the principles of ERP systems, their major components, and the relationships among these components

(7) Define the major ERP components, including material requirements planning, master production scheduling, and capacity requirements planning

(8) Realize the importance of project management in an ERP implementation project

(9) Understand what to expect, and not to expect, from a consultant implementing an ERP system

Detailed Syllabus:

Module 1:

Electronic Commerce: Overview, Definitions, Advantages & Disadvantages of E – Commerce, Drivers of E – Commerce, Myths, Dot Com Era,E-business.

Technologies :Relationship Between E – Commerce & Networking, Different Types of Networking For E – Commerce, Internet, Intranet & Extranet, EDI Systems, Wireless Application Protocol: Defn. Hand Held Devices, Mobility &Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement For E – Commerce .

Electronic Data Interchange (EDI): Meaning, Benefits, Concepts, Application, EDI Model, EDIFACT standard, Internet EDI

Module 2:

Business Models of e – commerce: Model Based On Transaction Type, Model B ased On Transaction Party - B2B, B2C, C2B, C2C, E – Governance, m-commerce.

E – strategy: Overview, Strategic Methods for developing E – commerce.

B2B E-commerce: Collaborative Commerce

Supply Chain Management: E – logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, effect of different technologies on Supply Chain Mnagement.

Module 3:

E – Payment Mechanism: Payment through card system, E – Cheque, E – Cash, E – Payment Threats & Protections.

E – Marketing: Home –shopping, E-Marketing, Tele-marketing

Risk of E – Commerce: Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

Module 4:

Enterprise Resource Planning (ERP): Features, capabilities and Overview of Commercial Software, re-engineering work processes for IT applications, Business Modules: Finance, Manufacturing (Production), Human Resources, Materials Management, QualityManagement, Sales&Distribution ERP Package,

ERP Market: ERP Market Place, SAP AG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

ERP-Present and Future: Enterprise Application Integration (EAI), ERP and E-Commerce, ERP and Internet, Future Directions in ERP

References:

1. E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH
2. E-Commerce- The cutting edge of business by Kamlesh K. Bajaj, TMH
3. E-Commerce through ASP by W Clarke- BPB
4. Enterprise Resource Planning – A Managerial Perspective by D P Goyal, Tata McGraw Hill Education, 2011
5. Enterprise Resource Planning by Ashim Raj Singla, Cengage Learning, 2008

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Computer Graphics & Multimedia					
Course Code: INFO3232					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

(1) Demonstrate activities and applications of device dependant and independent color models, image representation techniques (raster and random graphics), activities of active and passive graphics devices and computer graphics software.

(2) Compare effectiveness of DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm, Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method.

(3) Implement 2D and 3D transformation techniques (translation, rotation, scaling, shearing, reflection)

(4) Analyze and implement curve and surface representation techniques using Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves algorithms

(5) Describe hidden surface representation using Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal – geometry

(6) Demonstrate activities and applications of device dependant and independent color models, image representation techniques (raster and random graphics), activities of active and passive graphics devices and computer graphics software.

(7) Compare between image (.bmp, .jpg, .gif, .tiff), audio (.wav, .midi, .mp3), text (.txt, .doc, .pdf) and video (.mpeg, .wmv, .swf) formats according to their way of representing data, merits and demerits.

(8) Demonstrate image, video, text analysis tools and techniques.

<u>Detailed Syllabus:</u>

Module I (8 Lectures)

Introduction to computer graphics & graphics systems, Overview & use of computer graphics & Multimedia, Image, Image Processing, representing pictures, preparing, presenting & interacting with pictures for presentations, Visualization & image processing; Color Models, lookup table, Histogram; Image representing hardwares: Cathod Ray Tube, LCD & LED Display devices, Scanner, Digital Camera. Gamma, Interlacing, properties of display devices, different image formats.

Scan Conversion: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Module II (10 Lectures)

2D transformation & viewing: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines.

Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method

Overview of 3D Transformation and Viewing

Module III (8 Lectures)

Curves [3L]: Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.

Hidden surfaces [3L]: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal -

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geometry.
Color & shading models [2L]: Light & color model; interpolative shading model; Texture.

Module IV (10 Lectures)
Text: Different types of text representation, Hypertext, text representation formats.
Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI
Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture
Animation: Techniques of 2D & 3D animation, formats of Animation
Image and Video Database:Image representation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- k-d trees, R-trees, quad trees; Case studies- QBIC, Virage. Video Content, querying, video segmentation, indexing.

References:

1) Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education
2) Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
3) D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
4) Ralf Steinmetz and Klara Nahrstedt , Multimedia: Computing, Communications & Applications , Pearson Ed.
5) Fred Halsall , Multimedia Communications , Pearson Ed.
6) Ralf Steinmetz and Klara Nahrstedt , Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing , PHI.
7) Ranjan Parekh, "Principles of Multimedia", TMH

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : System Software and Administration					
Course Code: INFO3233					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) To understand the basics of system programs like editors, compiler, assembler, linker, loader, interpreter, debugger how linker and loader create an executable program from an object module created by assembler and compiler.

(2) To understand the various phases of compiler and compare its working with assembler.

(3) Use multiple computer system platforms, and understand the advantages of each.

(4) Protect and secure users' information on computer systems.

(5) Install and manage disks and file systems.

Detailed Syllabus:

Module – I [10L]

System Software:

Assemblers - General design procedures, Design of two pass assemblers, Cross Assemblers, Macro Processors – Features of a macro facility, (macro instruction arguments, conditional macro expansion, macro calls within macros), Implementation of a restricted facility - A two pass algorithm; Macro Assemblers.

Loader schemes - Compile and go loaders, absolute loaders, relocating loader, Linking, Reallocation – static & dynamic linking, Direct linking loaders, Binders, Overlays, dynamic binders; Working principle of Editors, Debuggers.

Module - II [10]

System Administration - Duties of the Administrator, Administration tools, Overview of permissions.

Processes - Process status, Killing processes, process priority.

Starting up and Shut down - Peripherals, Kernel loading, Console, The scheduler, init and inittab file, Run-levels, Run level scripts.

Managing User Accounts - Principles, password file, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users.

Managing Unix File Systems - Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making filesystems, Superblock, I-nodes, Filesystem checker, Mounting filesystems, Logical Volumes, Network Filesystems, Boot disks

Module – III [10]

Configuring the TCP/IP Networking - Kernel Configuration; Mounting the /proc Filesystem, Installing the Binaries, Setting the Hostname, Assigning IP Addresses, Creating Subnets, Writing hosts and networks Files, Interface Configuration for IP, ifconfig, netstat command, Checking the ARP Tables; Name service and resolver configuration.

TCP/IP Firewall - Methods of Attack, Firewall, IP Filtering, A Sample Firewall Configuration using iptables.

Module IV [10]

IP Accounting - Configuring the Kernel for IP Accounting, Configuring IP Accounting, Using IP Accounting Results IP Masquerade and Network Address Translation, Configuring the Kernel for IP Masquerade, Configuring IP Masquerade.

The Network Information System - Getting Acquainted with NIS, NIS Versus NIS+ , The Client Side of NIS, Running an NIS Server, NIS Server Security.

Network file system - Preparing NFS, Mounting an NFS Volume, The NFS Daemons, The exports File.

System Backup & Recovery - Log files for system and applications; Backup schedules and methods (manual and automated).

Prof. (Dr.) Siuli Roy
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References:

1. L.L. Beck – “System Software “ (3 rd Ed.)- Pearson Education
2. Michel Ticher – “PC System Programming” , Abacus.
3. Kirch – “ Linux network Administrator’s guide (2 nd Ed.)” – O’Rielly
4. Maxwell – “Unix system administration” – TMH
5. Limoncelli –“The Practice of System & Network Administration”-Pearson

Course Name : Artificial Intelligence					
Course Code: INFO3241					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

(1) Define the different problems of AI , different search techniques, Heuristic search strategies, Adversarial search technique etc.

(2) Analyze the behavior of intelligent agents, the nature of environment, and the structure of agents and then differentiate among different intelligent agents: goal based agents, utility based agents, learning agents.

(3) Solving problems by Searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search etc.

(4) Compare among different Heuristic search strategies: Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, constraint satisfaction problems.

(5) Differentiate between Heuristic search strategies and Adversarial Search strategies.

(6) Construct different planning technique: Goal stack planning, Hierarchical planning, other planning technique

(7) Discuss different Forms of learning: inductive learning, Learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning

<u>Detailed Syllabus:</u>

Module-I: [10L]
Introduction:
Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Problem Solving: Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Module-II: [10L]
Search techniques: Solving problems by searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies: Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, constraint satisfaction problems, local search for constraint satisfaction problems. Adversarial search: Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning.

Module-III: [10L]
Knowledge & reasoning: Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation. Using predicate logic: Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules:
Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge. Probabilistic reasoning: Representing knowledge in an uncertain domain, Fuzzy sets & fuzzy logics.

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Module-IV: [10L]

Planning: Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques. Expert Systems: Representing and using domain knowledge, expert system shells, knowledge acquisition. Basic knowledge of programming language like Prolog & Lisp.

References:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS

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Course Name : Wireless & Mobile Computing					
Course Code: INFO3242					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

1. Identify the basic concept of wireless networks;
2. Analyse traffic theories, mobile radio propagation, channel coding, and cellular concepts;
3.Compare and contrast multiple division techniques, mobile communication systems, and existing wireless networks;
4. Classify network protocols, ad hoc and sensor networks, wireless MANs, LANs and PANs.

Detailed Syllabus:

Module-I: [8L]

Fundamentals of wireless communication and computer networking: Electromagnetic spectrum; Characteristics of wireless channel; Modulation techniques; Multiple access techniques; Voice coding; Computer network architectures (reference models)

Module-II: [14L]

Fundamentals of wireless LANs, PANs, WANs, MANs and Wireless Internet: IEEE 802.11, HIPERLAN standards; Bluetooth; HomeRF; Cellular concept and architecture; First, second, and third generation cellular networks; Wireless in local loop systems, standards, and future trends; Mobile IP; TCP over wireless; Wireless application protocol; Optimizing Web over wireless.

Module-III: [8L]

Ad hoc wireless networks: Issues and challenges in infrastructure-less networks; MAC protocols; Routing protocols; Multicast routing protocols; Transport and security protocols; Quality of service provisioning; Energy management.

Module-IV: [10L]

Hybrid wireless networks and wireless sensor networks: Architectures and routing protocols for hybrid wireless networks; Load balancing schemes; Pricing schemes for multi-hop wireless networks; Issues and challenges in wireless sensor networks: Architectures and routing protocols; MAC protocols; Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Recent advances in wireless networks: Wide Band (UWB) communication; Issues and challenges in UWB communication; Applications of UWB communication; Wireless Fidelity (Wi-Fi) systems; Issues in Wi-Fi Systems.

References:

1. Kaveh Pahlavan, Prashant Krishnamoorthy, Principles of Wireless Networks, - A united approach – Pearson Education.
2. Jochen Schiller, Mobile Communications, Person Education.
3. Wang and H.V.Poor, Wireless Communication Systems, Pearson education.
4. M.Mallick, Mobile and Wireless design essentials, Wiley Publishing Inc.
5. P.Nicopolitidis, M.S.Obaidat, G.I. papadimitria, A.S. Pomportsis, Wireless Networks, John Wiley & Sons.
6. T. S. Rappaport, "Wireless Communications: Principles & Practice," Prentice-Hall.

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7. Feng Zhao, Leonidas Guibas ,"Wireless Sensor Networks :An Information Processing Approach",Elsivier.
8. C. Siva Ram Murthy, B.S. Manoj ," Ad Hoc Wireless Networks: Architectures and Protocols", Pearson Education

Course Name : Pattern Recognition					
Course Code: INFO3243					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Analyze classification problem probabilistically and estimate classifiers (bayesian, kNN, ANN, K-means) performance.

(2) Design and compare the machine learning models (nearest-neighbor rule, linear discriminant functions, NN and SVM) and which model is appropriate for a problem or why it is not appropriate.

(3) Analyze the performance of different clustering algorithm (k-means, Fuzzy C means and EM) on big data set based on isclassification rate.

Detailed Syllabus:

Module – I [10L]

Introduction: Basics of pattern recognition, Design principles of pattern recognition system, Metric and Non-Metric Proximity Measures: Distance between Pattern Collections.

Bayes Decision Theorem: Bayes Classifier, Linear and non-linear Discrimination functions, Minimum error rate classification, Error probability.

Module – II [10L]

Parameter Estimation: Maximum-Likelihood estimation, Gaussian mixture models, Expectation-maximization method, Bayesian estimation, Hidden Markov model

Nonparametric Techniques: Parzen-window method, Nearest Neighbor method

Module – III [10L]

Nonlinear Classifier: Learning - Supervised and Unsupervised, Perceptron, Decision Tree.

Clustering: Process, Algorithms (basic hierarchical, Agglomerative, Partitional, K-means and Fuzzy C-means)

Module – IV [10L]

Feature selection: class Separability Measures – Divergence, Chernoff Bound & Bhattacharyya Distance, Scatter Matrices, Dimensionality reduction, similarity measures, feature selection criteria and algorithms, principal component analysis.

References:

1. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification, 2nd ed., Wiley.
2. J. T. Tou and R. C. Gonzalez: Pattern Recognition Principles, Addison-Wesley, London.
3. Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press.
4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.

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Head, Dept. of Information Technology
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Course Name : Data Analysis Laboratory					
Course Code: INFO3211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>After successfully completing this course the students will be able to:</u>

(1) Demonstrate the importance of preprocessing the given datasets.

(2) Design and implement classification algorithm to classify given problems using modern tools.

(3) Design and implement clustering algorithm to group the given attributes in a datasetusing modern tools.

(4) Demonstrate to find association rules for the given datasetsusing modern tools.

(5) Develop skills to design data warehouse for an enterprise.

<u>Detailed Syllabus:</u>

Introduction:

Setting up R and/or python with NumPy, mlpy/mdp.

Assignment 1:

Based on Data Acquisition, Cleaning and feature extraction. Obtain a dataset which has features in text instead of numbers. Generate a csv from it which contains only numeric fields.

Assignment 2:

K-Means on a dataset: Observe the effects on variation of the number of centroids and different centroid selection algorithms.

Assignment 3:

Creating a perceptron and learning until stability; learn different other models of pf ANN

Assignment 4+5:

Using libSVM dataset: Compare libsvm values (obtained using libsvm's exe distributed free on the site) against your own SVM. (In the industry, DA is used mainly to generate reports. Hence it is very essential to understand how comparative charts are created and read)

Assignment 6:

Hadoop Set-up for big data.

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Course Name : Computer Network Laboratory					
Course Code: INFO3212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>After successfully completing this course the students will be able to:</u>

(1) Develop the C programs to send the message among the computers using datagram and internet socket.

(2) Compare the time complexity of the stop-n-wait, go-back-N and selective repeat ARQ.

<u>Detailed Syllabus:</u>

1. NIC Installation & Configuration
2. TCP/UDP Socket Programming – Introduction
3. Sockets – Operation, Socket types, Domains, Closing Sockets
4. Client/Server Models - Usage
5. Connection Based Services - Client and Server actions
6. Connectionless Services - Client and Server actions
7. Access Network Database - Host Information, Network Information, Protocol Information

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Course Name : Advanced Java & Web Technology Laboratory					
Course Code: INFO3213					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>After successfully completing this course the students will be able to:</u>

1) Experiment and analyze several kind of client side scripting (e.g : HTML,XML, and JavaScript) and server side scripting (e.g : Servlet and JSP) languages.

2) Practice and apply EJB, RMI and XML to implement J2EE application.

<u>Detailed Syllabus:</u>

1. HTML
2. CSS [Inline, External]
3. JavaScript Control Structure JavaScript Events and Functions
4. JavaScript Validation and implementation in HTML Form
5. Servlet
6. JSP
7. JDBC for Database Connectivity using JSP
8. Java Applet and its implementation through JSP
9. Java Bean Creation
10. Basic Concepts of EJB and RMI and its implementation by creating Bean
11. XML Document Creation, DTD, Schema

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<table>
<tr><td colspan="6">Course Name : E-Commerce & ERP Laboratory</td></tr>
<tr><td colspan="6">Course Code: INFO3236</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>2</td></tr>
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After successfully completing this course the students will be able to:

(1) Create web pages using HTML, DHTML and Cascading Styles sheets.
(2) Create dynamic web pages using JavaScript and VBScript.
(3) Create interactive web applications using ASP.NET.
(4) Build web applications using PHP.
(5) Integrate standard database applications like Oracle, SQL Server to a web site.
(6) Convert an e-commerce based business model into a live e-commerce system.
(7) Choose right kind of hardware and software platforms for the e-commerce system they are building.
(8) Evaluate and justify the system by testing it from different aspects.

Detailed Syllabus:

1. Following E-Commerce experiments are to be implemented using either VB, ASP, SQL or JAVA, JSP, SQL.

2. Creating E-Commerce Site: Designing and maintaining WebPages. Advertising in the Website, Portals.

3. E-Commerce Interaction : Comparison Shopping in B2C, Exchanges Handling in B2B, Interaction Examples: Virtual Shopping Carts.

4. E-Commerce Applications : Online Store, OnlineBanking, Credit Card Transaction Processing

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Course Name : Computer Graphics & Multimedia Laboratory					
Course Code: INFO3237					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

(1) Apply the concept of Scan conversion algorithms to draw geometrical without help of graphics.h
(2) Compare efficiency of different computer graphics algorithms.
(3) Apply and Combine different Adobe Photoshop tools to edit images.
(4) Design Animation videos using Adobe Flash software.
(5) Develop web pages using HTML, DHTML and Java Script

Detailed Syllabus:

1) Implementation of line drawing algorithms
2) Implementation of circle & ellipse drawing algorithms
3) Implementation of area filling algorithms
4) Implementation of 2D transformation algorithms
5) Implementation of line clipping algorithms
6) Familiarization of image editing softwares and performing image editing using them
7) Familiarization of animation softwares and creating 2D animations using them
8) Web page design using HTML
9) Use of CSS and Java Script in Web designing

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Course Name : System Software and Administration Laboratory					
Course Code: INFO3238					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

(1) To understand and configure different servers in linux system.

(2) Use multiple computer system platforms, and understand the advantages of each.

(3) configure firewall to Protect and secure users' information on computer systems.

(4) Install and manage disks and file systems.

Detailed Syllabus:

1. Packet Monitoring software - tcpdump, snort, ethereal, Trace route, Ping, Finger, Nmap
2. Server configuration - FTP, DHCP, NFS, NIS, SMTP, DNS, SAMBA
3. IP Accounting
4. Firewalls, Security and Privacy - iptables
5. System Startup and Operation
6. Disk Partitioning and Filesystem Installation
7. Filesystem and Device Manipulation
8. Process and Log Analysis
9. Startup Scripts and Configuration Files
10. User/Group Security and Permissions
11. Backup
12. Scheduling Maintenance Functions
13. Implement assembly language instructions using C.

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Head, Dept. of Information Technology
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Subject Name: Chemical Reaction Engineering					
Paper Code: CHEN 3102					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

1. Ability to apply the basic knowledge that allows the students to solve chemical reaction engineering problems through logic.
2. Ability to utilize experimental data for predicting rate equation and to use this information in designing homogeneous single and combination of multiple reactors for specified conditions.
3. Ability to use principles of chemical reaction engineering for selecting and designing suitable contacting device for multiple reactions system. .
4. Ability to solve problems of mass transfer with reaction in solid catalyzed reactions.
5. Ability to differentiate between ideal and non ideal reactors using suitable model equations and to utilize the design strategies of non ideal reactors.
6. Ability to apply the concepts of RTD as a tool for designing and scale up industrial reactors.

Module I [10L]

Introduction; Definition of reaction rate; Kinetics of homogeneous reaction: Concentration- dependent term of a rate equation, single and multiple reactions, rate equation from given mechanisms.

Elementary & Nonelementary reactions, Molecularity and order of reaction, Representation of reaction rate, Kinetics for non elementary reactions, related problems, Temperature dependent term of a rate equation: Arrhenius law, Collision theory, Transition-state Theory, related problems.

Interpretation of batch reactor data: Constant-volume batch reactor, Integral method of analysis of data: General Procedure, Irreversible unimolecular-type first-order reaction, Irreversible bimolecular-type second-order reactions, rate equation for enzymatic reaction, Zero-order reactions, Over-all order of irreversible reactions from the Half-life method, Initial rate method of analysis.

Irreversible Reactions in parallel, Autocatalytic reactions, Irreversible reactions in series, First- order Reversible Reactions, Differential method of Analysis of data: Analysis of the Complete Rate Equation, Partial analysis of rate equation,

Variable-Volume reaction system: Its Integral method of analysis for Zero-order reactions, First order reaction, Second-order reactions;

Module II [10L]

Single ideal Reactors: Introduction; Basic division of ideal reactors, Ideal Batch Reactor, Concept of flow reactors, Space-time and Space-velocity,

Steady-state Mixed Flow Reactor: Design Equation, Graphical Representation of Design Equation, related problem;

Steady-state Plug Flow Reactor: Design equation, graphical representation, related problem;Design for Single Reactions: Size and comparison of single reactors: Batch Reactor, PFR, MFR, General Graphical Comparison;

Multiple-Reactor Systems: PFRs in Series and/or in Parallel, Equal-size MFRs in Series, MFRs of different sizes in Series, Determining the best size combination of reactor size for a given combination, Reactors of Different Types in Series, Recycle Reactor: Definition of Recycle Ratio, Design Equation, and Optimum Recycle ratio.

Module III [10L]

Design for Multiple Reactions: Introduction, Reactions in Parallel, Qualitative aspects of Product Distribution, Quantitative Treatment of Product Distribution and of Reactor Size: Definition of Instantaneous and Overall fractional yield, graphical representation; Reactions in Series: Successive First- Order Reactions, Product Distribution, Quantitative Treatment of PFR, MFR and Batch Reactor.

Solid-Catalyzed Reaction: Introduction; Basic idea of catalysis, Catalyst properties, Steps in catalytic reaction: Qualitative discussion on Pore Diffusion, Adsorption, Surface reaction and Desorption, Concept of Rate limiting step;

Design of reactors for gas-solid reactions: Design equation and data analysis of heterogeneous system; Quantitative aspects of Pore diffusion controlled reactions (single cylindrical pore, first- order reaction): Material balance for the elementary slice of catalyst pore, Definition of Thiele Modulus and Effectiveness Factor.

Different methods of catalyst preparation. Catalyst surface area and pore volume measurement

Fluid-Particle Reactions: Introduction; Different behavior of reacting solid particles; Selection of a Model; Qualitative discussion on Progressive Conversion Model & Unreacted Core Model;

Introduction to non isothermal reactions: adiabatic and temperature programmed reactions.

Module IV [10L]

Distribution of Residence Times for Chemical Reactors: General Characteristics; Residence- Time Distribution (RTD) Function;

Measurement of the RTD: Pulse Input; Related problems; Characteristics of RTD: Integral Relationships, Mean Residence Time, Different Moments of RTD; RTD in Ideal Reactor: RTD in Batch and PFR, Single CSTR, PFR/CSTR series RTD; Concept of Macromixing & Micromixing, Zero Parameter Model: Segregation Model & Maximum Mixedness Model.

Models for Nonideal Reactors: Introduction; One-Parameter Models: Tanks in Series Model, Dispersion Model: Basic Formulation, Definition of Peclet Number & Vessel Dispersion Coefficient, Boundary Conditions (Closed-Closed & Open-Open), Correction for Sloppy Tracer Input, Relation between Flow, Reaction and Dispersion.

Text Books :

1. Elements of Chemical Reaction Engineering, 4th. Edition, H. Scott Fogler, Prentice Hall.
2. Chemical Reaction Engineering, 2nd. & 3rd. editions, O Levenspiel.: Wiley Eastern Ltd.

Books of reference :

1. Chemical Reactor Analysis and Design Fundamentals, J. B. Rawlings and J. G. Ekerdt. Nob Hill Publishing.
2. Chemical Engineering Kinetics, 3rd. Edition, J.M. Smith, MGH.

3. Chemical Engineering Kinetics and Reactor Design, C.G. Hill, Wiley.
4. The Engineering of Chemical Reactions, 2^{nd}. Edition, L. D. Schmidt, Oxford.
5. Experiments in Catalytic Reaction Engineering, J. N. Berty, Elsevier.

Subject Name: Separation Process – II					
Paper Code: CHEN 3103					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcome:

1. Students will be able to illustrate the characteristics of saturated and unsaturated vapor-gas mixtures, dry and wet-bulb thermometry and to design humidifier.
2. Students will be able to classify different types of cooling towers and will be able to design height of cooling tower.
3. Students will be able to illustrate selectivity, choice of solvent during extraction and leaching and will be able to determine number of equilibrium stages by graphical method.
4. Students will be able to describe the concept of crystallisation along with the mathematical formulation of the process.
5. Students will be able to describe the concept of drying and its relation with humidification process.
6. Students will be able to classify different membrane separation and will be able to evaluate the merits of the process.

Module I : 10L

Humidification & Dehumidification Processes:

Introduction to Humidification and dehumidification operations, Characteristics of saturated and unsaturated vapor gas mixtures, Dry and wet bulb thermometry, Psychrometric chart, Adiabatic saturation curves, Psychrometric ratio, Gas liquid contact, Design of humidifiers, Dehumidification operation, Principle and design of cooling towers -Natural draft, forced draft and induced draft cooling towers.

MODULE II : 10L

Liquid-Liquid Extraction & Leaching:

Introduction to Extraction, Liquid- liquid equilibria, Triangular diagram, Selectivity and choice of solvents, Stage-wise contact, Co- current & counter-current extractor, Stage type extractors and differential extractors, Determination of number of equilibrium stages by graphical method for multistage extraction, Supercritical Fluid Extraction.

Introduction to leaching, General principle, Factors affecting the rate of extraction, Calculation of number of stages, Batch processes, Counter-current washing, Stage calculation methods.

MODULE III :10L

Drying & Crystallization**:**

Introduction to drying, Rate of drying, Batch drying mechanism, Time of drying, the mechanism of moisture movement during drying, Classification and selection of dryer, Batch dryer and continuous dryer.

Introduction to crystallization, Theory of Crystallization, Formation and growth of crystals, Crystal yield, Rate of crystallization, Crystallizers.

MODULE IV: 10L

Membrane Separation Processes:

Introduction to membrane separation processes, Classification of membranes and membrane processes, Dialysis, Ultra filtration- Concentration Polarization, Application of Ultrafiltration Process, Reverse Osmosis, Reverse osmosis in water treatment plant, Pervaporation, Electrodialysis, Membrane fouling, Liquid membrane.

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, McGraw Hill, International StudentEdition, 1981.
2. Principles of Mass Transfer and Separation Processes, Binay K. Dutta, Prentice Hall of India, 2007.
3. Transport Process and Unit Operations: Christie J. Geankoplis. 3rd Edition., 1993, Prentice Hall of India.

References:

1. Separation Processes: King, C. J., McGraw Hill, Chemical Engineering Series.
2. Separation Process Principles, 3rd Edition, J.D. Seader, Earnest J. Henley, D. KeithRoper, 2010.
3. Unit Operations in Chemical Engineering: Mc Cabe and Smith, Harriot., McGraw Hill, Seventh Edition.
4. 4.Coulson and Richardson's Chemical Engineering, Volume 2, Fifth Edition, J. F.
5. Richardson and J.H. Harker with J.R. Backhurst, Pergamon Press.
6. Perry's Chemical Engineers' Handbook, , 8th Edition, McGraw Hill.

Subject Name: Numerical Methods of Analysis					
Paper Code: CHEN 3104					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcome:

After completion of the course the students will be able to

1. Given a mathematical problem to be solved numerically, students should be able to identifydifferent computational errors and evaluate them. Students should know how to perform numerical interpolation, numerical integration and find relative and absolute error in each case.
2. Given an engineering problem that can be mathematically modeled using linear algebra, students will be able to relate the dependent and independent variables to define the final equation. Students will be able to identify the broad category of numerical method to solvethe corresponding mathematical problem.
3. Given an non-linear engineering problem requiring single or simultaneous equation, studentsshould also be able to select the appropriate numerical algorithm to solve for roots of the equation. In case the algorithm does not converge, students should identify the source of problem and be able to solve for converged values.
4. Given an engineering problem that can be modeled through ordinary differential equation,students will be able to select appropriate numerical algorithm (e.g Euler or Runge Kutta method etc.) to determine the dynamic or spatial changes in the dependent variables undergiven initial/boundary conditions.
5. Given an engineering problem that can be modeled using partial differential equations (PDE),students will be able to identify the type of PDE and its associated boundary conditions. Students should develop the numerical form of the governing equation by applying principlesof numerical differentiation.
6. Given a problem as in 5, students will be able to predict values of dependent variable (e.g.Temperature as a function of time and position as in the case of heat conduction in a linearrod) for various types of initial and boundary conditions.

Module I: **10L**

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.

Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation.

Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding errorterms.

Module II: **10L**
Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion,LU Factorization method, Gauss-Seidel iterative method.
Bisection method, Secant method, Newton-Raphson method.

Module III: **10L**
Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods,Predictor-Corrector methods.

Module IV: **10L**
Numerical Differentiation – Forward and Backward difference algorithms, First and Secondorder derivatives. Finite Difference methods for Boundary Value Problems, Parabolic PDEs.

Textbook:
1. Numerical Methods for Engineers – R. Chapra and S. Canale, Sixth Edition 6thEdition, McGraw-Hill Science/Engineering/Math, 2009.

Reference:
1. Mathematical Methods in Chemical Engineering – V.G. Jenson and G.V. Jeffreys,Academic Press, 2^{nd} Edition.

Subject Name: PEDD- I					
Paper Code: CHEN 3112					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**3**

Course Outcome:

After completion of the course students will be able to

1. understand the concepts of pressure vessel and reactor along with their applicability.
2. understand of process equipment accessories and support systems.
3. design pressure vessel and reactor along with the cooling coil arrangement.
4. design horizontal pressure vessel with saddle support and various parts of vessels (e.g. heads, nozzels etc.).
5. design vertical reactor with lug support, spiral cooling coil, gasket and various parts of vessels (e.g.heads, nozzels etc.).
6. understand the procedure with proper scale to draw the aforesaid equipments using AUTOCAD.

Designs to be performed:

1. Design and Drawing Pressure Vessel - thin and thick cylinder design, design of cylinder head, cover plate, selection of gasket, design of bolt and flange.

2. Design and Drawing of Reactor.

Each student shall be allotted design problems on sl. no 1& 2 at the beginning of the 5th semester and the student shall carryout complete process and mechanical design under supervision of a faculty. The student shall also prepare engineering drawing of the equipmentand submit two copies of the design report in tight and bound form 7 days before commencementof 5th semester examination. Assessment would be made on the basis of the submitted report andthe viva voce examination conducted by a board of examiners constituted by the Departmental Academic Committee consisting of two faculty members and class teachers with Head of the Department as Chairman during 5th. Semester examination.

Text Book / References:

1. Process Equipment Design – Brownell and Young, John Wiley and sons.
2. Chemical Engineering Design, Fourth Edition: Chemical Engineering Volume 6 (Coulson & Richardson's Chemical Engineering) 4th Edition - by R K Sinnott (Author), Butterworth-Heinemann; 4 edition.

Subject Name: Chemical Reaction Engineering Laboratory					
Paper Code: CHEN 3113					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

1. Students will be able to draw concentration vs. time curve and determine the rate constant for a homogeneous liquid phase reaction in a batch reactor.
2. Students will be able to determine the rate constant for a homogeneous liquid phase reaction in a semi-batch reactor.
3. Students will be able to determine the rate constant, reaction rate, conversion and residence time for a non-catalytic homogeneous reaction in an isothermal CSTR.
4. Students will be able to determine the rate constant, residence time and conversion for a non-catalytic homogeneous reaction in an isothermal PFR (coiled type).
5. Students will be able to determine the rate constant, residence time and conversion for a non-catalytic homogeneous reaction in a packed bed reactor (coiled type).
6. Students will be able to determine the rate constant and equilibrium adsorption constant for a heterogeneous catalytic reaction in an U.V. photoreactor.
7. For a non-catalytic liquid phase reaction in a coiled PFR, students will be able to plot the concentration vs. time curve, exit age distribution curve and will be able to determine the mean residence time and axial dispersion coefficient for pulse input of tracer.

(At least eight experiments are to be performed)

Experiments:

1. Experimental studies on kinetics of a non catalytic homogeneous liquid phase reaction in an isothermal batch reactor.
2. Experimental studies on kinetics of a homogeneous liquid phase reaction in an isothermal semi batch reactor.
3. Experimental studies on kinetics of a non catalytic homogeneous liquid phase reaction in a Spiral plug flow reactor.
4. Experimental studies on kinetics of a non catalytic homogeneous liquid phase reaction in an isothermal CSTR.
5. Experimental studies on kinetics of a non catalytic homogeneous liquid phase reaction in a packed bed reactor.
6. Experimental studies on RTD in a tubular PFR using pulse input of tracer and measurement of axial dispersion coefficient.
7. Experimental studies on kinetics of a heterogeneous catalytic reaction in a UV photoreactor.
8. Experimental studies on RTD in a packed bed reactor using pulse input of tracer and measurement of axial dispersion coefficient.
9. Experimental studies on kinetics of hydrolysis of ethyl acetate in presence of acid catalyst in an adiabatic batch reactor.

10. Experimental studies on kinetics of sulfonation of toluene in an isothermal batch reactor.

Subject Name: Polymer Science & Engineering					
Paper Code: CHEN 3131					
Contact	**L**	**T**	**P**	**Total**	**Credit Points**
Hours PerWeek	**3**	**0**	**0**	**3**	**3**

Course Outcome:

1. The students will learn the principles of polymerisation and will be prepare organic polymeric materials in the laboratory and characterise the structure nad composition ofthe polymers.
2. The students will be able to identify and control the mechanism of polymerisation processes and properties of versatile polymeric materials in the industry and R&D activities.
3. The students will learn and apply the understanding of polymer processing techniques like Injection Molding, Blow molding, compression molding, extrusion molding etc and follow the process to make polymer articles in the industry.
4. The students will be exposed to the knowledge of developing biodegradable and bio-compatible polymers for maintaing ecology of the soil.
5. The students will learn various types of polymer composites to develop new materials.
6. The students will be knowledgeable in identifying and controlling the use of hazardous behaviour of plastics in the industrial applications and social applications, particularly heath issues.

Module I: 10 L

Definitions and concepts of terms used in polymer engineering, Classification of polymers; Polymer structures, functionality; polymerization reactions – mechanism of polymerization; stereospecific polymerization, copolymerization.

Introduction to nano-polymers: Characterisation techniques: XRD, FESEM and AFM

Module II: 10 L

Polymerization reactors, polymerization processes, characterization of polymers: DSC, DTGA, DMA, Creep Test analysis of polymerization reactions, polymer degradation.

Module III: 10 L

Molecular weight and molecular weight distribution in polymers, properties of polymers –physical, chemical, mechanical and electrical properties of polymers, elementary idea on polymer rheology, polymer blends.

Module IV: 10 L

Polymer processing: modeling – compression & transfer, injection & jet; casting; extrusion,calendaring, lamination, spinning & finishing.

Text Books:

1. Text Book of Polymer Science, 2nd Ed., F. W. Billmeyer, Jr., Wiley–Interscience, New York, 1971.
2. Polymer Science & Technology, P. Ghosh, Publisher: McGraw Hill Education (India) Private Limited; edition (26 November 2010)

References:

1. The elements of Polymer Science & Engineering, Alfred Rudin, Academic Press, 2nd Edition, 1999
2. Introduction to Polymers, 2nd edition, by (second edition) R. J. Young and P. A. Lovell Chapman and Hall, London, 1991.

Subject Name: Petrochemical Technology					
Paper Code: CHEN 3132					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

1. Students will understand the variety of petrochemical feedstocks and products
2. Students will understand the role of petroleum as energy source amidst world energy scenario.
3. Students will learn the design and operation of petrochemical complexes.
4. Students will familiar with major polymerization processes on industrial scale.
5. Students will gather the knowledge of various process technologies for Fibers, Elastomers and resins.
6. Students will motivate themselves towards innovations

Module I : 10L

Evolution of petrochemical industry in India, recent trend of petrochemical industry in India, Petrochemical industry feedstock: overview of petroleum refinery industry and its product, natural gas processing; impurities in feedstock for petrochemical industry and the process of their removal.

Synthesis gas production and its use: Steam reforming operation of Naphtha and natural gas, fuel oil partial oxidation method, Methanol production, synthetic liquid fuel production by Fischer- Tropsch process, aldehyde and alcohol production from synthesis gas, ammonia production and its application.

Module II : 10L

Steam cracking operation of naphtha and C2 to C4 saturates, downstream separation scheme of naphtha cracking. Manufacture of Petrochemicals based on Ethylene: EDC, VCM, VAM, Ethylene oxide, Ethanol amine Manufacture of Petrochemicals based on Propylene: Acrylonitrile, Acrolein, Propylene oxide, glycerine (acrolein route, allyl chloride route, propylene oxide route), Isopropanol Production of Butadiene from C4 cut.

Module III : 10L

Catalytic reforming of naphtha, catalyst and process variable of BTX reformer, separation of Benzene, Toluene and Xylene from BTX reformate, pyrolysis gasoline hydrogenation and separation of aromatics, separation of meta xylene from mixed xylenes, alkylation of benzene, production of styrene, cumene and phenol, production of Phthalic anhydride. Synthetic detergent and its classication, production of linear alkyl beanzene and keryl benzene sulfonate from kerosene cut, additives for detergent.

Module IV : 10L

Overview of plastic industry: Production of LDPE, LLDPE, HDPE, PP, PVC, Polystyrene and their application. Comparative study of Plastic, fibre and elastomer; production of SBR, Butadiene rubber, production of ABS plastic, polyamide, polyester, acrylic fibre, polycarbonates, production of phenol-formaldehyde resin; overview of polymer processing.

Text Books:

1. A Text on Petrochemicals: B.K.B. Rao, Khanna Publishers, 2011, ISBN 9788174090447 / 8174090444
2. Advanced Petrochemicals: Dr. G. N. Sarkar, Khanna Publishers, 2008, ISBN 8174090967
3. Introduction to Petrochemicals, Sukumar Maity. Oxford and IBH Publishing Co, 2002 ISBN 8120415558

References:

1. The Petroleum chemicals Industry: R. F. Goldstein and A. L. Waddams, E & F N Spon (An imprint of Routledge), 1967, ISBN 0419025308.
2. Petrochemical processes: Chauvel , Gulf Publishing Co, 1989, ISBN 0872017729.

Subject Name: Material Science & Engineering					
Paper Code: CHEN 3133					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

1. The students will be able to understand the basics of materials science and be familiar with all types of engineering materials and able to determine the crystal structure by XRD technique and properties used in engineering & technology development works.
2. The students will be able to apply the knowledge in correlating the material processing techniques to the materials structures, in turn to the properties and ultimately performance or applications of the materials and also to stengthen or improve the properties of materials for better quality.
3. The students will be able to identify any structural defects of the materials used in emgineering applications at micreo oe macro level and take corrective actions accordingly in the processing techniques or by introducing other processing techniques like heat treatment of metals or curing techniques of polymer, rubber etc.
4. The students will acquire adequate understanding about the phase diagramm of different valuable and commonly used alloys and materials in engineering and do necessary modifications in the composition of the materials like pure metals, alloys like steel, brass etc, polymeric materials, ceramic and composites like FRP, RC casting, Plywood boards, high performance cutting tools, Cermets etc.
5. The students will be knowledgable in eliminating or introducing structural defects or foreign elements in the original crystal lattice of the materials like preparation of innovative alloys, p & n - type semiconductors, piezoelectric materials etc so as to tailor the properties of the materials according to requirement.
6. The students will acquire basic knowledge about extraction processes of ferrous and nonferrous metals from the naturally occuring ores and deposits and shall be fit for working in metallurgical laboratories and manufacturing industries.

Module I: 10L

Structure of materials-Various types of bonds; Crystalline Structure of Solids- concepts of unitcell and space lattice, packing factor;
X-ray diffraction for determining crystal structure; Mechanical properties: Strength, hardness, toughness, ductility, brittleness of Engineering Materials**;** Elastic, Anelastic and visco-elastic behaviour of materials; Electrical, Electronic, Optical & Optoelectronic properties of material; Inorganic & organic amorphous materials and their structural & property characteristics; Optical fibers.

Module II: 10 L

Mechanism of plastic deformation, slip and twinning, structural imperfections: elementary concepts of point, line, surface & volume imperfections; Influence of dislocations/Line imperfections on the mechanical properties of materials; Strain hardening and recrystallisation; Elementary aspects of creep, fatigue, fracture; Phase Diagrams- Solidification and structure of metals, Grain boundaries; Phase equilibrium and phase diagrams of binary alloys; Phase diagram of ternary systems; Iron-Carbon diagram; Heat Treatment –Introduction and purposes of heat treatment; T-T-T diagram; Corrosion-Concepts and forms of corrosion; Corrosion Mechanism and prevention; Protective materials and coating.

Module III: 10 L

Basic principles of metal extraction: Pyrometallurgy: Smelting, calcinations, roasting—oxidizing, predominance area diagrams, multiple hearth, flash and fluo-solid, sintering, smelting, slag and its classification.

Steelmaking process flow diagram: Iron making (Operation involved in Blast furnace)– Steel making (oxygen blown converter –LD) – Secondary steel making / refining (ladle processing, vacuum degassing, ladle furnace processing) – Continuous casting – with emphasis on application of the concepts of physicochemical principles involved, moving/packed bed reactor, gas-liquid two-phase flow, heat transfer with phase change (solidification).

Module IV: 10 L

Principles of Hydrometallurgy and Electrometallurgy, Extraction of Aluminum: Hall-Heroult process, Electrolytic refining; Sources of Zinc & Copper: Pyro & Hydro metallurgical extraction of copper & Zinc; Extraction of Lead, Recent development in Lead smelting.

Text Books:

1. Raghavan, V. Material Science and Engineering, (5th Edition) V. Raghavan Prentice-Hall of India Pvt. Ltd., 2004;
2. Ray, Sridhar & Abraham. Extraction of non ferrous metal, 1985, EWP, New Delhi.
Sevryukov N.,

References:

1. Elements of Material Science and Engineering, by Lawrence, H. Vanvlack; Published by Pearson Education, 1980.
2. Engineering Physical metallurgy; Lakhtin, Y. Published by MIR Publishers, Moscow, 1975.
3. The Reduction of Iron Ores, by L. Von Bogdandy and H.J Engell Published by Springer- Verlag, New York.
4. Engineering in Process Metallurgy, by R.I.L Guthrie Oxford University Press (Paperback edition 1992).

Subject Name: Process Dynamics, Instrumentation and Control					
Paper Code: CHEN 3201					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

After completion of the course the students will be able to:

1. Explain the basic principles & importance of process control in industrial process plants.
2. Specify the required instrumentation and final elements to ensure that well-tuned control is achieved.
3. Explain the use of block diagrams & the mathematical basis for the design of control systems.
4. Knowledge on the use of Laplace transform in the control system for different forcing function.
5. Explain the importance and application of good instrumentation for the efficient design of feedback and feed forward control system.
6. Knowledge on the control strategies for different control configuration and controller tuning.

Module I [10 L]

Introduction: Principles of measurement. Error Analysis, Static and dynamic characteristics of instruments.

Temperature measurement: Filled system Thermometer, Thermocouples, Resistance Thermometers, radiation and optical pyrometers;

Pressure: Manometers: U tube manometer, inclined limb manometer, Ring balance manometer, Elastic deformation: bourdon, bellows, diaphragm and electrical type gauges: strain gauge, piezoelectric, pressure transducers.

Vacuum gauges: mechanical, electrical and ionization types;

Flow: Head flow meters, area flow meters, positive displacement flow meters, mass and magnetic flow meters;

Level: Direct and inferential type; composition.

Module II [10L]

Introduction to process control, Use of Laplace transforms in process control, Different forcing functions: Step, Pulse, Impulse, Ramp, Sinusoidal and frequency inputs & their graphical representation.

First order system; Transfer function; Examples of First Order Systems, Pure capacitive system, Response of different forcing functions; First order systems in series- non- interacting & interacting. Second order system- Under- damped, critically damped & over damped, Second order system examples - Damped vibrator, Control valve, U-tube manometer, terms related to under damped system, Transportation lag.

Module III [10 L]

Feedback control loop and its components, advantages and disadvantages of feedback control system Simple process models and their transfer functions**:** stirred tank heater, continuous stirred tank reactor, heat exchanger, distillation column, U-tube manometer.

State-space representation of linear systems.

Different types of controllers and their applications: P, PI, PD, PID & their transfer function, servo and regulatory control, transient responses of feedback control systems.

Block diagram: Block diagram of different chemical process units, block diagram reduction, open loop & closed loop transfer function, concept of poles and zeros.
Control valves: construction, types of control valves, characteristic curves & transfer function, valve sizing, applications.
Elementary idea of feed forward, cascade, ratio control.

Module IV [10L]
Definition of stability, concept of bound and unbound function.
Stability Analysis of Feedback control systems: Routh-Hurwitz stability criterion, Direct Substitution method, Root Locus Analysis, Frequency response analysis, Bode plot and Bode stability criterion, Nyquist stability criteria.
Performance Criteria for good control (ISE, ITAE, IAE etc), concept of empirical process models, development of empirical process models: FOPDT, SOPDT etc and evaluation of their performance, Process reaction curve method, Zeigler-Nichols and Cohen Coon controller tuning rules, and determination of controller settings.
Adaptive & digital control, concept of PLC & DCS.

Text books:

1. Process system analysis & Control-D.R. Coughanowr, McGraw-Hill, Inc., 2nd ed., 1991.
2. Chemical Process Control: An Introduction to Theory and Practice-George Stephanopoulos, pHI, 1st ed., 1984.
3. Industrial Instrumentation-D. P. Eckman, Wiley Eastern Ltd., 1st ed., 2004.

Books of reference :

1. Principles of Industrial Instrumentation-D. Patranabis, Tata McGraw Hill, Publishing Ltd., 1st ed., 1999.
2. Process Dynamics and Control-D.E. Seborg, T.F. Edgar, and D.A. Mellichamp, John Wiley & Sons,2nd ed., 2004.
3. Industrial Instrumentation Fundamentals-A.E. Fribance, McGraw-Hill, Kogakusha, 1962.
4. Process Control Modelling, Design and Simulation-B. Wayne Bequette, Prentice Hall, 1957.
5. Process Modelling, Simulation and Control for Chemical Engineers-William L. Luyben, McGraw Hill, 1990.

Subject Name: Project Engineering					
Paper Code: CHEN 3202					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. The students will be able to understand the basics of project engineering and aply that to organise the activities of project engineering including the plant & equipment deign and economic analysis for the project.
2. The students will be able to apply cost and profitability analysis for the project under considerations and study the preliminary feasibility of the project.
3. The students will be able to implement innovative ideas to optimisation of the plant design componenets in regard to requirement of energy , time and ultimately cost.
4. The students will be able to apply energy integration techniques (pinch technology) to reduce the external energy supply in addition to that generated in the process.
5. The students will be able to prepare network of activities involved in project for plant design or other business processes and critically examine the schedule for the completion of the project and cost impacts for the project.
6. The students will be able to carry out the final feasibility study and and economic assessment for the design of a new plant or expanding an existing business by taking recourse to critical path method or project eavaluation & review technique for reporting the success of the project.

Module I: 10L

Role of a Project Engineer, Development of Laboratory bench scale experiment to pilot & semi- commercial plant operation, scale up and scale down techniques, pre-design cost estimations, fixed capital and working capital, manufacturing cost, plant location and plant lay out, plant utilities, safety measures.

Time value of money, simple interest, nominal and effective interest rates, compound and continuous interest, present worth and discount, annuity, perpetuity and capitalized costs, Pay outperiod.

Module II: 10L

Depreciation: Types of depreciation, Depletion, concepts of service life, salvage value, and book value, straight-line method, Declining balance method, sum of the years digit method and sinking fund method for determination of depreciation, modified accelerated cost recovery system (MACRS),

Sulagna Chatty

Alternative investment, Choices among various alternatives, Replacements, Methods of profitability evaluation for replacements, Return on investment, Net present worth (NPW),

Discounted cash flow rate of return (DCFR), Effect of inflation on profitability, income taxes, GDP and national growth..

Module III: 10L

Optimum Design and Design strategy: Basic principle of Optimum Design, general procedure for determining optimum conditions, Breakeven analysis, Optimum production rate in plant, determination of optimum economic pipe diameter and optimum flow rate in condenser, minimum cost analysis, economics in selection of materials.

Basic concepts of process integration, Pinch analysis.

Module IV: 10L

Project scheduling: Bar chart, Milestone chart, Concept of network analysis: Numbering network, PERT, CPM, statistical distribution associated with PERT network, Earliest expected time and latest allowable occurrence time calculation, Slack, determination of critical path, concept of float.

Text Book:

1. Plant Design and Economics for Chemical Engineers -- Peters and Timmerhaus andWest, Mc Graw Hill, 5th Ed., 2003
2. PERT and CPM – Principles and Applications, Affiliâted East West, 3rd Ed., 1989

References:

1. Chemical Engineering Design – Coulson and Richardson, Volume 6, Elsevier, 5th Ed., 2009

Subject Name: PEDD II					
Paper Code: CHEN 3211					
Contact	**L**	**T**	**P**	**Total**	**Credit Points**
Hours PerWeek	**0**	**0**	**4**	**4**	**3**

Course Outcome:

After completion of the course students will be able to

1. understand the basics of process equipment design and important parameters of equipment design.
2. understand of process equipment accessories & support systems.
3. design different types of heat exchangers including condenser, boiler, shell and tube heat exchanger
4. design special vessels (e.g. tall vessels) and various parts of vessels (e.g. heads, nozzels etc.).
5. design different flow measuring devices like venturimeter, orifice-meter etc.
6. understand the operation of process equipment like heat exhangers, flow measuring devices anddraw different sectional view of them using AUTOCAD.

1. Design and Drawing of Heat Exchanger.

2. Design and Drawing of Orifice meter / Venturi meter/ Rotameter (Anyone).

Text Book / References:

1. Process Equipment Design – Brownell and Young, John Wiely and sons.

2. Chemical Engineering Design, Fourth Edition: Chemical Engineering Volume 6 (Coulson & Richardson's Chemical Engineering) 4th Edition - by R K Sinnott (Author), Butterworth-Heinemann; 4 edition.

Sulagna Chatterjee

Subject Name: Numerical Methods Laboratory					
Paper Code: CHEN 3212					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcome:

After completion of the course the students will be able to

1. **Illustrate** the basics of MATLAB or equivalent software programming.
2. **Develop** the logic for the chosen numerical method.
3. **Build** MATLAB or equivalent software code to apply the logic.
4. **Inspect** written code for syntactical and logical error.
5. **Assess** the code to obtain correct solutions after correcting the errors.
6. **Compile** the final outcome of the given problem with expected result either in numeric or ingraphical representation.

Module- I: Numerical Methods (Programming language: Matlab)

1. Solution of Linear System by Gauss Elimination method and Gauss-Seidel iterative method: Steadystate solution of isothermal CSTR in Series in which a first-order reactionis taking place.
2. Solution of a non-linear equation by Newton-Raphson method.

3. Solution of a set of non-linear equations by Newton method: steady-state solution ofa non-isothermal CSTR in which a first-order reaction is taking place.

4. Solution of one-dimensional unsteady state heat conduction problem using Taylor series based Finite Difference Method – Explicit scheme, Implicit scheme using Tri-diagonal Matrix Algorithm (TDMA).
5. Numerical solution of ODEs by Runge-Kutta method : Unsteady-state solution of Multiple reactions in a CSTR or Binary distillation column.

Subject Name: Nanotechnology					
Paper Code: CHEN 3231					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

After completion of the course the students will be able to

1. Exhibit knowledge of the fundamentals of solid state physics, lattice and atomic structure, energy bands and different types of bonding in matter.
2. Classify the various types of process used in nano-manufacturing of 1D, 2D and 3D nanostructures
3. Identify the processes necessary to build a particular nano structure.
4. Exhibit knowledge of the relevant physical, chemical, mechanical, electrical and optical properties of materials in nano configuration.
5. Exhibit understanding and decide on measurements and instruments used for characterizing ananomaterial.
6. Construct the processing steps and identify materials necessary to build a particular nano structure.

Module I : 10 L
Introduction to the physics of solid state; Structure & Bonding.Elements of nanoscience & nanotechnology.

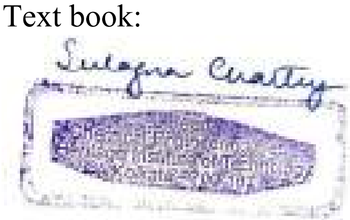
Module II : 10 L
Synthesis of nanomaterials: General approaches, Physical Methods, Chemical Methods &Biological Methods;

Properties of nanomaterials: Mechanical, Structural, Thermal, Electrical & Optical properties.

Module III : 10 L
Characterization techniques of nanomaterials: Microscopy; Spectroscopy; & Diffraction techniques; Some special nanomaterials: Carbon nanotubes, Porous silicon, Zeolites, Aerogels,Core-shell nanoparticles.

Module IV : 10 L
Application: Nanolithography, Nanocomposites, Nanoparticles as catalyst, conductingpolymers; nanotechnology: DNA Nanowires, Nanomedicines

Text book:



1. NANOTECHNOLOGY: Principles & Practices; Sulabh K. Kulkarni, SpringerInternational Publishing, 2015

Subject Name: Bioprocess Engineering					
Paper Code: CHEN 3233					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Ability to solve biochemical reaction engineering problems through logic.
2. Ability to utilize experimental data for predicting rate equation for both enzymatic and live cell fermentation process.
3. Ability to design bioreactors for free enzymatic reaction under enzyme uninhibited/inhibited conditions.
4. Ability to use principles of bioprocess engineering for selecting and designing suitable contacting device for immobilized enzyme reactions under mass transfer/bioreaction control condition.
5. Ability to select suitable bioreactor and its design and scale up for whole cell catalyzed reactions.
6. Ability to apply suitable modern separation techniques for isolation, purification and quantitative separation of target bio molecule from live cells.

Module I [10 L]

Principles of enzyme catalysis Proteins as enzymes; Michaelis-Menten kinetics; Briggs Halden theory Kinetics and Statistics; Inhibition; Effect of pH and temperature; Enzymology; methods of immobilization, diffusional limitations in immobilized enzyme systems.

Module II [10 L]

Microbial growth Introduction to metabolism; Nutrient transport; Glycolysis; TCA cycle and other pathways; Control of metabolism; Factors affecting microbial growth; Stoichiometry: mass balances; Stoichiometry: energy balances; Growth kinetics; Measurement of growth.

Agitation and aeration**:** types of impellors and sparger, oxygen transfer rate, oxygen uptake rate, volumetric oxygen transfer rate (kLa), measurement of k_La, power requirement for agitation in gaseous and non gaseous systems.

Module III [10L]

Bioreactors Introduction to bioreactors; Batch and Fed-batch bioreactors, Continuous bioreactors; Immobilized cells; Bioreactor operation; Sterilization; Aeration; Sensors; Instrumentation; Culture-specific design aspects: plant/mammalian cell culture reactors.

Scale up, operation and control of bioreactors**:** Concepts of various bioreactor configurations, scale-up, various criteria for scale-up, scale-down, bioreactor instrumentation and control.

Module IV [10 L]

Bioseparations Biomass removal; Biomass disruption; Membrane-based techniques; Extraction; Adsorption and Chromatography.

Industrial Processes and Process economics Description of industrial processes; Process flow sheeting; Process economics.

Subject Name: Seminar I					
Paper Code: CHEN 3221					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**0**	**0**	**2**

A Seminar topic will be allotted to individual student according to his/her subject of interest. A thorough report should be prepared based on which seminar presentation and question-answer session will be conducted. Assessment of the student would be done by the faculty members on the basis of presentation, performance in the question - answer session and the report submitted, giving equal weightage on each component.

Seminar Courses will enable the student to carry out independent review of existing and novel developments in Chemical Engineering Science. The courses will also enable them to develop presentation and communication skills.

Subject Name: Design of Heat Transfer Equipments					
Paper Code: REEN5141					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module1: [10L]

Fundamentals of heat transfer: steady state heat conduction through plane wall, composite wall, heat transfer resistance in series and parallel, conduction with heat generation, convective resistance, critical insulation thickness, steady state heat conduction through extended surface, fin efficiency, dimensionless number for convection, empirical correlation for free and forced convection. Correlation of heat transfer coefficient for condensation and boiling

Module 2: [10L]

Classifications of heat exchangers, overall heat transfer coefficient, LMTD and LMTD correction factor, fouling factors, Effectiveness and number of transfer unit of heat exchangers, sizing and rating problems of heat exchanger design. Flow and stress analysis: Effect of turbulence, friction factor, pressure loss, stress in tubes, header sheets and pressure vessels design, thermal stresses, shear stresses - types of failures.

Module 3: [10L]

Kern method of Heat Exchanger Design: Double-pipe heat exchanger, shell and tube heat exchanger, condenser and boiler design. Details of shell and tube heat exchanger construction. Design and construction of furnace, recuperator, regenerator and economiser. Heat exchanger network and its optimization.

Module 4: [10L]

Types of Compact heat exchanger, merits and demerits, design of compact heat, exchangers, plate type heat exchangers, performance influencing parameters, limitations, Design of surface and evaporative condensers, cooling tower, performance characteristics.

Text/ Reference Book:

1. Process Heat transfer by D.Q. Kern Tata McGraw-Hill Education, 1997
2. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1988
3. Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice,

McGraw- Hill Book Co. 1980.

4. Fundamentals of Heat Exchangers Design by Ramesh K. Shah and Dusˇan P. Sekulic
John Wiley & Sons, Inc., 2003

Subject Name: Internship					
Paper Code: REEN5221					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**0**	**0**	**2**

Students will be sent for training to an industry for a period of 4 to 6 weeks after completion of 1st Semester examination. After completion of the training the students will submit a comprehensive report consisting of general overview of the plant, process description of with process flow diagram, details of different equipments with specifications, process instrumentation and control, product with production capacity, raw materials utility and energy consumed per unit of product**.** Assessment would be made on the basis of the submitted report and the viva voce examination conducted by a board of examiners constituted by the Departmental Academic Committee consisting of two faculty members and training coordinator with Head of the Department as Chairman during 2nd Semester examination

Subject Name: Seminar -II					
Paper Code: REEN5222					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

A Seminar topic will be allotted to individual student according to his/her subject of interest. The seminar topic must be different from the topic already presented in Seminar-I. Topic of the seminar should not be on internship training. A thorough report should be prepared based on which seminar presentation and question- answer session will be conducted. Assessment of the student would be done by the faculty members on the basis of presentation, performance in the question - answer session and the report submitted.

Seminar Courses will enable the student to carry out independent review of existing and novel developments in Renewable Energy field. The courses will also enable them to develop presentation and communication skills.

ELECTRICAL MACHINE II

CODE: ELEC3101 **CONTACT: 3L+1T**

At the end of this course students will be able to

1. Able to solve complex electrical engineering problem related to operating principle of three phase IM and analyze the performance of three phase IM
2. Able to analyze the performance and starting of single phase Induction Motor with their uses depending on the torque speed characteristics.
3. Apply the knowledge of special motors for solving complex engineering problems related to various application of special electromechanical devices.
4. Identify and analyze the complex problems related to operation, installation and commissioning of Synchronous machines reaching substantiated conclusion using fundamental concept of Synchronous Machines.

MODULE I

Three Phase Induction Motor(IM) : Construction. Type and operating principle. Flux and MMF phasor in Induction motors. e.m.f equation. Determination of equivalent circuit parameters by No load & Block rotor test. Efficiency of 3-ph IM. Torque-slip characteristics. Conditions for maximum torque at start and run. Deep bar and double cage rotor. Methods of starting and speed control. Crawling & Cogging phenomena. Application of Polyphase Induction motor. Induction generator. [10L]

MODULE II

Single Phase Induction Motor : Construction. Double revolving field theory. Cross field theory. Starting methods. Speed-Torque characteristics. Phasor diagram. Determination of equivalent circuit parameters by No load and Block rotor test. Condition of Maximum torque. Applications. [6L]

Special Electromechanical Devices: Switched Reluctance motor. Stepper motor. Brush less DC machines. Application of A.C series motor. [4L]

MODULE III

Synchronous Generator: Construction and operating principle. Different excitation systems. Armature reaction. Theory for salient and non-salient pole machine. Two reaction theory. Transient and subtransient reactances during short circuit condition. Determination of synchronous machines parameters under steady state and transient condition. Phasor diagram of alternator under different types of loads. Operating characteristic of alternator. Determination of voltage regulation by Synchronous impedance method, M.M.F. method. Potier triangle method. Synchronous machine connected to infinite bus. Effect of change of excitation and speed of prime mover. synchronization of alternator. Power flow and power angle characteristic. Synchronizing power [14]

MODULE IV

Synchronous Motor: Construction and operating principle of synchronous motor. Damper winding. Method of starting. Phasor diagram. V curve under lagging and leading p.f, Under excitation and over excitation. Synchronous Condenser. Power factor control , Hunting. Applications. [6]

Text Books	Reference Books :
1. Electrical Machinery by Dr. P.S. Bimbhra. 2. Generalized Theory of Electrical Machines by Dr. P.S. Bimbhra 3. Electrical Machines by P. K. Mukherjee & S. Chakravorty 4. Electrical Machinery by S.K.Sen 5. Theory of Alternating Current Machinery by Alexander S Langsdorf	1. The Performance And Design Of Direct Current Machines by Clayton & Hancock. 2. The Performance And Design Of Alternating Current Machines by M.G.Say. HOD, EE

POWER SYSTEM - I
Code: ELEC3102
Contact: 3L+1T

COURSE OUTCOME

Students will be able

1. To learn about the basic structure of Power System.
2. To learn about the methods and components used in conventional power generation plants.
3. To learn about various means of power transmission.
4. To learn about the mechanical design of power transmission system.
5. To learn about the electrical parameters involved in power transmission system.
6. To learn the representation of the transmission lines and analyze their performance.
7. To learn about the components of distribution system and improve their performances.

MODULE – I

Introduction: Structure of a power system-Generation, transmission and distribution configurations. Choice of voltage and frequency.

Generation of Electric of Power: General layout of a typical coal fired power station, Hydro electric power station, Nuclear power station, Gas –turbine power station, their components and working principles, comparison of different methods of power generation. (9L)

MODULE – II

Overhead transmission line: Types of conductors, Skin effect and Proximity effect. Inductance and Capacitance of single phase and three phase (symmetrical and unsymmetrical) line, Charging current, Transposition, Bundle and composite conductors, GMD and GMR. Influence of earth on conductor capacitance.

Power Cables : Types of cables, insulation Resistance, stress and capacitance of single and multicore cables, grading of cables, sheath effects, dielectric loss. Comparison of cables and overhead lines.
(12L)

MODULE – III

Mechanical design of transmission line: Calculation of sag of Transmission lines, Variation of sag with wind and ice load, stringing chart.

Insulators: Types of Insulators, Potential distribution over a string of Suspension Insulators, String efficiency, Methods of Equalizing the Potential.

Corona: Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential , Corona loss, advantages & disadvantages of Corona, methods of reduction of Corona. (8L)

MODULE – IV

Transmission System: Short, Medium and Long transmission lines and their representation. ABCD constants, Ferranti effect, Surge Impedance Loading, Active and reactive power flow through transmission lines, Power Circle diagram.

Distribution Systems: Feeders, distributors, and service mains; Types of distribution systems- Radial, Ring Main; Interconnector ; Kelvin's law for design of feeders.
Power factor correction and Tariff. (11L)

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<u>Text Books</u>:

1. Modern Power System Analysis, D.P. Kothari & I.J. Nagrath, 4th Edition, Tata McGraw Hill.
2. Elements of power system analysis, C.L. Wadhwa, New Age International.
3. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors

<u>Reference Books</u>:

1. Power System Analysis by Grainger & Stevenson, Tata McGraw Hill
2. Power System analysis by H.Cotton

SIGNALS AND SYSTEMS
CODE: ELEC3103
CONTACT: 3L

COURSE OUTCOMES OF SIGNALS AND SYSTEMS

Students will be able to

- understand the concept of signals
- analyze the spectral content of different signals
- find Z and inverse Z transforms
- determine the mathematical model of physical systems
- model different systems by state variable approach

Module-I

Signals: Concept of Signals, Continuous and discrete time signals, Classification of Signals: Periodic and aperiodic, even and odd, energy and power signals, Deterministic and random signals, Exponential, sinusoidal signals. Decomposition of signals into odd and even components. Singularity functions- step, ramp ,impulse and doublet signals. Properties of Impulse Function. Decomposition of simple aperiodic waveforms in terms of singularity functions,. Transformation of signals: time scaling; time shifting. Convolution Theorem. **[6L]**

Fourier Series & Transform: Dirichlet's conditions, Fourier series-trigonometric and exponential. Fourier transform of aperiodic functions. Generalized Fourier transform. Properties of Fourier transform. **[6L]**

Module-II

Sampling: Representation of continuous time signals by its samples –Types of sampling, Sampling theorem. Reconstruction of a signal from its samples, aliasing. **[3L]**

Z-Transforms: z-transform definition, mapping between s-plane and z-plane, unit circle in z plane, region of convergence (ROC), properties of ROC. Properties of z-transform, Poles and Zeros, inverse z-transform using Residue Theorem, Power Series expansion and Partial fraction expansion. **[5L]**

Module-III

Systems: Concept of Systems, Classification, Differential equation representation of systems, Definition of Linear Time invariant (LTI) systems. Concept of transfer function, Poles and zeros. Time and frequency response of first and second order systems. **[6L]**

Modeling of Dynamic Systems: Mechanical systems (translational systems and rotary systems) electromechanical systems (DC Servo motor and PMMC). Electrical analogous systems. **[5L]**

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Module-IV

State space analysis: State variable representation of systems, Normalization of linear equations. Converting higher order linear differential equations into State Variable (SV) form. Obtaining SV model from Transfer Function. Obtaining characteristic equations and transfer functions from SV model. State variable representations of electrical and mechanical systems. Solutions of state equations. State transition matrix. Properties of state transition matrix. **[9L]**

Total: 40L

Text Books:

1. Signal Processing & Linear Systems, B.P.Lathi, Oxford
2. Signals and Systems, A.Nagoor Kani, McGraw Hill
3. Signals and Systems, S.Haykin & B.V.Veen, John Wiley
4. Signals and Systems, T.K.Rawat, Oxford

Reference books

1. Kuo, B. C; "Automatic Control System" Prentice Hall of India
2. Lindner D. K; "Introduction to signals and systems", McGraw Hill
3. C-T Chen- Signals and Systems- Oxford
4. Network Analysis & Synthesis, F.F Kuo., John Wiley & Sons

Data Structure and Database Concept
Paper Code : ELEC3104
Contact: 3 L/week,
Credit: 3
Total: 45L

Data Structures

Module I: **(13L)**

Array, Structure, and Pointers in C: creation of customized data type, Array of Structure, Pointers and its application in handling array and structure.

Linear Data structures:

Singly Linked List- Insertion at beginning, at end and any position of the List. Deletion by value, by position: beginning, end and any position of the List

Stack and Queue: Both array and Linked Representation, Circular queue using array only.

Application of stack: Infix to postfix conversion, Evaluation of postfix expression.

Module II: **(10L)**

Recursion: Design of Recursive algorithm.

Non-Linear Data Structures:

Trees: Binary Trees: Array and Linked representation, Binary tree Traversal Techniques, reconstruction of binary tree using traversal sequence.

Binary Search Trees - Insertion and Deletion algorithms.

Sorting Algorithms: Bubble sort, Insertion sort, Quick sort and their comparison.

Searching Algorithms: Linear search, Binary search and their comparison.

Database Concept

Module III: (10L)

Introduction to Database Concepts, File Processing System and Database Management System, DBMS Architecture and Data Independence.

Data Model: Basic Concepts, Entity-Relationship Diagram, Keys, Cardinality, Weak Entity Set.

Introduction to relational algebra & SQL: Operators like select, project, rename, Cartesian product, join, union, intersect, minus, DDL, DML.

Module IV: (12L)

Relational Database Design: Functional Dependencies, Normalization: Different anomalies in database designing

1NF, 2NF, 3NF and BCNF, Lossless-Join Decomposition and Dependency Preservation,
Introduction to Transaction Processing Concepts: ACID properties, Serializability and Recoverability

Text Books:

Data Structures:

I) Title: Data Structures.
Author: Seymour Lipschutz.
Publication: Tata McGraw-Hill (India)

II) Title: Data Structures and Program Design in C.
Author: Kruse Robert L., Robert Kruse, Cl Tondo.
Publication: Pearson Education India.

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Database Concept:
I) Title: Fundamentals of Database Systems
Author: Elmasri Ramez and Navathe Shamkant
Publication: Pearson.

II) Title: Database System Concepts
Author: A. Silberschatz, H.F Korth, S.Sudarshan
Publication: McGraw Hill Education (India) Private Limited

Reference Books:
Data Sturucture:
I) Title: Data Structures using C.
Author: Tanenbaum A. S, Langsam Y., Augenstein M.J.
Publication: Pearson.

II) Title: The Art of Computer Programming
Author: Donald E. Knuth
Publication: Addison-Wesley Professional

Database Concept:
I) Title: Introduction to Database Management Vol. I, II, III,
Author: Date C. J.
Publication: Addison Wesley.

II) Title: Principles of Database Systems
Author: Ullman JD.
Publication: Galgottia Publication

ELECTRONIC INSTRUMENTATION
CODE: ELEC3131
CONTACT: 3L

COURSE OUTCOMES OF ELECTRONIC INSTRUMENTATION

Students will be able to

- Understand the principle of operation of electrical transducers
- grasp the techniques to measure non-electrical quantities
- know the working principles of wave analyser and spectrum analyser
- understand signal conditioning circuits
- Acquire the concepts of data acquisition and virtual instrumentation.

Module -I

Sensors and Transducers: Introduction, Classification of Transducers, Characteristics and choices of Transducers. [1]

Temperature transducers: Resistance Temperature Detectors (RTD), Thermistors, Thermocouples and Radiation Pyrometers-construction, principle of operation, advantages and disadvantages. [6]

Resistive Strain Gauge: construction, principle of operation, application. [2]

Linear Variable Differential Transformer (LVDT): construction, principle of operation, phase-sensitive demodulation, advantages and disadvantages of LVDT, use of LVDT. [3]

Module-II

Capacitive Transducer: variable air gap, variable plate overlap, variable dielectric, differential arrangement, measurement of Displacement and Liquid level, advantages and disadvantages, use of capacitive Transducer. [3]

Piezoelectric Transducers: Fundamental concepts, materials, charge sensitivity, voltage sensitivity. Force/displacement transducers, Buffer amplifiers, charge amplifiers, Static and dynamic responses. Accelerometers. [3]

Pressure transducers: Primary sensing elements: Bourdon tube, diaphragm, bellows, Electronic pressure gauges, Capacitive pressure transducers. [2]

Measurement of Flow: Electromagnetic Flow meter, Hot wire anemometers, Ultrasonic Flow transducer. [3]

Module-III

Frequency Domain Instruments: Wave analyser, Frequency Selective wave analysers, Heterodyne Wave analyser, application of Wave analyser, Basic Spectrum analyser [4]

Special Instruments: Q meter, function generators. [3]

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Module-IV

Data Acquisition Systems: General Block diagram of Data Acquisition Systems (DAS), Objectives of DAS, classification of DAS, Applications of DAS [2]

Signal Conditioner: Review of digital to analog and analog to digital converters, Sample and hold circuit, Multiplexing, Analog to Digital Multiplexing, Digital to Analog Multiplexing, Analog Multiplier. [5]

Virtual Instrumentation: Virtual Instruments versus Traditional Instruments, Software in Virtual Instrumentation, Virtual Instrumentation in the Engineering Process [1]

Total: 38L

TEXT BOOKS:

1. Modern Electronic Instrumentation & Measurement Techniques : by Helfrick & Cooper
2. Transducer & Instrumentation, D.V.S Murty,PHI
3. A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.
4. Sensors & Transducers : by D. Patranabis
5. Electronic Instrumentation : by Oliver & Cage

HOD, EE

REFERENCE BOOKS:

1. Measurement Systems: by Ernest Doebelin
2. Instrument Measurement & Analysis : By Nakra & Chaudhry
3. Principles of Measurement Systems : by John P. Bentley

ILLUMINATION ENGINEERING
CODE : ELEC 3132
CONTACT: 3L
Credit : 3

COURSE OUTCOME

- To get acquainted with the laws of photometry for calculation of illuminance levels for different lighting applications
- To understand the principles of operation of different photometers
- To understand the principles of operation of different lamps and their accessories
- To analyse indoor lighting schemes and design energy efficient installations complying with lighting codes
- To design energy efficient road lighting installations in conformity with lighting codes
- To understand the parameters of sports lighting installations

Module – I **[9L]**
Illumination Engineering Basics and Photometers
Light and Electromagnetic Radiation, Visible spectrum of radiation.
Radiometric and photometric quantities, visual response curve of standard observer, relation between Lumen and Watt.
Laws of Illumination, perfect diffuser, Lambert's law.
Bench photometer, luxmeter, distribution photometer, integrating sphere.

Module – II **[9L]**
Lamps and its Accessories: Incandescent lamps, tungsten halogen lamps, fluorescent tubes, compact fluorescent lamps (CFL), low and high pressure sodium vapour lamps, high pressure mercury vapour lamps, metal halide lamps, Light Emitting Diode (LED) lamps.
Ballast- function, electromagnetic and electronic types, principles of operation.

Module – III **[9L]**
Interior Lighting Design
Objectives, quantity and quality of light, selection of lamps and luminaires. Design considerations for lighting of offices, conference rooms, hospitals. Design calculations by lumen method in accordance with lighting code.

Module – IV **[9L]**
Outdoor Lighting : Road, Playground and Landscape Lighting Design
Basic concepts of outdoor lighting design- objectives, design parameters, qualitative & quantitative evaluation of outdoor lighting systems.

References / Books

1. Lighting Engineering Applied Calculations – R. H. Simons & A.R. Bean, Architectural Press
2. Applied Illumination Engineering, Second Edition, Jack L Lindsey, Prentice Hall.
3. Lamps and Lighting – Edited by J.R.Coaton and A.M.Marsden, 4th Edition Arnold
4. IES Lighting Handbook – IES North America.
5. National Lighting Code- Published by Govt of India,2011

HOD, EE

ELECTRICAL MACHINE LAB-II
CODE: ELEC 3111
CONTACT HR: 3P

List of Experiments:

1. Different methods of starting of a 3 phase Cage Induction Motor & their comparison [DOL, Auto transformer & Star-Delta]
2. Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control].
3. Speed control of 3 phase slip ring Induction motor by rotor resistance control.
4. Determination of regulation of Synchronous machine by
   a. Potier reactance method.
   b. Synchronous Impedance method.
5. Determination of equivalent circuit parameters of a single phase Induction motor.
6. Load test on single phase Induction motor to obtain the performance characteristics.
7. To determine the direct axis resistance [Xd] & quadrature reactance [Xq] of a 3 phase synchronous machine by slip test.
8. Load test on wound rotor Induction motor to obtain the performance characteristics.
9. To make connection diagram to full pitch & fractional slot winding of 18 slot squirrel cage Induction motor for 6 poles & 4 pole operation.
10. To study the performance of Induction generator.
11. Parallel operation of 3 phase Synchronous generators.
12. V-curve of Synchronous motor
13. Determination of equivalent circuit parameters of 3 ph induction machine
14. Performance of 3 ph squirrel cage induction motor

HOD, EE

POWER SYSTEM – I Lab
Code: ELEC3112
Contact: 3P

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1. Determination of the generalized ABCD Constant of a long transmission line
2. Dielectric strength test of insulating oil
3. Determination of break down strength of solid insulating material
4. Measurement of earth resistance by a Earth-Tester
5. Determination of Phase Sequence Test of a given Three Phase Supply
6. Simulation of DC distribution by network analyzer for Single-end fed system
7. Simulation of DC distribution by network analyzer for Double-end fed system
8. Study and analysis of an electrical transmission line circuit with the help of PSPICE
9. Study of different types of insulators

HOD, EE

SIGNALS & SYSTEMS LAB.
CODE: ELEC3113
CONTACT: 3P

1. The generation of different type of continuous and discrete signals using MATLAB.
2. Spectrum analysis of different signals.
3. Study of aliasing phenomenon and convolution.
4. Time response of first and second order systems for step, ramp and impulse input.
5. Study of performance indices of second order system excited by step input.
6. Frequency response of first and second order systems.
7. Determination of z- transform and inverse z transform using MATLAB.
8. Obtain Transfer Function of a given system from State Variable model and vice versa using MATLAB.
9. Obtain the step response and initial condition response of SISO and MIMO systems in SV form by simulation.

HOD, EE

DBMS Laboratory
Paper Code : ELEC3114
Contact : 3 hours /week
Credit : 2

Experiments on Database on RDBMS Platform (Oracle):
DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding and modifying column data types, etc.
DML: Inserting rows, Updating rows, Deleting rows
SQL Query: Cartesian Product, All types of Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause, Nested Sub-Queries
Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc. Programming using Cursors.

Books:
DBMS Laboratory
Title: SQL, PL/SQL: The Programming Language Of Oracle (With CD-ROM) (English) 4th Revised Edition
Author: Ivan Bayross
Publisher: BPB Publications

HOD, EE

B.Tech in Electrical Engineering
3rd Year 2nd Semester

POWER SYSTEM-II
Code: ELEC3201
Contact: 3L+1T

COURSE OUTCOME

Student will be able

1. To learn the representation of power system components by equivalent per unit reactance diagram.
2. To learn to perform various power system analyses like fault analysis, power flow and stability analysis.
3. To learn the basic principles of Power System relaying.
4. To learn the basic principle of Circuit Breaking.
5. To learn the protection schemes for different power system components.

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MODULE – I

Representation of Power system components: Single-line diagram of balanced three phase system, Impedance & Reactance diagram, Per unit system representation, Base values-phase and line quantities.

Symmetrical & Unsymmetrical Fault Analysis: Transient on a transmission line, short circuit of a synchronous machine under no load & loaded condition. Symmetrical component transformation, sequence impedance and sequence network of power system.

Symmetrical fault analysis.

Symmetrical component analysis of unsymmetrical faults, single line-to-ground fault, line-to-line fault, double line-to-ground fault. [11L]

MODULE – II

Power system stability: Classification of power system stability – voltage stability, Rotor angle stability/ steady state stability, transient stability, equal area criteria, swing equation, multi machine stability concept.

Load flow Analysis: Load flow problem, Y-bus Formulation of problem, Solution technique using Gauss-Seidal method, Newton-Raphson method [10L]

MODULE – III

Basic principles of power system protection, block diagrams of protective schemes and fundamental principles of Induction relay. Single input relays, Principle and application of non-directional & directional over current and earth fault relays. Distance relays, Differential relays. Basic aspects of static relay.

Protection schemes for transformer, generators and motors. [10L]

MODULE – IV

Circuit Breaker : General requirements of circuit breakers. Formation of electric arc, quenching theories, recovery voltage and RRRV, Arc re-striking phenomena. Problems in capacitive and low inductive current interruptions. Rating of circuit breakers.

Different types of circuit breakers - their operating mechanisms & applications. Testing of circuit breakers. D.C circuit breaking.

Substation grounding [9L]

<u>Text Books</u>:

1. Modern Power System Analysis, D.P. Kothari & I.J. Nagrath, 4th Edition, Tata McGraw Hill.
2. Power System Analysis by Grainger & Stevenson, Tata McGraw Hill
3. Switchgear protection and power systems, Sunil S Rao, Khanna Publications.
4. Elements of power system analysis, C.L. Wadhwa, New Age International
5. Power System Protection and Switchgear, B. Ravindranath, M. Chander

<u>Reference Books</u>:

1. Protection & Switchgear, B. Bhalja, R.P. Maheshwari, N.G.Chothani, Oxford.
2. Power system protection & switchgear, B.Ram & D.N. Vishwakarma, Tata McGraw Hill.
3. Power System Stability & Control - Prabha Kundur
4. Power Systems Stability, Vol. I,II& II, E.W. Kimbark, Wiley.
5. Power Systems Analysis, A. R. Bergen & V. Vittal, Pearson Education.
6. Power System Operation by James Malinowski , Robert Miller
7. The Art and Science of Protective Relaying by C. R. Mason, John wiley & Sons

Power Electronics
Paper Code: (ELEC3202)
Contact: 3L

Course Outcomes:

Students will be able to

- Understand the basic theory and characteristics of power semiconductor devices.
- Analyze basic converter (AC-DC, DC-DC, DC-AC, AC-AC) topologies.
- Understand and design single-phase and three-phase thyristorized converters.
- Learn the application of power electronics in electric drives.
- Understand role of Power Electronics in utility-related applications.

Module 1 [10L]

Introduction:

Need for power conversion; Power electronic converters: classifications and scope.

Power Semiconductor Devices:

Basic structure & switching characteristics of power diodes, SCR, TRIAC & GTO, V-I characteristics and applications. Two transistor model of SCR, switching characteristics of SCR, Gate Triggering methods of SCR - R, RC, and UJT firing circuits for SCR, series and parallel operation of SCR, Need for snubber circuits, di/dt & dv/dt protection, Different commutation techniques of SCR.

Introduction to Power transistor, MOSFET, IGBT - Ratings, static and dynamic characteristics.

Gate drivers and switching circuits, snubbers, cooling and heatsinks.

Module 2[12L]

Phase controlled converters:

Input and output characteristics of common rectifier topologies: Single-phase half-wave and full-wave controlled rectifiers with R, RL and RLE load. Effect of Free-wheel diode. Semiconverters with R, RL and RLE load. Three-phase half-wave and full-wave controlled and uncontrolled rectifiers with R, RL load (effects of continuous and discontinuous current on converters), Effect of Free-wheel diode, Power quality aspects in converters, Effect of source inductance in controlled rectifier and loss of voltage due to commutation, Introduction to 1-phase dual converter operation and three phase dual converter.

Selection of devices and its specifications.

HOD, EE

DC Choppers:

Classification & operation of choppers (A, B, C, D, E), Control strategies, Buck, Boost and Buck-Boost converters: circuit configuration and analysis, Multiphase chopper.

Module 3[10L]

Inverters:

Definition and classification of inverters: VSI and CSI, SPWM, Brief idea of Resonant Pulse converter.

Principle of operation of 1-phase VSI and 3-phase VSI (120°, 180°) modes.

PWM inverters.

Series and parallel connections of inverters: Basic series inverter, Modified series Inverter, 1-phase parallel inverter operation (without feedback diode).

Multilevel inverters.

Power quality aspects of inverters, Improvement of power quality.

Module 4[8L]

AC-AC direct converter:

Principle of on-off voltage regulator and phase controlled voltage regulator, Operation of 1-phase controlled voltage regulator with R, RL loads.

Principle of operation of cycloconverters, circulating and non-circulating mode of operation single phase to single phase cycloconverters, three phase to three phase cycloconverters.

Introduction to matrix converter.

Applications:

Speed control of AC and DC motors, HVDC transmission, Static circuit breaker, SMPS, UPS, Static VAR compensators, FACTS - shunt and series compensators.

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Text Books:

1. Power Electronics, Mohan, Undeland & Robbins, Wiley India.
2. Power Electronics, M.H. Rashid, PHI, 3rd Edition.
3. Power Electronics, M.D Singh and K.B. Khanchandani, Tata Mc Graw Hill, 2015.
4. Power Electronics, P.S. Bimbhra, Khanna Publishers, 2012.
5. Power Electronics, Dr. P.C Sen, Mc Graw Hill Education, 1st Edition.

Reference Text Books:

1. Modern Power Electronics and AC Drives, B.K Bose, Prentice Hall.
2. Element of Power Electronics, Phillip T Krien, Oxford, 2007.
3. Analysis of Thyristor power conditioned motor, S.K. Pillai, University Press.
4. Power Electronics: Principles and applications, J.M. Jacob, Thomson.

CONTROL SYSTEM
CODE: ELEC3203
CONTACT: 3L+1T

COURSE OUTCOMES OF CONTROL SYSTEMS

Students will be able to

- Know the fundamental concepts of Control systems and mathematical modeling of the system
- Analyze time and frequency response of the system
- Understand the concept of stability and examine it by various approaches
- Acquire knowledge about determination and improvement of system performance
- Design and realize systems using state variable modeling technique

Module -I

Introduction to control systems: Introduction of automatic control, Classification of control systems, open loop and closed loop systems. Examples of control systems. Properties of Control Systems, Elementary concepts of sensitivity and robustness, concepts of non minimum phase systems and time delay systems. [2L]

Representation of Systems: Block diagram representation of control systems. Block diagram algebra. Block diagram reduction and signal flow graph. Mason's gain formula. [4L]

Control system components: Potentiometer, Tacho-generator, Synchro and resolver, DC and AC servomotor, Actuators, Gyroscope. [4L]

Module -II

Time domain analysis: Review of transient & steady state response of first and second order systems. Concept of undamped natural frequency, damping, overshoot, rise time, peak time and settling time. Effects of Poles and Zeros on transient response. Steady-state and transient errors, concept of system types and error constants. [5L]

Stability Analysis: BIBO stability, stability by pole location, Routh-Hurwitz criteria and applications, Root locus techniques, construction of Root Loci. [7L]

Module -III

Frequency domain analysis: Review of frequency response of first and second order systems. Frequency Domain Specifications. Bode plot and Nichols chart. Polar plots. Nyquist criterion, Stability margins. Comparison of absolute and relative stability. [10L]

Module -IV

Design of Control System: Control actions: Proportional, integral, derivative actions and their combinations. Design of compensators. Lead, Lag ,Lead- Lag and Lag-Lead compensators. [4L]
State Variable Analysis: State variable formulation of control systems, Canonical forms of SV equations, diagonalization. Introduction to Controllability and Observability. Linear state variable feedback controllers, the pole placement problem. Linear system design by state variable feedback. [6L]

Total: 41L

HOD, EE

Text Books:

1. Control Systems: Principles and Design, M Gopal, TMH
2. Modern Control Engineering, Ogata;Katsuhiko, PHI
3. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition, PHI
4. Control system Engineering: I.J. Nagrath & M. Gopal, New Age International.

Reference books:

1. Digital Control & State Variable Methods: M. Gopal, 2nd Edition, TMH
2. Control system Engineering, Ananda Natarajan , P. Ramesh Babu, Scitech
3. Control System Engineering: D. Roy Chowdhuri, PHI

Microprocessor and Microcontroller (ELEC3204) (3 + 0 + 0)

Course Outcome:

After completing the course, the students will be able to

1. interface both read/write and read-only memories and Input & output devices to microprocessor.
2. write programs in assembly level language in Personal Computer environment, to convert it into .HEX file and download the .HEX file to Read/Write memory of a microprocessor based system for execution.
3. have an idea on microcontrollers / embedded systems
4. Develop the real time systems related to Electrical Engineering

Microprocessor (8085)

Module -I

1. Introduction (1L)
2. Architecture of 8085, Programming model and Instruction set (2L)
3. Timing Diagrams and execution of instruction (1L)
4. How to write simple programs (addition/subtraction, delay routine etc.) (1L)
5. Interfacing of Memory Device (ROM & R/WM) (2L)
6. Interfacing of IO devices, Keyboard, LED, 7-segment display, ADC, DAC, matrix keyboard (5L)

[12L]

Module -II

7. Generation of different waveforms (1L)
8. Programs of higher level and conversion of codes (2L)
9. Interrupts –(software and hardware) and realisation with examples (3L)
10. Interfacing of standard I/O devices – 8255A, 8253/54, concept of serial communication (3L)

[9L]

Microcontroller (8051)

Module - III

1. Introduction
2. Architecture of 8051, facility provided thru pins and concepts of I/O ports, Power-on-reset, Oscillator circuit
3. Memory organization: detailing of internal RAM, SFRs
4. Instruction set, Assembly level Programming concept and simple programs
5. Timers and counters and its different modes
6. Simple programs using timer-counter
7. Interrupts and its priority
8. Serial Communication **[11L]**

Module - IV

9. Programming of Microcontroller in C Language
10. Interfacing of Keyboard, LEDs , 7- segment display, LCD
11. Interfacing of ADC and DAC and sensors,
12. Interfacing of relays, opto-coupler, DC Motor, stepper motor
13. Interfacing of real time clock
14. Advanced serial data transfer protocols: I2C, SPI **[7L]**

PIC Microcontroller

Inrtoduction and basic features **[1L]**

Text Books:

1. Microprocessor Architecture, Programming and Applications with 8085 by R. S. Gaonkar, Penram Pub.
2. The 8051 Microcontroller Based Embedded Systems by Manish K Pate, McGrawHill Pub.
3. 8051Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Janice Mazidi, Janice Gillispie Mazidi .

HOD, EE

DIGITAL SIGNAL PROCESSING
CODE: ELEC3231
CONTACT: 3L

COURSE OUTCOMES OF DIGITAL SIGNAL PROCESSING

Students will be able to

- Develop a clear conception about discrete time signals
- Understand the concept of convolution sum and its properties
- Realize the fundamentals of various transformation techniques
- Compute discrete Fourier Transform by various algorithms
- Design FIR and IIR filters
- Acquire elementary knowledge about digital signal processors

Module-I

Discrete-time signals: Review of concepts of sampling and discrete time signals. Sequences- periodic, energy, power, sample, step, ramp and complex exponentials. Arithmetic operations on sequences. Concept of convolution, graphical, analytical and overlap-add methods to compute convolution. [6]

LTI systems: Definition, difference-equation representation, impulse response. Properties of convolution with physical interpretations-interconnection of LTI systems. [3]

Module-II

z-transform: Review of z-transform and its properties, Application of z-transform. Concepts of z-transfer function. Stability and causality conditions for LTI systems. Recursive and non recursive systems, FIR and IIR systems. [5]

Transformation techniques: Continuous-time to discrete-time transformation: Mapping using impulse invariant transformation, bilinear transformation, approximation of derivative and matched z-transformation. [5]

Module-III

Discrete Fourier Transform: Introduction to discrete-time Fourier transform (DTFT). Concepts of discrete Fourier transform (DFT) and inverse discrete Fourier transform (IDFT), properties of DFT. Computational burden of DFT, DFT/IDFT matrices, multiplication of DFTs. Concepts of circular convolution and its computation. [6]

Fast Fourier Transform: Importance of Fast Fourier Transform (FFT), Implementation- Radix-2 algorithm, decimation-in-time and decimation-in-frequency algorithms, concepts of Butterflies, signal flow graphs. Comparison of computational load of DFT and FFT. [4]

Module-IV

Filter Design: Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR filters using impulse invariant and bilinear transforms, design of linear phase FIR filters, rectangular window function, circular complex convolution integral, Gibbs phenomenon. Concepts of Hamming, Hanning and Blackman window. [8]

Digital Signal Processor: Elementary ideas of the architecture and important instruction sets of TMS320C 5416/6713 processor, development of small programs in Assembly Language. [2]

Total= 39L

HOD, EE

TEXT BOOKS:

1. Digital Signal Processing,Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal processing – T.K. Rawat, Oxford

REFERENCE BOOKS:

1. Digital Signal Processing, Chen, OUP
2. Digital Signal Processing, Johnson, PHI
3. Digital Signal Processing using MATLAB, Ingle, Vikas.
4. Digital Signal Processing, Ifeachor, Pearson Education.

Electrical Machine Dynamics

CODE: ELEC 3232 **CONTACT: 3L**

The subject helps the student to become familiarized with modern machines which are to be applied in practical field and to design and development for the research skill and find solution of real problems.

MODULE-I

Generalized theory of electric machines:

The Primitive machine, Voltage equations of the Primitive machine. Invariance of power. Transformation from a displaced brush axis, Transformation from three phases to two phases, Transformation from rotating axes to stationary axes. Physical concepts of Park's transformations. Transformed impedance matrix. Electrical torque. Restriction of the generalized theory of electrical machines. [12]

MODULE-II

Direct Current machine dynamics:

Steady state analysis, and transient analysis of D.C machines. Transfer functions of D.C machines. Electrical braking of D.C motors. Parallel operation of D.C generators. [8]

MODULE-III

Synchronous Machine Dynamics:

Basic synchronous machine parameters. Behavior of the machine under certain short circuit condition, short circuit oscillogram. Transient analysis of synchronous machine. Transient torque. Sudden reactive loading and unloading. Steady state and transient Power angle Characteristic. Large angular oscillation. Synchronous machine Dynamics. Electrical braking of synchronous motor. . [12]

MODULE-IV

Induction Machine Dynamics:

Induction machine dynamics during starting and braking. Acceleration time, Induction machine dynamics during normal operation, Operation on unbalanced supply voltage. Slot harmonics. Harmonic effects on Induction motor, Harmonic equivalent circuit and harmonic torque. [8]

Text Books :	Reference Books :
1. Generalized Theory of Electrical Machines by Dr. P.S. Bimbhra 2. Electrical Machinery by S.K.Sen 3. Electric motor drives, modeling, analysis and control, R. Krishnan 4 Dynamic Simulation of Electric Machinery using MATLAB by C. Ong, 5 Analysis of Electric Machinery and Drive Systems by P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff 6. Electromechanical Motion Device by P.C. krause, O.Wasynczuk	1. Modern power electronics and AC drives, B.K. Bose 2. Electrical Machinery, A.E. Fitzgereld, C. Kingslay and S.D. Uman

HOD, EE

POWER SYSTEM-II Lab
Code: ELEC3211
Contact: 3P

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1. Polarity, ratio and magnetization characteristics test on CT and PT
2. To Study & Testing of ON-delay relay and OFF-delay relay
3. To Study the Inverse characteristics of a Under-Voltage relay
4. To Study the Inverse characteristics of Earth Fault relay
5. To Study the Inverse characteristics of Over-Current relay
6. To Study the Inverse characteristics of Directional Over-Current relay
7. To Study Transformer Protection using Electro-mechanical Type Differential relay
8. To study Short Circuit Analysis using Network Analyzer
9. To Study the Performance of Over-Current Relay using ETAP software simulation.
10. To Study the Performance of Under-Voltage Relay using ETAP software simulation.
11. To Study the Performance of Differential Relay for Transformer Protection using ETAP software simulation.
12. To Study the Load Flow analysis by Gauss-Seidel & Newton-Raphson method using ETAP or MATLAB software simulation

HOD, EE

POWER ELECTRONICS LAB
ELEC3212
Contact: 3P

List of Experiments:

1. Study of the characteristics of an SCR.
2. Study of the characteristics of a TRIAC.
3. Study of different triggering circuits of an SCR
4. Study of the operation of a single phase full controlled bridge converter with R and R-L load.
5. Study of performance of single phase half controlled symmetrical and asymmetrical bridge converters.
6. Study of performance of step down chopper with R and R-L load.
7. Study of performance of single phase controlled converter with and without source inductance (Simulation).
8. Study of performance of step up and step down chopper with MOSFET, IGBT and GTO as switch (Simulation).
9. Study of performance of single phase half controlled symmetrical and asymmetrical bridge converter (Simulation).
10. Study of performance of three phase controlled converter with R & R-L load (Simulation).
11. Study of performance of PWM bridge inverter using MOSFET as switch with R and R-L load (Simulation).
12. Study of performance of three phase AC controller with R and R-L load (Simulation).
13. Study of performance of a Dual converter (Simulation).
14. Study of performance of a Cycloconverter (Simulation).

HOD, EE

CONTROL SYSTEM LABORATORY
CODE: ELEC3213
CONTACT: 3P

1. Familiarization with MATLAB control system tool box, MATLAB Simulink tool box
2. Simulation of Step response and Impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB**.**
3. Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box and different control system specifications from the plot.
4. Determination of approximate transfer functions from the Bode plot.
5. Study of P, PI, PD and PID control action for first and second order system using Z-N method.
6. Tuning of P, PI, PD and PID controllers for higher order plants with and without dead time.
7. Design of Lead and Lag compensators.
8. Evaluation of steady state error, rise time, setting time, percentage peak overshoot, gain margin, phase margin etc. with incorporation of Lead and Lag compensators.
9. Design of linear state feedback controllers for a system using MATLAB.

HOD, EE

Department of Electrical Engineering
Microprocessor and Microcontroller Lab (ELEC 3214)
Contact Hours: (0+0+3)

LIST OF EXPERIMENTS

1. a) Familiarization with Microprocessor kit
    i) Starting and ending address of R/W Memory
    ii) To write a program in assembly level consulting the Hex table and address generation
    iii) To enter a program, how to run and how to verify the result in a Microprocessor kit
    iv) To edit a program in PC, how to assemble it, how to link it to generate a .hex file and how to download the .hex file to the kit using serial com port and execute it etc. etc.

   b) To write a program (WAP) in assembly level to add two numbers, taken in registers and store the result in a memory location.

Write a program (WAP) in assembly level

2. a) to add two numbers stored in two consecutive memory locations and store the sum in next memory location.
   b) to add ten numbers stored in consecutive memory locations and store the sum in a memory location (assuming the result will not produce any carry).
3. a) to store the incremental data in consecutive memory locations.
   b) to copy the block of data from one memory area to another memory area
   c) to copy and paste the block of data from one memory area to another memory area
4. a) to find the largest / smallest number in a block of data.
   b) to arrange the block data in ascending / descending order.
5. a) to unpack a BCD number and pack an unpacked BCD number.
   b) Addition of two BCD numbers.
6. a) to convert a BCD number to the corresponding Binary number.
   b) to convert a binary number to the corresponding BCD number.
7. a) to convert a BCD code to a common anode 7-segment code.
   b) to convert a binary code to the corresponding ASCII code.
8. a) to configure the ports of 8255 Programmable Peripheral Interface (PPI)
   b) to interface a 7 segment LED display, to blink the LEDs of a 7-segment for half second 'on' and half second 'off'
9. to display 0 thru 9 on 7-segment display for half second display and half second off.
10. to generate different waveforms (square, saw-tooth, triangle and sine) using DAC0808 interfacing.
11. to interface an ADC0808/0804 with microprocessor/microcontroller and take a digital data in corresponding to an analog data and store it in a memory.
12. to interface a 16X2 LCD display with 8051 microcontroller.
13. 4X4 keyboard interfacing with 8051 microcontroller.
14. Familiarization with integrated development environment (IDE) of PIC microcontroller, programming and running a sample program to blink an LED etc.

HOD, EE

Course Name: MICROELECTRONICS & ANALOG VLSI DESIGN					
Course Code : ECEN3103					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:
After completing the course the student will be able to:

1. Understand the fundamentals of MOSFET Device Physics.
2. Correlate the fundamental understanding with the evolving VLSI Design Trends and Challenges.
3. Understand the IC Fabrication Process Flow leading to the practical realization of the scaled MOSFETs.
4. Analyze analog VLSI sub-circuits and design them namely, current mirrors, voltage, and current references.
5. Design circuits of practical importance e.g., amplifiers.
6. Apply the knowledge of analog sampled data circuits to synthesize practical circuits such as switched- capacitor filters.

Module I: Introduction and the MOS Transistor: [8L]

Unit1: Evolution of Microelectronics, Moore's Law, Process Node Definition, Evolution of Process Technology, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), ITRS, VLSI Design Trend and Challenges.

Unit2: Knowledge about MOS, Structure and Principle of operation of enhancement-mode MOS transistor, MOS-Characteristics, MOS Capacitors, Short Channel MOS, NMOS vs PMOS.

Module II: Fabrication Flow: [10L]

Unit1: IC Process Flow, clean environment, Wafer Growth and Preparation, CVD Techniques, Epitaxy, Oxidation (Dry and Wet), Photo Lithography: Contact, Proximity, Projection, Photo Resist, Etching (Wet and Dry), Diffusion, Ion Implantation, Metallization and interconnects. VLSI Process Integration. Assembly & Packaging of VLSI devices.

Unit2: CMOS Fabrication flow step by step using self aligned techniques (N-well Process), CMOS Fabrication Process Overview and Structure for N-Well, P-Well, Twin Tub, Lamda and Micron rules, SOI, FINFET. Yield loss & Reliability analysis in VLSI design.

Module III: Analog VLSI Sub-circuits: [10L]

Analog VLSI Design Steps, Basic Building Blocks of Analog VLSI Chips, large signal and small signal analysis and equivalent circuit model, small signal parameters for low frequency and high frequency model, MOS Switch, MOS Diode, Active Load/Resistors,

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Voltage Dividers, Current Mirror, CMOS Current Mirror & Sink (Cascode), CMOS Voltage Reference, CMOS Bandgap Reference (Basic Circuit Only).

Module IV: Analog VLSI Circuits: [10L]

Unit1: Common-Source, Common-Drain and Common-Gate single stage amplifiers, Differential Amplifier: Common Mode, Differential Mode, Transfer Characteristic Curves, CMRR, Differential Amplifier with Active Load.

Unit2: CMOS OPAMP, Switched Capacitor Filter .

Text Book:

1. VLSI Technology 2ND Edition, Author: Sze, S.M.; MCGRAW HILL COMPANIES .
2. CMOS Analog Circuit Design (second edition) Phillip E. Allen and Douglas R. Holberg (Oxford) .
3. Microelectronic Circuits- A.S. Sedra & K.C.Smith- Oxford International student edition.

References:

4. The MOS Transistor (second edition) Yannis Tsividi s (Oxford) .
5. Design of Analog CMOS Integrated Circuit, B. Razavi, Mc, Graw Hill .

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Course Name:	**MICROELECTRONICS & ANALOG VLSI DESIGN LABORATORY**				
Course Code	**: ECEN3113**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After completing the following experiments, students will be able to:

1 Understand Basics of microelectronics and VLSI design
2. Categorize various types of MOS, IC manufacturing Process - the steps
3. Analyze Analogue VLSI circuits – the intricacies
4. Design important Circuits like OP AMP and their analysis

List of Experiments:

Sub Micron and Deep Sub Micron Technology based Experiments:

1. Introduction to Tanner Design & Layout Tools and SPICE Analysis:
    a. Familiarity with Tanner CAD Tools (S-Edit, W-Edit, L-Edit, DRC, LVS)
    b. Familiarity with T-Spice
    c. NMOS, PMOS VI Characteristics
    d. Transient analysis of CMOS Inverter Circuit
2. Tanner Tool Based Analog Experiments:
    a. MOS as Resistors, Current Source, Sink, Current Mirror
    b. DC, Transient and AC analysis of Single Stage Amplifier
    c. Circuit Analysis of Differential Amplifier

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Course Name:	MICROPROCESSORS, MICROCONTROLLERS & SYSTEMS				
Course Code	: ECEN3104				
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

After completing the course the student will be able to:

1. Understand the basics of microprocessor and microcontroller with the help of previous knowledge of Digital Electronics.
2. Develop the concepts of MPU, timing and control signals I/O devices, types of BUS, etc that form the background of this course.
3. Develop the ALP for given problems with flowchart and learn about the interrupts stack and subroutine.
4. Learn and apply the architecture of 8086 family.
5. Analyze and solve memory interfacing and I/O interfacing problems and develop idea about several peripheral devices.
6. Analyze the architecture of microcontroller 8051 with respect to I/I ports, Memory, Counters and Timers etc.

Module I: Introduction [4L]

MPU, I/O devices, Memory, Timing and Control Signals, Bussed Architecture, Tristate logic, Latch, Address Bus, Data Bus and Control Bus.

Module II: Microprocessor

8085 [10L]

Intel 8085 Microprocessor Architecture – Signals – Addressing modes – Instruction classification Instruction set—Timing diagram – Memory Mapped and Peripheral I/O- ALP format – Programming 8085 – 8-bit and 16-bit Operation including stack-subroutine – Interrupt structure of 8085 microprocessor, Processing of vectored and Non-vectored interrupts, Latency time and Response time; Handling multiple interrupts.

8086 [8L]

Intel 8086 microprocessor - Architecture - Signals- Segmented Memory – EU and BIU - Instruction Set-Addressing Modes – Minimum and Maximum Modes of Operation- Even and Odd Memory Bank- Basics of Assembly Language Programming.

Module III: I/O Interfacing [8L]

Memory interfacing and I/O interfacing with 8085– PPI 8255 – Programmable keyboard display –Interface 8279 – Programmable interrupt controller 8259 –Programmable DMA controller 8257 –USART 8251 –Programmable interval timer 8253. ADC & DAC Interfacing.

Module IV: Microcontroller & Systems

8051 [6L]

Architecture of 8051 Microcontroller – Signals – I/O ports – Memory – Counters and Timers – Serial Data I/O – Interrupts. Interfacing - Keyboard, LCD, Stepper Motor Control.

Text Books:

1. Microprocessor Architecture, Programming & Application with 8085-R. Gaonkar (Penram International).
2. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, Mc Grawhill Education.
3. The 8051 Microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (Pearson).
4. Microprocessor and Programmed Logic by Kenneth L Short.2nd Edition, Pearson.

Reference Books:

1. Microprocessors and microcontrollers -N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford University Press
2. An Introduction to Microprocessor and Applications –Krishna Kant (Macmillan).
3. Fundamentals of Microprocessor and Microcontrollers by B. Ram. Dhanpat Rai Publications
4. Microprocessors and Microcontrollers by A. Nagoorkani Mc Grawhill Education.

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Course Name:	**MICROPROCESSORS, MICROCONTROLLERS & SYSTEMS LABORATORY**				
Course Code	**: ECEN3114**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course outcomes:

After completing the following experiments, students will be able to:

1. Select proper instructions and build different assembly language program for 8085 microprocessor

2. Understand the assembly language programming concept of microprocessor

3. Design the interfacing of input/output devices with 8085 microprocessor using partial and absolute address decoding

4. Build assembly language program to control input/output devices for various applications

5. Analyze the processing of analog signal and generation of various analog signals using interfacing circuit

6. Realize the programming concept of hardware interrupts in 8085 microprocessor

List of Experiments:

1. Write an Assembly Language Program (ALP) using 8085 to

(a) Store a certain data byte in memory location.

(b) Exchange the content of memory locations.

(c) Find the 2's complement of the number and store it in a certain memory location.

(d) Find the square of first nine natural numbers from look up table.

(e) Add two 8-bit numbers stored in consecutive memory locations.

2. Write an ALP using 8085 to multiply two 8-bit numbers by shift and add method.

3. Write an ALP using 8085 to convert HEX Number to ASCII number.

4. Write an ALP using 8085 to arrange a series of numbers in (a) ascending order (b) descending order.

5. Write an ALP using 8085 to generate a Fibonacci series.

6. Write an ALP using 8085 to pack and unpack a BCD number.

7. Interfacing of peripheral devices with the 8085 microprocessor using 8255 PPI.

(a) To perform the addition of two hex numbers and display the result.

(b) To obtain the complement of a hex number and display the result.

(c) To scroll a bit using a delay subroutine.

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8. Write an ALP to convert an analog voltage (0-5 Volts) using the 0809 A/D Converter and display the corresponding digital value suitably using 8085 microprocessor and with 8255 PPI.

9. Write an ALP to display a data in the 7-segment display using 8085 and 8255 PPI.

10. Write an ALP to:

(a) Perform the addition of two 8-bit numbers using 8051 microcontroller.

(b) Swap the nibbles of an 8-bit data (without using the SWAP instruction) using the 8051 microcontroller.

11. One novel experiment beyond the scope of the syllabus.

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Course Name: DIGITAL COMMUNICATION					
Course Code : ECEN3105					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completing the course the student will be able to:

1. Apply the concepts of various techniques for analog signal transmission and modulation from the knowledge gathered earlier.
2. List the functions of different components of a digital communication system and understand Pulse code Modulation System.
3. Identify some mathematical concepts like probability theory and random process and design the source coder and channel coder blocks of the digital communication system using these concepts.
4. Analyze error performance of a digital communication system in presence of noise and other interferences and apply this knowledge to solve numerical problems.
5. Understand performance of Digital modulation and demodulation techniques in various transmission environments and concept of OFDM and Spread Spectrum Communication system.
6. Design a digital communication system and evaluate the performance of the system in presence of noise.

Module I: [8L]

Elements of Digital Communication System, Pulse code modulation : Sampling, Quantization, quantization noise, linear and non linear quantization, Companding, A-Law and μ -law companding, Source encoding, Differential pulse code modulation, linear predictive coders, Delta modulation, Adaptive delta modulation.

Module II: [13L]

Probability Theory and Random Processes: Concept of probability, Conditional probability, communication example, joint probability, statistical independence, random variable-continuous and discrete, cumulative distribution function, Probability Distribution Function – Gaussian and Rayleigh, mean, variance, random process, stationary and ergodic processes, correlation coefficient, covariance, autocorrelation function and its properties, power spectral density.

Different type of line coding : Properties of line coding – Polar/Unipolar/Bipolar NRZ and RZ, Manchester, Differential encoding and their PSDs, pulse shaping, Inter Symbol Interference (ISI), Eye pattern, Nyquist criterion for zero ISI, equalizer, zero forcing equalizer, Regenerative repeater, Bit synchronization, Frame synchronization.

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Module III: [8L]

Signal Vector Representation: Analogy between signal and vector, distinguishability of signal, orthogonal and orthonormal basis functions, orthogonal signal space, message point, signal constellation, geometric interpretation of signals, likelihood functions, Schwartz inequality.

Baseband transmission: Baseband signal receiver, integrate and dump type filter, probability of error calculations, optimum filters, coherent reception, matched filter and its transfer function, Probability of error of matched filter, Concept of error function, complementary error function and Q function.

Module IV: [9L]

Digital Modulation Techniques: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, Geometrical representation, generation, detection, error probability and power spectra of basic digital carrier modulation techniques: ASK, PSK and FSK. Concept of QAM and M-ary Communication, M-ary phase shift keying, average probability of symbol error for coherent M-ary PSK, power spectra of MPSK, Quadrature Phase Shift Keying (QPSK), Generation, detection, error probability and power spectra of QPSK signal, Offset Quadrature Phase shift Queuing (OQPSK), Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal, Gaussian Minimum Shift Keying: GMSK, Basic Concept of OFDM and Spread Spectrum Modulation

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TEXT BOOKS:

1. Digital Communications, S. Haykin, Wiley India.
2. Principles of Communication Systems, H. Taub and D.L.Schilling, TMH Publishing Co.
3. Digital Communications, J.G.Proakis, TMH Publishing Co.
4. B.P. Lathi, Modern Digital and Analog Communication System, Oxford University Press.
5. Electronic Communications Systems, Wayne Tomasi, Pearson Education.

REFERENCE BOOKS:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
2. Digital Communication, A. Bhattacharya, TMH Publishing Co.
3. Wireless Communication and Networks : 3G and Beyond, I. Saha Misra, TMH Education.
4. L.W. Couch II, Modern Communication System, Prentice Hall India.
5. Roden, Analog & Digital Communication Systems, 5e, SPD
6. Communication Systems (Analog and Digital), Sanjay Sharma, Katson Books

Course Name:	**Digital Communication Laboratory**				
Course Code	**: ECEN3115**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After completing the following experiments, students will be able to:

1. Understand, design and implement PN sequences with shift registers, Pulse Amplitude Modulators and demodulators etc.

2. Describe Line codes like polar/ uni polar NRZ, RZ.

3. Analyze various digital modulation and demodulation schemes.

4. Acquire an insight into Digital Communication systems in totality

List of Experiments:

1. Design and implementation of 7-length PN sequences using shift register.
2. Implementation and study of Pulse Amplitude Modulation and demodulation.
3. Study of Pulse Width Modulation and Demodulation
4. Implementation and study of Line Codes : polar/unipolar NRZ , RZ.
5. Implementation and Study of BASK Modulator.
6. Implementation and Study of BASK Demodulator
7. Implementation and Study of BFSK Modulator
8. Implementation and Study of BFSK Demodulator
9. Implementation and Study of BPSK modulator
10. Experiment beyond curriculum.

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ECE Department B.Tech., 3rd. Year, 2nd Semester

Course Name: DIGITAL VLSI DESIGN					
Course Code : ECEN3201					
Contact Hours	L	T	P	Total	Credit Points
per week	3	0	0	3	3

Course outcomes:
After completing the course the student will be able to:

Students will be able to relate to different MOS structures and functions in order to apply the knowledge in building CMOS circuits
2. Students can classify between VLSI Design Cycle, Style and Methodology.
3. Students will be able to determine logic and performance of CMOS combinational and sequential logic.
4. Students will be able to construct physical layout design and stick diagram of digital gates.
5. Students will be able to make use of various synthesis flow and HDL modeling in ASIC Semi custom design.
6. Students will be able to interpret Si testing and debug related algorithms and fault modeling.

Module I: VLSI Design Flow and CMOS Combinational Circuits: [14L]
Unit1: VLSI Design Cycle . Short channel threshold voltage. Design Heirarchy, Layers of Abstraction, Y-Chart, Design Styles, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX.

Unit 2: Switching Characteristics of MOS Transistors: Capacitive Effects, Process Characteristic Time Constant, propagation delay models, switching delay in logic circuits. High field effects.

Unit 3 : Inverter Characteristics and CMOS Combinational Logic : MOS inverters, CMOS inverter, DC characteristics, Noise Margin and Switching point, switching characteristics, dynamic power dissipation issues. Propagation delay & Delay equation. Static CMOS Logic gate design, pseudo-nMOS gates, pass transistor logic, Logical effort, transmission gate, TG logic, basic idea of dynamic and domino logic.

Module II: CMOS Sequential Circuits and Physical Design[10L]
Unit 1 : Bistability principle, SR Latch circuit, clocked JK Latch/ Master-Slave JK, CMOS D-latch & Edge triggered flip-flop, basic idea of DRAM and SRAM.

Unit 2 : CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm .

Module III: Synthesis and HDL [8L]

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Unit 1 : Synthesis – High level, Logic level, Brief ideas on partitioning, floorplanning, placement, routing and compaction

Unit 2 : Why HDL ? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), Verilog Coding, Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, FSM Example: Mealy Machine and Moore Machine.

Module IV:Test Methodology of VLSI Circuits: [6L]

Unit 1: Si Testing: Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, DFT, Scan Design, BIST.

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Text Books:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000 .
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011. Fundamental of VLSI Devices – Y. Taur & T.H. Ning- Cambridge University Press.

Reference Books:

3. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006 .
4. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
5. VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011.

Course Name: DIGITAL VLSI DESIGN LABORATORY					
Course Code : ECEN3211					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:
After completing the following experiments, students will be able to:

1. Understand Basics of designing logic gates, LUT etc.
2. Categorize CMOS sequential circuits, Stick diagram etc. and their implications
3. List the Usages of HDL, state machine models
4. Gain insight into Testing of ICs, different techniques.

List of Experiments:

1. Sub Micron and Deep Sub Micron Technology based Experiments:
   Backend Design flow using Tanner Design & Layout Tools and SPICE Analysis
   a. Transient analysis of CMOS Inverter Circuit
   b. DC & Parametric analysis of CMOS Inverter
   c. Layout Design and Verification of CMOS Inverter Using Tanner Tools
   d. Implementation of Various Logic Gates
   e. Implementation of Various Sequential Gates
2. Introduction to XILINX-Vivado Simulator, Verilog Coding and Test Bench Simulation
   a. Logic Design and Verification of Digital Gates, Mux, Encoder, Decoder
   b. Logic Design and Verification of a 15 Bit Ripple-Carry Adder
   c. Logic Design and Verification of Sequential Gates: D-Latch, Flop
   d. Logic Design and Verification of a Finite State Machine
3. FPGA Programming Flow using XILINX Hardware Kits: Implementing and verifying many of above experiments in FPGA hardware Kits.

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Course Name : DIGITAL SIGNAL PROCESSING & APPLICATIONS					
Course Code : ECEN3202					
Contact Hours per	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:
After completing this course, the students will be able to:

1 Use concepts of trigonometry, complex algebra, Fourier transform, z-transform to analyze the operations on signals and acquire knowledge about Systems

2 Apply computational tools to evaluate fourier transform on a digital computer , implementation of many signal processing algorithm and designed hardware .

3 Design, implementation, analysis and comparison of digital filters for processing of discrete time signals

4 Application of multirate signal processing for conversion of A/D and D/A and can design multiplexing system for communication.

5 Student can analyze the application of microprocessor with architecture and instruction sets optimized DSP operation.

6 Assess the techniques, skills, and modern engineering tools necessary for analysis of different communication signals and filtering out noise signals in engineering practice. Also develop creative and innovative designs that achieve desired performance criteria within specified objectives and constraints, understand the need for lifelong learning and continuing professional education.

MODULE I: [7L]

Introduction to Discrete time signals and systems:

Concept of discrete-time signal and systems: basic idea regarding sampling and reconstruction of signals, arithmetic operations on sequences, representation of systems, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical methods to compute convolution supported with examples and exercises, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems

Z-Transform:

Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples and exercises,

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characteristic families of signals along with ROCs, convolution, correlation and multiplication using Z-transform, initial value theorem, Parseval's relation, inverse Z-transform by contour integration, power series & partial-fraction expansions with examples and exercises.

MODULE II: [8L]

Discrete Fourier Transform:

Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples and exercises.

Fast Fourier Transform:

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.

MODULE III : [13 L]

Filter Concepts:

Introduction to the concept of Digital Filters, frequency response and filter characteristics, basic concepts of IIR and FIR filters .

IIR Filters:

Introduction to analog filter design: Butterworth and Chebyshev filters design, Transformation techniques: Impulse invariant method and bilinear transformation, Warping effect and prewarping. Design procedure for low pass digital Butterworth and Chebyshev filter design.

FIR Filters:

Linear phase filters: Condition for filter to have linear phase response and its frequency response (Type I, II, III, IV),

Design techniques: Fourier series method, Gibb's phenomenon, Windowing method (Rectangular, Hamming and Hanning window). Comparative advantages & disadvantages of FIR & IIR Filters.

MODULE IV: [8L]

Realization of Digital Filters

Direct form I, Direct Form II, Cascade form structure, Parallel form structure.

Multirate Signal Processing

Introduction: Advantage of Multirate Digital Signal Processing

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Decimation: Time domain characteristic, frequency domain characteristic, aliasing effect and anti-aliasing filter specification.

Interpolation: Time domain characteristic, frequency domain characteristic .

Introduction to Digital Signal Processor
Evaluation of DSP processor, DSP architecture, TMS320C3XX .

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson Ed.
2. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co
3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal Processing, A. Nagoor Kani, TMH Education .
5. Theory and application of digital signal processing- L.R. Rabiner & B. Gold- PHI.
6. Analog & digital Signal Processing- A. Ambardar- Books/Cole Pub.

References:

6. Digital Signal Processing,Tarun Kumar Rawat,Oxford Press
7. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co .
8. Digital Signal Processing; A Hands on Approach, C. Schuler & M.Chugani, TMH Publishing Co.
9. Digital Signal Processing S. Poornachandra & B. Sasikala, MH Education .
10. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press .
11. Texas Instruments DSP Processor user manuals and application notes.

Course Name: DIGITAL SIGNAL PROCESSING & APPLICATIONS LABORATORY					
Course Code : ECEN3212					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After completing the following experiments, students will be able to:

1. Understand the basics of sampling, convolution etc, Z-transform
2. Identify DFT and FFT and their applications
3. Analyze Filters – IIR and FIR
4. Categorize Digital filters, multirate signal processing etc

Simulation Laboratory using standard Simulator:

1. Convolution of two sequences using graphical methods and using commands- verification of the properties of convolution.
2. Z-transform of various sequences – verification of the properties of Z-transform.
3. Twiddle factors – verification of the properties.
4. DFTs / IDFTs using matrix multiplication and also using commands.
5. Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.
6. Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.
7. Butterworth filter design with different set of parameters.
8. Chebyshev filter design with different set of parameters.
9. FIR filter design using rectangular, Hamming and Blackman windows.

Hardware Laboratory using Xilinx FPGA:

1. Writing of small programs in VHDL and downloading onto Xilinx FPGA.
2. Mapping of some DSP algorithms onto FPGA.

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Course Name: TELECOMMUNICATION SYSTEMS (PROF ELECTIVE 1)					
Course Code : ECEN3234					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Course Outcomes:
After completing the course the student will be able to:

1. Apply the previous knowledge of analog communication to appreciate the contents of this paper.
2. Understand basics of Telecommunications and its entities along with the evolution of different types of exchanges.
3. Identify concepts of Telecommunication like signaling techniques, setting up links etc effectively.
4. Describe working principles and practical applications of FAX, EPABX,ISDN etc effectively.
5. List salient features of EWSD, NGN, ADSL etc.
6. Evaluate performance of a telecom network using the concepts of Traffic Engineering and case studies based on the observation.

Module I: (10L)
Introduction to Telephone and Switching Systems
Evolution of Telecommunication, Components and Examples of Telecommunication Systems, Pulse and Tone Dialing, Telephone Instruments- Rotary Dial and Push Button Types, Electro-mechanical switching – Strowger and Crossbar, Circuit Switching and Packet Switching, Digital Switching Systems- Time Division Time Switch, Time Multiplexed Space Switch, Time Multiplexed Time Switch, Hybrid Switching, TS,ST,STS,TST systems, Architecture of 5ESS systems.

Module II: (8L)
Telecommunication Transmission Lines and Subscriber Loop Systems (8L)
Copper, co-axial and Fiber-Optic cables, Transmission Fridge- Hybrid Circuit for 2-wire to 4-wire conversion and vice versa. PCM Carriers, American and European standards of carrier channels.
BORSCHT Functions, Switching Hierarchy and Routing, Signaling Techniques- In channel and Common Channel Signaling, Signaling System 7 (SS7).
Introduction to Global Telecom Link through Satellite Networks

Module III: (10L)
Stored Program Control
Software architecture, Application Software, Electronic Exchanges, Introduction to Cordless Telephones and Digital PABX.
Introduction to Modems, FAX, Broadband Transmission- ISDN, DSL, ADSL, ISDN, B-ISDN, Introduction to IP Telephony.
INTRODUCTION TO NEW GENERATION OF ELECTRONIC EXCHANGES- EWSD (ELECTRONIC WORLDWIDE SWITCH DIGITAL), NGN (NEXT-GENERATION NETWORK)

Module IV: (8L)
Traffic Engineering
Blocking network, Blocking Probability, Grade of Service, Traffic Load, Erlang-B congestion formula- case studies

Text Books:

a) T. Viswanathan “Telecommunication Switching System and Networks”, PHI
b) J.C Bellamy “Digital Telephony” – Wiley India

Reference Books:

a) O Hersent, D Gurle, J P Petit “ IP Telephony” Pearson
b) J. E Flood “ Telecommunication Switching, Traffic and Networks” Pearson
c) R L Freeman “ Telecommunication System Engineering” Wiley-India
d) A Gokhale “ Introdcution to Telecommunication” – Cengage Learning

Course Name : Communication Techniques					
Course Code: AEIE3101					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [10L]

Analog Communication: Introduction to baseband transmission & modulation (basic concept); elements of communication systems (mention of transmitter, receiver and channel); Origin of noise and its effect, importance of SNR in system design; AM modulator & demodulator, basic principles of non-linear modulation (angle modulation - FM, PM); bandwidth requirements for angle modulated waves, comparison of various analog communication system (AM –FM – PM), VCO and PLL.
Maxwell's equations-interpretation of equations, displacement current, continuing, transmission lines-field distribution of E & H field, concept on transmission of EM wave (mention of lumped & distributed parameters, line parameters, propagation constant, characteristic impedance, wavelength, velocity of propagation, distortion-less line, reflection and transmission co-efficients).

Module II – [9L]

Digital Communication: Bit rate, baud rate; information capacity, Shanon's limit; m-ary encoding, introduction to the different digital modulation techniques - ASK, FSK, PSK, BPSK, QPSK, FSK & QPSK modem, quadrature amplitude modulation (QAM); Delta modulation, adaptive delta modulation (basic concept and applications); Introduction to DPCM and spread spectrum modulation.

Module III – [13L]

Digital Transmission: Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, aliasing; analog pulse modulation - PAM (natural & flat topped sampling), PWM, PPM; basic concept of pulse code modulation, block diagram of PCM; Multiplexing - TDM, FDM.
Concept of quantization & quantization error, uniform quantizer; non-uniform quantizer, conceptual idea of A-law & μ-law companding; encoding, coding efficiency, source, line coding channel coding & properties, NRZ & RZ, AMI, manchester coding PCM, DPCM; baseband pulse transmission, matched filter (its importance and basic concept), error rate due to noise; error control & coding, nyquist criterion for distortion-less base-band binary transmission, concept of eye pattern, signal power in binary digital signals.

Module IV – [8L]

Multiple Access Techniques and Radio Communication: Multiple access techniques, TDMA, FDMA and CDMA in wireless communication systems, advanced mobile phone system (AMPS), global system for mobile communications (GSM), cellular concept and frequency reuse, channel assignment and handoff, Bluetooth, introduction to satellite communication.

References:

1. Simon Haykin, *Communication Systems;* 4th Edition, John Wiley & Sons. 2001.
2. B.P.Lathi, *Modern Analog And Digital Communication systems;* 3/e, Oxford University Press, 2007.
3. H.Taub,D L Schilling ,G Saha , *Principles of Communication;* 3/e,2007.
4. Martin S.Roden, *Analog and Digital Communication System*; 3rd Edition, PHI.
5. G. S. N. Raju, *Electromagnetic Field Theory & Transmission Lines*; Pearson Education.

Course Outcomes:

After the completion of the course students will be able to

1. Distinguish among different analog modulation techniques with their advantages, disadvantages and applications
2. Interpret Maxwell's equations physically and explain wave properties in lossy, lossless and distortion less medium
3. Compare the merits and short comings of the basic digital modulation techniques
4. Apply sampling theorem to sample analog signal properly and Differentiate among pulse modulation & demodulation techniques and signal multiplexing for engineering solutions
5. Describe and determine the performance of coding schemes for the reliable transmission of digital representation of signals & information over the channel and methods to mitigate inter symbol interference
6. Compare modern multiple access schemes, explain the concept of frequency reuse, channel assignment strategies and make use of wireless communication tools

Course Name : Microprocessors- Architechture And Applications					
Course Code: AEIE3102					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I - [12L]

Introduction of microcomputer system.
Introduction to 8 bit Microprocessor: History of microprocessor, 8085A microprocessor internal architecture, buses, 8085 pin description.
Software instruction set, addressing modes and assembly language programming.

Module II - [10L]

Instruction cycle, machine cycle, timing diagrams.
Interrupts: Introduction, interrupt vector table, interrupt service routine, programs using interrupts, DMA operation.
Stack and stack handling, call and subroutine, counter and time delay generation.

Module III - [6L]

Interfacing of memory chip and input / output devices: Absolute and partial address decoding, interfacing of different size of memory chips with 8085A, Memory mapped I/O and I/O mapped I/O, interfacing of input/output devices with 8085A.

Module IV - [12L]

Programmable peripherals and applications: Block diagram, pin description and interfacing of 8255(PPI) with 8085A microprocessor. Interfacing of LEDs, switches, stepper motor, ADC and DAC using 8255.
Block diagram, pin description and interfacing of 8259, 8254 and 8251 USART with 8085A microprocessor.

References:

1. Ramesh S. Gaonkar, *Microprocessor architecture, programming and applications with 8085/8085A*; Wiley eastern Ltd.
2. B. Ram, *Fundamental of Microprocessor and Microcontrollers*; Dhanpat Rai Publications.
3. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, *Microprocessors and Microcontrollers*; Oxford Publications.
4. A. Nagoor Kani, *8085 Microprocessor and its Applications*; Third Edition, TMH Education Pvt. Ltd.

Course outcome:

After the completion of the course the students will be able to:

1. Understand the architecture of 8 bit microprocessor (8085A).
2. Describe the importance and function of each pin of 8085A Microprocessor.
3. Develop the skill in program writing for 8085A microprocessor.
4. Describe different types of memory and I/O interfacing with 8085A microprocessor.
5. Describe the architecture of different types of programmable peripheral devices and their interfacing with 8085A microprocessor.
6. Develop the skill to interface different types of I/O devices with 8085A microprocessor using programmable peripheral device.

Course Name : Industrial Instrumentation					
Course Code: AEIE3103					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [10L]

Measurement of Pressure and Vacuum: Introduction, manometers, diaphragm, capsule, bellows, bourdon tube, pressure switch, differential pressure gauge, dead weight tester; Flapper nozzle assembly, pneumatic relay, pneumatic transmitter - force balance and motion balance system; Electronic Pr / DP transmitters – capacitive, piezoresistive and resonating wire type; installation of pressure measuring instruments with accessories like seals, snubbers, valve manifolds and installation of DP measuring instruments; Mcleod gauge, thermal conductivity gauge, ionization gauge.

Module II – [12L]

Flow rate Measurement: General concepts – Reynolds's number, laminar flow, newtonian & non-newtonian fluids; head type flow meters – orifice, venturi, pitot tube, multiport averaging pitot, flow nozzle; variable area flow meters – glass and metal tube rotameters; electromagnetic flow meters; ultrasonic flow meters; vortex flow meters; positive displacement flow meters; turbine flow meters; Coriolis flow meters; open channel flow measurement - different shapes of weirs and corresponding flow relations, solid flow measurement.

Module III – [8L]

Level Measurement: Sight glass, float and displacers type instruments – gauges and switches, interface level measurement; resistive and capacitive type level instrument; D/P type sensors and boiler drum level measurement; ultrasonic and microwave type level instruments, radioactive level measurement, solid level measurement.

Module IV – [10L]

Temperature Measurement: filled in systems – liquid, gas and vapour, ranges, media, errors, construction details and comparison, classification; bimetal elements, thermostats; RTD – working principle, different wired configuration, characteristics, typical industrial application; thermocouples – working principle, cold junction compensation, different types of thermocouples and their application in industry and laboratory, thermopiles; thermowells, thermistor; total radiation pyrometer, optical pyrometers; hazardous area instrumentation: basic concepts, classification based on site, material and temperature – IEC and North American system; methods of protection – explosion proof, intrinsic safety, zener barrier, purging and pressurization, non-incendiary; IEC equipment protection level (EPL); NEMA and IP codes.

References:

1. B. G. Liptak, *Instrument Engineers Handbook, vol-I and vol-II*; Chilton Book Co. Philadelphia.
2. D. Patranabis, *Principles of industrial Instrumentation*; TMH, New Delhi, 2nd Ed.
3. Eckman, *Industrial Instrumentation*; Wiley Eastern Ltd.
4. D. M. Considine and G. D. Considine (Eds.) *Process Instruments and controls Handbook*; Mc Graw Hill, New York.
5. Ernest O. Doeblin, *Measurement Systems – Application and Design*; Tata-McGraw Hill.
6. K Krishnaswamy, *Industrial Instrumentation*; New Age International.
7. S. K. Singh, *Industrial Instrumentation & Control*; Tata McGraw-Hill.

Course Outcome:

After the completion of the course students will be able to

1. Learn the working principle of measuring devices for pressure and apply their knowledge for selection and installation of proper sensing instruments applicable to the process in hand.
2. Design different flow measuring devices towards the choice of proper sensing instruments required in industry
3. Analyze level measuring devices with necessary accessories for industry and societal needs
4. Demonstrate working knowledge of temperature measuring devices as well as safety practices used in the measurement and control of industrial processes
5. Design electronic instrumentation system for the acquisition of measurement data produced by measuring instruments for flow, level, temperature and pressure
6. Formulates industrial process parameters towards the analysis of process data

Course Name : Control Systems					
Course Code: AEIE3104					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [10L]

Elementary control concept - control system terminology and examples, basic structure of open loop, feedback and feed forward control system; mathematical model of physical system - importance, differential equation representation of physical systems, transfer function models, block diagram models, signal flow graphs models, model of standard test signals, concept of system sensitivity.

State space analysis - concepts of state, state variables and state model, state space representation of linear continuous-time systems, solution of linear time invariant state equation, concept on controllability and observability, illustrative examples.

Module II – [11L]

Developments of models for industrial control devices and systems - dc servomotors, ac servomotors, dc motor speed and position control;

Time domain analysis -time domain performance criterion, transient response of first order and second order with standard test signals, steady state error coefficient, effect of pole-zero addition in system response.

Basic control action- introduction to conventional controller (P, PI, PD, PID), effect of control action, basic knowledge for implementing of controller.

Module III – [7L]

Stability analysis - concept of stability necessary and sufficient condition for stability, Routh stability criterion, concept of relative stability; root locus technique - introduction, the root locus concept, root locus construction rules, stability analysis from the root locus plot.

Module IV – [12L]

Frequency domain analysis techniques -introduction, polar plot: guideline for sketching polar plot, stability analysis; Nyquist plot- introduction, mapping of close contour and principle of arguments, development of Nyquist stability criterion; Bode plot - minimum and non minimum phase system, concept of phase margin and gain margin, procedure for drawing Bode plots. Assessment of relative stability–gain margin and phase margin.

Compensation techniques - the design problems, lead compensation, lag compensation, lead-lag compensation.

Reference

1. Nagrath I. J. and Gopal M., "*Control System Engineering*", 5th Ed., New Age International Private Ltd. Publishers.
2. Kuo B. C., "*Automatic Control Systems*", 8th Ed., Wiley India
3. Ogata K., "*Modern Control Engineering*", 4th Ed., Pearson Education.
4. Dorf R. C. and Bishop R. H., "*Modern Control Systems*" Pearson Education.
5. Norman S. N., "*Control Systems Engineering*", 4th Ed., Wiley India.

Course Outcomes:

After the completion of this course students will be able to:

1. Develop mathematical model of physical and simulated systems in forms of transfer function.
2. Represent the block diagram and signal flow graph of the systems.
3. Investigate the time response of systems and calculate performance indices.

4. Analyze frequency response and stability of linear systems using different methods.
5. Understand the concept of state variable representation and design principle.
6. Check the observability and controllability of the systems.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Microprocessors & Microcontrollers					
Course Code: AEIE3105					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module I - [8L]
Introduction to microcomputer system, History and evolution of microprocessor and microcontrollers and their advantages and disadvantages;
Introduction to 8 bit microprocessor: 8085 microprocessor internal architecture, buses, 8085 pin description; Software instruction set, timing diagram of the instructions, addressing modes and assembly language programming; Interrupts of 8085 processor: classification of interrupts, Programming using interrupts.

Module II - [10L]
Introduction to 8086/8088 Architecture: Architecture, memory segmentation, signal descriptions, clock generator, resetting the microprocessor, wait state inserting, bus buffering, interrupts, instruction set, addressing modes and assembly language programming of 8086/8088.

Module III - [10L]
Introduction to microcontrollers: Intel MCS-51 family features, 8051 architecture, pin configuration, I/O ports and memory organization; Instruction set and basic assembly language programming, interrupts and returns; Interrupts, timer/counter and serial communication;MCS-51 applications: Square wave generation, LED, A/D converter and D/A converter interfacing with 8051;
Brief introduction to PIC microcontroller (16F877): Architecture, pin details, memory layout etc.

Module IV - [12L]
Memory and ADC / DAC interfacing with 8085/ 8086;
Support IC chips: 8255, 8237, 8259 and 8251- Block diagram, pin details, modes of operation, control word(s) format and interfacing with 8085/8086/8051.

References:

1. Ramesh S. Gaonkar, *Microprocessor architecture, programming and applications with 8085/8085A*; Wiley eastern Ltd.
2. B. Ram, *Fundamental of Microprocessor and Microcontrollers*; Dhanpat Rai Publications.
3. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, *Microprocessors and Microcontrollers*; Oxford Publications.
4. A. Nagoor Kani, *8085 Microprocessor and its Applications*; Third Edition, TMH Education Pvt. Ltd.
5. Douglas V. Hall, *Microprocessors & Interfacing*, Tata McGraw-Hill.
6. Ray & Bhurchandi, *Advanced Microprocessors & Peripherals*, Tata McGraw-Hill.
7. Barry B. Brey, *The Intel Microprocessors*, PHI/Pearson Ed. Asia.
8. Muhammed Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems*, Pearson Education Inc.
9. Ajay V Deshmukh, *Microcontrollers Theory and Applications*, Tata McGraw-Hill.
10. Raj Kamal, *Embedded systems- Architecture, Programming and Design*, McGraw Hill Education (India) Pvt. Ltd.

Course outcome:
After the completion of the course the students will be able to:
1. Learn the architecture and function of each pin of 8 bit microprocessor 8085, 16 bit microprocessor 8086/8088, 8051 and PIC microcontroller.

2. Develop the skill in program writing for 8085 microprocessor, 8086 microprocessor, 8051 and PIC microcontroller.
3. Perform memory and I/O interfacing with 8085 microprocessor, 8086 microprocessor.
4. Describe the architecture of different types of programmable peripheral devices and their interfacing with microprocessor, 8086 microprocessor and 8051 microcontroller.

Course Name : Economics for Engineers					
Course Code: HMTS3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I:
Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market.
The basic concept of economics – needs, wants, utility.
National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity.
Inflation: meaning, reasons, etc. **(6L)**

Module II:
Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics.
Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India.
International Business or Trade Environment. **(4L)**

Module III:
Financial Accounting-Journals. Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet.
Financial Statement Analysis (Ratio and Cash Flow analysis). **(8L)**

Module IV:
Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs.
Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis.
Marginal Cost based decisions. **(6L)**

Module V:
Time Value of Money: Present and Future Value, Annuity, Perpetuity.
Equity and Debt, Cost of Capital. **(4L)**

Module VI:
Capital Budgeting: Methods of project appraisal - average rate of return - payback period - discounted cash flow method: net present value, benefit cost ratio, internal rate of return.
Depreciation and its types, Replacement Analysis, Sensitivity Analysis. **(8L)**

References:
1. R. Narayanswami, *Financial Accounting- A Managerial Perspective.* Prentice-Hall of India Private Limited. New Delhi
2. Horne, James C Van, *Fundamentals of Financial Management*. Prentice-Hall of India Private Limited, New Delhi
3. H. L. Ahuja., *Modern Economic Theory*. S. Chand. New Delhi.
4. Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. *Engineering Economic Analysis.* New York: Oxford University Press. 2012.

Course Name : Sensors and Transducers Lab					
Course Code: AEIE3111					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Comparative studies of some temperature measuring sensors like AD590 IC sensor, RTD and thermistor.
2. Study of capacitive transducer.
3. Study of I/O characteristics of LVDT and hence measure Pressure and displacement through it.
4. Study of a load cell with tensile and compressive load.
5. Rotational speed measurement using magnetic proximity sensor.
6. Measurement of rotational speed measurement using a stroboscopic principle.
7. Comparative studies of some optical sensors like LDR, photo diode and photo transistor.
8. Design a suitable signal conditioning circuit for a given sensor.

Course Outcome:

After the completion of the assignments, the students will be able to

1. Explain working principles of sensors and transducers.
2. Study the working principle of displacement transducers and their applications.
3. Understand principle of working of various transducers used to measure Temperature, comparative study of various transducers.
4. Learn the various types of level measurement transducers and their applications, basic principle of working.
5. Understand applications of various transducers in industry
6. Understand applications of miscellaneous other sensors.

Course Name : Microprocessor Lab					
Course Code: AEIE3112					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above using 8085A simulator.
2. Study of prewritten programs using basic instruction set (data transfer, load/store, arithmetic, logical) on the simulator and related assignments.
3. Programming using kit/simulator for:
   a. Look up table
   b. Copying and shifting block of memory
   c. Packing and unpacking of BCD numbers
   d. Addition/subtraction of two 8-bit unsigned/signed hex numbers,
   e. Addition of 16-bit unsigned hex numbers.
   f. BCD addition.
   g. Multiplication of two 8-bit unsigned numbers using sequential shift - add method.
   h. Division of two 8-bit numbers.
   i. Factorial calculation.
   j. Binary to ASCII conversion
   k. String matching
   l. String sorting
4. Interfacing with switches and LEDs through PPI 8255A with 8085A trainer kit and glowing LEDs according to read switch status, scrolling, blinking of LEDs using delay subroutines.
5. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using a trainer kit and 8255A PPI employing absolute and partial decoding concept as a peripheral mapped output port with absolute address decoding.
6. ADC, DAC, stepper motor interfacing with 8085A trainer kit and their programming.
7. Programming with hardware interrupts of 8085A microprocessor.
8. Familiarization with EEPROM programming and erasing.

Course Outcome:

After the completion of the course the students will be able to:

1. Select proper instructions and build different assembly language program for 8085 microprocessor.
2. Understand the assembly language programming concept of microprocessor.
3. Design the interfacing of input/output devices with 8085 microprocessor using partial and absolute address decoding.
4. Build assembly language program to control input/output devices for various applications.
5. Analyze the processing of analog signal and generation of various analog signals using interfacing circuit.
6. Realize the programming concept of hardware interrupts in 8085 microprocessor.

Course Name : Industrial Instrumentation Laboratory					
Course Code: AEIE3113					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Familiarization of/with diaphragm, capsule, bellow, Bourdon tube, orifice plate, pitot tube, etc.
2. Calibration of pressure gauges using dead weight tester.
3. Study the characteristics of thermocouple.
4. Study the characteristics of RTD.
5. Fluid flow rate measurement using orifice meter.
6. Measurement of fluid flow rate using rotameter.
7. Level measurement using capacitive/ultrasonic type level transducer.
8. Moisture measurement using moisture analyzer.
9. Measurement of kinematic viscosity using Ostwald viscometer.

Course Outcome:

After completion of this course students will be able to

1. Build a knowledge selecting particular sensing elements for the measurement of physical parameters.
2. Demonstrate the calibration process of pressure measuring devices using dead weight taster.
3. Measure process parameters like flow and level using different measuring devices.
4. Select particular temperature sensing elements for the measurement of temperature.
5. Determine the measurement of viscosity of a specific solution.
6. Formulate moisture percentage of a given sample.

Course Name : Control Engineering Lab					
Course Code: AEIE3114					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Familiarization with MATLAB control system toolbox, MATLAB-SIMULINK toolbox.
2. Block diagram reduction techniques using MATLAB.
3. Transient response of first order and second order system with standard test signals, and study of system parameter using MATLAB .
4. Design and study of the response of first and second order electrical circuits using RC and RLC circuits in hardware.
5. Study of system stability root-locus, Bode plot, Nyquist plot using MATLAB toolbox for any given transfer function with P-Z mapping.
6. Familiarization with state space representation of models using MATLAB toolbox.
7. Study the effect of P, I, D actions on first order / second order simulated processes.
8. Position control of DC servo motor.
9. Speed control of Servo motor or DC motor.

Course Outcomes:

After the completion of this course students will be able to:

1. Understand the concept of pole-zero and transfer function.
2. Derive the overall transfer function from block diagram.
3. Analyze the time response of first order and second order system for different standard input signals and calculate the transient response parameters.
4. Check the stability of a system using root locus method.
5. Find the frequency response of a system using Bode plot and Nyquist plot method.
6. Control the speed of dc motor using different controllers.

11. Implement Flip/Flop(RS, JK, D, T), b)Register,(4/8 bit Synchronized Data Transfer).
12. Design a ripple counter and comparator.
13. Use a multiplexer unit to design a composite ALU.
14. Design a Control Unit.
15. Design a simplified communication protocol.

Course Outcome:

1. After completion of this, students would be able to have adequate knowledge of basics of computer architecture.
2. Students would be able to understand detailed implementation of machine instructions, their classifications and their relevance to programming paradigms.
3. Students would have sufficient knowledge of design implementations of various arithmetic operations such as adder, multiplier etc.
4. Students would be able to design and simulate various combinatorial and sequential logic circuits using Vivado/Xilinx.
5. Students would be able to understand various memory functions.
6. Students would be able to design a formal testbench from informal system requirements.

Course Name : Microprocessors & Microcontrollers Lab					
Course Code: AEIE3115					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above all using 8085A Simulator.
2. Study of prewritten programs using basic instruction set (data transfer, load/store, arithmetic, logical) on the simulator. Assignments based on above.

3. Programming using kit/simulator for:
   a) Addition/Subtraction of two 8-bit Hex numbers
   b) Packing and unpacking of BCD numbers
   c) Copying and Shifting block of memory
   d) Addition of two 16-bit Hex numbers.
   e) BCD Addition
   f) Multiplication of two 8-bit unsigned numbers using sequential Shift - Add Method
   g) Binary to ASCII conversion
4. Familiarization of 8086 microprocessor kit/simulator and assembly language programming using 8086 microprocessor/simulator for :
   a) Addition of two 32-bit Hex numbers.
   b) String matching
   c) Shifting a block of data from one memory location to another
   d) Finding the largest/ smallest number from an array
5. Interfacing with switches and LEDs and glowing LEDs according to read switch status and scrolling-
   blinking using delay subroutines through
   a) PPI 8255A with 8085A trainer kit
   b) 8051 microcontroller
6. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using- a) 8085A trainer kit, b)8086A trainer kit and 8255A PPI employing absolute and partial decoding concept as a peripheral mapped output port with absolute address decoding.

7. ADC, DAC and Stepper motor interfacing with 8086 microprocessor/8051 microcontroller and their programming.

Course outcome:

After the completion of the course the students will be able to:

1. Understand and apply assembly language of 8085 microprocessor, 8086 microprocessor and 8051 microcontroller.
2. Write programs based on the arithmetical and logical algorithms.
3. Work with microprocessor 8085A,8086Aand microcontroller 8051 interfaced, with LEDs, seven segment displays ADC, DAC, and stepper motor etc.

Course Name : Process Control					
Course Code: AEIE3201					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [6L]

Process control system: process control and automation, basic process control loop block diagram, terms and objectives, piping and instrumentation diagram, servo and regulatory control, classification of variables; process characteristic: process equation, degrees of freedom, process quantity, process potential, process resistance, process capacitance, process lag, process dead time, self-regulating processes, interacting and non- interacting processes; modeling of simple systems: liquid, thermal and gas systems.

Module II – [14L]

Theory of controllers: basic control action, two position, multi-position, floating control modes; continuous controller modes: proportional, integral, derivative; composite controller modes: P-I, P-D, P-I-D, integral wind-up and prevention, auto/manual transfer, bump less transfer, position and velocity algorithm; response of controllers with different test inputs; closed loop response of 1st & 2nd order systems with and without valve, measuring element dynamics; selection of control modes for processes like: level, pressure, temperature and flow; design of electronic/pneumatic controllers; controller tuning methods: evaluation criteria - IAE, ISE, ITAE, process reaction curve method, continuous oscillation method, damped oscillation method, auto tuning.

Module III – [10L]

Final control elements: final control element: actuators (pneumatic actuators, electrical actuators) and control valves (globe, ball, butterfly, gate, pinch), different parts, single & double seated valves, fail-safe operation, valve characteristics, inherent and installed valve characteristics, valve sizing, valve selection, cavitations, flashing, noise, instrument air supply specifications; control valve accessories: air filter regulator, I/P converter, pneumatic positioner, electro-pneumatic positioner, limit switches, motion transmitters; brief study of safety and solenoid valves.

Module IV – [10L]

Complex control system: cascade control, ratio control, feed forward control, overide, split range and selective control, multivariable process control, interaction of control loops; case studies: boiler drum level control, combustion control and ph control; introduction to programmable logic controllers (PLC): basic architecture and functions; input-output modules and interfacing; CPU and memory; relays, timers, counters and their uses; PLC programming and applications; introduction to DCS and SCADA; introduction to digital control; automation hierarchy.

References:

1. Surekha Bhanot, *Process Control: Principles and Applications*, Oxford University Press, 1st Edition, 2008.
2. G.Stephanopoulos, *Chemical Process Control-An Introduction to Theory and Practice* Prentice Hall of India, New Delhi, 2nd Edition, 2005.
3. B.W. Bequette, *Process Control Modeling, Design and Simulation*, Prentice Hall of India, New Delhi, 2004.
4. Curtis D.Johnson, *Process Control: Instrumentation Technology*, Prentice Hall College Div; Custom edition, 2008.

5. C.L.Smith and A.B Corripio., *Principles and Practice of Automatic Process Control*, John Wiley and Sons, New York, 2nd Edition 1998.
6. Paul W. Murril, *Fundamentals of Process Control Theory*, 3rd Edition, ISA press, New York, 2000.
7. Bela G. Liptak, *Instrument Engineers' Handbook,: Process Control*, CRC Press; 3rd edition, 1995.

Course Outcomes:

After the completion of this course students will be able to:

1. Develop the mathematical model for the liquid, thermal and gas systems by their knowledge of Mathematics, Science and engineering.
2. Design and simulate the ON-OFF, P, PI, PID etc. controllers both in hardware and software using electronic components, simulink, MatLab, LabVIEW etc.
3. Identify; analyze the process and accordingly able to choose the modes of controller best suited for the control of the process.
4. Apply their contextual knowledge of control valve to provide engineering solutions of various societal, professional & environmental responsibilities if imposed.
5. Design and develop the ladder logic program in PLC towards the solution of the sequential events performed in industry.
6. Identify, formulate/model, analyze the process and provide solution using knowledge of complex control systems like cascade control, ratio control, feed forward control, overide, split range and selective control, multivariable process control.

Course Name : Electronic Instrumentation and Measurement					
Course Code: AEIE3202					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [12L]

Analogue electronic instruments: introduction, emitter follower voltmeter, D.C. and A.C. voltmeters with operational amplifiers, true R.M.S voltmeter, peak response voltmeter, current-to-voltage converter type electronic ammeters, chopper stabilized amplifiers for measurement of very low voltage and current, electronic multimeter; voltage controlled oscillator, phase locked loop, applications; current mirror, programmable gain amplifier, charge amplifier; voltage to frequency and frequency to voltage converters.

Module II – [10L]

Cathode ray oscilloscopes and its applications: cathode ray tube, deflection amplifiers, sweep generator, oscilloscope automatic time base, dual-trace oscilloscopes, oscilloscope controls, oscilloscope probes, delayed time base oscilloscope, analog storage oscilloscope, sampling oscilloscope, digital storage oscilloscope, applications of oscilloscope.

Module III – [9L]

Digital instruments: introduction, digital voltmeters: characteristics, types- ramp type, dual slope integrating type, successive approximation type, voltage to frequency converter type, microprocessor based ramp type; basic digital displays, LED and LCD panels, display drivers and latches, time base generation with crystal oscillators and dividers; design and implementation of a simple digital frequency meter, errors in frequency measurement–possible remedies, time period and frequency ratio measurement.

Module IV – [9L]

Q meter: basic circuit, series connection method, parallel connection method, sources of errors; electronic ohmmeter; spectrum analyzers; interference and noises; introduction to virtual instrumentation.

References:

1. David Bell, *Electronic Instrumentation & Measurement*; Reston Publishers.
2. H.S. Kalsi, *Electronic Instrumentation*; Tata McGraw Hill.
3. A.D. Helfrick & W.D. Cooper , *Modern Electronic Instrumentation & Measuring Instruments*; Wheeler.
4. D.C. Patranabis, *Principles of Electronic Instrumentation*; PHI.
5. Oliver, Cage, *Electronic Measurements and Instrumentation*; Mc Graw Hill

Course Outcome:

After completion of this course students will be able to

1. Select electronic voltmeters and ammeters suitable for typical measurements.
2. Use electronic instruments like VCO, PLL, current mirror, charge amplifier, voltage to frequency and frequency to voltage converter.
3. Explain the circuit operation of CRO, dual trace oscilloscope, delayed time base oscilloscope.
4. Familiar about digital storage oscilloscope, spectrum analyzer.
5. Explain the working of different types of digital voltmeters, digital frequency meter and digital display unit.
6. Check the quality of a coil, capacitor using Q meter.

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Course Name : Advanced Microprocessors and Microcontrollers					
Course Code: AEIE3203					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I - [10L]

Introduction to 8086/8088 architecture: architecture, memory segmentation, signal descriptions, clock generator, resetting the microprocessor, wait state inserting, bus buffering, interrupts; instruction set, addressing modes and assembly language programming of 8086/8088.

Module II - [6L]

Interfacing memory: interfacing static ram (6116–2K, 6264–8K), interfacing EPROM (2764 – 8K, 27256 – 32K), designing memory modules (higher capacity say 512K) using memory chips (say 8K); interfacing I/O devices.

Module III - [12L]

Introduction to microcontrollers: Intel MCS-51 family features, 8051 architecture, pin configuration, I/O ports and memory organization; instruction set and basic assembly language programming; interrupts, timer/counter and serial communication; MCS-51 applications: square wave generation, LED, A/D converter and D/A converter interfacing with 8051.

Module IV - [12L]

PIC microcontroller: introduction, architectural overview, memory organization, data memory and flash memory, interrupts and reset, timer, analog and digital I/O; programming concepts and embedded programming in C; PIC applications: temperature monitoring and control, stepper motor control.

References:

1. Douglas V. Hall, *Microprocessors & Interfacing*, Tata McGraw-Hill.
2. Ray & Bhurchandi, *Advanced Microprocessors & Peripherals*, Tata McGraw-Hill.
3. Barry B. Brey, *The Intel Microprocessors*, PHI/Pearson Ed. Asia.
4. Muhammed Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems*, Pearson Education Inc.
5. Ajay V Deshmukh, *Microcontrollers Theory and Applications*, Tata McGraw-Hill.
6. Muhammed Ali Mazidi, Rolin D. McKinlay, Danny Causey, *PIC Microcontroller and Embedded Systems*, Pearson Education Inc.
7. Raj Kamal, *Embedded systems- Architecture, Programming and Design*, McGraw Hill Education (India) Pvt. Ltd.

Course outcome:

After the completion of the course the students will be able to:

1. Describe the architecture of 16 bit microprocessor (8086/8088), 8051 and PIC (PIC16F877) microcontroller
2. Develop the skill in program writing for 8086 microprocessor, 8051 and PIC microcontroller.
3. Understand and realize the interfacing of memory, input/output devices with 8086 microprocessor.
4. Understand the interrupts of 8086 microprocessor, 8051 and PIC microcontroller.
5. Understand the use of timer/counter and serial data communication process in 8051 microcontroller.
6. Apply the knowledge to interface different type of I/O devices with 8051 and PIC microcontroller.

Course Name : Process Control Lab					
Course Code: AEIE3211					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Study of flow, level and pressure processes and construction of P&I diagram in accordance with ISA guidelines /Standards.
2. Study of typical pressure control loop having pressure source, pressure transmitter, control valve and conventional PID controller.
3. Study of a typical level control loop having level transmitter, control valve and conventional PID controller.
4. Study of a typical air duct flow monitoring and control.
5. Study of a furnace temperature control loop.
6. PLC programming through PC.
7. Study of single element & three element control of boiler drum level and burner management system using boiler simulation software.

Course Outcomes:

After completion of this course students will be able to

1. Draw and explain P&I diagram of flow, pressure, level and temperature control loop from their engineering knowledge.
2. Analyze the process responses with respect to various process parameter values.
3. Use software tool to study the close loop process responses.
4. Create ladder logic diagram for various sequential operations commonly used in industrial environment.
5. Conduct experiments either in group or by individual means.
6. Provide engineering solutions of various societal, professional & environmental responsibilities.

Course Name : Electronic Instrumentation and Measurement Lab					
Course Code: AEIE3212					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Study of static and dynamic characteristics of a measuring instrument.
2. Acquaintance with basic structure of DMM and measurement of different electrical parameters.
3. Realization of data acquisition system.
4. Spectrum analysis using spectrum analyzer.
5. Realization of a V-to-I & I-to-V converter.
6. Study of VCO (voltage controlled oscillator) & PLL (phase locked loop).
7. Study of analog to digital converter.
8. Study of digital to analog converter.
9. Statistical analysis of errors in measurement using MATLAB.

Course Outcomes:

After completion of this course students will be able to

1. Use data acquisition system to gather output data from transducer.
2. Able to make statistical analysis on large number of data.
3. Implement analog to digital and digital to analog converter.
4. Get hands on experience on voltage controlled oscillator, phase locked loop and spectrum analyzer.
5. Design voltage to current converter, current to voltage converter and digital multimeter.
6. Study static and dynamic characteristics of measuring instruments.

Course Name : Advanced Microprocessors and Microcontrollers Lab					
Course Code: AEIE3213					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

Experiments with 8086 microprocessor:

1. Familiarization of 8086 microprocessor kit/simulator, its operation along with prewritten programs on it using data transfer, load/store, arithmetic and logical instructions.
2. Write assembly language programs (ALP) using 8086 microprocessor/simulator on the following:
   i) Finding the largest/ smallest number from an array
   ii) Arranging numbers in ascending/descending order
   iii) Shifting a block of data from one memory location to another
   iv) Addition of a series of BCD numbers
   v) String matching

Experiments with 8051/ PIC 16F or 18F series microcontroller:

3. Write a program using microcontroller to read a digital input from a push button switch and toggle a LED ON and OFF every time the switch is pressed.
4. Write a program using microcontroller to develop a 4-bit binary counter and display the counts using seven segment displays.
5. Write a program using microcontroller to interface LCD and display characters.
6. Write a program using microcontroller to generate square wave, saw tooth wave and triangular wave of specified frequency.
7. Write a program to develop a temperature monitoring system using temperature sensor, LCD and microcontroller.
8. Write a program to perform pulse width modulation of a voltage signal using a microcontroller.
9. Write a program to control a stepper motor/servo motor and control it's rotational direction, speed and number of steps using microcontroller.
10. Write a program to transmit data through serial port between microcontroller and PC.
11. Write a program to interface a matrix keypad with microcontroller and display the pressed key information on a character LCD.

Course Outcomes:

After the completion of the course the students will be able to:

1. Understand the assembly language programming concept of 8086 microprocessor.
2. Develop 8051/ PIC 16F or 18F series microcontroller based systems to implement various tasks such as switch state read, development of binary counter, data transfer, etc.
3. Design the interfacing of display devices (LED/LCD) with microcontroller and write program using them.
4. Build program to control input/output devices like motor (stepper motor/servo motor), temperature sensor, key board, etc., with microcontrollers for various applications.
5. Build program using microcontroller to generate different waveforms (like square wave, saw tooth wave) and perform pulse width modulation of a voltage signal.
6. Design and implement an embedded system using 8051/ PIC 16F or 18F series microcontrollers.

Course Name : Technical Seminer I					
Course Code: AEIE3221					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

The seminar should be on any topic having relevance with Instrumentation engineering and related areas of technology. The topic should be decided by the student and concerned teachers. Seminar work shall be in the form of presentation to be delivered by the student regularly throughout the semester. The candidate will deliver a final talk on the topic at the end of the semester and assessment will be made by a group of internal examiners.

Course Outcomes:

After the completion of the course the students will be able to:

1. Explore literature to identify promising new directions of various cutting edge technologies to solve real-world issues.
2. Build up knowledge in the field engineering, with specialization related to Electronics and Instrumentation engineering and the ability to integrate information across disciplines.
3. Prepare quality presentation on a topic with proper organization and demonstrate the content properly with the aid of audio-video, pictures and documents, etc.
4. Communicate effectively by making an oral presentation before an evaluation committee.
5. Interact efficiently with audience.
6. Develop habits of maintaining regularity and punctuality.

Course Name : Fundamentals of Digital Signal Processing					
Course Code: AEIE3231					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [10L]

Discrete-time signals and systems: discrete time signals- generation of discrete and digital signals, sampling of continuous time signals and aliasing, classification of discrete time signals, mathematical operations on discrete time signals- time shifting, scaling, folding, addition and multiplication; correlation of discrete time signals; discrete time systems: description, block diagram representation, classification of discrete time systems- static and dynamic, time invariant and time variant, linear and nonlinear, stable and unstable, FIR and IIR and recursive and non-recursive systems; response of LTI discrete time system; linear and circular convolution.

Module II - [6L]

Z-transform and its applications; z-transform –direct z-transform, inverse z-transform, properties of z-transform, rational z-transforms- poles and zeros, pole location and time domain behavior for causal signals; system function of linear time invariant system; inverse z-transform; one-sided z-transform; analysis of Linear Time Invariant (LTI) systems in z-domain.

Module III-[10L]

Signal transforms: Fourier Transform of Discrete-Time signals (DTFT)- definition, frequency spectrum of discrete time signal, inverse discrete time Fourier transform; Discrete Fourier Transform (DFT) – definition of forward and inverse DFT, frequency spectrum using DFT, properties and limitations of DFT; Fast Fourier Transform (FFT) – algorithm, 8-point DFT using Decimation in Time (DIT) radix-2 FFT; drawbacks of Fourier transform; introduction to time-frequency analysis- Short Time Fourier Transform (STFT), Continuous and Discrete Wavelet Transform (CWT and DWT) and their applications in signal processing.

Module IV- [10L]

Digital filter design and realizations: design of FIR filters- Fourier series method, frequency sampling method and window technique; design of IIR filters- approximation of derivatives, impulse invariance technique and bilinear transformation; structures for realization of FIR and IIR filters- direct form-I, direct form-II, cascade, parallel and linear phase structure of FIR filters; finite word length effect in digital filters.

References:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 3rd ed, Pearson Education Inc., New Delhi, India.
2. Sanjit K. Mitra, *Digital Signal Processing- A computer based Approach*, McGraw-Hill.
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, *Digital Signal Processing*, TMH, 2nd Edition, 2010.
4. A.V. Oppenheim, R.W. Schaffer and John R. Buck, *Discrete Time Signal Processing*, 3rd Edition, Prentice-Hall Signal Processing Series, 2009.
5. Nagoor Kani, *Signals and Systems, McGraw Hill Education (India) Privet Limited, New Delhi, 2013.*

Course Outcomes:

After the completion of the course, the students will be able to:

1. Characterize, analyze and perform mathematical operations on discrete time signals
2. Characterize and analyze the properties of discrete time systems
3. Analyze a discrete linear time invariant system using Z-transform
4. Perform Fourier Transform of Discrete-Time signals and their properties and Fast Fourier Transform algorithms
5. Design algorithms of digital FIR and IIR filters according to the given specification
6. Realize structure of a digital filter for given transfer function

Course Name : Mobile Communication					
Course Code: AEIE3232					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [8L]

Cellular concept and system design fundamentals: introduction to wireless communication-evolution of mobile communication, mobile radio systems- examples, trends in cellular radio and personal communications; cellular concept- frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, trunking and grade of service, improving coverage and capacity of cellular systems.

Module II – [9L]

Mobile radio propagation: reflection, ground reflection model (2 ray model), diffraction, practical link budget design using path loss models, small-scale multipath propagation, parameter of multi-path channels, types of small scale fading, Rayleigh and Ricean distribution, diversity, rake receiver; instrumentation for multiple access technique in wireless communications: review of frequency division multiple access (FDMA) and time division multiple access (TDMA), spread spectrum multiple access (SSMA), space division multiple access (SDMA).

Module III – [10L]

Introduction to modern technologies: GSM network architecture, signaling protocol architecture, identifiers, channels, introduction frame structure, speech coder RPE-LTP, authentication and security, call procedure, handoff procedure, services and features; GPRS and EDGE: architecture and services offered; IS-95 A & B (CDMA-1): frequency and channel specifications of forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management.

Module IV – [9L]

Wireless network & access protocols: wireless LAN – IEEE 802.11 standards – architecture – services – wireless local loop (WLL), WAP model mobile, location based services, WAP gateway, WAP protocols, WAP user agent profile-caching model and wireless bearers for WAP; 3G Technology: IMT-2000/UMTS: network architecture, air interface specification, forward and reverse channels in W-CDMA and CDMA 2000.

References:

7. Schiller, *Mobile Communication;* Pearson Ed.
8. C.Y Lee, *Mobile Communication*; Wiley.
9. Rappaport. T.S., *Wireless communications*; Pearson Education, 2003.
10. Simon Haykin & Michael Moher, *Modern Wireless Communications*; Pearson Education, 2007.
11. Gordon L. Stuber, *Principles of Mobile Communication*; Springer International Ltd., 2001.

Course Outcomes:

After the completion of the course students will be able to

1. Explain cellular concept and the strategies associated with cellular communication
2. Analyze mobile radio propagation models considering losses and fading
3. Compare multiple access techniques used for mobile communications
4. Evaluate GSM and CDMA technologies with their architecture, frame structure, system capacity as well as services provided by them
5. Design wireless local area networks utilizing the wireless access protocols
6. Determine the merits and limitations of 3G technology

Course Name : Opto Electronics and Fibre Optics					
Course Code: AEIE3233					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [8L]

Optoelectronics: characteristics of optical emission, electro-luminescence, photo electric effect, photo conducting effect, photo voltaic effect.

Module II – [8L]

Photo diode: PIN photodiode, hetero junction diode, avalanche photo diode, phototransistor, LDR, photo voltaic cell. LED: power and efficiency calculation, structure of LED and its characteristics, hetero-junction LED.

Module III - [10L]

LASER fundamentals: fundamental characteristics of lasers, three level and four level lasers, properties of lasers, laser modes, resonator configuration-Q switching and mode locking, cavity damping, types of lasers- gas lasers, liquid laser, solid lasers, semi-conductor lasers: double hetero-junction broad area laser, stripe geometry DH laser; industrial applications of LASER; laser for measurement of distance, length, velocity, acceleration and atmospheric effect; material processing: laser heating, welding, melting and trimming of material-removal and vaporization.

Module IV - [10L]

Optical fibers and their performances : principle of light propagation through fiber, different types of fibers and their properties, fiber characteristics, absorption losses, scattering losses, dispersions, connectors; industrial applications of optical fiber; fiber optic sensors, fiber optic instrumentation system; different types of modulators, infer metric method of measurement of length, Moire fringes, birefringence fringes, measurement of pressure, temperature, current, voltage, liquid level and strain.

References:

1. J.M. Senior, *Optical Fibre Communication, Principles and Practice;* Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, *Introduction to Opto Electronics*; Prentice Hall of India, 2001.
3. Donald J.Sterling Jr, *Technicians Guide to Fibre Optics;* 3rd Edition, Vikas Publishing House, 2000.
4. M. Arumugam, *Optical Fibre Communication and Sensor;* Anuradha Agencies, 2002.
5. John F. Read, *Industrial Applications of Lasers;* Academic Press, 1978.
6. Monte Ross, *Laser Applications*; McGraw Hill, 1968.
7. G. Keiser, *Optical Fibre Communication*; McGraw Hill, 1995.
8. S.M. Zse, *Physics of Semiconductor Devices;* Wiley; Third edition , 2008
9. Ajay Ghatak, *Optics*; TMH, 2012.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. Learn the various optical source materials, LED structures, quantum efficiency, Laser diodes.

3. Learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration
4. Specify and analyze optical optoelectronic devices in optical fiber communication.
5. Specify the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
6. Gain the basic concepts of optoelectronics, properties and industrial applications.

Course Name : Biomedical Instrumentation					
Course Code: AEIE3241					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I- [7L]
Introduction to the physiology of cardiac, nervous, muscular and respiratory systems; basic medical instrumentation system; origin of bioelectric signals: resting and action potentials; electrode theory, electrode tissue interface, polarizable and non-polarizable, different types of electrodes- hydrogen, calomel, Ag-AgCl, pH, pO_2, pCO_2 electrodes, selection criteria of electrodes.

Module II – [6L]
Biomedical transducers: different physiological variables: blood pressure, pulse rate, cardiac output, body temperature, blood pH etc.; different types of transducers: piezoelectric, strain-gauge, LVDT, magnetic induction, thermocouple, thermistor, diaphragm etc. and their selection for biomedical applications.

Module III-[9L]
Cardiovascular measurement: the heart and other cardiac systems, measurement of blood pressure & blood flow, heart sounds, cardiac output and cardiac rate; ECG : amplifiers and leads, cardiac pace-maker, defibrillator.

Module IV-[8L]
Measurement of electrical activities in muscles and brain: EMG, EEG, and their interpretations; medical imaging: ultrasound imaging, radiography, CT Scan, MRI and applications; philosophy of biotelemetry: transmission and reception aspects of biological signals via long distances; electrical safety of patients.

References:

1. L Cromwell, *Biomedical Instrumentation and Measurements*; Pearson Education.
2. R. S. Khandpur, *Handbook of Biomedical Instrumentation;* TMH.
3. J. S. Webster, *Medical Instrumentation Application and Design;* Wiley India Pvt. Limited.
4. J. J. Carr & J. M. Brown, *Introduction to Biomedical Equipment Technology;* Pearson Education.
5. B. R. Astor, *Introduction to Biomedical Instrumentation and Measurement;* McMillan.
6. S. Chatterjee & A. Miller, *Biomedical Instrumentation*; Delmar Cengage Learning.

Course Outcomes:

After the completion of the course, the students will be able to
1. Describe the origin of biopotentials and explain the role of biopotential electrodes and to design and operate biopotential amplifiers.
2. Inspect common bioelectrical and biochemical signals and sensors with distinguish characteristic features.
3. Correlate working principle of different sensors used to measure process variables with that of cardiac variables like- blood flow rate, blood pressure, heart sound, cardiac outputs etc.
4. Explain the design of cardiac pacemaker, Defibrillator or other therapeutic instruments.
5. Understand the various method of medical imaging systems like-MRI, X-Rays, Ultrasounds along with the concept of bio-telemetry.
6. Understand the patient safety issues related to biomedical Instrumentation.

Course Name : Advanced Sensors					
Course Code: AEIE3242					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	0	3	3

Module I – [9L]

Overview of micro-sensors: principle of transduction; classification of micro-sensors; chemical, thermal, pressure, acoustic, optical, electrical, mechanical, biological sensors, their calibration and determination of characteristics; materials for micro-sensors: substrates and wafers, silicon as substrate material; silicon compounds: silicon dioxide, silicon carbide, silicon nitride and polycrystalline silicon, silicon piezo-resistors, gallium arsenide, quartz, piezoelectric crystals, polymers.

Module II - [10L]

Micro-fabrication process: IC technology used in micro sensor system; crystal growth and wafer making, different techniques of deposition; physical vapor deposition - evaporation, thermal oxidation, sputtering, epitaxy, ion implantation and diffusion; chemical vapor deposition- LPCVD, APCVD, PECVD, spin coating, electrochemical deposition; pattern generation and transfer- masking, photolithography, photoresists and applications, light sources, photo resist development and removal; different types of etching: chemical and plasma; overview of micro-manufacturing techniques: bulk micro-machining, surface micro-machining, LIGA.

Module III - [9L]

Testing and packaging: partitioning, layout, technology constraints, scaling, compatibility study; scaling laws in miniaturization; examples of selected micro sensors.

Module IV - [9L]

Smart sensors: introduction; nature of semiconductor sensor output, information coding, integrated sensor principles, sensor networking, present trends.

References:

1. J. W Gardner, V. K. Varadan, *Microsensors, MEMS And Smart Devices*, Wiley, 2001.
2. Stephen Beedy, *MEMS Mechanical Sensors*, Artech House, 2004
3. N. P. Mahalik, *MEMS*, McGraw Hill, 2007
4. Jon Wilson, *Sensor Technology Handbook*, Elseiver, 2005.
5. Leondes, Cornelius T. (Ed.), *Mems/Nems Handbook Techniques and Applications*, Springer, 2006
6. Mohamed Gad-el-Hak, *The MEMS Handbook*, CRC Press; 2nd edition, 2005.
7. G. Steetman and Sanjay Banerjee, *Solid State Electronic Devices*, Prentice Hall; 6th edition, 2005.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Know the concepts of micro sensors.
2. Know the basic concepts of sensors, selection criteria and industrial applications.
3. Acquaint the fundamentals of sensing materials, properties and industrial applications.
4. Understand microfabrication techniques.
5. Explain the need for smart sensors
6. Tell the importance of choice of materials in microfabrication techniques.

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Course Name : Non Conventional Energy Sources					
Course Code: AEIE3243					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [8L]

Introduction: fossil fuel based systems, impact of fossil fuel based systems, non conventional energy – seasonal variations and availability, renewable energy – sources and features, hybrid energy systems, distributed energy systems and dispersed generation (DG); solar thermal systems: solar radiation spectrum, radiation measurement, conversion technologies, applications- heating, cooling, drying, distillation, power generation.

Module II – [9L]

Solar photovoltaic systems: operating principle, photovoltaic cell concepts - cell, module, array, series and parallel connections, maximum power point tracking, applications - battery charging, pumping, lighting, solar cell power plant, limitations; wind energy: wind patterns and wind data, site selection, types of wind mills, characteristics of wind generators, performance and limitations of energy conversion systems, load matching, recent developments.

Module III – [8L]

Energy from bio-mass: resources and conversion process: bio gas conversion, bio gas plant, bio mass gasifier, cogeneration, bio-diesel; fuel cells: principle of working of various types of fuel cells - working, performance and limitations, advantages of fuel cell power plants, future potential of fuel cells; geothermal energy: resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Module IV – [11L]

Energy from the ocean: ocean thermal electric conversion (OTEC) systems like open cycle, closed cycle, hybrid cycle, prospects of OTEC in India; energy from tides: basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy; energy power from wave: wave energy conversion devices, advantages and disadvantages of wave energy; concept of energy management and audit.

References:

1. G.D. Rai, *Non-conventional energy sources*; Khanna Publishers.
2. H.P. Garg & Jai Prakash, *Solar Energy: Fundamentals and Applications;* Tata McGraw Hill.
3. Bansal, Kleeman & Melisa, *Renewable Energy Sources & Conversion Technology*; Tata McGraw Hill New Delhi.
4. Twidell & Weir, *Renewable Energy Resources*; ELBS
5. D.S. Chauhan, *Non-conventional Energy Resources*; New Age International.
6. C.S. Solanki, *Renewal Energy Technologies: A Practical Guide for Beginners*; PHI Learning.
7. Peter Auer, *Advances in Energy System and Technology- Vol. I & II*; Edited by Academic Press.

Course Outcomes:

After the completion of the course students will be able to

1. Discuss the issue of fuel availability and analyze the supply and demand of fuel in the world
2. Illustrate solar energy conversion techniques
3. Compare the working principle and environmental impacts of a biomass based power plant with a coal-fired power plant
4. Estimate the scope of wind energy for electricity generation
5. Explain the process to harness energy from nonconventional energy sources like geothermal, tidal, ocean-thermal and wave
6. Evaluate the economical use of renewable energy resources compared to conventional energy sources

Seminar-I [INFO3221]

Course Outcomes:

After completion of this course, students will be able to:

1. Acquire presentation skills.

2. Acquire discussion skills.

3. Acquire listening skills.

4. Acquire argumentative skills and critical thinking.

5. Acquire questioning skills.

6. Acquire interdisciplinary inquiry.

2. Develop the skill in program writing for 8085 microprocessor, 8086 microprocessor, 8051 and PIC microcontroller.
3. Perform memory and I/O interfacing with 8085 microprocessor, 8086 microprocessor.
4. Describe the architecture of different types of programmable peripheral devices and their interfacing with microprocessor, 8086 microprocessor and 8051 microcontroller.

Course Name : Economics for Engineers					
Course Code: HMTS3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I:
Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market.
The basic concept of economics – needs, wants, utility.
National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity.
Inflation: meaning, reasons, etc. **(6L)**

Module II:
Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics.
Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India.
International Business or Trade Environment. **(4L)**

Module III:
Financial Accounting-Journals. Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet.
Financial Statement Analysis (Ratio and Cash Flow analysis). **(8L)**

Module IV:
Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs.
Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis.
Marginal Cost based decisions. **(6L)**

Module V:
Time Value of Money: Present and Future Value, Annuity, Perpetuity.
Equity and Debt, Cost of Capital. **(4L)**

Module VI:
Capital Budgeting: Methods of project appraisal - average rate of return - payback period - discounted cash flow method: net present value, benefit cost ratio, internal rate of return.
Depreciation and its types, Replacement Analysis, Sensitivity Analysis. **(8L)**

References:

1. R. Narayanswami, *Financial Accounting- A Managerial Perspective.* Prentice-Hall of India Private Limited. New Delhi
2. Horne, James C Van, *Fundamentals of Financial Management*. Prentice-Hall of India Private Limited, New Delhi
3. H. L. Ahuja., *Modern Economic Theory*. S. Chand. New Delhi.
4. Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. *Engineering Economic Analysis.* New York: Oxford University Press. 2012.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Principles of Management					
Course Code: HMTS3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**2**

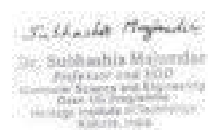
Module 1:
Management: Definition, nature, purpose and scope of management, Skills and roles of a Manager, functions, principles; Evolution of Management Thought: Taylor Scientific Management, Behavioral Management, Administrative Management, Fayol's Principles of Management, Hawthorne Studies. **(4L)**

Module 2:
a) **Planning:** Types of plans, planning process, Characteristics of planning, Traditional objective setting, Strategic Management, premising and forecasting.
b) **Organizing:** Organizational design and structure, Coordination, differentiation and integration.
c) **Staffing:** Human Resource Management and Selection, Performance appraisal and Career strategy, Managing Change.
d) **Decision-Making:** Process, Simon's model of decision making, creative problem solving, group decision-making.
e) **Coordinating:** Concepts, issues and techniques.
f) **Controlling:** Concept, planning-control relationship, process of control, Types of Control, Control Techniques (**8L)**

Module 3:
Span of management, centralization and de-centralization Delegation, Authority & power - concept & distinction, Line and staff organizations. **(4L)**

Module 4:
Organization Behaviour: Motivation, Leadership, Communication, Teams and Team Work. **(6L)**

Module 5:
Management by Objectives (MBO): Management by exception; Styles of management: (American, Japanese and Indian), McKinsey's 7-S Approach, Self Management. **(2L)**



References:

1. Harold Koontz & Heinz Weihrich, Essentials of Management, TMH.
2. Stoner, Freeman, Gilbert Jr., Management, PHI.
3. Bhatt & Kumar, Principles of Management, OUP.

Course Name : Circuit Theory					
Course Code: ELEC3001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Total: 40L
Module-I
Network equations: Formulation of Node & Mesh equations. Loop and node variable analysis. Network Theorems: Thevenin's, Norton's and Superposition theorem applied to circuits containing dependent sources. [10L]

Module-II
Laplace Transform: Review of Laplace transform. Properties of Laplace transform. Transform of standard periodic and non periodic waveforms. Circuit elements and their transformed equivalents. Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Concept of natural frequency and damping. Sketching transient response, determination of time domain specifications. [10L]

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Personality Development					
Course Code: HTMS3221					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**0**	**1**	**1**

Module 1

Self-Growth

(i) Self Growth- Maslow's Hierarchy of Needs Theory
(ii) Anger, Stress & Time Management- Theories and application
(iii) SWOT Analysis

Module II

Stepping Up

(i) Growth & Environment
(ii) Competitive Spirit
(iii) Responsibility Factor

Module III

Professional Communication

(i) Impression Management- theory on social psychology
(ii) Employability Quotient
(iii) Cross-cultural communication

Module IV

Leadership & Team Playing

(i) Leadership & Team Playing: Theories, Styles, Stages
(ii) Motivation, Negotiation Skills, Conflict Management
(iii) Planning & Envisioning: Initiative and Innovation in the Work Environment- De Bono's Six Thinking Hats

Dr. Subhashis Majumdar
Professor and HOD

References:

1. Personality Development and Soft Skills by Barun K. Mitra, Oxford University, 2011
2. Soft Skills: An Integrated Approach to Maxmise Personality by Gajendra Singh Chauhan and Sangeeta Sharma, Wiley, 2016.
3. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success by Gopalaswamy Ramesh and Mahadevan Ramesh, Pearson, 2010

Course Name: HEAT TRANSFER					
Course Code: MECH 3102					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes:

After completion of the course, the students will be able to:

CO1 Identify the basic laws of heat transfer, and implement the concepts to account for the heat transfer in thermal analyses of engineering systems.

CO2 Judge heat transfer rates involving one-dimensional steady-state heat conduction in simple geometries

CO3 Examine heat transfer rates for extended bodies and heat transfer in transient conduction. Explain and appraise radiation heat transfer between black surfaces, as well as between gray bodies.

CO4 Explain concepts related to convection phenomena, examine practical situations where convection heat transfer is dominant, use correlations to describe forced convection phenomena for external and internal flows, and investigate practical problems by applying the knowledge.

CO5 Analyze heat transfer for (i) free convection and (ii) laminar film condensation on a vertical flat plate, and investigate practical situations where such phenomena are predominant.

CO6 Describe boiling heat transfer phenomenon, analyze heat exchanger performance by using the methods of LMTD and ε-NTU, and assemble all relevant concepts to design heat exchanger applications.

Sl. No.	Syllabus	Contact Hrs
Module 1	Fundamentals: Modes of heat transfer: Physical origins and rate equations; Relationship to Thermodynamics; Analysis of heat transfer problems-methodology; Relevance of heat transfer.	1
	Introduction to Conduction: The conduction rate equation (Fourier’s law); Thermal conductivity, isotropic, homogeneous medium, effect of temperature on thermal conductivity of solids, liquids and gases; Thermal diffusivity.	2
	The heat diffusion equation in Cartesian, Cylindrical and Spherical coordinates and its reduction to specific cases.	2
	One-dimensional, steady-state conduction without heat generation: Plane Wall — temperature distribution, thermal resistance, electrical analogy, composite wall, thermal contact resistance.	3
	Radial Systems— the Cylinder and the Sphere, critical thickness of insulation; Overall heat transfer coefficient.	2
	One-dimensional, steady-state conduction with heat generation: Plane wall and radial systems.	2

Module 2	Heat Transfer from Extended Surfaces: General conduction-convection analysis, types of fin, heat flow analysis through fin of uniform cross section (infinitely long, insulated tip, fixed rate of heat loss at the tip and tip with fixed temperature), efficiency and effectiveness of fin Transient Conduction: Lumped capacitance method, thermal time constant, validity of lumped parameter approach, Biot number, Fourier number Radiation: Physical mechanism of thermal radiation, spectral radiation intensity, spectral emissive power and total emissive power; Blackbody radiation: definition of black body, radiation laws, emissivity, absorptivity, reflectivity, transmissivity, Kirchoff's identity; Gray body. Radiation exchange between black bodies, radiation shape factors and various relationships; Heat exchange between non-black bodies, concept of opaque, gray and diffuse surface, irradiation, radiosity, radiation heat exchange among surfaces forming enclosure.	3 2 3 3
Module 3	Forced Convection: Principles of convection; Newton's law of cooling and significance of heat transfer coefficient. Dimensional analysis applied to forced convection; Dimensionless numbers and their physical significance; Empirical correlations Derivation of continuity, momentum and energy equations in 2-D The velocity and thermal boundary layer and its significance; Local and average convection coefficients; Momentum and energy equations of laminar boundary layer on a flat plate; Similarity methods. General solution of von Kármán integral momentum and energy equation of boundary layer; Relation between fluid friction and heat transfer; Introduction to turbulent boundary layer heat transfer. Forced Convection (Continued): Heat transfer in laminar tube flow; Bulk temperature; Empirical relations for pipe and tube flow.	1 1 3 3 4 2

Module 4	Natural Convection: Mechanism of free convection; Velocity and thermal boundary layers.	2
	Free convection heat transfer on a vertical flat plate; Empirical relations for free convection.	2
	Introduction to Boiling Heat Transfer: General aspects, Boiling regimes, Bubble shape, size, growth and collapse, Critical diameter; Factors affecting nucleate boiling.	1
	Condensation Heat Transfer: General aspects; laminar film condensation.	1
	Heat Exchangers: Uses and types of heat exchangers; Parallel and counter-flow types.	1
	Introduction to LMTD method; correction factors; Fouling factor.	2
	ϵ-NTU method for heat exchangers	2
		48

Text Books:

1. Introduction to Heat Transfer- S.K. Som, PHI, 2e
2. Heat & Mass Transfer, P.K. Nag, TMH, 3e

Reference Books:

1. Fundamentals of Heat and Mass Transfer-Incropera, DeWitt, Bergmam, & Lavine, Wiley India
2. Heat and Mass Transfer: A Practical Approach- Yunus A. Cengel, McGraw-Hill, 2007
3. Heat Transfer-J P Holman &Souvik Bhattacharyya, TMH
4. NPTEL lecture series on heat transfer

<table>
<tr><td colspan="6">Course Name : FLUID MECHANICS & HYDRAULIC MACHINES LAB</td></tr>
<tr><td colspan="6">Course Code: MECH 3111</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>2</td></tr>
</table>

<u>Course Outcomes:</u>

<table>
<tr><td colspan="2">At the end of the course, a student will be able to</td></tr>
<tr><td>CO 1</td><td>Identify different flow patterns and regimes.</td></tr>
<tr><td>CO 2</td><td>Evaluate Coefficient of Discharge of Flow Measuring Devices.</td></tr>
<tr><td>CO 3</td><td>Understand the determination of airflow velocity by a Pitot Static Tube.</td></tr>
<tr><td>CO 4</td><td>Analyze the validity of the Bernoulli's equation for steady flow of water in a tapered duct.</td></tr>
<tr><td>CO 5</td><td>Demonstrate practical understanding of friction losses in internal pipe flow.</td></tr>
<tr><td>CO 6</td><td>Evaluate the overall efficiencies of Pelton turbine, Francis Turbine and Centrifugal pump.</td></tr>
</table>

List of Experiments:

1. Characteristics of Laminar & Turbulent flow.
2. Verification of Bernoulli's Equation.
3. Determination of Coefficient of Discharge of Flow Measuring Devices in pipe flow.
4. Pipe friction characteristics in different flow regimes for flow through pipes.
5. Determination of Coefficient of Discharge of V-Notch & Rectangular Weir.
6. Determination of airflow velocity by using a Pitot Static Tube.
7. Performance test of a Centrifugal Pump.
8. Performance test of a Pelton Turbine.
9. Performance test of a Francis Turbine.

N.B: A minimum of six experiments must be performed in the semester.

09/08/2022

Course Name : DESIGN PRACTICE-I					
Course Code: MECH 3112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Justify deference between 'Computer Aided Design' and 'Computer Aided Drafting' with its practical interpretations.
CO 2	Select most appropriate 3-D modeling tools of a CAD Software named 'PTC Cre Parametric 2.0' to create 3-D model of any machine part parametrically in simplest possible way.
CO 3	Execute advanced modeling job of a very complicated part with the CAD software 'PTC Creo Parametric' using its advanced 3-D modeling tools like 'Helical Sweep', 'Variable Section Sweep', 'Swept Blend' etc.
CO 4	Assemble 3-D parts of a whole machine with 'PTC Creo Parametric' software in fully constrained way without any type of interference created.
CO 5	Generate detailed drafting parametrically along with sectional view and enlarged view incorporating detailed dimensioning and industrial standards using a the CAD Software 'PTC Creo Parametric'
CO 6	Handle any machine modeling job using a CAD Software like 'PTC Creo Parametric' staring from part modeling to automated drafting along with the generation of detailed BOM.

Experiment/ Study	Syllabus	Contact Hrs.
1	**Introduction:** A comparative discussion on Computer Aided Design	3

	(CAD) software and Computer Aided Drafting (CAD) software, Discussion of different capabilities of a CAD software and different categories of its tools.	
2	**3D modeling tools:** Discussion about following tools of a 3D modeling software like ***PTC Creo Parametric*** with suitable examples-Extrude, Revolve, Sweep, Blend, Variable section sweep, Sweep-Blend, Helical Sweep, Hole, Pattern, Mirror, Copy, Round, Chamfer, Draft and Shell.	6
3	**Assembly:** Discussion on the methodology about generating an assembly of different machine parts following perfect constraints using software like ***PTC Creo Parametric.***	6
4	**Drafting:** A detailed discussion on the methods of generating detailed drafting from a 3-Dimensional model using software like ***PTC Creo Parametric.***	3
5	**To design and create 3D model of following machine part and assembly and to generate their 2D drafting automatically using software like *PTC Creo Parametric.*** a) Knuckle/Cotter joint b) Bolted bracket/ turn buckle c) Helical compression spring/ Leaf spring	9
6	**To design and create 3D model of following machine part and assembly and to generate their 2D drafting automatically using software like *PTC Creo Parametric.*** a) Screw jack b) Shaft Couplings c) Belt pulley drive	9
	Total	**36**

Recommended Book:

1. PTC Creo Parametric 3.0- for engineers and Designers by Prof. Sham Tickoo, Dreamtech Press.

Course Name : SEMINAR – I					
Course Code: MECH 3121					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	**Prioritize** himself/ herself by **learning** to **choose** a novel topic of his own interest.
CO 2	**Compile** and **reproduce** facts and data in presentations with audio visual format.
CO 3	**Adapt** the manners, behaviors and strategies to **present/employ** own ideas.
CO 4	**Build** himself/herself to **value** corporate relationships in a real life environment .
CO 5	**Learn** to **argue** and **exemplify** for his/her submission with clients and superiors in his/her career.
CO 6	**Discuss, compare, debate, judge** and **Criticize** others' presentations with confidence .

The students have to deliver a talk individually through power point presentation on technical topics, preferably related to mechanical engineering. The topic will be chosen by the students but subject to the respective teacher's approval. The topic should not be a part of the subjects already taught in the class. Score will be based on presentation and its defense, quality of the slides, and novelty of the topic and class attendance. The students have to submit a report on the seminar talk which will also carry marks.

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Course Name : FLUID POWER CONTROL					
Course Code: MECH 3131					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Relate the fundamental laws of fluid mechanics with fluid power and control systems.
CO 2	Identify the applications of the basic components in fluid power systems.
CO 3	Examine different types of pumps, actuators, valves and other components used in hydraulic and pneumatic circuits.
CO 4	Justify the use of different components in the fluid power control circuits.
CO 5	Demonstrate the applications of fluid power circuits.
CO 6	Investigate the performance of different fluid power control circuits.

Module	**Syllabus**	**Contact Hrs.**
1	**Fluid power:** Applications and advantages; Components of a hydraulic and pneumatic system. Desired properties of a working fluid; advantage of mineral oil over water; compressibility and incompressibility. Pascal's law; analysis of simple hydraulic jack, Mechanical advantage; continuity equation. Hydraulic Pumps: positive displacement pumps; constructional features, working principle and volumetric capacity of external gear pump, vane pump, axial piston pump and radial piston pump.	3 2 4
2	**Hydraulic Actuators :** (i) Constructional features of single acting and double acting hydraulic cylinders; mounting of cylinders, cushioning of cylinder; different application of cylinder through mechanical linkages; force, velocity and power from a cylinder. (ii) Hydraulic motors; torque, power and flow rate in a hydraulic motor. Hydraulic Valves: (i) Direction control valves – operation and graphical symbol of 3 way and 4 way valves; different modes of activation of valves; (ii) Operation and graphical symbols of check valves, pressure relief valve, pressure reducing valve,	5

	unloading valve and flow control valve.	4
3	**ANSI symbols for different hydraulic components. Analysis of hydraulic circuits for :** i) Single acting cylinder control. ii) Double acting cylinder control. iii) Regenerative circuit. iv) Pump unloading circuit. v) Double pump hydraulic system. vi) Cylinder synchronization circuit. vii) Speed control of a hydraulic motor. viii) Circuit to lift and hold heavy load. ix) Automatic sequencing of two cylinders.	9
4	Advantages & disadvantages of pneumatic system compared to hydraulic system; constructional details and operation of a reciprocating compressor; working principle and use of filter, pressure regulator, lubricator and silencer; symbols of different pneumatic components; compressed air distribution system in a plant; drawing pneumatic circuits for different operations. Use of electrical devices for controlling fluid circuits; function of electrical devices like push-button switches, limit switches, pressure switches, solenoids, relays and timers and their symbols; concept of ladder diagram; study of following circuits using electrical control devices : i) control of a solenoid actuated cylinder using one limit switch. ii) reciprocation of a cylinder using pressure or limit switches. iii) two cylinder sequencing circuit using two limit switches.	9
	Total Classes	**36**

Text Books:

1. Fluid Power with Applications- A. Esposito, 7e; Pearson.
2. Pneumatic Systems: Principles and Maintenance- S.R. Majumdar, Tata McGraw Hill.

Reference Books:

1. Introduction to Hydraulics and Pneumatics- Ilango and Soundararajan, 2e; PHI.
2. Fluid Power, Generation, Transmission and Control- Jagadeesha. T and Gowda T, 1e; Wiley Publication.
3. Fluid Power: Theory and Applications- James A. Sullivan, 3e; PHI.

09/08/2022

Course Name : REFRIGERATION & AIR CONDITIONING					
Course Code: MECH 3132					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

CO1	Differentiate between cooling and Refrigeration , Calculate refrigeration capacity, understand the nomenclature of various refrigerants, List various important properties of refrigerants and their impact on environment.
CO2	Understand how standard vapour compression cycle works, its various key components, their functions, Analyse different thermodynamic cycles , Calcualte COP of the SVCRs, Identify the limitations of single stage vapour compression refrigeration cycle and Understand the utility of Multi stage, multi evaporator system.
CO3	Understand Air Refrigeration system, its advantages and limitations, and its applications ,Understand how different types (Li – Bromide , Aqua-Ammonia) of Vapour absorption cycle operates, its advantages and disadvantages over VCRs, Calculate actual COP and theoretical max. COP.
CO4	Understand how different types of compressors work , List their advantages and disadvantages, Calculate Cylinder dimensions of reciprocating compressors, understand the utility of intercooler , List the advantages of multistage compression with or without inter cooling.
CO5	Understand the different types of condensers, expansion devices and evaporators used in various refrigeration systems, Calculate the Heat Rejection Rate , Critical charge and its importance on system performance .
CO6	Understand various properties of moist air, Read Psychrometric chart and collect data based on various psychrometric processes, Estimate the heating and cooling load calculations, Design ducts based on field requirement, Estimate ventilation load

Module	Syllabus	Contact Hrs.
1	**Introduction:** Concepts of Refrigeration and Air-conditioning, Unit of refrigeration, Refrigerants-Desirable Properties, Nomenclature. **Simple Vapour Compression Refrigeration System (Simple VCRS):** Vapour compression cycle on $p-h$ and $T-s$ diagrams, Cycles with subcooling, superheating and their effects; Effect of changes in evaporator pressure and condenser pressure on the performance of a simple VCRS. Multi-stage and multiple evaporator system, Cascade system, COP comparison. Dry compression and wet compression of refrigerant; Actual Vapour Compression Cycle.	2 3 2 2
2	**Air Refrigeration System (ARS):** Bell-Coleman refrigerator. COP determination, actual air refrigeration cycle. **Vapour Absorption Refrigeration System (VARS):** Advantages of VARS over VCRS, Working principle of simple VARS, practical VARS, Refrigerant-absorbent combinations. Limitations of VARS, Maximum COP of VARS, Lithium bromide-water System, Aqua-ammonia systems.	3 3 3
3	**Equipment and Control:** Major Refrigeration Equipment - Compressors: reciprocating, rotary & centrifugal, volumetric efficiency, Condensers: types used in refrigeration systems; Evaporators: expansion devices: capillary tubes and thermostatic expansion valves. **Air-conditioning equipment:** Airhandling units, Cooling Towers.	6 4
4	Basic definitions and principles related to Psychometry ; Psychometric Charts & Their Uses; Heating, Cooling, Heating & Humidification and Cooling & Dehumidification processes. Adiabatic Saturation, Cooling Coils, By-pass Factor. Sensible Heat Factors. Heat Load estimation: Simple cases of Cooling and Dehumidification. Ventilation: Definition & Requirements, Natural & Mechanical Ventilation, Ventilation Load Calculation, Duct Sizing & Design.	4 2 2

Total Classes	**36**

Text Books:

1. Refrigeration and Air Conditioning- C.P. Arora, TMH, 3e.
2. Refrigeration and Air Conditioning- W.F. Stoecker & J.W. Jones, McGraw Hill.

Reference Books:

1. Refrigeration and Air Conditioning- R.C. Arora, PHI.
2. Basic Refrigeration and Air Conditioning- P.N. Ananthanarayanan, TMH, 3e.
3. Refrigeration and Air Conditioning- S.C. Arora and S. Domkundwar, Dhanpat Rai Publication.

09/08/2022

Course Name : ELECTRICAL MACHINES					
Course Code: MECH 3133					
Contact Hours per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

At the end of this course students will be able to

CO1: Acquire the knowledge of the constructional details and operating principle of DC generator and analyze the performance under various operating conditions to solve complex electrical engineering problems.
CO2:- Acquire the knowledge of the operating principle of DC motor and analyze the performance under various operating conditions to solve complex electrical engineering problems.
CO3: Identify and analyze the problems related to performance analysis of single phase transformer reaching substantiated conclusion.
CO4 Identify, formulate and solve the numerical problems related to three phase induction motor.
CO5: Acquire the knowledge of synchronous generator to identify and analyze the problems related to performance analysis.
CO6: Understand the knowledge of synchronous motor to solve complex engineering problems related to various applications.

Module I:-

Construction of DC machine. Different methods of excitation of DC machine. [1]

DC Generators:- EMF equation.Concept of armature reaction. Voltage build-up of shunt Generator. Characteristics of DC Generator. [3]

D.C. Motors:- Principle of operation. Back EMF. Torque equation. Characteristics of DC motors. Speed control of DC motor. Starting of DC shunt motor. Different methods of braking. [5]
Losses and Efficiency of D.C Machine . Application of D.C Machine [2]

Module II:-

Single phase Transformers:-Construction of Transformer. Operating principle of 1-ph transformer. Emf Equation, Equivalent circuit and Phasor diagram of ideal and practical transformer. Losses and efficiency-Open & short circuit tests. Voltage regulation. Parallel operation. [7]

ModuleIII :-

Three phase Induction Motor:-Construction. Production of rotating magnetic field. Working principle. Slip, frequency of rotor current, stator and rotor emf. Equivalent circuit and phasor diagram. Torque speed characteristic. Different methods of speed control. Methods of improving the starting torque. Different methods of braking of induction motor. Application of three phase Induction Motor. [7]

Module IV:-

Alternator:-Construction. Excitation Systems. E.M.F equation. Pitch factor and Distribution factor. Armature reaction- Lagging, Leading, Unity p.f load. Equivalent circuit and phasor diagrams. Voltage regulation- Open circuit and short circuit test. Use of salient pole and cylindrical rotor alternator. [5]

Synchronous Motor:-Principle of operation. Phasor diagram. Effect of varying field current- v curve, synchrorous condenser. Starting of synchronous motor. Hunting. Application of synchronous motor. [4]

Special Machine:-Stepper Motor, Servo Motors (A.C and D.C), Universal motor. [2]

Text Books :	Reference Books :
1.Electrical Machinery by Dr. P.S. Bimbhra. 2.Electrical Machines by S. K. Bhattacharya 3. Electrical Machines by Ashfaq Hussain	1.Theory & Performance Of Electrical Machines By J.B.Gupta 2.Electrical Machines By Abhijit Chakarabarti And Sudipta Debnath.

09/08/2022

Course Name : FLUID POWER CONTROL LAB					
Course Code: MECH 3136					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Identify the basic components of fluid power control systems.
CO 2	Apply the knowledge of engineering fundamentals to understand the working principle of different components used in fluid power control circuits.
CO 3	Build different circuits for actuator control and demonstrate the same.
CO 4	Investigate and calculate various useful parameters from the experimental readings with some knowledge on related errors in the experimental readings/setup/procedure/instruments.
CO 5	Justify the use of different fluid power control circuits for desired outcome.
CO 6	Perform effectively as an individual, and as a member of a team in a laboratory.

List of Experiments:

1. Study of a hydraulic trainer system.
2. Study of a pneumatic trainer system.
3. Controlling the speed of a hydraulic cylinder by operating a flow control valve.
4. Controlling the speed of a pneumatic cylinder by operating a flow control valve.
5. Prepare an 'AND' valve circuit using pneumatic components.
6. Prepare an 'OR' valve (shuttle valve) circuit using pneumatic components.
7. Operation and study of the function of a pressure reducing valve in a hydraulic circuit.
8. Design, preparation and operation of a hydraulic circuit for sequencing two hydraulic cylinders using a sequence valve.

N.B: A minimum of six experiments must be performed in the semester.

09/02/2022

Course Name : REFRIGERATION AND AIRCONDITIONING LAB					
Course Code: MECH 3137					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

CO1	Determination of cooling load from psychometric chart.
CO2	Evaluate the COP from p-h diagram.
CO3	Demonstrate the VCRS and calculate the theoretical and experimental COP.
CO4	Understand the different components of air refrigeration test rig and perform the theoretical and experimental COP.
CO5	Analyze the domestic refrigeration and calculate the various COP.
CO6	Understand the thermoelectric cooling system.

List of Experiments:

1. Determination of COP of a VCR system.
2. Determination of COP of a VAR system.
3. Study of a room (window type) Air Conditioner and determination of COP.
4. Determination of heat rejection by the condenser of Window air conditioner
5. Experiment in an Air Conditioning Test Unit; Determination of COP and plotting of the cooling – dehumidification process on a psychrometric chart.
6. Experiment in an Air Conditioning Test Unit; Determination of COP and plotting of the Heating – humidification process on a psychrometric chart.
7. Performance test of thermoelectric refrigeration system used as cooler.
8. Performance test of thermoelectric refrigeration system used as heater.

MECH 3138: ELECTRICAL MACHINES LAB

Contacts: 3P **Credit: 2**

List of Experiments:

1. To study the open circuit and short circuit tests of a single phase Transformer.
2. To study the speed control of a D.C shunt Motor.
3. To study the saturation characteristics of a D.C shunt Generator.
4. Speed control of D.C shunt Motor by ward-Leonard method.
5. To study the Speed-Torque characteristics of a Slip-ring Induction Motor.
6. To study the external load characteristics of a D.C Shunt Generator.
7. To study the open and short circuit characteristics of an Alternator.

09/08/2022

Course Name : FINITE ELEMENT METHOD					
Course Code: MECH 3142					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of this course students will be able to

CO1	Understand the transformation of the solution methodology of Governing Equation of any physical phenomenon from its analytical approach to a numerical approach like method of Finite Element Analysis (FEA).
CO2	Justify the expressions of Shape Functions of different 1D elements like (BAR, BEAM and FRAME) used for solving any physical problem numerically with 1D topological consideration through energy method like PSTP and Rayleigh-Ritz method.
CO3	Implement 1D elements like BAR element, BEAM element and FRAME element correctly in accordance with the Boundary conditions and Loading conditions of a particular problem to solve numerically using FEA method.
CO4	Justify 'Plane Stress' approach and 'Plane Strain' approach to solve any physical problem numerically using FEA method with 2-Dimensional elements like 'TRIA' and 'QUAD' for 2-Dimensional topological consideration.
CO5	Use 'Normalized Co-ordinate System' in place of 'User Co-ordinate System' in solving a physical problem numerically using FEA method with 2-Dimensional topological consideration using 2-Dimensional elements.
CO6	Justify the method of operation of steps of operation of any FEA software like MSC Software, ANSYS etc using computer as working or solving media.

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Module	Contents	Contact Hrs.
1	**Introduction:** Historical background, FEM application on design problems, Concept of governing Equations for continuum, Solution of Governing Equation using Galerkin method, Weighted residual and Weak form method, Piece wise continuous trial function solution of weak form, Concept of Shape Function and Element stiffness matrix, Principle of Stationary Total Potential (PSTP) (Ritz Method), Coordinates and Shape Function	10
2	**One Dimensional Problem:** The Potential Energy Approach to find Element Stiffness Matrix of BAR Element, FEA formulation and understanding of Boundary Condition terms and Force Terms, Shape	8

	function and Stiffness Matrix of Quadratic BAR Element and BEAM element,	
3	**One Dimensional Problem (contd):** Concept of FRAME Elements. Assembly of elements and Technique of Stiffness Matrix Globalization, Solving 2-Dimensional Truss Problems. **Two Dimensional Problem:** Dimensionality of a Problem, Overview about different Two Dimensional elements and their geometrical approximation, CST element (Iso-parametric Representation, Potential Energy Approach, Element Stiffness; Basic concept of Jacobian Method, Numerical integration of Two Dimensional Iso-parametric Elements.	10
4	**Two Dimensional Problems (contd):** Stress Calculation and Heat Transfer problems. **Computer implementation:** Pre-processor, Processor, Post-processor. Discussion about finite element packages.	8
Total Classes		**36**

Text Books:

1. Introduction to Finite Elements in Engineering by T.R. Chandrupatla and A.D. Belegundu, Prentice Hall of India.
2. A Text Book of Finite Element Analysis by P Seshu, PHI Learning Pvt. Limited.
3. Concepts and Applications of Finite Element Analysis by R.D. Cook, D.S. Malkus and M.E. PleshaPrentice Hall-India, NewDelhi.

Reference Books:

1. Finite Element Analysis by C.S. Krishnamoorthy, TMH.
2. Finite Element Procedures by K-J. Bathe, Prentice Hall.
3. The Finite Element Method: Its Basis and Fundamentals by O.C. Zienkiewicz, R.L. Taylor, J.Z. Zhu, Elsevier.
4. An Introduction to the Finite Element Method by J.N. Reddy, McGraw-Hill.

09/08/2022

Course Name : TURBO MACHINERY					
Course Code: MECH 3143					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of the course, the students will be able to:

- Classify different types of turbo machines.
- Understand the basic working principle of different types of turbo machines.
- Identify different losses in turbo machines.
- Select an appropriate class of turbo machine for a particular application.
- Analyze different performance characteristics of various turbo machines.
- Differentiate between fans, blowers & compressors.
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Module No.	Syllabus	Contact Hrs.
1	**Introduction**: Definition, Classification and Application of turbo machines. Incompressible and compressible flow turbo machines. Radial, Axial and Mixed flow type machines. Basic equation of energy transfer in turbo machines. Comparison of turbo machines with positive displacement machines; Similarity and model study in turbo machines; dimensional analysis of incompressible flow turbomachines; unit and specific quantities, non-dimensional parameters and their significance; effect of Reynolds number, specific speed. Installation losses of turbo machines.	2 7
2	**Pump:** Classification, Main components and their functions. Velocity diagram; Different heads and efficiencies for centrifugal pump. Priming in centrifugal pump. Multi stage of pump, influence of vane exit angle on head capacity & power capacity relationship, slip factor, pump losses and efficiencies; minimum speed of pump to deliver liquid; overall design considerations of pump; similarity relations and specific speed, selection of pump, cavitation and NPSH, horizontal and vertical pump, bore hole pump/ deep well pump / submersible pump.	9
3	**Hydraulic Turbines:** Classification, main components and their functions; degree of reaction, comparison between impulse and reaction turbines; design aspects of Pelton wheel, Francis and Kaplan turbines; model and selection of turbine: models and their testing, similarity considerations, relation between the characteristics data of a turbine and that of its model; governing of water turbine; water conveyance system and surge tank.	9

4	**Compressible flow machines:** Introduction: comparison among fans, blowers & compressors; classification and applications; set up and operating characteristics of fans, blowers & compressors. **Centrifugal Compressor**: Introduction, elements of centrifugal compressor, Work done and pressure rise, inlet duct impeller, pre-whirl vanes, Diffuser design, Choking, Overall pressure ratio developed; losses in centrifugal compressor. **Axial flow compressor**: Axial compressor characteristics, compressor staging, flow through stages, velocity triangles, pressure ratio developed per stage – work done factor.	9
Total Classes		**36**

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines- Som, Biswas and Chakraborty, TMH, 3e.
2. Hydraulic Machines- Dr. Jagdish Lal, Metropolitan Book Co. Pvt. Ltd, Reprint 2011.
3. Mechanics of Fluids- B Massey, Taylor & Francis, 8e.

Reference Books:

1. Fluid Mechanics and Machinery- C.S.P Ojha, R. Berndtsson, P.N.Chandramouli, OUP, 1e.
2. Turbomachinery: Designed and theory- Gorla, Taylor & Francis (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011.
3. Incompressible Flow Turbomachines- Rowal, Elsevier (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011.
4. Principle of Turbomachinery- Turton R. K, Springer (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011.
5. Turbomachines- B.U.Pai; WILEY, 1e, 2013.

09/08/2022

Course Name : NEW PRODUCT DEVELOPMENT					
Course Code: MECH 3144					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Understand the opportunities and challenges of new product development working in a team.
CO 2	Develop concept of Reverse engineering and redesign methodology.
CO 3	Familiarization with legal and ethical issues in Product development.
CO 4	Assess market demand, develop broad outline of the product and work out its profitability.
CO 5	Prepare detailed product architecture and product costing.
CO 6	Set final product specification taking into account its manufacturability, prototype making and validation for real life products.

Module	Syllabus	Contact Hrs.
1	**Introduction:** Need for the new product development; Product development Process: understand opportunity, develop concept, implement concept of Reverse engineering & redesign methodology; Development Vs design; Product development team; Product development planning; Legal and ethical issues in product development; case studies.	**10**
2	**What to Develop:** 'S' curves and technical forecasting; Market demand assessment; Customer needs and satisfaction; Product function and FAST (function analysis system technique) method. Volume and profit breakdown; Estimating project facility cost and ROI.	**8**
3	**Product Architecture:** Integral and modular architecture; types of modularity; Modular design : Clustering method and functional method; Generating concepts/ value engineering: brain storming, direct search, morphological analysis; Product costing; case studies.	**8**
4	**Design Process:** Bench marking process steps; Setting product	**10**

	specifications; Design for manufacture, assembly and disassembly; maintenance, quality and usability; Prototype making and validation; Casus of new product failure; Case studies.	
	Total Classes	**36**

Note to the Teachers: Sufficient number of case studies should be cited and discussed during teaching the subject.

Text Books:

1. Product Design: Technique in Reverse Engineering and New product Development- K.Otto and K.Wood, Pearson Education.
2. Product Development- Anil Mital et al, Elsevier, 2008.
3. New Product development- M.A. Annacchino, Elsevier, 2003.

Reference Books:

1. Engineering Design by George E. Dieter, McGraw Hill, International Editions, 3rd Ed.

09/03/2022

Course Name : TOOL ENGINEERING					
Course Code: MECH 3145					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of this course, students will be able to:

- Select different materials for manufacturing various tools.
- Learn design features of various types of tools used in Manufacturing Industry.
- Explain various tool making practices.
- Design Jigs and fixtures for various work holding and machining situations.
- Design Inspection Gauges.

Module No.	Syllabus	Contact Hrs.
Module 1	**Introduction:** Concept of Tool Design and Manufacturing, its importance in Manufacturing Industry. Fundamentals of Cutting and Forming tools. **Tool Materials**: Work hardening Tool Steels, Shock Resisting Tool Steels, Cold-Work Tool Steels, Hot-Work Tool Steels, High Speed Tool Steels, Non-ferrous Tool Materials- Cemented Carbide, Coated Carbide, Non-Metallic Tool Materials- Ceramic, Cubic Boron Nitride (CBN), Polycrystalline Diamond (PCD).	**4** **5**
Module 2	**Manufacturing tools:** Drills, Milling Cutters: Profile sharpened Milling Cutters, Form relieved Milling Cutters, Inserted blade Cutters, Gear tooth Milling Cutters, Gear Hobs, Gear shaping Cutters; Press tools.	**9**
Module 3	**Tool Manufacturing:** Blank Preparation, Machining locating datum surfaces, Manufacturing body of cutting tool, Marking of cutting edge, Sharpening and lapping. Punch and Die Manufacture, Tracer and Duplicating Mills for cavity applications, EDM for cavity applications. Production of carbide tools.	**4** **4** **1**
Module 4	**Jigs & Fixtures:** **Drill Jigs:** Introduction, Types of Drill Jigs, Drill Bushings, and Methods of construction. **Fixtures:** Introduction, Types of fixtures, Milling, Boring, Lathe and Grinding fixtures. **Inspection Gauges:** Introduction, Fixed gauges, Gauge tolerances,	**3** **3** **3**

	Material selection, Methods of construction.	
	Total	**36**

Text Books:

1. Tool Design, C. Donaldson and V. C. Goold, TMH Publication.

Reference Books:

1. Fundamentals of Tool Design, Jeff Lantrip, John G. Nee, and David Alkire Smith, Society of Manufacturing Engineers.

09/08/2022

Course Name : INDUSTRIAL ROBOTICS					
Course Code: MECH 3146					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of this course, students will be able to:

- Learn basic concept of Robotics and its capabilities.
- Define and formulate kinematics of robots.
- Select end effectors, actuators and sensors used in robots.
- Specify a robot for industrial application.
- Write program for a robot.

Module No.	Syllabus	Contact Hrs.
Module 1	Introduction: Brief history of robotics; definition of robot; Main components of robot, Robot geometry: types of joints, workspace, number of degrees of freedom; Common configurations used in arms: rectangular, cylindrical, spherical, jointed; Classification of robot according to coordinate system: Cartesian, cylindrical, polar, articulated or jointed; Classification of robots according to control method: non-servo, servo; Robot specifications. Robot Kinematics: Definition of Robot kinematics, Tool frame and base frame. World – coordinate system, Direct kinematics, Inverse kinematics, Position and orientation of objects, Homogenous transformation, Denavit-Hartenberg (D- H) representation.	**3** **7**
Module 2	Robot End Effector: Definition, gripper, tools; Types of grippers: mechanical grippers, vacuum cups, magnetic grippers, adhesive grippers; Robot Tools: Spot welding gun, pneumatic wrench, welding torch, grinder, spray painting gun. Characteristics: Power to weight ratio, Stiffness, Compliance, Reduction gears; Conventional actuators: Hydraulic actuator, Pneumatic actuator, Electric motor: DC motor, Stepper motor, Servo motor; Special actuators: Magnetostrictive, Shape memory alloy, Elastomeric.	**4** **4**
Module 3	Robot Sensors: Basic categories of sensing devices: analog, digital; Types of sensors: tactile and non-tactile; position, velocity, acceleration, force, pressure, torque, slip, and proximity. Robot Vision System: definition, use, functions, components, classification; Application of robot vision system.	**8**
Module 4	Robot Programming: Different methods of robot programming: teach-pendant	**8**

	programming, key board programming; Programming languages: VAL II, AML/2, ARM BASIC	
	Industrial applications: Welding, Spray painting, Grinding; Machine loading and unloading, Assembly operation; Inspection.	**1**
	Special applications: Underwater prospects and repairs, Mining, Space Exploration, Surgery.	**1**
	Total	**36**

Text Books:

1. Industrial Robotics: Technology, Programming and Applications, Mikell P. Groover, Mitchell.Weiss, Roger N. Nagel, Nicholas G. Odrey, McGraw-Hill International Edition.
2. Robotics Technology and Flexible Automation, S.R. Deb, Tata McGraw-Hill Publication.
3. Robotics for Engineers, Koren, Yoram, McGraw-Hill Book Company, Singapore.

Reference Books:

1. Robotic Engineering:An Integrated Approach, Klafter, Richard D. Chmielewski, Thomas A. and Negin, Michael (2001), Prentice-Hall of India Pvt. Limited.
2. Introduction to Robotics: Analysis, Systems, Applications, Niku, Saeed B., Prentice Hall of India Private Limited, New Delhi.
3. A Textbook on Industrial Robotics, Hegde, Ganesh S., Laxmi Publications (P) Ltd.

09/08/2022

MECH 3201: I C ENGINES

Contacts: 3L **Credits: 3**

Course objectives:

After going through the course, the students will be able to:

- Calculate the work output and thermal efficiencies of engines working with Otto/Diesel/Dual combustion cycle.
- Understand and quantify the differences in work outputs between theoretical cycles and actual cycles in operation.
- Compare the differences between combustion processes in SI and CI engines and accordingly appreciate the characteristics of fuels.
- Make a quantitative analysis of air-fuel ratio in a simple carburetor.
- Understand ignition system in an SI engine.
- Analyze the requirement of heat transfer with cooling.
- Learn the various performance testing procedures and estimate IHP, BHP, FHP and efficiency parameters.
- Analyze an ideal gas turbine cycle and calculate thermal efficiency and work output.

Module	Syllabus	Contact Hrs.
1	**Heat engines:** Working principle of 2-stroke and 4- stroke IC engines. Basic engine components and nomenclature; First law analysis of engine cycle; Nomenclature of various engine parameters.	2
	Analysis of air standard cycles: Otto cycles, Diesel cycles and dual combustion cycles; comparison; Other cycles: Carnot, Stirling, Erricsson, Lenoir, Atkinson, Brayton cycles; numerical problems.	3
	Analysis of fuel- air cycles: significance; effects of variable specific heat, composition of gases, dissociation, number of moles; numerical problems; Analysis of actual cycles with respect to factors of time loss, heat loss and exhaust blowdown.	4
2	**Fuels**: Gaseous and liquid fuels; Desirable characteristics of I.C. engine fuels; Rating of S.I. and C.I. engine fuels; HCV and LCV of the fuels	2
	Fuel- air mixing in S.I. engines: Volumetric efficiency, concept of supercharging, working principle of a simple carburetor; Analysis of simple carburetor; Numerical problems.	4
	Combustion of fuels in I.C. engines: Stages of combustion in SI and CI engines; flame front propagation; factors influencing combustion; knocking / detonation and their preventions.	3

3	Mechanical injection systems in C I engines: Principles of different injection systems; Fuel feed pump, injection pumps; Fuel injector and nozzles; Quantity of fuel and size of nozzle orifice; Numerical problems; Basic principles of MPFI in SI engines. Ignition in S I engine: Requirement of an ignition system; Battery ignition system with different components; ignition timing and spark advance; Reference to other ignition systems. Lubrication system in I.C. engines: Losses and requirement of lubrication; Different systems; Properties of lubricating oil.	4 3 2
4	Cooling system in I.C. engines: Temperature distribution and heat transfer; Principles of liquid cooled and air cooled Performance and testing of I.C. engines: Engine power; Engine efficiencies; Engine performance characteristics. Measurement of speed, torque, fuel consumption, determination of IHP, BHP and FHP, sfc, different efficiencies; plot of efficiency vs. speed curves, numerical problems Engine emissions and their control: Different exhaust and non-exhaust emission, relation with equivalence ratio; Emission control methods Introduction to Gas Turbine: Open cycle/ closed cycle gas turbine; Analysis of simple ideal gas turbine cycle; real gas turbine cycles with isentropic efficiencies, numerical problems	2 3 2 2
	Total Classes	**36**

Text Books:

1. Internal Combustion Engines- V. Ganesan, Tata McGraw-Hill Companies.
2. A course in Internal Combustion Engines - M.L. Mathur and R.P. Sharma, Dhanpat Rai & Sons.
3. Fundamentals of Internal Combustion Engines- H.N. Gupta, PHI Learning Private Ltd.

Reference Books:

1. Fundamentals OF IC Engines by Paul W Gill , Oxford &IBH-Pubs Company-New Delhi.
2. Gas Turbines- V. Ganesan, Tata McGraw-Hill Companies.
3. Internal Combustion Engine and Air Polution - Obert, Edward Frederic.
4. Internal Combustion Engines; Applied thermo sciences- Colling R Farguson, Allan T, Kirkpatrick, Willey Publication, 3e.
5. Internal Combustion Engine Fundamentals -John B Heywood, Mc-Graw Hills.

09/08/2022

Course Name : MACHINING PRINCIPLE & MACHINE TOOLS					
Course Code: MECH 3202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Acquire knowledge on basic principle and purpose of machining.
CO 2	Familiarization with tool geometry and to designate a single point cutting tool.
CO 3	Analyze mechanism of machining, mechanics of machining and determine time of machining.
CO 4	Learn tool failure mechanisms, assess tool life and select an appropriate cutting tool material for a particular application.
CO 5	Learn the use of different power drives, gear layout, gear box etc. and kinematic structure of different machine tools.
CO 6	Appreciate principles and applications of CNC machine tools.

Module	Syllabus	Contact Hrs.
1	**Ia. Introduction:** Machining: Basic principle, purpose, definition and requirements.	1
	Ib. Geometry of cutting tools: 1. Geometry of single point turning tools in ASA and ORS systems. Significance of rake and clearance angles.	1
	2. Conversion of tool angles from one system to another by graphical methods.	2
	3. Geometry of drills and milling cutters.	1
	Ic. Mechanism of machining: 1. Chip formation mechanism, yielding and brittle fracture, chip reduction coefficient, cutting ratio, shear angle and cutting strain.	1
	2. Built-up edge formation, cause, type and effects, orthogonal cutting and oblique cutting.	1
	3. Machining chips: types and conditions, chip formation in drilling and milling.	1
2	**IIa. Mechanics of machining:** 1. Purposes of determination of cutting forces and basic two approaches, cutting force components in orthogonal cuttings and merchant's circle diagram. 2. Determination of cutting forces, analytical methods, measurement. 3. Dynamometers, construction and working principles of strain gauge	3

	type and piezoelectric crystals type turning, drilling dynamometers. **IIb. Cutting temperature:** 1. Heat generators and cutting zone temperature, sources, courses and effects on job and cutting tools, role of variation of the machining parameters on cutting temperature. 2. Determination of cutting temperature by analytical and experimental methods. 3. Control of cutting temperature and application of cutting fluids (purpose, essential properties, selection and methods of application). **IIc. Cutting tools-failure, life and materials:** 1. Methods of failure of cutting tools mechanisms, geometry and assessment of tool wear. 2. Tool life, definition, assessment and measurement, Taylor's tool life equation and it's use. 3. Cutting tool materials, essential properties, characteristics and applications of HSS, carbide (uncoated/coated), ceramic, diamond and CBN tools; carbide tool inserts & tool holders. **IId. Grinding:** 1. Modes and mechanisms of chip formation, selection and application. 2. grinding forces, surface roughness and wheel life.	3 5
3	**IIIa. Machine tools – Introduction:** 1. Purpose of use , definition and general features of machine tools. 2. Generatrix and Directrix and tool – work motions in different operations of conventional machine tools. **IIIb. Machine tool classification:** Broad classification of machine tools. **IIIc. General constructional features and functions of machine tools :** 1. Major components and their functions in lathes ; shaping , planning and slotting machines ; drilling machines and milling machines, capstan and turret lathes. 2. Machining operations and application of the common machine tools and their way of specification. **IIId. Kinematic structure of machine tools:** 1. Types of kinematic structures and diagrammatic representation. 2. Kinematic structure of centre lathe & shaping machine.	2 1 3 3

4	**IVa. Machinability and machining economics:** 1. Machinability: definition, assessment, improvement and evaluation of optimum cutting velocity and toll life.	1
	IVb. Control of speed and feed of machine tools : 1. Need of wide ranges of speeds and feeds, machine tool drive. 2. Design of speed, gear box, speed layout, ray diagrams, gear layout, gears and spindle. 3. Control (selection and change) of feed in centre lathes and hydraulically driven machine tools.	4
	IVc. Machining time : 1. Estimation of time required for various operations like turning, drilling , shaping and milling.	1
	IVd. Computer numerical controlled machine tools : 1. NC and CNC system; purpose, principle, advantages, limitations and application in machine tools.	2
Total Classes		**36**

Text Books:

1. Machining and Machine Tools- A.B. Chattopadhyay, Wiley India (P) Ltd., New Delhi.
2. Principles of Metal Cutting- G. Kuppuswamy, University Press, Hyderabad.
3. Metal Cutting Principles and Practices- M.C. Shaw, Oxford University Press.

Reference Books:

1. Metal Cutting Theory and Practice- Stephenson & Agapion, Taylor and Francis, NY.
2. Principles of Machine Tools- G.C. Sen and A. Bhattacharyya, New Cantral Book Agency (P) Ltd., Kolkata.
3. Machine Tool Design- Acharkan, Vol. I, II, III and IV, Mir Publication, Moscow.

09/08/2022

Course Name : **APPLIED THERMODYNAMICS & HEAT TRANSFER LAB**					
Course Code: MECH 3212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Understand a combined separating and throttling calorimeter and determine the dryness fraction of a steam sample by using the mentioned calorimeter.
CO 2	Evaluate the thermal conductivity of a cylindrical metallic rod using the technique of least square method.
CO 3	Comprehend the fundamentals of thermal conduction in spherical geometry and measure thermal conductivity of an insulating powder.
CO 4	Study a shell and tube heat exchanger for the determination of log-mean temperature difference and effectiveness of the heat exchanger.
CO 5	Estimate the convective heat transfer coefficient for forced convection over a cylindrical fin and plot the spatial variation of temperature along the fin.
CO 6	Learn the basic terminologies related to thermal radiation and assess the emissivity of a gray body.

List of Experiments:

1. Determination of dryness fraction of steam by a combined separating and throttling calorimeter.
2. Determination of thermal conductivity of a metal rod.
3. Determination of thermal conductivity of an insulating powder.
4. Study of a shell and tube heat exchanger for determination of LMTD and calculation of effectiveness.
5. Determination of local heat transfer coefficient (h) for forced convection over a cylindrical fin and temperature plotting.
6. Determination of emissivity of a grey body.
7. Determination of the Natural Heat Transfer Co-efficient in a heated vertical cylinder.
8. Determination of Convective Heat Transfer Co-efficient with the use of Transient Heat Conduction.

09/08/2022

Sessional

MECH 3221: SEMINAR – II

Contacts: 3 P **Credits: 2**

This seminar presentation will be prepared and presented by a group consisting 4/5 students, based on a topic to be assigned by the Department. The seminar presentation will be evaluated by a group of senior faculty members, based on depth of understanding of the topic, quality of presentation, its defense and report; to be submitted after presentation.

09/08/2022

Course Name : MECHATRONICS					
Course Code: MECH 3252					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Learn the basic idea of a Mechatronics system
CO 2	Apply mechanical engineering knowledge to problems in the areas of Mechatronics engineering.
CO 3	Acquire knowledge on hydraulic drives, pneumatic drives and electrical drives used in Mechatronics System.
CO 4	Familiarise with analog and digital control systems.
CO 5	Know the operational principle of a microcontroller and its programming.
CO 6	Learn the basics of the PLC system and its application in Mechatronics system.

Module	Syllabus	Contact Hrs.
1	**Mechanical:** Introduction, Mechanical Drives: Different mechanisms, Ball screws, Linear motion bearings, Transfer systems. **Pneumatic and Hydraulic Drives:** Elements of pneumatic and hydraulic drives, comparison between them. Design of pneumatic and hydraulic circuits, symbolic representations of such circuits indicating different valves, actuators, etc. **Electrical Drives:** Stepper and Servo motors.	8
2	**Analog:** Review of negative feedback control, Op-amp- Review of inverting and non-inverting amplifier, Adder, Subtractor, Differential amplifier, Comparators, Schmitt trigger, Astable and Monostable multivibrators.	8
3	**Digital:** Review of number systems (+ve and –ve number representation), Digital codex (BCD, GRAY, XS3, and ASCII), Digital GATES (AND, OR, NOT, NAND, NOR, XOR, and XNOR), Concept of Decoder and Encoder, Concept of Multiplexer and Demultiplexer, Flip-flops and Registers, Counters and shift registers, Analog to Digital and Digital to Analog converter.	10
4	**Microcontroller:** Introduction, Instruction set, Programming in Assembly and C language, Ports, Counters, Interrupts, Design of microcontroller based circuits, **PLC:** Introduction to PLC.	10
	Total Classes	**36**

Text Books:

1. Mechatronics- N.P. Mahalik, Tata McGraw Hill Publication
2. Mechatronics- W. Bolton, Pearson Education
3. Mechatronics- A. Smaili and F. Arnold, Oxford University Press, Indian Edition
4. Mechatronics- M.D. Singh and J.G. Joshi, Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Digital principles and applications- Albert Paul Malvino, Donald P. Leach, McGraw Hill.
2. The 8051 Microcontroller based embedded systems- Manish. K. Patel, McGraw Hill.
3. Microcontrollers: principles and applications- Ajit Pal, PHI
4. Mechatronics- HMT Ltd., Tata McGraw Hill Publication 8.

09/08/2022

Course Name : ADVANCED FLUID MECHANICS					
Course Code: MECH 3253					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Understand fundamental physical and analytical principles of ideal fluid flow.
CO 2	Analyze the mechanics of potential flow.
CO 3	Solve standard bench mark problems like Couette flow, annular flow etc.
CO 4	Apply the fundamental laws to solve problems of compressible fluids in engineering systems.
CO 5	Differentiate between the effects of drag and lift force on submerged bodies.
CO 6	Explain the basic principle of flow dynamics past an aerofoil

Module	Syllabus	Contact Hrs.
1	**Ideal Fluid Flow and flow kinematics:** Velocity potential function and stream function, equipotential line, relation between stream function and potential function.	2
	Circulation and vorticity; Vortex flow: forced and free vortex flow, equation of motion for vortex flow.	3
	Important cases of potential flow: uniform flow, source flow, sink flow, free vortex flow, super imposed flow (source and sink pair, doublet, flow past a half body, source and sink pair in a uniform flow, doublet in uniform flow)	4
2	**Viscous Laminar Flow of Incompressible Fluid:**	
	Flow between parallel surfaces: Couette flow and plane Poiseuille flow.	3
	Flow between concentric rotating cylinders.	2
	Laminar boundary layer equation through scale analysis- Prandtl boundary layer equation, Blasius flow over flat plate and shooting technique.	4
3	**Compressible Flow:** Compressible Flow: speed of propagation of a small disturbance through a compressible fluid, sonic velocity, Mach number, Mach cone and Mach wave; isentropic flow, stagnation properties of a compressible flow, isentropic pressure, temperature and density ratios;	9

	compressibility correction factor in the measurement of air speed; area – velocity relationship for compressible flow through a variable area duct, mass flow rate through a duct, maximum mass flow rate through a duct, critical condition and choking; flow through convergent-divergent nozzle.	
4	**Flow of fluid around submerged bodies:** drag on a sphere and cylinder; development of lift on a circular cylinder(both stationary and rotating). Expression of lift coefficient for rotating cylinder, location of stagnation point for a rotating cylinder in a uniform flow field, Magnus Effect. Development of lift on an aerofoil.	8 1
Total Classes		**36**

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines- Som, Biswas and Chakraborty, TMH, 3e.
2. Advanced Engineering Fluid Mechanics - K. Murlidhar & G. Biswas, Narosa Publication, 2e.

Reference books:

1. Fluid Mechanics- Kundu, Cohen & Dowling, Academic Press (Elsevier), 5e.
2. Engineering Fluid Mechanics- Graebel. W. P, Taylor & Francis (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint, 2013.
3. Fundamental Mechanics of Fluid- I.G. Currie, 3e, Marcel Dekker, Inc./McGraw-Hill.

09/08/2022

Professional Elective –III Lab

Course Name : **DESIGN PRACTICE-II LAB**					
Course Code: MECH 3256					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

On completion of this course students will be able to

CO1	Implement as well as understand different international codes like ASME codes, AGMA codes, ISO codes etc. when they will be encountering with industrial drawings in their professional life.
CO2	Understand about a detailed methodology of design validation or modification done in industry or in research work numerically using any FEA software like MSC Software or ANSYS etc.
CO3	Use different tools of any FEA software like MSC Software or ANSYS when they will be taking part in any R-n-D activity regarding Structural analysis and/or Thermal analysis and/or Couple Field (Thermo-Mechanical) analysis.
CO4	Take active part in design activity regarding designing of shaft or equivalent machine components where ASME codes are used extensively in detail and also FEA software is used for design calculations and validations.
CO5	Engage themselves fruitfully in the process of any power driving system design like designing of Gear Drive and/or Pulley Drive and/or Cam Drive etc. where AGMA and ASME codes are used as well as FEA Software are used.
CO6	Understand design process of a Thermo-Mechanical system like designing of pressure vessel etc. where ASME as well as TEMA codes are used along with FEA software for the design validation.

Experiment/ Study	Topics	Contact Hrs.
1	**Introduction:** A over view about different design standards like AGMA (American Design Manufacturing Association) standard for Gear design, ASME (American Society for Mechanical Engineers) for Pressure Vessel Design, ISO (International Standardization Organization).	6
2	A Detailed discussion on methodology of solving a structural problem using FEA software MSC Patran and Nastran or equivalent software.	6
3	A Detailed discussion on methodology of solving a thermal problem using FEA software MSC Patran and Nastran or equivalent software.	3
4	**Design of shaft and bearing assembly:** ➢ Identification of loads and boundary conditions for a shaft which is to be designed and to be assembled between to roller bearings. ➢ Design of shaft and selection of bearings as per identified load and boundary conditions. Designing of shaft will be done complying ASME and ISO standards. ➢ 3-Dimensional modeling of shaft, bearing and assembly of shaft and bearing in a 3-D modeling software named PTC Creo Parametric 3.0 ➢ Numerical validation of the design using a FEA software like MSC Nastran or equivalent software.	9
5	**Design of a simple spur gear assembly:** ➢ Identification of required input data from the problem definition. ➢ Calculations for module and other constructional parameters of the spur gear following AGMA standard. ➢ Parametric modeling of the gears and their assembly using a 3D modeling software named PTC Creo Parametric 3.0 or equivalent software. ➢ Numerical validation of the design using a FEA software like MSC Nastran or equivalent software.	6
6	**Design of a pressure vessel:** ➢ Identification of required input data from the problem definition. ➢ Calculation of plate thickness for autofritage condition following ASME code. ➢ Parametric modeling of pressure vessel using a 3D modeling software named PTC Creo Parametric 3.0 or equivalent software. ➢ Numerical validation of the design using FEA software like MSC Nastran or equivalent software.	3
7	Determination of critical speed of a shaft using dynamic module of any FEA soft ware like MSC Nastran or equivalent software.	3
	Total	**36**

Recommended Books:

1. Mechanical Component Design- Robert C Juvinall and Kurt M Marshek. Published by Wiley Publication, 5th Edition 2012.
2. Mechanical Design of Machine Elements and- Jack A Collins, Henry Busby and George Staab. Published by 'Wiley Publication', 2nd Edition, 2010.
3. ISO Codes: All parts of ISO 6336.
4. AGMA Codes: AGMA 901/908/913/917/918/923/933, ANSI/AGMA- 2004 and ANSI/AGMA-2012.
5. ASME Codes: BPVC Section I- Rules for Construction of Power Boilers and BPVC Section IV-Rules for Construction of Heating Boilers.

09/08/2022

Course Name : MECHATRONICS LABORATORY					
Course Code: MECH 3257					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Familiarise with analog and digital circuit components.
CO 2	Understand the physical principles of different analogue and digital sensors and measure load, linear displacement and anguler displacement using sensors.
CO 3	Operate and control of DC motor / AC motor / Stepper motor.
CO 4	Analyse the basic concepts and programming of 8051 microcontroller
CO 5	Develop PLC programs for control of conveyor belt.
CO 6	Develop pneumatic and hydraulic circuits using trainer kit.

Experiment No.	Experiment
1	To study a strain gauge type load cell and measure load using such sensor.
2	To study the working principle of a force sensing resistor (FSR)/ pressure dependent resistor (PDR) and measure load with the help of FSR/PDR.
3	To study the constructional features & working principle of an LVDT and measure linear displacement using LVDT.
4	To study the characteristics of light dependent resistor and measure distance using such sensor.
5	To study the working principle of ultrasonic proximity sensor and measure distance using such sensor.
6	To study the working principle and application of inductive type proximity sensor.
7	To study the working principle and application of an infrared proximity sensor.
8	To study the angular position control of a D.C. servo motor and to measure angular position.

9		To study and determine the torque - speed characteristics of D.C. servo motor
10		To study the construction and working principle of three phase induction motor and control the speed by controlling the supply frequency
11		To study and run an Assembly language program (or Hex Code) in AT 89C51 / 52 microcontroller.
12		To study a hydraulic circuit involving different components to operate hydraulic actuators and limit control units.
13		To study a pneumatic circuit involving different components to operate pneumatic actuators and limit control units.
14		To study a Programmable Logic Controller (PLC) and to operate a D.C. motor driven conveyer belt unit using a PLC program.

Course Name : ADVANCED FLUID MECHANICS LAB					
Course Code: MECH 3258					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Identify the basic components used in different fluid flow systems.
CO 2	Apply the knowledge of engineering fundamentals to understand the viscous fluid flow in pipelines and associated losses.
CO 3	Investigate the effect of design and off-design conditions for centrifugal pumps.
CO 4	Investigate the characteristics of open channel flow.
CO 5	Investigate and calculate various useful parameters from the experimental readings with some knowledge on related errors in the experimental readings/setup/procedure/instruments.
CO 6	Perform effectively as an individual, and as a member of a team in a laboratory.

List of Experiments:

1. Verification of Stokes' Law.
2. Study of minor losses in pipe fittings apparatus.
3. Determination of cavitation parameters of a centrifugal pump.
4. Performance test of centrifugal pumps in parallel operation.
5. Performance test of centrifugal pumps in series operation.
6. Performance test of submersible pump.
7. Study of characteristics of hydraulic jump.
8. Study of an open circuit wind tunnel.

09/08/2022

Course Name : MAINTENANCE ENGINEERING					
Course Code: MECH 3261					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>Course Outcomes:</u>

After going through the course, the students will be able to:

CO1: **Understand** the difference between repair and maintenance, **Classify** different types of maintenance and their applicability.

CO2: **Appreciate** the importance of implementing TPM in an organization**, List** out the common factors between TPM and TQM and **Prioritize** actions based on Pareto analysis.

CO3:**Compute** overall equipment effectiveness, reliability and maintainability of different machines and **Decide** if a machine due for replacement .

CO4 : **Design** a Maintenance organization chart based on the type of business , **Prepare** a maintenance budget and Initiate maintenance audit procedure .

CO5 : **Understand** the importance of lubrication , **List** out the most economic method of lubrication, **Guide** common repairs job.

CO 6 :**Select** common types of general maintenance tools and equipment , **Choose** appropriate NDT methods to detect cracks .

Module	Syllabus	Contact Hrs.
1	**Introduction:** Definitions of repair and maintenance; Importance of maintenance. Different maintenance systems- breakdown, preventive, planned; predictive maintenance through condition monitoring; Safety engineering, Maintainability, failure pattern, availability of equipment / systems, design for maintainability. **Total Productive Maintenance (TPM):** definition, objective & methodology; Implementation of TPM; Lean maintenance; Overall equipment effectiveness (OEE)	5 4
2	**Organizational structures for maintenance:** Objective; Maintenance functions and activities; Organizational requirements; Types of maintenance organizations, maintenance planning & scheduling. Manpower planning; Engineering stores. **Economic Aspect of Maintenance:** Life cycle costing; Maintenance cost & its impact; Maintenance budget; Cost control; Maintenance audit- Procedure, tools,	4 5

	planning, reports.	
3	**Function and use of Maintenance Equipment, Instruments & Tools:** Facilities like NDT, painting, coating and cladding, Gas cutting and welding, crack detection, vibration monitor, balancing equipment, compressor, basic machine tools, lubricators and lubricants, chain pulley block, Tools like different types of wrenches, torque wrench, pipe wrench, plier, screw driver, dimension measuring instruments, feeler gauge, scraper, fitting shop tools, spirit level, hand grinder & drill, screw jack, etc.	5
	Lubrication: Purpose & importance; Type of lubricants, Properties of lubricants; Types of lubrication and their typical applications, lubrication devices, centralized lubrication system; Gasket, packing and seals;	4
4	**Repair & Maintenance Procedures:** Repair of cracks, threads, worn shafts, keyways, bush bearing, damaged gear tooth. Assembly and dismantling of antifriction bearing; Maintenance of bearing, clutches, coupling, brakes, Alignment of shafts, belt and chain drives, gear drives, centrifugal pump, pipe and pipe fittings, small induction motors; Steps for installation of a machine.	9
	Total Classes	**36**

Text Books:

1. Maintenance Engineering and Management- Mishra and Pathak, PHI.
2. Maintenance Engineering and Management- Srivastava, S. Chand & Company Ltd., New Delhi.
3. Maintenance Engineering and Management- K. Venkataraman, PHI.

09/08/2022

Course Name : MATERIALS HANDLING					
Course Code: MECH 3263					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Interpret the importance of materials handling (UNDERSTAND)
CO 2	Identify the application of different types of materials handling systems and equipments (REMEBERING)
CO 3	Implement the concept of maximizing productivity for designing of effective materials handling system (APPLY)
CO 4	Infer suitable materials handling equipment for specific applications (ANALYZE)
CO 5	Evaluate alternative or innovative solutions, concepts and procedures for effective utilization of materials handling equipments (EVALUATE)
CO 6	Develop specific conveying equipment for designated bulk material handling systems (CREATE)

Module	Syllabus	Contact Hrs.
1	**Introduction :** Definition, importance and scope of materials handling (MH); Objectives of Material Handling; classification of materials; codification of bulk materials; utility of following principles of MH – (i) materials flow, (ii) simplification, (iii) gravity, (iv) space utilization, (v) unit size, (vi) safety, (vii) standardization, (viii) dead-weight, (ix) idle time (x) motion. **Unit load :** Definition; advantages & disadvantages of unitization; unitization by use of platform, container, rack, sheet, bag and self contained unit load; descriptive specification and use of pallets, skids, containers, boxes, crates and cartons; shrink and stretch wrapping. **Classification of MH Equipment :** Types of equipment – (i) industrial trucks & vehicles, (ii) conveyors, (iii) hoisting equipment, (iv) robotic handling system and (v) auxiliary equipment; Independent equipment wise sub classification of each of above type of equipment.	9
2	**Industrial trucks & vehicles:** Constructional features and use of the following equipment – (i) wheeled hand truck, (ii) hand pallet truck, (iii) fork lift truck; Major specifications, capacity rating and attachments of fork lift truck. **Auxiliary Equipment :** Descriptive specification and use of – (i) Slide and trough gates, (ii) belt, screw and vibratory feeders, (iii) Chutes, (iv) positioners like elevating platform, ramps, universal vise; (v) ball table.	8

3	**Conveyors :** Use and characteristics of belt conveyor, constructional features of flat and troughed belt conveyor; Use and constructional features of Flg. types of chain conveyors – apron, car and trolley type; Construction of link-plate chains; Dynamic phenomena in chain drive; Use and constructional features of roller conveyors; Gravity and powered roller conveyor; Pneumatic conveyor-use and advantages; Positive, negative and combination system of pneumatic conveyors; constructional feature, application and conveying capacity of screw conveyor, bucket elevator.	9
4	**Hoisting Equipment:** Advantage of using steel wire rope over chain; constructional features of wire ropes; Rope drum design; Pulley system-simple vs. multiple pulley; Load handling attachments : hooks, grabs, tongs, grab bucket; Arrangement of hook suspension with cross piece and pulleys (sheaves); Use and constructional features of (i) hand operated trolley hoist, (ii) winch; (iii) Jib crane, (iv) overhead traveling crane and (v) wharf crane; Level luffing system of a wharf crane; Utility of truck mounted and crawler crane. **Robotic handling:** Materials handling at workplace; Major components of a robot; Applications of robotic handling; AGV (automated guided vehicle)	10
	Total Classes	**36**

Books Recommended:

1. Introduction to Materials Handling- S. Ray, New Age Int. Pub.
2. Mechanical Handling of Materials- T. K. Ray, Asian Books Pvt. Ltd.
3. Materials Handling: Principles and Practices- T.H. Allegri, CBS Publishers and Distributors.
4. Material Handling System Design- J.A. Apple, John Wiley & Sons.

09/08/2022

Course Name : CAD/CAM					
Course Code: MECH 3264					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of this course students will be able to

CO1	Understand the working methodology of different Drawing and Transformation tools of any drafting and design software which will help them to work with the drafting and design software at the program level.
CO2	Use the detailed understanding about the mathematical approach of Analytical as well as Synthetic curve building, Surface generation and 3D modeling when they will be working in the field of research and development.
CO3	Adoptcorrect element type and meshing parameters when they will analyze any physical phenomenon with structural load or thermal load or thermo mechanical load using Finite Element Method
CO4	Select the correct parameters of process planning where Computer Integrated Manufacturing (CIM) plays very important role in the whole manufacturing procedure for efficient production of any product.
CO5	Generate as well as check 'G' code and 'M' code sequence of any part programming for machining with CNC or DNC machines in any manufacturing process.
CO6	Accustom themselves in the modern design, development and manufacturing activities in the now-a-days industries.

Module No.	Syllabus	Contact Hrs.
Module 1	**INTRODUCTION:** Fundamental of Computer Aided Design process, Benefits of Computer Aided Design process, Basics of Computer Graphics, Transformations-Introduction, Formulation, Translation, Rotation, Scaling, and Reflection. Homogenous Representation, Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations.	8
Module 2	**MODELLING:** Curves: - Introduction, Analytic Curves - Line, Circle, Ellipse, Parabola, Hyperbola. Synthetic Curves - Bezier Curve, B-Spline Curve and NURBS. Numericals on Line, Circle, Ellipse. Surfaces:- Introduction, Surface Representation, Analytic Surfaces, Synthetic Surfaces, Bezier surfaces, B-spline Surfaces, Coons Surface [no analytical treatment]. Solids:- Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry, Boolean operation for CSG, Hybrid	10

	Modeling, Feature Based Modeling, Parametric Modeling, Constraint Based Modeling, Mass, area, volume calculation.	
Module 3	**FINITE ELEMENT ANALYSIS:** Introduction, Stress and Equilibrium, Boundary Condition, Strain – Displacement Relations, Stress- Strain Relation, Potential Energy and Equilibrium: - Rayleigh-Ritz Method, Galerkin's Method. One Dimensional Problem: Finite Element Modelling, Coordinate and Shape function, Potential Energy Approach, Galerkin Approach, Assembly of Stiffness Matrix and Load Vector, Finite Element Equations, Quadratic Shape Function, Temperature Effects . Trusses: Introduction, 2D Trusses, Assembly of Stiffness Matrix.	10
Module 4	**COMPUTER AIDED MANUFACTURING:** Introduction to computer aided manufacturing (CAM) systems, Basic building blocks of computer integrated manufacturing (CIM). CNC programming using CAM Software.	8
	Total	**36**

Text Books:

1. CAD/CAM - Theory and Practice, Ibrahim Zeid and R. Sivasubramanian, Tata McGraw Hill Publishing Co.
2. Introduction to Finite Elements in Engineering, Chandrupatla T.R. and Belegunda A.D, Prentice Hall India.

Reference Books:

1. Fundamentals of Finite Element Analysis, David V. Hutton, Mcgraw-Hill.
2. Introduction to CAD/CAM, P N Rao, Tata McGraw Hill Publishing Co.
3. Automation, Production Systems and Computer Integrated Manufacturing, Groover M. P., Prentice Hall of India

09/08/2022

Course Name : OPERATIONS MANAGEMENT					
Course Code: MECH 3265					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of the course, students will be able to:

- Appreciate importance of production and operations management.
- Learn various forecasting methods.
- Apply inventory control strategies and plan materials requirement in an industry.
- Implement concepts of machine scheduling and project scheduling.
- Develop an idea of quantity assurance practices.

Module No.	**Syllabus**	**Contact Hrs.**
Module 1	**Introduction**: System concept of production; Product life cycle; Types and characteristics of production system; Productivity, Line balancing. **Forecasting**: Patterns of a time series-trend, Forecasting techniques: moving average, simple exponential smoothing, linear regression; Forecasting a time series with trend and seasonal component, Qualitative methods, Forecasting errors.	3 6
Module 2	**Materials Management and Inventory Control :** Components of materials management; Inventory control : EOQ model, Economic lot size model, Inventory model with planned shortages, Variable demand and variable lead time, ABC analysis; Just-in-time inventory management. **Materials Requirement Planning:** MRP concept – bill of materials (BOM), master production schedule; MRP calculations. Concept of aggregate planning.	6 4
Module 3	**Machine Scheduling:** Concept of Single machine scheduling – shortest processing time (SPT), Minimize mean flow time, Earliest due date (EDD), Minimize maximum lateness, Total tardiness Minimizing model; Johnson's rule for 2 and 3 Machines scheduling. **Project Scheduling:** Activity analysis; Network construction; critical path method (CPM), PERT; Crashing of Project network, Resource planning.	4 5
Module 4	**Quality Assurance:** Meaning of Quality; Quality assurance system; choice of process and quality; Inspection and control of quality; Maintenance function & quality; Process control charts : X-chart and R-Chart, p-chart and c-chart; Acceptance sampling : Operating characteristic (O.C) curve, Single sampling plan, Double sampling plan, Acceptance sampling by variables; concept of Six Sigma.	8
	Total	**36**

Text Books:

1. Modern Production/Operations Management, Buffa and Sarin, John Wiley & Sons.
2. Production and Operations Management, R. Panneerselvam, PHI.
3. Operations Management, Russell & Taylor, PHI.

Reference Books:

1. Production and Operations Management, Adam and Ebert, PHI.
2. Production & Operations Management, Starr, Cenage Learning India

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Professional Elective II

Course Name : TOTAL QUALITY MANAGEMENT (TQM)					
Course Code: MECH 3141					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Explain the concepts of Total Quality Management and Total Quality Education (UNDERSTANDing)
CO 2	Identify the problems in Quality Improvement Process (REMEBERING)
CO 3	Apply various Quality Improvement Techniques(APPLYING)
CO 4	Analyze Statistical Process Control(SPC) data to improve processes (ANALYZE)
CO 5	Appreciate the incorporation of ISO System standard and its benefits(EVALUATE)
CO 6	Propose how business leaders might plan and execute quality management straggles to gain and sustain competitive advantage in today's global business arena (CREATE)

Module	Syllabus	Contact Hrs.
1	**Introduction:** Definition of quality ; Quality control vs. Quality Assurance ; TQM- Components of TQM; TQM vs. TPM; Quality Gurus ; Quality Planning and Quality costs; Collection and reporting of quality cost information; Leadership role in TQM; Role of senior management in TQM; Implementation and Barriers to TQM ; Customer Satisfaction-Customer perception of quality-customer complaints- customer feedback- customer retention; Employee involvement.	9

2	**QMS (ISO 9000):** Evolution of QMS- ISO 9000 series of standards- Quality manual – ISO 9001 requirements ; Different clauses of ISO 9001 system and their applicability in various business processes ; Documentation ;Internal Audits and Implementation; ISO 9000 certification process. **EMS (ISO 14000):** Concepts of ISO 14001 ; Requirements of ISO 14001 ; Benefits of ISO 14001	9
3	Continuous process improvement; PLAN-DO-CHECK-ACT (PDCA); 7 QC tools and their use for quality improvement; Quality Function Deployment; QFD team ; Benefits of QFD; QFD Process KAIZEN; 5 – S Principle; Concept of quality circles.	9
4	Statistical process control; Measures of central tendency; Measurers of dispersion; control charts for variables; Control charts for attributes; OC Curve ; Process capability; six sigma and its applications; Design of experiments and Taguchi Methodology	9
	Total Classes	**36**

Text Books:

1. Total Quality Management – J.D. Juran , MHE.
2. Total Quality Management **-** Besterfield,Pearson Education.

Reference Books:

1. Total Quality Management – Arasu & Paul , Scitech.
2. Total Quality Management – Poornima M Charanteemath , Pearson Education .

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<table>
<tr><td colspan="6">Course Name : DYNAMICS OF MACHINES</td></tr>
<tr><td colspan="6">Course Code: MECH 3101</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
</table>

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	**Analyze** the dynamic forces and torque in a reciprocating mechanisms.
CO 2	**Understand** the application of a flywheel and **Evaluate** the fluctuation of energy.
CO 3	**Evaluate** an unbalanced system and **solve** the problem for balancing the same graphically and analytically.
CO 4	**Analyze** a free and forced single degree vibrating system with and without damping.
CO 5	**Understand** the gyroscopic effects and **analyze** stability of motion of different system based on the effects.
CO 6	**Understand** and **explain** different governors used in different applications.

Module	**Syllabus**	**Contact Hrs.**
1A	**Dynamic analysis of Mechanism:** Inertia force and inertia torque in reciprocating engine; Dynamic Equivalent System; correction couple (torque); Turning moment diagram and flywheel design.	5
1B	**Introduction:** Definition & types of vibration **Free Undamped Vibration:** Determination of Equation of motion and solution function of a linear and rotary vibratory motion by Equilibrium method, Energy method (Rayleigh's maximum energy principle), About Natural Frequency of the free undamped linear and rotary vibration. Effect of inertia in longitudinal vibration and its natural frequency.	4
2A	**Linear Free Damped Vibration:** Equation of motion and solution function for free damped vibration. Understanding the damping factor or ratio. A detailed discussion about under damped motion, critically damped motion and over damped motion. Logarithmic decrement.	3
2B	**Forced Damped Vibration:** Equation of motion and solution function for forced damped vibration. Understanding the physical significance of the solution. Steady state condition and amplitude. Dynamic Magnification Factor and phenomenon of resonance. Vibration Isolation and Transmissibility. Effect of unbalance and support motion.	4

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2C	**Transverse vibration of Shaft:** Vibration with single concentrated load, uniformly distributed load and with several loads (Dunkerley's Method and Energy Method), Whirling of shaft and calculation of critical speed.	3
3	**Balancing**: Static balancing and dynamic balancing of rotating masses - graphical and analytical methods; Balancing of reciprocating mass – primary and secondary balancing; Balancing of Locomotive; Effects of partial balancing in Locomotives (Swaying couple; Hammer blow); Balancing of inline Engine; Balancing of V- Engine.	9
4A	**Governors**: Use and classification; Study and analysis of Porter, Proell, Hartnell and Wilson-Hartnell governors; Sensitiveness, stability, isochronism, hunting, effort and power of governors; Controlling force diagram and stability criteria analysis; coefficient of insensitiveness.	4
4B	**Gyroscope:** Gyroscopic Torque; Gyroscopic effects on Aero-plane; Gyroscopic Effects on Naval Ship; Stability of an Automobile; Stability of Two-wheel Vehicles.	4
	Total Classes	**36**

Text Books:

3. Theory of Machines – S S Rattan, Tata McGraw Hill, 4e, 2014.
4. Theory of Machines – R. S. Khurmi and J. K. Gupta, S. Chand Technical, 14e, 2005.

Reference Books:

1. Theory of Machines and Mechanisms – Uicker, Pennock and Shigley, Oxford University Press, 3e, 2009.
2. Kinematics and Dynamics of Machinery – R. L. Norton, McGraw Hill Education, 1e, 2009.
3. The Theory of Machines through Solved Problems – J. S. Rao, New Age International Publication, 1e, 2012.
4. Mechanism and Machine Theory – Ashok G. Ambekar, PHI Learning, 1e, 2007.
5. Theory of Mechanisms & Machines (3rd edition) – Ghosh and Mallik; East West Press, 3e, 2006.

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Course Name : DESIGN OF MECHANICAL SYSTEMS-I					
Course Code: MECH 3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

On completion of this course students will be able to

CO1	Select suitable material of the object to be designed, as per the requirement of strength and other physical properties in accordance with the given loading and boundary conditions.
CO2	Judge relevant 'Mode of Failure' and 'Theory of Failure' when designing an object according to a required failure criteria under specified loading condition and boundary constraints.
CO3	Design machine components under different types of loading like tensile, bending and torsional with different combinations of two dimensional stress conditions.
CO4	Justify the design of an object subjected to reversed or fluctuating load with different combinations of loading types like tensile, bending and torsional for infinite life as well as for any specified finite life.
CO5	Determine the size specifications of power screw and fastening components like nut-n-bolt, rivets with its required arrangements and various welds according to object dimensions, type of use and loading imposed.
CO6	Design the specification of transmission shaft, keys, flanges and belt for the purpose of a power and torque transmission in a machine.

Module	Syllabus	Contact Hrs.
1A	**Introduction:** Objective and scope of Mechanical Engineering Design, Design considerations; Review and selection of materials and manufacturing processes; codes and standards, Importance of preferred size.	4
1B	**Design Under Static Load:** Modes of failure; Design/allowable stress; Factor of safety (fs); Bi-linear Stress –Strain; Theories of failure– maximum normal stress theory, maximum shear stress theory, Distortion energy theory. Choice of Failure criteria; Design for stability: buckling analysis – Johnson and Euler columns, Design of (i) Cotter joint; (ii) Knuckle joint.	8
2	**Design Under Fluctuating Load:** Fatigue in metals; S-N curve; Endurance limit and fatigue strength; Stress concentration factors – effect of discontinuity, fillets and notches; Effect of size, surface finish, stress concentration and degree of reliability on endurance limit; Design for finite and infinite life; Cumulative fatigue damage – Miner's equation, Goodman, modified Goodman and Soderberg diagrams with respect to fatigue failure under variable stresses; Fatigue design under combined stresses.	11

3	**Design of :** **(a) Bolted joints** : Fasteners- Metric thread, standard sizes, use of lock nuts and washers; Applications in structures including brackets, turn buckle; Pre-stressed bolts, Design under concentric loading and eccentric loading (b) **Riveted joints** : Unwin's formula; Brief discussion on single, double and triple row lap joints, butt joints with single or double strap / cover plate; simple strength design; joint efficiencies, Design under concentric loading as well as eccentric loading. (c) **Welded Joints**: Butt Joint, Single Fillet and Double Fillet Joint under concentric loading as well as Eccentric Loading **Design of Transmission screw and Screw jack.**	10 2
4	**Design of :** (i) Solid and hollow shafts: design under transverse and torsional load. (ii) Helical compression spring: stress and deflection equations, stiffness, curvature effect : Wahl's factor, springs in parallel and series. (iii) Multi-leaf springs: load-stress and load-deflection equations, Nipping. (iv) Shaft coupling-rigid, pin-bush and geared flexible type, alignment of coupling. (v) Belt drives-geometrical relations, derivation of torque and power transmission by flat and V-belt drives, selection of belt from manufacturers' catalogues, pulley. (vi) Chain drives – roller chains, polygonal effect, power rating, sprocket wheel, silent chain.	13
	Total Classes	**48**

Text Books:

1. Design of Machine Elements - V. B. Bhandari, TMH.
2. Fundamentals of Machine Design - P.C. Gope, PHI.

Reference Books:

1. Mechanical Engineering Design – Shigley and Mischke, TMH.
2. Theory and Problems of Machine Design – Hall, Holowenko and Laughlin, TMH.
3. Design of Machine Elements – M.F. Spotts, Prentice Hall.
4. Machine Design – P. Kannaiah, Scitech Publications.

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Course Name : DYNAMICS OF MACHINES LAB					
Course Code: MECH 3211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	To teach students concepts of generalized forces, couple and the principle of virtual work.
CO 2	To create linkage, cam and gear mechanisms for a given motion or a given input/output motion or force relationship.
CO 3	To remember and understand the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.
CO 4	To analyze and evaluate the forces and motion of complex systems of linkages, gears and cams.
CO 5	To understand and remember the concepts of static and dynamic mass balancing and flywheels
CO 6	To Analyze mathematical models used dynamical analysis of machinery.

List of Experiments:

1. Studying and designing different mechanisms for performing specific tasks in a machine tool and for common engineering applications.
   I. Four bar mechanism
   II. Slider crank mechanism
   III. Whitworth quick return mechanism
   IV. Crank slotted lever mechanism
2. Experiments on working of governor, operation and analysis.
   I. Watt governor
   II. Porter governor
   III. Proell governor
   IV. Hartnell governor
3. Experiments on working of gyroscope, operation and analysis.
4. Drawing a cam.
5. Studying operation of cams and its analysis.

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6. Static and dynamic balancing of rotating masses.
7. Balancing of reciprocating masses.
8. Studying vibratory systems of single and more than one degree of freedom in linear and rotary systems.

N.B. A minimum of six jobs / experiments must be performed in the semester.

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Course Name : DESIGN OF MECHANICAL SYSTEMS –II					
Course Code: MECH 3251					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>Course Outcomes:</u>

On completion of this course student will be able to:

CO1	Know different technical terminologies of different gears and their physical interpretation.
CO2	Understand design methodology of different gears like Spur, Helical, Bevel and Worm wheel.
CO3	Implement all the technical nitty-gritty in the process of pressure vessel design with thermo-mechanical loading.
CO4	Impart fruitful contribution in the process of sliding contact and rolling contact bearing design and selection.
CO5	Take active participation in the process of designing and/or selectionof Clutch and Brake for a drive system.
CO6	Become an active member in the design validation and modification activity as well as R-n-D activity in any Industry and/or Research.

Module	Syllabus	Contact Hrs.
1A	**Gear Design- Introduction:** Design objectives of Gears, Classification of Gears and their Technical Terminologies, Different tooth profile of Gears, Interference and Undercutting, Backlash of Gear, Gear materials, Laws of gearing.	2
1B	**Design of Spur Gear:** Strength design, static and dynamic considerations in strength design, Lewis formula, Lewis form factor, beam strength, Buckingham equation for dynamic tooth load; Endurance strength and wear strength; Designing a pinion based on above considerations.	4
1C	**Design of Helical Gear:** Helical Gear: Helix angle, minimum face width, virtual number of teeth; Strength design, Buckingham formulae for checking dynamic load and wear load.	2
2A	**Design of Bevel Gear:** Terminologies, formative number of teeth; Lewis equation, dynamic load, endurance strength and wear strength checking.	2
2B	**Design of Worm- worm wheel:** Terminologies and their inter-relation; Preferred combination of various parameters; Efficiency; Materials.	2

2C	**Design of Pressure vessels**– thin cylinder, thick cylinder, Lame's equation, Clavarino's equation, Bernie's equation, Autofrettage– compound cylinders, End Covers, Opening in pressure vessel – area compensation method, Fired and unfired vessels – category, Industrial Code.	5
3	**Design of Clutch and Brakes:** **Clutches:** Function, types; Friction clutches – torque capacity based on uniform pressure and uniform wear theory for disc and cone clutch; Centrifugal clutch; Friction materials; Considerations for heat dissipation. **Brakes:** Function, types; pivoted block brake (single and double block brakes), internal expanding shoe brake, self-energizing and self-locking; Pivoted block brake; Band brake-simple and differential; Energy equation for braking time calculation; Magnetic and hydraulic thruster operated fail-safe brakes; Brake lining materials; Thermal considerations during braking.	9
4A	**Design of Sliding contact bearings:** Bearing types and materials; Stribeck Curve, Petroff equation, Hydrodynamic lubrication theory - pressure development; Tower experiment, Reynolds equation, Finite bearings – Raimondi-Boyd charts, Design factors/variables, Heat generation & dissipation; Hydrostatic bearing; Plummer block.	6
4B	**Rolling contact bearings:** Bearing types, nature of load; Static and dynamic load capacity, Stribeck equation ,Load - Life relation; Bearing selection from manufacturers' catalogues; Methods of lubrication; Bearing mounting on journal and bearing block.	4
	Total Classes	**36**

Text Books:

1. Design of Machine Elements- V. B. Bhandari, TMH.
2. Fundamentals of Machine Design- P.C. Gope, PHI.

Reference Books:

1. Mechanical Engineering Design- Shigley and Mischke, TMH.
2. Theory and Problems of Machine Design- Hall, Holowenko and Laughlin, TMH.
3. Design of Machine Elements- M.F. Spotts, Prentice Hall.
4. Machine Design- P. Kannaiah, Scitech Publications.

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Course Name : Genetics					
Course Code: BIOT3101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

After completing the course, the students will be able to:

1. Understand the basic principles of Mendelian mode of inheritance and also analyze the reasons behind the exceptions to this phenomenon.
2. Interpret the different modes of linkage, sex determination patterns and chromosomal abnormalities.
3. Identify and analyze the genetic network of carcinogenesis to reach out for novel therapeutic strategies.
4. Comprehend the mechanism of action of microbial genetics and genetic patterns of embryonic development.
5. Apply the mathematical and biostatistical models in biological systems for testing of hypotheses, estimation of group differences and case-control studies.
6. Use the Hardy-Weinberg model to quantify the allele frequency in a population for better understanding of evolutionary changes and gene flow.

Module I: Classical Genetics and its deviations [10L]

Principles of Mendelian inheritance, multiple alleles, pseudoallele, Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and chromosome mapping, sex linkage, sex limited and sex influenced characters; sex determination, extra-nuclear inheritance, special types of chromosomes; structural and numerical chromosomal abnormalities and their genetic implications; pedigree analysis, lod score for linkage testing, linkage disequilibrium.

Mod-II: Mutation and Cancer Genetics [10L]

Gene Mutation: Induced and spontaneous mutation**,** mutation types, causes and detection, mutant types. Molecular basis of genetic disorders, karyotypes, inborn errors of metabolism. Cancer Genetics: genetic rearrangements in progenitor cells, oncogenes, proto-oncogenes, tumour suppressor genes – p53, RB and others, virus-induced cancer; cell cycle check points and cancer.

Module III: Microbial and Developmental Genetics [10L]

Methods of genetic transfers: transformation, conjugation, transduction and sex-duction. Gene mapping methods: interrupted mating, recombination and complementation analysis. Genetics of animal virus. Developmental genetics in Drosophila model: egg-polarity genes and formation of body axes; molecular control of segmentation: gap genes, pair-rule genes, segment polarity genes; homeotic genes, Wnt and cadherin pathways; cellular ageing & senescence.

Module IV: Biostatistics and Population Genetics [10L]

Biostatistics: Mean, median, mode, standard deviation, variance, discrete and continuous probability distributions, Poisson, normal and binomial distributions; T test, chi-square analysis, ANOVA. Population genetics: Hardy-Weinberg equilibrium, allele frequency and genotype frequency. Extensions of H-W equilibrium: mutation, selection, continuous variation, genetic drift, migration.

Textbook:

1. Concepts of Genetics, 7th edition. M.R. Cummings, A.W. Klug. Pub: Pearson Education.
2. Genetics, 3rd edition. M.W. Strickberger. Pub: Pearson Education.

Reference Books:

1. Introduction to Genetic Analysis, 8th edition, Anthony J. F. Griffiths, Jeffrey H. Miller, David T. Suzuki, Richard C. Lewontin, and William M. Gelbart. Pub: W.H. Freeman & Co.
2. Principles of Genetics, 5th edition. D. Peter Snustad, Arthur J. Simmons. Pub: John Wiley & Sons.
3. iGenetics: a Conceptual Approach, 3rd edition. Peter J. Russell. Pub: WH Freeman & Co.
4. Microbial Genetics, 2nd edition. Stanley R. Maloy, John E. Cronan, David Freifelder. Pub: Jones and Bartlett Publisher Inc.
5. Genetics: analysis of genes and genomes, 6th edition. D.L. Hartl & E.W. Jones. Pub: Jones and Bartlett Publishers.
6. An introduction to Human Molecular Genetics: Mechanism of Inherited Diseases. 2nd edition. J. Pasternak. Pub: Fitzgerald Science Press.
7. Developmental Biology, 10th edition. S.F. Gilbert. Pub: Sinauer Associates.
8. Introduction to Biostatistics, 2nd edition, Pranab Kumar Banerjee. Pub: S. Chand & Co.
9. Problems on Genetics, Molecular Genetics and Evolutionary Genetics. Pranab Kumar Banerjee. New Central Book Agency Pvt. Ltd.
10. Statistics in Biology and Psychology, 4th edition. Debajyoti Das, Arati Das. Academic Publishers.

Srabanti Basu

Course Name : Bioinformatics					
Course Code: BIOT3102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module 1: Bioinformatics Resources and Databases [10L]
Definition and application of bioinformatics to biological research; Introduction to different primary and secondary databases (viz: Genbank,PDB) introduction to different modules of NCBI

Module 2: Sequence Analysis of proteins and nucleic acids [10L]
Introduction to sequence analysis, Basic concepts: Sequence similarity, identity and similarity, definitions of homologues, orthologues, paralogues, Tandem and Interspersed repeats, local and global alignment, pair wise and multiple alignment, sequence alignment algorithm: Needleman - Wunsch and Smith-Waterman algorithms; Substitution Matrices; Introduction to phylogenetics analysis through multiple sequence alignment: CLUSTALW A brief introduction to gene prediction

Module 3: Perl Programming [10L]
Accessing and installing Perl and BioPerl , Using modules, like BioPerl. Sequences and Strings: Variables, Arrays, Files .Motifs and Loops-Flow control, String operators, Writing files. Subroutines –Scoping, Arguments, Command line arguments, passing data to subroutines, Modules and Libraries, Debugging. Data Structures and Algorithms for Biology-Hashes, Translating DNA into Proteins, Working with the FASTA Format, Reading frames. Regular Expressions.

Module 4: Protein structure prediction and drug designing [10L]
Hierarchical organization of protein structures-e.g.SCOP, CATH; Secondary structure prediction via Chou-Fasman , GOR and other methods; Hidden Markov Model and Neural network algorithms and their applications; 3D protein structure prediction using homology modeling, fold recognition and ab-initio methods; CASP; Drug design applications: Receptor-ligand interactions; binding sites, docking and virtual screening; Structure and Ligand Based drug design; QSAR and in silico predictions of drug activity and ADMET.

Textbook:

1. Xiong.J, Essential Bioinformatics, Cambridge University Press
2. An Introduction to Bioinformatics, Arthur W. Lesk, Cambridge University Press.
3. Bioinformatics-Principles and applications-Ghosh and Mallick- Oxford University Press.
4. James Tisdall, Beginning Perl for Bioinformatics, SPD

Reference books:

1. Cynthia Gibbs and Per Jambeck, Introduction to Bioinformatics computer Skills, 2001 SPD
2. Atwood, Introduction to Bioinformatics, Person Education
3. Baxevanis, A.D, Quellette. B.F.F, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.
4. Andrew Leach, Molecular Modelling: Principles and Applications,Pearson Education
5. Molecular Modelling and Drug Design-K.Anand Solomon-1st edition (2011)-MJP Publishers

Course Name : Recombinant DNA Technology					
Course Code: BIOT3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module -I: Tools of Recombinant DNA Technology [10L]

DNA & RNA manipulating enzymes and other tools used in Recombinant DNA technology: Restriction endonuclease; DNA polymerases (DNA Pol I, T4, T7, Taq), reversetranscriptases, DNA ligases; alkaline phosphatases; polynucleotidekinase; terminal deoxy-nucleotidetransferase; topoisomerases; DNase; RNase and others; linker and adapter. Physical map, specific host and features of Vectors: Plasmids, bacteriophage vectors, cosmids, phagemids, PAC, BAC, YAC, and MAC, Expression vectors (pET vectors, Baculovirus vectors and others).

Module -II: Techniques Recombinant DNA Technology: [10L]

DNA and RNA labeling (radioactive and non radioactive methods); Restriction mapping; DNA sequencing (Maxum & Gilbert, Sangers, pyro-sequencing, and others methods); Protein and RNA sequencing; Polymerase chain reactions (PCR), different modified PCR and Real time PCR; Techniques of separation of nucleic acid and protein (electrophoresis, chromatography and others); Southern, northern, and western blotting & hybridization; In-situ hybridization; Site-directed mutagenesis; DNA and protein based microarray.

Module -III: Gene Cloning Methods: [10L]

Isolation and preparation of DNA fragments from prokaryotic and eukaryotic source; Different types of cloning and expression methods of gene in prokaryotic and eukaryotic host cell system using different vectors (by restriction enzyme, PCR product cloning and other methods); Transfer of recombinant DNA into host; Screening & Expression of cloned gene; Gene isolation; Subcloning strategies; Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors and their screening.

Module - IV: Application of Recombinant DNA technology [10L]

Genetically engineered vaccine; DNA vaccine; recombinant Biopharmaceuticals (insulin, human growth factor and others); Gene therapy (gene transfer technologies, antisense and ribozyme technology); Molecular biomarker in disease diagnostics and forensic science (RFLP, RAPD, AFLP SNP, EST and others), DNA fingerprinting; Human genome project (strategies for genome sequencing and its application); Genetically modified organism and food; Large scale gene expression analysis.

Srabanti Basu

Textbook:

1. Principles of Gene Manipulation& Genomics, 7th Ed, (2006) Old and Primrose, Pub: Blackwell Scientific.

2. Genetic Engineering by S. Rastogi and N. Pathak, Pub: Oxford Univ. Press.

3. Molecular Cloning: A Laboratory Manual (3-volume set 4th Edn.): (2012) by Michael R. Green, Joseph Sambrook , Pub: CSHL press

Reference books:

1. Molecular Biotecnology: Principles and Applications of Recombinant DNA, 4th Edn. (2010) by Glick, Pasternak and Pattern. Pub: ASM press
2. Recombinant DNA: Genes and Genomes - A Short Course, 3rd Edn. (2007) by James D. Watson, Richard M. Meyers , Amy A. Caudy, Jan A. Witkowski. pub: CSHL
3. H.K. Das, Text Book of Biotechnology, 4th ed, 2010, Wiley Publishers
4. Genetics a Molecular Approach, 7th Ed (2010) by Brown, T.A., pub: Chapman and Hall,
5. Genomes, 3rd ed (2006) by Brown TA, Pub: Garland Science
6. Human Molecular Genetics, 4th Ed. (2011) by Tom Strachan, Andrew Read**,** Pub: Garland Science

Course Name : Transfer Operations - II					
Course Code: BIOT3104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

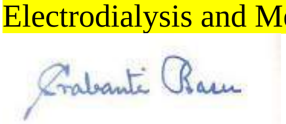
Course Outcomes:
After completing the course, the students will be able to:
1. Understand the concept of diffusion and diffusivity and identify the type of diffusion in a given problem and solve it.
2. Determine gas-liquid mass transfer coefficient in a wetted wall column or packed bed absorption column and calculate the number of stages required for the unit operation.
3. Apply McCabe-Thiele Method and Rayleigh's equation as required in a distillation process.
4. Comprehend different other unit operations like adsorption, liquid-liquid extraction and crystallization explicitly.
5. Draw the drying characteristic curve under a given constant drying condition.
6. Study and apply the principle and operation of different advanced separation processes like dialysis, ultrafiltration, reverse osmosis, pervaporation and electrodialysis in the field of biotechnology.

Module I: Introduction to Mass Transfer [10L]
Introduction to Mass Transfer: Molecular diffusion in fluids. Diffusivity, Mass Transfer Coefficients, Interphase
Mass Transfer, Gas Absorption, co-current and counter-current multistage operation, Packed Tower, Drying, adsorption and Leaching principles

Module II: Distillation [10L]
Distillation: Vapor-liquid equilibrium, Rayleigh's Equation, Flash and Differential distillation, McCabe-Thiele Method to determine stages

Module III: Miscellaneous Mass Transfer Operations [10L]
Liquid–liquid equilibrium. Liquid extraction, Stagewise contact; Adsorption Equilibria: batch and fixed bed adsorption, Batch drying and mechanism of batch drying. Freeze drying, Basic idea of crystallization

Module IV: Advanced Separation Processes [10L]
Advanced Separation Processes: Dialysis, Ultrafiltration, Reverse osmosis, Pervaporation, Electrodialysis and Membrane separation- Principle and operation



Textbook:
1. Unit Operations of Chemical Engineering: McCabe,Smith & Harriot, TMH, 5thedition

Reference books:
1. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition

Course Name : Immunology					
Course Code: BIOT3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completing the course, the students will be able to:

1. Understand the basic principles of innate and adaptive immunity and the underlying mechanisms of cellular and humoral immune responses.
2. Develop an idea about strcuture, biogeensis, function and molecular diversity of different antibody classes.
3. Apply the techniques of antibody engineering and antigen-antibody reactions in disease diagnostics and research.
4. Analyze the role of MHC molecules in transplantation and the diseases due to their incompatibility.
5. Understand the immunological basis of hypersensitivity, autoimmunity and immunodeficiency disorders.
6. Gain knowledge about different approaches of vaccine development and their applications in human diseases.

Module 1: Basics of Immunology [10L]

History and evolution of immune system; innate and acquired immunity, hematopoiesis;
humoral and cell-mediated immunity; cells of the immune system; complement system: activation pathways, functions and regulation; primary and secondary lymphoid organs: structure and function; concept of epitope, immunogens, haptens, adjuvants;
B and T cells: maturation, activation and differentiation; organization and rearrangement of TCR genes; macrophage and other Antigen Presenting Cells (APCs).

Module II: Antibodies: structure, functions and applications [10L]

Structure and function of antibody classes, concept of isotype, allotype and idiotype;
genetic basis of antibody diversity: DNA rearrangements, somatic hypermutation, class switching, allelic exclusion; antibody engineering; phage display libraries; antibodies as *in vitro* and *in vivo* probes, abzymes; primary and secondary immune response; monoclonal antibody: hybridoma technology and applications, recombinant and chimeric antibodies, humanized and bispecific antibodies, immunotoxins; antigen-antibody reaction and its application; immunoelectrophoresis, Immunodiffusion, RIA and ELISA.

Module III: Major Histocompatibility Complex (MHC) and host-graft reactions [10L]
General organization, structure and functions of MHC molecules; antigen processing and presentation; transplantation immunology: graft versus host reaction, HLA typing, immunosuppressive therapy; development of inbred mouse strain, blood group classification and Rh factor; cytokines and other co-stimulatory molecules.

Module IV: Immune tolerance, immune disorders and vaccinology [10L]
Immune tolerance: T cell anergy and T cell elimination; hypersensitivity reactions; autoimmunity with respect to Myasthenia gravis and Rheumatoid arthritis; immunodeficiency, animal models for disease study; tumour immunology: tumour antigens, tumor vaccines and immunotherapy; active and passive immunization: live, killed, attenuated, sub-unit vaccines; vaccine technology: recombinant DNA and protein based vaccines, plant-based vaccines; reverse vaccinology; peptide vaccines, conjugate vaccines.

Text books:

1. Immunology and Immune Technology by A. Chaktraborty, Oxford Univ. Pub.
2. Weir, Immunology, 8th ed, W.B. Saunders & Co.

Reference books:

1. Kuby Immunology, 6th edition. T. Kindt, R. Goldsby, B. Osborne. Pub: W.H. Freeman & Co.
2. Immunology, 7th edition. D. Male, J. Brostaff, D. Roth & I. Roitt, I. Pub: Mosby.
3. Cellular and molecular Immunology, 6th edition. .A.K. Abbas, A.H. Lichtman, S. Pillai. Pub: Saunders.
4. Fundamental Immunology, 7th edition. William E. Paul. Pub: Lippincott Williams & Wilkins.
5. Technological Applications of Immunochemicals (BIOTOL). L.S. English. Pub: Butterworth- Heinemann, Oxford Freeman & Co.
6. Immunology. C.V.Rao. Pub: Narosa Publishing House, New Delhi.
7. Janeway's Immunobiology, 7th edition. K. M. Murphy, P. Travers, M. Walport. Pub: Garland Science.
8. Immunology: An Introduction. Tizard. Pub: Cengage Learning India (P) Limited.

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<table>
<tr><td colspan="6">Course Name : Plant Biotechnology</td></tr>
<tr><td colspan="6">Course Code: BIOT 3211</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
</table>

Course Outcomes:

On completion of the course, students will be able to:

1. Explain the basic concepts of plant tissue culture and its application of numerous techniques.
2. Interpret how various plant biochemical metabolic pathways work in the plant system and relate them with medicinally important bioactive compounds.
3. Understand basic molecular biological aspects of plant by studying the structure and organization of plant genome
4. Describe the molecular biological techniques of gene transfer to plants.
5. Understand concept of raising transgenic plants
6. Impart knowledge on all recent biotechnological developments related to GMO through quality improvement of crops.

Module I: Plant tissue culture – theory and methods [10L]

Propagation of plant tissue and cells under *in vitro* condition, Totipotency. Role of physico-chemical conditions and hormone requirement for propagation of plant cells and tissues . Mode of action of auxin and cytokinin. Micropropagation via axillary and adventitious shoot proliferation, somaclonal variation and haploid culture, protoplast culture, cybrids. Plant breeding and heterosis. Green revolution in India.

Module II: Mass cultivation of plant cell products: [10L]

Basic strategies and factors for secondary metabolite production, Immobilisation technology for yield enhancement , bioreactor system and models for mass cultivation of plant cells. Biotransformation for product development and selection of cell culture (only plant tissue culture products).

Module III: Structure and organization of plant genome [10L]

Structure, function and assembly of genetic material, regulation of plant genome expression at each step: Chromosome assembly, transcriptional, translational and post transcriptional regulation, protein localization and turnover; Basic structure of chloroplast and mitochondrial genome; rubisco synthesis and assembly. Transposon. (Arabidopsis should be taken as the model for study of plant genome).

Module IV: Plant genetic engineering[10L]

Direct and indirect methods of transgene incorporation; Design of plant expression vectors: Promoters, Plant selectable markers; Reporter genes; Ti-based binary vector system. Agrobacterium mediated gene delivery, Biolistic method. Transgene silencing and strategies to avoid transgene silencing, Chloroplast transformation, Targeted gene delivery and methods of detection.

Theory and techniques for the development of transgenic plants conferring resistance to herbicide (Glyphosate, Basta), pesticide (Bt gene), plant pathogens PR-Proteins. Plant engineering towards development of enriched food products – Golden rice, therapeutic products.

Textbooks:

1. Plant Biotechnology: The Genetic Manipulation of Plants,Slater.A., Nigel W.S,Flower. R.Mark , 2009, Oxford Univesity Press.
2. Comprehensive Biotechnology Ramawat.K.G. ,Goyal, S. 2009, S.Chand & Company, New Delhi

Reference books:

1. Biochemistry and Molecular Biology of Plants Buchaman, Gursam, Jones, , 1ed, 2000, L.K.International.
2. Plant Tissue Culture: Theory and Practice Bhozwani and Razdan –1996 Elsevier
3. In vitro Cultivation of Plant Cells, Butterworth & Heineman, Biotol Series.
4. Tissue culture and Plant science, H.E Street(ed) Academic press, London, 1974
5. Tissue and Organ Culture, Gamborg O.L.,.Phillips G.C, Plant Cell, Narosa Publishing House
6. Text Book of Biotechnology Das.H.K. -First Edition 2004, Wiley Dreamtech.

Course Name : Bioreactor Design and Analysis					
Course Code: BIOT3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completing the course, the students will be able to:

1. Develop basic concept of reaction engineering.
2. Understand basic concepts of bioreactor design and analysis.
3. Understand the basic operating principles of bioreactors.
4. Interpret batch reactor data with reference to basic reactor design for a single reaction ideal reactor.
5. Analyze non-ideal flow pattern with reference to residence time distribution (RTD) and dispersion numbers (D/UL)
6. Analyze basic cell growth data to verify Monod model.

Module I: Basic reaction and microbial growth kinetics [10L]

Sterilization of air and media, Microbial growth and product kinetics: Monod equation, Chemostat, Dimension-less numbers and their importance in reactor operation.

Transport Phenomenon in Bioreactor: Role of dissolved oxygen concentration in mass transfer,Determination of mass transfer coefficient (K_La); Factors effecting K_La and their relationship.

Module II: Ideal Bioreactor [10L]

Overview of Chemical Reaction Engineering, Kinetics of homogenous reactions, Elementary Reactions. Molecularity and Order of reaction.

Introduction to batch reactor data –Different methods of analysis of data, Autocatalytic reactions, Reversible reaction, Differential method of analysis of data,Parallel and multiple reaction.Ideal batch, mixed flow and plug flow reactors and their analysis.

Module III: Non-ideal Bioreactors [10L]

Basics of non-ideal flow: Residence time distribution (RTD), Age distribution of fluids: C, E and F curve, experimental method and their relations,

Dispersion model:its significance and analysis.

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<table>
<tr><td colspan="6">Course Name : Molecular Modeling & Drug Designing</td></tr>
<tr><td colspan="6">Course Code: BIOT3241</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
</table>

Module I: Molecular Modeling: (**10L**)

Useful concept in molecular modeling; molecular simulation techniques-Monte Carlo methods-Metropolis Monte Carlo algorithm, types of Monte Carlo algorithm, flow calculations in Metropolis Monte Carlo algorithm with examples; molecular dynamics and simulations- basic concepts including the integration of dynamical Equations; structural information from molecular dynamics, Monte Carlo calculation and energy minimization methods.

Module II: Molecular Mechanics: (**10L**)

Introduction to Molecular mechanics, intra molecular interactions; physicochemical parameters in drug design: hydrophobicity, electronic effect, ionization constants, chelation, solubility and partition co- efficient; over view of molecular descriptors.

Module III: Drug Discovery, Design and Development: (10L)

Introduction to diseases, drugs and drug targets; pharmacodynamics and pharmacokinetics of drug**,** rational basis of drug designing, criteria for synthesizing drugs; types of drug designing: ligand based drug design, structure based drug design, lead optimization, receptor based design and other methods;case studies.

Module IV: Tools for Drug Design: (10L)

Overview of computer based tools for drug designing- Ludi, Ludi/CAP, Autodock, GRAMM, CAMD tools; Force fileld and types of force fields; protein-protein, protein-nucleic acid, protein-ligand interaction with example; types of scoring functions, scoring and docking mode; QSAR principles and methods in drug designing; current research in drug designing- a case study.

Textbooks:

1. Molecular Modeling Principles and application, 2nd edn. (2001) by A. Leach. Pub: Pearson

2. Introduction to Medicinal Chemistry (2013) by G. L. Patrick, Pub: OUP

Reference books:

1. Biopharmaceuticals-Biochemistry and Biotechnology 2nd edn. (2003) G.Walsh, pub: Wiley
2. Drug Discovery and Design (2001) by Scolnick. J.; pub: Academic Press,
3. Guidebook on Molecular Modeling in Drug Design (1996) by N. R. Cohen, Editor. Pub:AP,
4. Text Book of Drug Design and Discovery 3rd edn. (2002) by Liljefors, Krogsgaard,-Larsen pub: CRC press.

Course Name : Biophysics of Macromolecules					
Course Code: BIOT3242					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

After completing this course, students will be able to

1. Describe the structure of different macromolecules.
2. Elucidate structure-function relations of enzymes
3. Explain the interactions of macromolecules.
4. Illustrate the thermodynamics and kinetics of macromolecular transition.
5. Describe the spectroscopic techniques for biomolecular structural analysis.
6. Explain the working principle of some non-spectroscopic techniques for structural analysis.

Module1: Fundamental interactions in macromolecules [10L]

Introduction to biophysics, strong and weak interactions in biomolecules: electrostatic and Van der Waal's interaction, hydrogen bonding, hydrophobic Interactions. Conformation and configuration of biomolecules. Structural characteristics of α-helix, β-sheet and β-turn, supersecondary structure, Protein domains and domain architecture. Tertiary structure: effect of amino acids on the structure of proteins. Quaternary structure of proteins. Conformation of nucleic acids: Structural characteristics of A, B and Z-DNA. 3D structure of t-RNA, ribozymes and riboswitches.

Module 2: Thermodynamics and kinetics of macromolecular transitions [10L]

Energy status of a protein molecule, denaturation and renaturation of proteins and DNA, helix coil transformation of proteins and DNA: kinetic study, Melting of helices: thermodynamics of melting / denaturation of alpha helix and DNA double helix, Cooperativity of melting of helices. Structure-function relations of enzymes, allosteric enzymes. Changes in nucleic acid structures during biochemical processes.

Module 3: Spectroscopic techniques for biomolecular structural analysis [10L]

Basic concepts of absorption spectroscopy, UV/visible, IR and FTIR spectroscopy, circular dichroism spectroscopy, NMRS; Emission spectroscopy - luminescence, phosphorescence and fluorescence, quenching, FRET and fluorescence lifetime measurements.

Module 4: Non-spectroscopic techniques for structural analysis

Methods for study of biomolecule structure and surface morphology: X-ray diffraction and X-ray crystallography, and electron microscopy (SEM and TEM), MS, Surface Plasma Resonance Method.

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Course Name : Biosensors and Diagnostics					
Course Code: BIOT3243					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: Introduction to biosensor [10]
Biosensor: Principle, General Characteristics, Advantages and its limitations. Classification of biosensors based on bioreceptor. Immobilization and coupling of bioreceptors. Enzyme Biosensor: Principle, kinetics and its response to different types of inhibitors.

Module II: Bio-recognition element based sensors [10]
Principle, Operation and Limitation of: Microbial sensor, Immunological sensor, Nucleic acid sensor. Other bioreceptors (e.g. animal, plant tissue)

Module III: Biosensor based on transducer [10]
Classification of biosensor based on transducer. Principle, Construction, Calibration and Limitations of Calorimetric, Electrochemical (potentiometric, amperometric), Optical, Piezoelectric, Semiconductor biosensor etc.

Module IV: Application of biosensor [10]
Clinical and diagnostics sector, Industrial sector: Food, Environmental, defense sector and others. Commercially available biosensor.

Reference books:

1. Biosensors by Tran Minh Canh. London. Chapman and Hall, 1993.
2. Turner, A.P.F, Karube.I.,and Wilson,G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.
3. Engineering biosensors, kinetics and design applications by Ajit Sadana..San Diego, Academic Press, 2002.
4. D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.

ourse Name : Biofertilizers and Biopesticides					
Course Code: BIOT3244					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completing this course, students will be able to :

1. Explain the role of beneficial microbes in sustainable agriculture.
2. Gain knowledge on isolation and identification of nitrogen fixing bacteria.
3. Role of phophate solubilizing bacteria.
4. Understand molecular biology of nitrogen fixation.
5. Understand the importance of biopesticides over chemical pesticide.
6. Isolate and identify biopesticides for increased agricultural productivity.

Module-I Biofertlizers in agriculture [10L]

Definition of bio-fertilizers; composition and nutritional role based classification of different bio-fertilzers viz., composts – vermicompost and nitrogen fixers; basic knowledge and procedure of bacterial, fungal and composite bio-fertilizer production; role of *Azola, Tichoderma Cianobacteria, Trichogramma* in bio-fertilization; importance of bio-fertilizer used in agriculture; knowledge of bacterial and fungal suspensions as inocula and their preparations.

Module-II Biological nitrogen fixation [10L]

Basic outline of processes, characteristics and significance of biological nitrogen fixation (BNF) and phosphate solubilizing bacteria/ micro organisms (PSB and PSM) functioning; outline of biological nitrogen fixation from biochemical and biological points of view with special reference to different enzymes and other key role players; biological and biochemical process of symbiosis in nitrogen fixation by *Rhizobium* sp. with legume plants and others.

Module-III Molecular Biology of symbiotic Nitrogen fixer [10l]

Biological and biochemical process of symbiosis in nitrogen fixation by *Rhizobium* through root nodulation process and nitrogen fixation by it.

Brief concept of nod genes and nitrogen fixing genes (nif genes) --- their organization and role in the different steps of biological nitrogen fixation. Rhizosphere engineering.

Module-IV Biopesticides [10l]

Use of chemical pesticides and environmental effects, Definition and importance of biological pests and bio-pesticides in agriculture.

Brief conception of Integrated Pest Management (IPM), Integrated Pest and Disease Management (IDPM).

Advantages of bio-pesticides over chemical pesticides and developing them.

Types of Bio-pesticides with special reference to protein with anti-pest activity; gene from *Bacillus thuringenensis* and its proteins as biopesticide

Textbook

1. Stacey, Burris and Evans (ed), Biological Nitrogen Fixation, Chapman & Hall, 1992

References :

1. J K Ladha, M B Peoples, Management of Biological Nitrogen Fixation for the Development of More Productive and Sustainable Agricultural Systems, Springer.
2. P.S. Nutman, Symbiotic Nitrogen Fixation in Plants, Cambridge University Press
3. Sushil K Khetan, Microbial Pest Control, Marcel Dekker
4. Opender Koul, G S Dhaliwal, Microbial Biopesticides, Taylor & Francis

Subject Name: ANALYSIS OF STRUCTURES II

Subject Code: CIVL 3101

Contacts: 3L+1T

Credit: 4

Course Outcome:

On completion of the course, the students will be able to:

1. Apply the Slope Deflection and Moment Distribution Method to analyze indeterminate structures.
2. Develop and analyze the concept of suspension bridge and stiffness girders
3. Apply and analyze the concepts of curved beam analysis in hooks, rings and Bow girders.
4. Develop the concept bending in unsymmetrical beams.
5. Develop the fundamental concepts of plastic analysis using kinematic method and apply them in frames and continuous beam analysis.
6. Develop and analyze the portal frames using Portal and Cantilever method. Develop and analyze the indeterminate structures (continuous beams and frames) using flexibility and stiffness matrix method.

Sl. No.	Module	Details of Course content	Hours	Total
1.	I	Analysis of statically Indeterminate Structures: Moment distribution method-solution of continuous beam, effect of settlement and rotation of support, frames with or without side sway. Slope deflection method: method and application in continuous beams and frames. Suspension Bridge and stiffening girders.	6 4 2	42
2.	II	Curved Beam analysis: Hooks, rings and Bow girders. Unsymmetrical bending.	12	
3.	III	Plastic analysis of structures: beams and portal frames.	8	
4.	IV	Approximate method of analysis of structures: Portal and Cantilever methods. Matrix methods of structural analysis – Stiffness and flexibility approaches for analysis of beam.	4 6	

Text & References:

Sl.No	Name	Author	Publishers
1.	Basic Structural Analysis	C.S.Reddy	Tata Mc. Graw Hill
2.	Statically Indeterminate structures	C.K.Wang	Mc.Graw Hill
3.	Structural Analysis-A unified Classical and matrix approach.	A. Ghali and A.M. Neville	E & FN SPON
4.	Theory of structure	Timoshenko and Wang	Tata McGraw Hill

Subject Name: SOIL MECHANICS II

Subject Code: CIVL 3102

Contacts: 3L+1T

Credit: 4

Course Outcome:

After going through this course, the students will be able to:

1. Assess the compaction and consolidation characteristics of soil for solving geotechnical problems.
2. Calculate earth pressure on rigid retaining walls on the basis of classical earth pressure theories.
3. Analyze and design rigid retaining walls (cantilever types) from geotechnical engineering consideration.
4. Evaluate the bearing capacity of shallow foundation by applying established theory.
5. Estimate settlement in soils by different methods.
6. Compute safety of dams and embankments on the basis of various methods of slope stability analysis.

Sl. No.	Module	Details of Course Content	Hours	Total
1.	I	**Compressibility & Consolidation of Soil :-** Terzaghi's theory of one dimensional consolidation, Compressibility characteristics of soils, Compression index, Coefficient of compressibility and volume change, Coefficient of consolidation, Degree and rate of consolidation, Time factor, Settlement computation, Consolidometer and laboratory one dimensional consolidation test as per latest IS Code, Determination of consolidation parameters. **Compaction of Soil: -** Principles of compaction, Standard and modified proctor compaction test, Field compaction methods, Field compaction control, Factors affecting compaction, Effect of compaction on soil properties.	12	41
2.	II	**Earth Pressure Theories :-** Plastic equilibrium of soil, Earth pressure at rest, Active and passive earth pressures, Rankine's and Coulomb's earth pressure theories, Different types of backfill, Wedge method of analysis. Analytical and graphical methods for determination of earth pressure against various earth retaining structures. **Stability of retaining walls:** Cantilever retaining wall.	10	
3.	III	**Bearing capacity of shallow foundations :-** Bearing capacity, Definition, Factors affecting bearing capacity, Modes of failures, Methods of determining bearing capacity of soils. Terzaghi's bearing capacity theory, Effect of depth of embedment, Eccentricity of load, Foundation shape on bearing capacity, Effect of	11	

Tapas Sadhu

		water table and eccentric loads. Isolated footings with combined action of loads and moments, Bearing capacity as per IS: 6403.		
4.	IV	**Settlement:-** Allowable bearing pressure and settlement analysis (as per IS: 8009), Immediate and consolidation settlements, Rigidity and depth factor corrections, Settlement values as per IS: 1904 recommendations. **Stability of slopes :-** Types of failure, Analysis of finite and infinite slopes, Swedish and friction circle method, Ordinary method of slices, Factor of safety, Taylor's stability number, Bishop's simplified method of stability analysis.	8	

RECOMMENDED BOOKS:-

TEXT BOOKS:	
Sl. No.	Name
1.	Murthy, V.N.S., *Textbook of Soil Mechanics and Foundation Engineering* (Geotechnical Engineering Series), CBS Publishers and Distributors Pvt. Ltd.
2.	Punmia, B.C. and Jain A.K., *Soil mechanics and Foundations*. Laxmi Publications (P) Ltd.
3.	Das, B.M., *Principles of Geotechnical Engineering*, Thomson Brooks / Cole
4.	Gopal Ranjan & A.S.R. Rao, *Basic and Applied Soil Mechanics*, New Age International Pvt.Ltd, Publishers

REFERENCE BOOKS:	
Sl. No.	Name
1.	Lambe, T. W. and Whitman, R.V., *Soil Mechanics*, Wiley Eastern Ltd.
2.	Rao, A.V. and Venkatramaiah, R.C., *Numerical Problems - Geotechnical Engineering*, University press.
3.	Terzaghi, Peck and Mesri, *Soil Mechanics in Engineering Practice*, Wiley-Interscience.
4.	Alam Singh, Soil Engineering in Theory & Practice (Vol.1, 2 & 3), Jain Book Agency Publishers.

Subject Name: HIGHWAY & TRAFFIC ENGINEERING
Subject Code: CIVL 3103
Contacts: 3L+1T
Credit: 3

Course Outcome:

At the end of the course, the student will be able to:

1. Remembering the highway development in India including understanding the highway planning surveys & alignment.
2. Design highway geometrics.
3. Understanding the component parts of flexible and rigid pavement including the importance of soil & bitumen as pavement material.
4. Analyze and design flexible and rigid pavement (IRC Method).
5. Understand the principles of construction, maintenance and safety of highways.
6. Conduct traffic studies, analyze traffic data and design intersections including traffic signal and analyze parking & accidents.

SL. No	Module	Details of Course Contents	Hours	Total
1.	I	**Highway Network Planning**: Different modes of transportation, Role & Development of highway transportation, Classification, Network patterns, Planning surveys, Evaluation by saturation system, Introduction to highway economics.	2	42
		Highway Alignment: Factors controlling alignments, Principles of highway alignment, engineering surveys for highway alignment and location.	2	
		Highway Geometric Design: Importance of geometric design, design controls, pavement cross-sectional elements, PIEV theory, Sight distance, Design of horizontal alignments, Design of vertical alignments, Geometric Design of Hill Roads.	8	
2.	II	**Pavement Materials**: Types and component parts of pavement and their functions, highway and airport pavement materials, basic soil & aggregate properties relevant to pavement application, basic properties of bitumen and tar, Modified Bitumen (PMB, CRMB) tests on pavement materials, Use of geo-synthetics.	4	
		Design of Pavements: Design factors, classification of axle types, contact pressure, EWLF & ESAL concept, Traffic analysis: vehicle damage factor.		
		Flexible Pavement Design: Design of flexible pavements (GI method, CBR method, Triaxial method - only introduction), IRC method of design.	8	
		Rigid Pavement Design: Design considerations, Westergaard's theory and assumptions, Design of dowel and tie bars, Joints in Rigid Pavements, IRC method of design.		

3.	III	**Highway Construction**: Construction of earth roads, gravel roads, WBM roads, Cement Concrete Pavements, Bituminous pavements. **Highway Maintenance**: Pavement failures, causes of failure, routine and periodic maintenance of highways. **Highway Drainage**: Importance of highway drainage, surface and sub-surface drainage, drainage of slopes and erosion control, road construction in water logged areas. **Highway Safety**: Introduction to highway safety, accident characteristics and factors, accident recording and analysis, road safety audit, safety education, traffic law enforcement, elements of highway safety management system, road safety management system.	2 2 2 2	
4.	IV	**Traffic Engineering**: Introduction, road users and vehicle characteristics, microscopic and macroscopic flow characteristics, time headways, interrupted and un-interrupted traffic, speed and travel time variation, travel time and delay studies, flow and density measurement techniques, highway capacity and level of service, level of service estimation, traffic signs. **Traffic Signal Design and Design of at grade Intersections**: Signal phasing, cycle length, fixed and vehicle actuated signal, Webster method, IRC method, signal co-ordination and problems on signal design, types of intersections, rotary and round-about, design aspects. **Parking and Accident Analysis**: Parking inventory study, on street and off street parking facilities, introduction to Intelligent Transport System, accident characteristics, accident recording and analysis.	4 4 2	

RECOMMENDED BOOKS:

TEXT & REFERENCE BOOKS	
Sl. No.	**Name of the books**
1.	High Way Engineering, Khanna& Justo, Nemchand& Brothers, Roorkee
2.	Principles of Transportation Engineering, P. Chakraborty& A. Das - PHI
3.	Transportation Engineering- C.J Khisty& B.K Lall., PHI
4.	Kadiyali L.R. Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India, 1997
CODES FOR REFERENCE	
Sl. No.	**Name of the Codes**
5.	I.S Specifications on Concrete , Aggregate & Bitumen Bureau of Indian Standard
6.	Relevant latest IRC Codes (IRC-37 – 2001, IRC-37 – 2012, IRC 58 – 2011, IRC 73 - 1980, IRC 86 - - 1983, IRC 106 – 1990, IRC 64 – 1990, IRC 15-2002 - Indian Road Congress

Subject Name: ENVIRONMENTAL ENGINEERING

Subject Code: CIVL 3104

Contacts: 3L+1T

Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Identify the nature and quality of water & waste water as per its characteristics like physical, chemical & biological.
2. Estimate the future water demand by using various population forecasting methods.
3. Define & design in detail about the various water treatment units.
4. Define & design in detail about the various waste water treatment units.
5. Estimate the quantity of sewage produced and design the sewerage system.
6. Analysis and design of water distribution networks.

SL. No.	Module	Details of Course Content	Hours	Total
1	I	**Water Quality Parameter:** Physical and Chemical water quality parameters; Sources, impacts and methods of measurement	7	40
2	II	**Water Demand:** Per capita demand; Variations in demand; Factors affecting demand; Design period; Population Forecasting Methods. **Sources of water**: Surface and ground water. **Water Distribution:** Analysis of pipe networks by Hardy Cross Method, Storage and distribution of water; Estimation of reservoir capacity. **Water Treatment :** Typical flow chart for ground and surface water treatments; Unit Processes- Aeration, Plain sedimentation, coagulation & flocculation, Water Softening, Filtration, Disinfection.	15	
3	III	**Conveyance of Waste Water:** Definition of Common Terms, Quantity of sewage and storm sewage. **Sewer Design:** Hydraulic design of sewers, Analysis of partial flow diagrams and Nomograms.	8	
4	IV	**Wastewater Quality Parameters:** Physical, chemical and biological. **Wastewater treatment:** Typical flow chart for municipal wastewater treatment; Primary, Secondary & Tertiary Treatments: Unit Processes- Activated Sludge Process, Trickling Filter Process, Septic Tank, Advance Methods of Wastewater treatment.	10	

RECOMMENDED BOOKS:-

1. Water Supply & Sanitary Engineering. G. S. Birdie, Dhanpat Rai Publishing CO.
2. Environmental Engineering by P.V. Rowe, McGraw-Hill
3. Wastewater Engineering by Metcalf & Eddy, McGraw-Hill
4. Environmental Engineering, N. N. Basak, McGraw-Hill
5. Water Supply Engineering by Santosh Kr Garg, Khanna Publishers
6. Wastewater Engineering by B.C. Punmia & A.K. Jain, Laxmi Publications

Subject Name: DESIGN OF R.C.C. STRUCTURES
Subject Code: CIVL 3105
Contacts: 3L+1T
Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Understand material properties and design methodologies for reinforced concrete structures.
2. Assess different type of loads and prepare layout for reinforced concrete structures.
3. Identify and apply the applicable industrial design codes relevant to the design of reinforced concrete members.
4. Analyse and design various structural elements of reinforced concrete building like beam, slab, column, footing, and staircase.
5. Assessment of serviceability criteria for reinforced concrete beam and slab.
6. Prepare structural drawings and detailing and produce design calculations and drawing in appropriate professional format.

SL. No	Module	Syllabus	Hours	Total
1	I	**Introduction:** Principles of Design of Reinforced Concrete Members - Working Stress and Limit State Method of Design	2	42
		Basic concepts of Balanced, Under-reinforced and Over-reinforced Beam section by Working Stress Method and Limit State Method	1	
		Working Stress Method of Design: Analysis and Design of Beams and Columns.	4	
		Limit State Method of Design: Basic Concepts and IS Code Provisions (IS: 456 2000) for Design against Strength and Serviceability Limit States. Concepts of bond stress and development length; Use of 'design aids for reinforced concrete' (SP: 16).	4	
2	II	**Analysis, design and detailing** of singly reinforced rectangular, 'T', 'L' and doubly reinforced beam sections by limit state method.	5	
		Design and detailing of one-way and two-way slab panels as per IS code provisions	3	
		Design and detailing of continuous beams and slabs as per IS code provisions	3	

3	III	**Staircases:** Types; Design and detailing of reinforced concrete doglegged staircase	2	
		Design and detailing of reinforced concrete short columns of rectangular and circular cross-sections under axial load.	4	
		Design of short columns subjected to axial load with moments (uniaxial and biaxial bending) – using SP 16.	4	
4	IV	**Design and detailing** of reinforced concrete isolated square and rectangular isolated and combined footing for columns as per IS code provisions by limit state method	6	
		Design and detailing of Pile foundation as per IS code provisions.	4	

RECOMMENDED BOOKS:-

CODES:

1. IS: 456 - 2000
“Indian Standard for Plain and reinforced concrete – code of practice” Bureau of Indian Standard
2. SP: 16 Design Aid to IS 456

TEXT BOOKS:

1. Reinforced Concrete Design by Pillai and Menon
2. Reinforced concrete Design by S.N.Sinha
3. Limit State Design of Reinforced Concrete by P. C. Varghese

REFERENCE BOOKS:

1. Fundamental design of Reinforced concrete by N.C.Sinha & S.K. Roy

Subject Name: SOIL MECHANICS LAB I
Subject Code: CIVL 3111
Contacts: 3P
Credit: 2

Course Outcome

After going through this course, the students will be able to:

1. Identify different types of soil by visual inspection.
2. Determine natural moisture content and specific gravity of various types of soil.
3. Estimate in-situ density by core cutter method and sand replacement method.
4. Analyze grain size distribution and Atterberg limits for soil.
5. Perform laboratory tests to determine permeability and compaction characteristics of soil.
6. Prepare technical laboratory report.

List of Experiments:

1. Field identification of different types of soil as per Indian Standards [collection of field samples and identifications without laboratory testing].
2. Determination of natural moisture content.
3. Determination of specific gravity of cohesionless and cohesive soils.
4. Determination of in-situ density by core cutter method and sand replacement method.
5. Determination of grain size distribution by sieve and hydrometer analysis.
6. Determination of Atterberg limits (liquid limit, plastic limit and shrinkage limit).
7. Determination of co-efficient of permeability by constant and variable head permeability tests.
8. Determination of compaction characteristics of soil by standard proctor compaction test.

REFERENCES:

1. Soil Testing by T.W. Lamb (John Willey).
2. SP: 36 (Part - I and Part - II).
3. Soil Mechanics Laboratory Manual by Braja Mohan Das (Oxford university press).

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Subject Name: CONCRETE TECHNOLOGY LAB
Subject Code: CIVL 3112
Contacts: 3P
Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Outline the importance of testing of cement and its properties
2. Assess the different properties of aggregate
3. Summarize the concept of workability and testing of concrete
4. Describe the preparation of fresh concrete
5. Describe the properties of hardened concrete.
6. Develop mix design of concrete as per provision of the IS Codes.

List of Experiments:

1. **Tests on cement** – specific gravity, fineness, soundness, normal consistency, setting time, compressive strength on cement mortar cubes.
2. **Tests on fine aggregate** – specific gravity, bulking, sieve analysis, fineness modules, moisture content, bulk density and deleterious materials.
3. **Tests on coarse aggregate -** specific gravity, sieve analysis, fineness modulus and bulk density.
4. **Tests on Fresh Concrete**: Workability: Slump, Vee-Bee, Compaction factor tests.
5. **Hardened Concrete**: Compressive strength on Cubes, Split tensile strength, Static modulus of elasticity, Flexure tests, Non destructive testing (Rebound hammer & Ultrasonic pulse velocity)
6. **Mix Design of Concrete**.

References:

1. Relevant latest IS codes on Aggregates, Cement & Concrete [269, 383, 2386, 10262(2009), SP23]
2. Laboratory manual of concrete testing by V.V. Sastry and M. L. Gambhir

Subject Name: ENVIRONMENTAL ENGINEERING LAB.

Subject Code: CIVL 3113

Contacts: 3P

Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Determine physical, chemical and biological characteristics of water and wastewater.
2. Determine optimum dosage of coagulant.
3. Assess the quality of water and wastewater.
4. To understand the different important water quality parameters, their relevance to human health and in treatment processes.
5. To know the permissible limits of different water quality parameter as per the standards.
6. Prepare technical laboratory report.

List of Experiments:

Experiment no.	Experiment name	Type of test
01	Determination of Color & Turbidity in an aqueous sample	Physical
02	Determination of pH and various solids (Total solids, Total suspended solids and Total dissolved solids) in an aqueous sample	
03	Determination of electrical conductivity and chloride in an aqueous sample	
04	Determination of Total & Phenolpthalein alkalinity in an aqueous sample and speciation of different alkalinities	Chemical
05	Determination of total and calcium hardness in an aqueous solution	
06	Determination of concentration of fluorides in an aqueous solution	
07	Determination of total and soluble iron of aqueous sample.	
08	Determination of the optimum coagulant dose for a given sample of water through Jar test	
09	Determination of chlorine demand of a contaminated water sample	
10	Determination of biochemical oxygen demand (BOD_5 at 20 deg C) for a given wastewater sample.	
11	Determination of chemical oxygen demand for a given wastewater sample.	
12	Determination of bacteriological quality of water : presumptive test, confirmative test and determination of Most Probable Number(MPN)	Bacteriological

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Subject Name: R. C. C. DESIGN & DETAILING

Subject Code: CIVL 3121

Contacts: 3P

Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Understand material properties and design methodologies for reinforced concrete structures.
2. Assess different type of loads and prepare layout for reinforced concrete structures.
3. Identify and apply the applicable industrial design codes relevant to the design of reinforced concrete members.
4. Analyse and design various structural elements of reinforced concrete building like beam, slab, column, footing, and staircase.
5. Assessment of serviceability criteria for reinforced concrete beam and slab.
6. Prepare structural drawings and detailing and produce design calculations and drawing in appropriate professional format.

Course Details:

1. **General considerations**: Design principle of R.C.C. sections. Limit state method of design Loads and stresses to be considered in the design as per I.S. code provision. General Introduction to IS 1893-2002
2. **Design & detailing of a** Continuous T- Beam.
3. **Design & Detailing of** columns, isolated and combined footing
4. **Design & detailing of a** One way Continuous slab.
5. **Design of different units**: Slab, beam column, roofing and staircase from floor plan of a multistoried frame building, typical detailing of a two way floor slab.

References:

I.S- 456-2000, SP 34, SP 16, IS-875, IS 1893-2002
Standard text books of RCC design.

Subject Name: DESIGN OF STEEL STRUCTURES
Subject Code: CIVL 3201
Contacts: 3L + 1T
Credit: 4

Course Outcome:

After going through this course, the students will be able to:

1. Identify the material properties of structural steel. Moreover, the students will identify different bolted and welded connections, analyse and design them for axial and eccentric loads.
2. Design different steel sections subjected to axial compression and tension following Indian codes of practices.
3. Comprehend the differences between laterally supported and unsupported flexure members. Designing of the flexure members using Indian codes of practice.
4. Analyse and design rolled and built up compression members along with base connection subjected to axial compression, bending and tension.
5. Calculate shear force and bending moment on rolled and built up girders, dimension the section and finally design it following Indian standard design guidelines.
6. Identify different components of gantry system, calculate lateral and vertical loads acting on the system, dimension the components and design them.
7. Design different components of an industrial building.

Sl. No.	Module	Details of Course Content	Hours	Total
1	I	**Materials and Specification**: Rolled steel sections, mechanical properties of steel and their specifications for structural use. Codes of practices. **Structural connections:** Bolted and welded connections: Introduction to different types of connectors, types of bolted and welded joints, assumptions, failure and efficiency of joints. Design of bolted and welded connections for axial load, torsion and shear, tension and shear, interaction check. High strength friction grip bolted joints.	8	42
2	II	**Tension members**: Working stress and limit state design of tension members, I.S code provisions, design rules, examples. **Compression members**: Effective lengths about major and minor principal axes, I.S code provisions. i) Design of axially loaded compression member: Working stress and limit state design of axially loaded compression members using rolled steel and built up sections.	13	

		Examples. ii) Design of beam – column: Design of rolled steel and built up columns under eccentric loading, design of lacing and batten plates. Design of column bases: Design of slab base, gusseted base, connection detailing.		
3	III	**Beams:** Working stress and limit state design in bending, compression and tension. Design of rolled steel sections, plated beams, concepts of curtailment of flanges. **Plate girders**: Design of web, flanges and stiffeners. Splices and connections using bolts and welding.	13	
4	IV	**Gantry system**: Design gantry girder and gantry column considering I.S code provisions.	8	

Text and References:

Sl. No	Name	Author	Publishers
1.	Design of steel structures	N. Subramanian	Oxford University Press
2.	Design of steel structures	A.S. Arya and J.L. Ajmani	Nemchand and Bros.
3.	Limit state design of steel structures (2nd edition)	S.K. Duggal	McGraw Hill India, New Delhi.
4.	Fundamentals of structural steel design	M.L. Gambhir	McGraw Hill India, New Delhi
5.	Analysis and design of steel structures, 2nd ed.	Karuna Moy Ghosh	Prentice Hall, India

Reference code: IS: 800 – 2007, SP 6 (I) – 1964.

Subject Name: FOUNDATION ENGINEERING
Subject Code: CIVL 3202
Contacts: 3L
Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Determine the load carrying capacity of pile foundation.
2. Compute the efficiency and settlement of pile group.
3. Understand different subsoil exploration methods and interpret field and laboratory test data to obtain design parameters for geotechnical analysis.
4. Correlate bearing capacity of shallow foundation from field test data.
5. Analyze and design sheet pile structure on the basis of earth pressure theories.
6. Understand and apply various types of ground improvement methods for solving complex geotechnical problems.

Sl. No.	Module	Details of Course Content	Hours	Total
1.	I	**Foundations: -** Classification, selection- shallow and deep foundations. **Deep foundations:- Pile foundation:** Types of piles, material, Suitability and uses, Method of installation of piles - classification of piles based on material, Installation Techniques – Selection and uses, Determination of types and lengths of piles, Load transfer mechanism, Determination of load carrying capacities of piles by static and dynamic formulae as per IS codes, Pile spacing and group action, Group efficiency, Negative skin friction, Pile load test, Settlement of pile group, Lateral load capacity of pile by IS: 2911 and Reese & Matlock methods, Uplift capacity of pile - introduction.	14	40
2.	II	**Site Investigation & Soil Exploration:-** Planning of sub-surface exploration, Methods of boring, sampling, Different types of samples, Spacing, Depth and number of exploratory borings, Bore log, Preparation of sub-soil investigation report. **Insitu tests:-** Standard penetration test, Static cone penetration test, Dynamic cone penetration test, Field vane shear test, Plate load test. **Indirect methods of soil exploration:-** Geophysical method: seismic refraction and electrical resistivity methods.	9	
3.	III	**Shallow Foundations:-** Bearing Capacity from SPT, SCPT and Plate load Test data.	9	

		Sheet pile structures: - Type of sheet pilling, Design of sheet pile, Cantilever sheet piling, Anchored sheet piling, Free earth and fixed earth support methods, Analysis with anchored bulk heads.		
4.	IV	**Introduction to Ground Improvement Techniques:-** Introduction, Economic considerations, Consolidation by preloading and sand drains, Stone columns, Compaction by vibrofloatation, Grouting techniques and principles, Applications of geosynthetics, Ground anchors and soil nailing.	8	

Recommended books:-

TEXT BOOKS:	
Sl. No.	**Name**
1.	Murthy, V.N.S., *Textbook of Soil Mechanics and Foundation Engineering* (Geotechnical Engineering Series), CBS Publishers and Distributors Pvt. Ltd.
2.	Das, B.M., *Principles of Foundation Engineering*, Thomson Brooks / Cole
3.	Punmia, B.C. and Jain A.K., *Soil mechanics and Foundations*, Laxmi Publications (P) Ltd.
4.	Das, B.M., *Principles of geotechnical Engineering*, Thomson Brooks / Cole

REFERENCE BOOKS:	
Sl. No.	**Name**
1.	Bowels, J.E. *Foundation Analysis & Design*, Mc Graw Hill
2.	Rao, A.V. and Venkatramaiah, R.C., *Numerical Problems- Geotecnical Engineering*, University press.
3.	Terzaghi, Peck and Mesri, *Soil mechanics in engineering practice*, Wiley-Interscience.
4.	Alam Singh, Soil Engineering in theory & Practice (Vol.1, 2 & 3), Jain Book Agency Publishers.

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Subject Name: PRESTRESSED CONCRETE
Subject Code: CIVL 3203
Contacts: 3L + 1T
Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Learn the introduction of prestressed concrete member and its deflection properties
2. Develop the design criteria of prestressed concrete section for flexure and shear properties
3. Analyze the anchorage zone stress for post-tensioned members
4. Impart knowledge regarding the methods of Analysis of Statically Indeterminate Structures.
5. Impart knowledge regarding the composite construction of Prestress and In-situ concrete.
6. Impart knowledge regarding Design of Prestressed concrete poles and sleepers and introduction of partial prestressing.

SL. No	Module	Syllabus	Hours	Total
1	I	**Introduction of Prestressed Concrete**: Materials, Prestressing System, Advantages of Prestressing, Analysis of Prestress and Bending Stress, Losses **Deflections of Prestressed Concrete Members**: Importance, Factors, Short term and Long term Deflection	8 4	42
2	II	**Shear and Torsional Resistance**: Design of Shear Reinforcement, Design of Reinforcement for Torsion, Shear and Bending. **Limit State Design Criteria**: Inadequacy of Elastic and Ultimate Load Method, Criteria for Limit States, Strength and Serviceability. **Design of Prestressed Concrete Section:** for Flexure & methods by Lin and Magnel	6 2 4	
3	III	**Anchorage Zone Stresses in Post Tensioned Members**: Stress Distribution in End Block, Anchorage Zone Reinforcement **Statically Indeterminate Structures**: Advantages of Continuous Member, Effect of Prestressing, Methods of Achieving Continuity and Method of Analysis of Secondary Moments	4 6	
4	IV	**Composite Construction of Prestressed and In-situ Concrete**: Types, Analysis of Stresses **Prestressed Concrete Poles and Sleepers**: Design of Sections for Compression and Bending. Introduction to Partial Prestressing.	4 4	

Recommended books:-

Code: IS 1343:1980

Text Books:

1. Prestressed Concrete, Fourth Edition, N Krishna Raju McGraw Hill
2. Fundamentals of Prestressed Concrete, N.C.Sinha and S.K.Roy
3. Prestressed Concrete, S.Ramamurthan

Reference Books:

1. Design of Prestressed Structures, T.Y.Lin and N.H.Burns, Wiley Eastern Ltd.

Subject Name: DATA STRUCTURE & RDBMS

Subject Code: CSEN 3206

Contacts: 3L

Credit: 3

Module I: (11L)

Linear Data structures:
Singly Linked List- Insertion at beginning, at end and any position of the List. Deletion by value, by position: beginning, end and any position of the List
Stack and Queue: Both array and Linked Representation, Circular queue using array only.
Application of stack: Infix to postfix conversion, Evaluation of postfix expression.

Module II: (10L)

Recursion: Design of Recursive algorithm.
Non-Linear Data Structures:
Trees: Binary Trees: Array and Linked representation, Binary tree Traversal Techniques, reconstruction of binary tree using traversal sequence.
Binary Search Trees - Insertion and Deletion algorithms.
Sorting Algorithms: Bubble sort, Insertion sort, Selection sort, Quick sort and their comparison.
Searching Algorithms: Linear search, Binary search and their comparison.

Database Concept

Module III: (10L)

Introduction to Database Concepts, File Processing System and Database Management System, DBMS Architecture and Data Independence.
Data Model: Basic Concepts, Entity-Relationship Diagram, Keys, Cardinality, Weak Entity Set.
Introduction to relational algebra & SQL: Operators like select, project, rename, Cartesian product, join, union, intersect, minus, DDL, DML.

Module IV: (10L)

Relational Database Design: Functional Dependencies, Normalization: Different anomalies in database designing
1NF, 2NF, 3NF and BCNF.
Introduction to Transaction Processing Concepts: ACID properties, Serializability and Recoverability

Text Books:

Data Structures:

I) Title: Data Structures.
Author: Seymour Lipschutz.
Publication: Tata McGraw-Hill (India)

II) Title: Data Structures and Program Design in C.
Author: Kruse Robert L., Robert Kruse, Cl Tondo.
Publication: Pearson Education India.

Database Concept:

I) Title: Fundamentals of Database Systems
Author: Elmasri Ramez and Navathe Shamkant
Publication: Pearson.

II) Title: Database System Concepts
Author: A. Silberschatz, H.F Korth, S.Sudarshan
Publication: McGraw Hill Education (India) Private Limited

Reference Books:

Data Sturucture:

I) Title: Data Structures using C.
Author: Tanenbaum A. S, Langsam Y., Augenstein M. J.
Publication: Pearson.

II) Title: The Art of Computer Programming
Author: Donald E. Knuth
Publication: Addison-Wesley Professional

Database Concept:

I) Title: Introduction to Database Management Vol. I, II, III,
Author: Date C. J.
Publication: Addison Wesley.

II) Title: Principles of Database Systems
Author: Ullman JD.
Publication: Galgottia Publication

Subject Name: RAILWAY & AIRPORT ENGINEERING
Subject Code: CIVL 3231
Contacts: 3 L + 1 T
Credit: 3

Course Outcome:

At the end of the course, the student will be able to:

1. Understand the importance of railway infrastructure, planning & design and identify the factors governing the design.
2. Understand the function of various permanent way components and design railway geometrics & turnouts.
3. Calculate tractive effort & platform height and understand the function of signaling & interlocking.
4. Get an idea about components of aircraft, airport planning and obstruction.
5. Design Runways and Taxiways.
6. Have a brief knowledge of airport layout, airport drainage and airport marking & lighting.

SL. No	Module	Details of Course Contents	Hours	Total
1.	I	**Railways in India**: *Introduction* **-** Role of Indian railways in National Development, Railways for urban transportation. *Alignment of Railway Lines* **-** Location survey, Engineering surveys for track alignment- Obligatory points, Conventional and modern methods. (Remote sensing, GIS).	2	42
		Permanent Way components and Functions: Rails- Types of rails, Rail fastenings, Concept of gauges, Coning of wheels, Sleepers- Functions, Materials, Density, Ballast - Functions, Materials, Ballast less tracks.	8	
		Geometric Design of railway tracks: Grade compensation and gradient, Widening of gauges in curves, Super elevation, Horizontal, Vertical and Transition curves.	4	
2.	II	**Track Maintenance**: Points and Crossings- Design of Turnouts, Working principles, Various types of track junctions.	2	
		Rolling Stock, Railway Section and Yards: Rolling Stock. Tractive power, Track resistance, Layouts of railway stations and yards, Re-laying of tracks, Level crossings.	2	
		Signalling and Interlocking: Signalling, Interlocking and Track circuiting- Construction and Maintenance.	2	
		Design of tracks for high speed: Geometrical requirements, Ballasted or Ballast less, Design methodology, Maintenance considerations.	2	
3.	III	**Aircraft component and Airport planning**:		

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		Component parts and its function, aircraft characteristics and their influence on airport planning, air traffic characteristics, development of new airports, factors affecting airport site selection, Airport Maintenance.	2	
		Airport obstruction: Zoning laws, classification of obstructions, imaginary surfaces, approach zones, turning zones.	4	
		Design of Runway and Taxiway: Runway orientation, wind rose diagrams, basic runway length, corrections for runway length, airport classification, geometric design, airport capacity, runway configuration, taxiway design, geometric standards, exit taxiways, holding aprons, location of terminal buildings, aircraft hangers parking.	6	
4.	IV	**Terminal area & airport layout**: Terminal area, planning of terminal buildings, apron, size of gate position, number of gate position, aircraft parking system, hanger, general planning considerations blast considerations.	2	
		Airport drainage: Requirement of airport drainage, design data, surface drainage design.	2	
		Airport marking and lighting: Marking lighting of runways, taxiway, approach other areas.	2	

RECOMMENDED BOOKS:

TEXT AND REFERENCE BOOKS	
Sl. No.	Name of the books
1.	A Text Book of Railway Engineering, S.P. Arora& S.C. Saxena
2.	Railway Engineering, Satish Chandra, Oxford University press
3.	Airport planning and Design, S.K.Khanna&M.G.Arora
4.	Airport Transportation Planning & Design-. Virendra Kumar &Satish Chandra, Galgotia Publication Pvt. Ltd., New Delhi

Subject Name: ADVANCED SURVEYING

Subject Code: CIVL 3232

Contacts: 3 L + 1 T

Credit: 3

Course Outcome:

After successful completion of the course student will be able to:

1. Record the accurate and thorough data from the field work, for documentation.
2. Analyse the data from the records of the Global Positioning System, Geographic Information System and Remote Sensing.
3. Employ the knowledge to use modern survey equipment to measure angles and distances with accuracy considering the curvature of the earth.

SL. No	Module	Details of Course Content	Hours	Total
1	I	**Setting out works** Laying out of building, setting out of Culverts, setting out of Bridges, setting out of Tunnels. **Tacheometry** Concepts of anallactic lens, Stadia systems, movable hair stadia method, calculation of horizontal and vertical distance using tachometer.	10	40
2	II	**Geodetic survey** Concepts of triangulation and triangulation systems in brief, order of triangulation, strength of figures. **Astronomical survey** Spherical trigonometry, Celestial sphere, Coordinate systems-Altitude and Azimuth systems, Declination-Hour Angle system, application of astronomical survey.	10	
3	III	**Aerial surveying** Terrestrial photogrammetry, aerial photogrammetry, photo interpretation, Parallax. **Curve surveying** Elements and setting out of compound curves, reverse curve and vertical curves.	10	
4	IV	**Theory of errors and adjustments** Direct and indirect observations, sources of errors, types of error, elimination of errors, error propagation, method and application of error adjustment. **Remote Sensing** Introduction, historical perspective, uses, basic Principles, types, Platforms and Satellites, Sensors, Spectral Bands, Spectral reflectance curves. **Geographic Information Systems** Introduction, Data, Information Systems and Planning, GIS subsystems.	10	

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Recommended books:-

TEXT BOOKS:

1. Punmia B.C., Jain A.K. and Jain A.K. Higher Surveying (Vol-3). 15th edition, LaxmiPublications (P) Ltd.

REFERENCE BOOKS:

1. Subramanian R. Surveying and Levelling. 2nd editon, Oxford university Press
2. Satheesh Gopi, R. Sathikumar, and N. Madhu, Advanced Surveying: Total Station, GIS and Remote Sensing (English) 1st Edition, Pearson
3. W. Norman Thomas., Surveying, Edward Arnold, 1920.

Subject Name: DESIGN OF TALL STRUCTURES

Subject Code: CIVL 3233

Contacts: 3 L + 1 T

Credit: 3

Course Outcome:

After attending the course, students will be able to:

1. Understand the advanced methods of analysis and design of high rise structures.
2. Design high rise structures such as multistoried buildings, chimney structures etc.
3. Analyse the static as well as dynamic effect of seismic and wind on tall structures.

SL. No	Module	Details of Course Content	Hours	Total
1	I	**INTRODUCTION** Concept of tall buildings, factors affecting growth, height and structural forms. Tall building structure- design process, strength and stability, stiffness and drift limitation, creep, shrinkage and temperature effects. **BASIC STRUCTURAL FORMS** Braced frame structures, rigid frame structures, in filled frame structure, flat plate and flat- slab structures, shear wall structures, wall- frame structures, framed-tube structures, outrigger –braced structures, suspended structures, core-structures, space and hybrid structures. Modelling concept of 2D and 3D structures, exposure to the design philosophy of Staad software.	10	44
2	II	**WIND ANALYSIS** Design considerations for nature of wind, use of Gust Factor Method to assess the dynamic effect of wind on structures. Introductory concept of wind tunnel test, objectives of wind tunnel tests.	10	
3	III	**SEISMIC ANALYSIS** Tall building behaviour during earthquakes, use of Response Spectrum Method to assess the dynamic effect of earthquake on structures. Basic concept of Time History Analysis.	12	

4	IV	**DESIGN PHILOSOPHY OF A TALL BUILDING WITH SHEAR WALLS** Concept of P-delta effects. Concepts of ductile detailing of building, referring to IS 13920-1993. Detailed concept of shear wall design for a Tall building.	12	

Recommended books:-

TEXT BOOKS:

1. Bryan S. Smith and Alex Coull., *Tall Building Structures: Analysis and Design*, John Wiley & Sons, Inc, New York, 1991.
2. Agarwal P and Shrikhande M., *Earthquake Resistant Design of Structures*, PHI Learning Pvt. Ltd, 2006.
3. Manohar, S.N., "Design and Construction of Tall Chimneys", McGraw-Hill Book Co., New York, 1972.

REFERENCE BOOKS:

1. Taranath B.S., *Structural Analysis and Design of Tall Buildings- Steel and Composite Construction*, CRC Press, 2012.
2. Sarkisian M., *Designing Tall Buildings- Structure as Architecture*, Routledge, 2012
3. Parker D and Wood A., *The Tall Buildings-Reference Book,* Routledge, 2013.

CODES:

IS 875 (Part-3): 1987, IS 1893 (Part-1): 2002, IS 1893 (Part 4): 2005, IS 4998 (Part 1): 1992, IS 13920: 1993.

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Subject Name: SOIL STABILIZATION & GROUND IMPROVEMENT TECHNIQUES
Subject Code: CIVL 3234
Contacts: 3 L + 1 T
Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Understand soil stabilization using cement, lime and flyash for various critical geotechnical problems.
2. Illustrate in-situ densification techniques applied to both cohesionless and cohesive soils.
3. Examine different types of geotextiles on the basis of its properties and applications.
4. Interpret functions of geotextiles with its applications.
5. Apply the knowledge of grouting for various field applications.
6. Review the methods of soil stability such as reinforced earth, soil nailing, underpinning etc.

Sl. No.	Module	Details of Course Content	Hours	Total
1.	I	**Soil Stabilization**:- Introduction, Stabilization of soil with and without granular skeleton, Common nomenclature of stabilized soil systems and stabilization methods, Specific methods of soil stabilization: stabilization with cement, lime and fly-ash.	10	38
2.	II	**In-situ densification**: - Introduction, Compaction methods and controls, Densification of granular soil**,** Impact at ground surface, Vibrofloatation. Densification of cohesive soils, Preloading and dewatering, Design of sand drains and stone columns, Electrical and thermal methods.	10	
3.	III	**Geotextile**:- Over view, Classification of geotextile, Geotextile as separator and reinforcement, Geotextile in filtration and drainage, Geotextile in erosion control, Natural and artificial geotextiles.	8	
4.	IV	**Grouting**: - Over view, Grouting equipments and methods, Grout design and layout, Grout monitoring schemes. **Soil stability**: - Reinforced earth fundamentals, Soil nailing, Soil and rock anchors, Underpinning.	10	

Recommended books:-

TEXT BOOKS:	
Sl. No.	**Name**
1.	Bowels, J.E., *Foundation Analysis and Design*, Mc Graw Hill
2.	Das, B.M., *Principles of Foundation Engineering*, Thomson Brooks / Cole
3.	Koerner, R.M., *Construction and Geotechnical methods in foundation engineering*, Mc Graw Hill
REFERENCE BOOKS:	

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Sl. No.	**Name**
1.	Ingold, T. S., *Reinforced Earth*, Thomas Telford.
2.	Koerner, R. M., *Designing with Geosynthetics*, Prentice Hall
3.	Saran, S., *Reinforced soil and its engineering application*, I. K. International Publishing House.

Subject Name: SOIL MECHANICS LAB II

Subject Code: CIVL 3211

Contacts: 3P

Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Estimate compressibility characteristics of soil.
2. Determine shear strength parameters of soil by unconfined compression test and vane shear test.
3. Determine shear strength parameters of soil by direct shear test.
4. Perform triaxial test to determine shear strength parameters of soil.
5. Determine California Bearing Ratio (CBR) of soil.
6. Prepare technical laboratory report.

List of Experiments:

1. Determination of compressibility characteristics of soil by oedometer test.
2. Determination of unconfined compressive strength of soil by unconfined compression test.
3. Determination of shear strength parameters of soil by direct shear test.
4. Determination of undrained shear strength of soil by vane shear test.
5. Determination of shear strength parameters of soil by unconsolidated undrained triaxial test.
6. Determination of California Bearing Ratio (CBR) of soil.
7. Determination of relative density of soil.
8. Standard Penetration Test.

REFERENCES:

1. Soil Testing by T.W. Lamb (John Willey).
2. SP: 36 (Part - I and Part - II).
3. Soil Mechanics Laboratory Manual by Braja Mohan Das (Oxford university press).

Subject Name: TRANSPORTATION ENGINEERING LAB

Subject Code: CIVL 3212

Contacts: 3P

Credit: 2

Course Outcomes:

After going through this course, the students will be able to:

1. Access the quality of different bitumen grade.
2. Characterize the pavement materials.
3. It will help the students to gather knowledge about the quality control techniques of various aggregates and pavement materials.
4. Enable the students to characterize bituminous grade according to their work suitability.
5. Recognize the knowledge and idea about the different physical properties of aggregates by performing different test on aggregates.
6. Prepare technical laboratory report.

List of Experiments:

A. Test on Highway Materials:

1. Aggregates –
    a) Impact Value Test.
    b) Los Angeles Abrasion Value Test.
    c) Water Absorption and Specific Gravity.
    d) Elongation and Flakiness Index.
2. Bitumen –
    a) Specific Gravity Test.
    b) Penetration Value Test.
    c) Softening Point Test.
    d) Loss on Heating Test.
    e) Flash and Fire point Test.
    f) Ductility Test.
    g) Viscosity Test.

B. Bituminous Mix Design by Marshall Stability Method.

C. Stripping Value Test.

D. Benkelman Beam Deflection Test.

References:

1. BIS Codes on Aggregates and Bituminous Materials.
2. Highway Material Testing (Laboratory Manual) by S.K. Khanna and CE. G. Justo.
3. Relevant IS and I.R.C codes.

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Subject Name: RDBMS Lab

Subject Code: CSEN 3216

Contacts: 3P

Credit: 2

Experiments on Database on RDBMS Platform (Oracle):

DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding and modifying column data types, etc.

DML: Inserting rows, Updating rows, Deleting rows

SQL Query: Cartesian Product, All types of Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause, Nested Sub-Queries

Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc. Programming using Cursors.

Books:

DBMS Laboratory
Title: SQL, PL/SQL: The Programming Language Of Oracle (With CD-ROM) (English)
4th Revised Edition
Author: Ivan Bayross
Publisher: BPB Publications

Subject Name: STEEL STRUCTURE DESIGN & DETAILING
Subject Code: CIVL 3221
Contacts: 3P
Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Identify the material properties of structural steel. Moreover, the students will identify different bolted and welded connections, analyse and design them for axial and eccentric loads.
2. Design different steel sections subjected to axial compression and tension following Indian codes of practices.
3. Comprehend the differences between laterally supported and unsupported flexure members. Designing of the flexure members using Indian codes of practice.
4. Analyse and design rolled and built up compression members along with base connection subjected to axial compression, bending and tension.
5. Calculate shear force and bending moment on rolled and built up girders, dimension the section and finally design it following Indian standard design guidelines.
6. Identify different components of gantry system, calculate lateral and vertical loads acting on the system, dimension the components and design them.
7. Design different components of an industrial building.

List of topics:

I) Problems on general consideration and basic concepts
II) Discussion on different loads (i.e. Dead load, live load, wind load and others) as per IS 875.
III) Introduction to PEB (pre-engineered building) structures.
IV) Design and drawing of the following components of a factory shed:

1. Members of the roof truss.
2. Joints of the roof truss members.
3. Purlins.
4. Wind bracings.
5. Columns.
6. Gantry girder and gantry column.
7. Column base connection.

References: I.S. 875 (part I, II and III) - 1987, I.S: 800-2007, SP: 6 (I) – 1964.

Text & References:

Sl. No	Name	Author	Publishers
1.	Design of steel structures.	N. Subramanian	Oxford University Press
2.	Design of steel structures.	A.S.Arya and J.L.Ajmani	Nemchand and Bros.
3.	Limit State design of steel structures (2nd edition).	S.K.Duggal	McGraw Hill India, New Delhi
4.	Fundamentals of structural steel design.	M.L. Gambhir	McGraw Hill India, New Delhi
5.	Analysis and design of steel structures (2nd edition).	Karuna Moy Ghosh	Prentice Hall, India

Tapas Sadhu

Object Oriented Programming using C++ [Code: CSEN3004] Contact: 3L Credits: 3

Module-A:

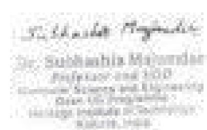
- **Overview of Object Oriented Concepts [2L]**
  - Difference between OOP and other conventional programming – advantages and disadvantages
  - Class, object, message passing, inheritance, encapsulation, polymorphism
- **Basic Programming with C++ [6L]**
  - Data Types, Operators
  - Control Statements and Loops
  - Functions and Parameters
  - Arrays, Pointers and References
  - String Manipulation

Module-B:

- **Classes and Objects [10L]**
  - Fundamentals of Class and Object
  - Abstraction, Encapsulation, Access Specifier
  - Static Member and Friend Function
  - Constructor and Destructor

Module-C:

- **Overloading and Inheritance [8L]**
  - Function Overloading
  - Operator Overloading
  - Inheritance
  - Derived Class
- **Polymorphism and Overriding [4L]**
  - Abstract Class
  - Runtime Polymorphism
  - Virtual Base Class
  - Overriding



Module-D:

- **Exception Handling [2L]**
- **Namespace [2L]**
- **Templates [4L]**
  - Class Template
  - Function Template

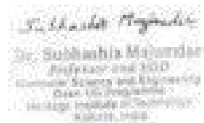
Textbooks / References:

1. Bjarne Stroustrup – “The C++ Programming Language” – Pearson
2. E Balagurusamy – "Object Oriented Programming with C++” – 6th Edition – McGraw Hill
3. Robert Lafore – "Object-oriented Programming in C++” – SAMS Publishing
4. Steve Oualline – “Practical C++ Programming” – O’Reilly
5. James Rambaugh & Michael Blaha – "Object Oriented Modeling and Design" – Prentice Hall, India

Object Oriented Programming Lab **[Code: CSEN3014]** **Contact: 2P** **Credits: 1**

Assignments on: *[based on Lectures]*

1. Basic Programming
2. Class
3. Constructor
4. Overloading
5. Inheritance
6. Polymorphism
7. Overriding
8. Exception Handling
9. Templates



Note: use C++ for programming to carry out assignments based on lectures

Course Name : **RDBMS LABORATORY**					
Course Code: CSEN 3216					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

1. To give a good formal foundation on the relational model of data.
2. To present SQL and procedural interfaces to SQL comprehensively
3. To give an introduction to systematic database design approaches covering conceptual design, logical design and an overview of physical design.
4. To present the concepts and techniques relating to query processing by SQL engines.
5. To present the concepts and techniques relating to ODBC and its implementations.
6. To introduce the concepts of transactions and transaction processing.

Experiments on Database on RDBMS Platform (Oracle):

DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding and modifying column data types, etc.

DML: Inserting rows, Updating rows, Deleting rows.

SQL Query: Cartesian Product, All types of Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause, Nested Sub-Queries.

Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc. Programming using Cursors.

Books:

DBMS Laboratory

Title: SQL, PL/SQL: The Programming Language Of Oracle (With CD-ROM) (English) 4th Revised Edition

Author: Ivan Bayross

Publisher: BPB Publications

SUBJECT NAME: MICRO-ELECTRONIC DEVICES AND CIRCUITS					
Paper Code: AEIE5101					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [10L]

Introduction to Microelectronics: IC Production Process- Basic Steps involved in Production, Layout and Fabrication.

Analog Building Blocks: Active resistors, Current mirrors/amplifiers, Current sources and sinks, Voltage and Current references.

Digital Building Blocks: NMOS inverter and CMOS inverter.

Module II - [8L]

Analysis of Analog Integrated Circuits:

DC analysis and small signal (ac) analysis of 741 Op-amp: Input stage, intermediate (second) stage and output stage – Gain, input-output resistance and frequency response.

Module III-[6L]

Analysis of two stage CMOS amplifier

Design (Synthesis) of analog Integrated Circuit.

Module IV-[16L]

Digital Integrated Circuits Analysis: Performance analysis of CMOS inverter, CMOS logic Circuits; Pass-transistor Circuits; Dynamic Logic Circuits.

Design: Flip-flops and multivibrator circuits; Dynamic MOS Storage Circuit; (Fussable) Programmable logic array: (Fussable) Logic gate array; Introduction to VHDL & FPGA.

References:

1. Sedra Smith, Microelectronic Circuits. 5th Edition, McGraw Hill.
2. R. L. Geiger, P. E. Allen & N. R. Strader – Design techniques for Analog & Digital Circuits,
   McGraw Hill, Singapore, 1990.
3. D. A. Hodges & H. G. Jackson – Analysis and Design of Digital Integrated Circuits,
   McGraw Hill, New York, 1983.
4. S. M. Sze – VLSI Technology, Second Edition, TMH, New Delhi, 2004.

Course Outcome:

After the completion of the course, the students will be able to:

1. Detail analysis Op-Amp circuits to understand loading effects in application circuits.
2. Selection of MOS Transistor as per datasheet parameters to design a simple current mirror.
3. Study of digital logic gates based on various transistor types.

Subject Name: DIGITAL SIGNALS AND SYSTEMS					
Paper Code: AEIE5102					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [10L]

Discrete-Time Signals and Systems:

Generation of discrete and digital signals, Sampling of continuous time signals and aliasing, Classification of discrete time signals, Mathematical operations on discrete time signals, Discrete time system description, Response of LTI discrete time system, Linear and circular convolution.

Module II - [10L]

Spectrum Analysis and Wavelet Theory:

Introduction to Fourier series and Fourier transform of discrete-time signals (DTFT), Discrete Fourier transform (DFT) - properties and limitations, Fast Fourier Transform (FFT) algorithm. Introduction to time frequency analysis, Short Time Fourier Transform, continuous time Wavelet Transform, Discrete wavelet transform, construction of wavelets, Multiresolution analysis, Application of wavelet transforms.

Module III-[10L]

Design of Digital Filters:

Design methods of FIR and IIR filters, Structures for realization of FIR and IIR filters, Finite word length effect in digital filters.

Module IV- [10L]

Multirate Digital Signal Processing and Discrete Time Random Process:

Introduction to change of sampling rate – Decimation and Interpolation- Direct digital domain approach - Decimation by integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization – Applications of Multirate signal Processing - Subband coding and filter banks. Random variables- Definitions, Ensemble averages, Jointly distributed random variables, Gaussian random variables, Joint moments, Linear mean square estimation; Random process- Definitions, Ensemble averages, Gaussian processes, Stationary processes, Autocovariance and Autocorrelation Matrices, Ergodicity, White noise, Power spectrum, Spectral Factorization, Response of linear systems to random input.

References:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 3rd ed, Pearson Education Inc., NewDelhi,India.
2. Sanjit K. Mitra, *Digital Signal Processing- A computer based Approach*, McGraw-Hill.
3. Monson H. Hayes, Statistical Digital Signal Processing & Modeling, John Wiley & Sons
4. P. P. Vaidyanathan, *Multirate Systems and Filter Banks*, Prentice Hall, 1992.
5. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, *Digital Signal Processing*, TMH, 2nd Edition, 2010.

6. A.V. Oppenheim, R.W. Schaffer and John R. Buck, *Discrete Time Signal Processing*, 3rd Edition, Prentice-Hall Signal Processing Series, 2009.
7. A. Nagoor Kani, *Signals and Systems, McGraw Hill Education (India) Privet Limited, New Delhi, 2013.*

Course Outcome:

After the completion of the course, the students will be able to:

1. Characterize and analyze the properties of discrete time signals and systems.
2. Understand and apply signal transform algorithms such as discrete Fourier transform (DFT), fast Fourier transform (FFT), discrete wavelet transform (DWT).
3. Design digital FIR and IIR filters according to the given specification.
4. Realize decimator, interpolator and filter banks using multirate signal processing algorithms.
5. Calculate ensemble averages, joint moments, linear mean square estimation; ensemble averages, autocorrelation Matrices, ergodicity, power spectrum, Response of linear systems to random input.

Subject Name: ADVANCED INDUSTRIAL INSTRUMENTATION					
Paper Code: AEIE5103					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [10L]

Review of Industrial Instrumentation:
Measurement of Pressure; Temperature; Flow; Level: Classification and modern methods; signal processing circuits.

Module II - [10L]

Measurements and analysis in Thermal Power Plant:
Fuel, Air and steam flows, Drum level, Steam temperature and pressure, Dissolved oxygen, Coal/Oil, Water quality analyzers, Pollution monitoring equipments: O_2, CO and CO_2, SO_x and NO_x.

Module III - [12L]

Measurements and analysis in chemical Plant:
Temperature measurements in Distillation column, heat exchanger, Level measurements of liquid –Liquid; Liquid-gas phases etc. Flow and pressure measurement in Pyrolysis, Catalytic cracking, Calibration and Maintenance of process instruments.

Module IV-[8L]

Special Purpose Instrumentation:
Electrical and Intrinsic safety; Zener Barrier; Flame, Fire and smoke detectors, Hydrocarbon (HC) detector; Flame Scanner.

References:

1. Liptak B. G.; Instrumentation Engineers Handbook (Measurement) ; Chilton Book Co.; 1994
2. D. A. Reay; Industrial Energy Conservation; Pergamon Press; 1997.
3. Ness S.A.; Air monitoring for Toxic explosions Air Integrated approach, Von Nostrand.
4. Hodge B. K.; Analysis and Design of Energy Systems; Prentice Hall; (1988).
5. U. A. Bakshi, A.V.Bakshi; Instrumentation Engineering; Technical Publications; 2009.
6. Harold E. Soisson; Instrumentation in Industry; John Wiley & Sons Canada, Limited, 1975.

Course Outcome:

After the completion of the course, the students will be able to:

1. Understand the operating principle of commonly used industrial sensors/transducers.
2. Apply the measurement and analysis techniques of different polluting gasses produced by thermal power plant.
3. Know the operation and control of distillation column.
4. Apply the instruments needs for safety purpose of different hazardous area of the plant.

Subject Name: PROCESS INSTRUMENTATION LAB					
Paper Code: AEIE5111					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	4	4	2

1. Study of boiler using Boiler SIM software (MS Window version).
2. Testing & Calibration of Instruments through Automatic test equipments.
3. Characteristics study of various sensors using Microprocessor based Data Acquisition and Control system.
4. Tuning of different simulation process in MATLAB environment.
5. DC motor and Furnace control using PID controller.
6. Dual control scheme for crane position and swing angle control of a Digital pendulum.
7. Studies of Process telemetering and remote control.

Course Outcome:

After the completion of the course, the students will be able to:

1. Understand the activity and importance of Boiler Drum in an industry.
2. Study, calibrate and test the instruments.
3. Study the characteristics of different sensors.
4. Simulate, tune and control different processes.
5. Understand principle of modeling and control.

Subject Name: DIGITAL SIGNAL PROCESSING LAB					
Paper Code: AEIE5112					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	4	4	2

1 Generations of different types of sequences and operations on them.

2 Simulation of some simple discrete-time systems and investigation of their time domain properties.

3 Spectral Analysis-
Discrete Fourier Transform, Fast Fourier Transform, Spectral Analysis with FFT, Time varying spectra, Spectrogram of Chirp Signal, Wavelet transform.

4 Design of IIR filters and their realizations.

5 Design of FIR filters and their realizations.

6 Analysis of Finite Word-Length effects.

7 Real Time signal Processing by TI C6713 and Code Composer studio –
Introduction to Code Composer Studio as an integrated development environment, Creating projects, writing and compiling programs for the C6713 DSK, Real-time FIR and IIR filtering, Real-time FIR and IIR filtering, The fast Fourier transform (FFT), adaptive filtering, code optimization.

References:

1. Vinay Ingle and John Proakis, Digital Signal Processing Using MATLAB, 2nd edition, CL-Engineering, 2006
2. Thad B. Welch, et al., Real-Time Digital Signal Processing from MATLAB® to C with the TMS320C6x DSPs, Second Edition, 2nd Edition, CRC Press, 2011, ISBN-13 978-1439883037.
3. RulphChassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley & Sons, Inc., Hoboken, New Jersey, 2005.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Write MATLAB programs to determine time domain properties of the discrete time signals.
2. Determine FFT and DFT of a discrete time signal.
3. Design and implement FIR and IIR digital filters in MATLAB.
4. Implement real time FIR and IIR digital filters and FFT algorithm using DSP kit like C6713 DSK.

Subject Name: SEMINAR I					
Paper Code: AEIE5121					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	1

The seminar should be on any topic having relevance with Instrumentation engineering and related areas of technology. The topic should be decided by the student and concerned teacher. Seminar work shall be in the form of presentation to be delivered by the student regularly throughout the semester. The candidate will deliver a final talk on the topic at the end of the semester and assessment will be made by a group of internal examiners.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Enhance their presentation and communication skill.
2. Gain information on latest technological upliftment.
3. Strive constantly so as improve the quality of the mentors as well as students.

Subject Name: MECHATRONICS					
Paper Code: AEIE5131					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [11L]

Overview of Mechatronic and Physical System Modeling :
Introduction to Mechatronics, Mechatronic Design Approach, Elements of Mechatronics—Control Interface/Computing Hardware; Mechatronics-based Product Realization, Revolution of Mechatronics as a Contemporary Design Paradigm.
Introduction to System Modeling; Mechanical System, Electrical System, Fluid Systems, Thermal System, Translational and Rotational Mechanical System with spring, damper and mass.

Module II - [12L]

Transducers and Sensors and Actuators:
Introduction and Background, Difference Between Transducer and Sensor, Transducer Types, Transduction Principle, Photoelectric Transducers, Thermistor, Thermocouple, Inductive Transducers, Capacitive Transducer, Pyroelectric Transducers, Piezoelectric Transducer, Hall-effect Transducer, Ionization Transducer.
Introduction to Actuator types and Application Areas, Electromechanical Actuator, DC motor, AC motor, Fluid Power Actuators, Piezoelectric Actuators, Magnetostrictive Actuator, Memory-metal Actuator, Ion-exchange Polymer-metal Actuator, Micro Actuator.

Module III - [8L]

Signal Conditioning Theory, Circuits and Systems:
Introduction to signal conditioning, Voltage divider, Rectification, Diode Voltage Stabilizer, Clipping and Clamping Circuit, Amplifier, Instrument Amplifier, Bridge Circuit, Comparator, Oscillator, Multivibrator. Logic System Design, Synchronous and Asynchronous Sequential System

Module IV - [9L]

Computers and Logic Systems, Software and Data Acquisition:
System Interfaces, Communication and Computer Networks, Fault Analysis in Mechatronic Systems, Architecture, Control with Embedded Computers and Programmable Logic Controllers.
Introduction to Data Acquisition, Measurement Techniques: Sensors and Transducers, A/D and D/A Converters, Signal Conditioning, Computer-Based Instrumentation Systems, Software Design and Development, Data Recording and Logging.

References:

1. Robert H. Bishop, *The Mechatronics Handbook*, CRC Press 2006
2. W. Bolton, *Mechatronics, Electronic Control Systems in Mechanical and Electrical Engineering*, Pearson Education, 2003.
3. N. P. Mahalik, *Mechatronics, Principles, Concept and Applications*, McGraw Hill, 2003.
4. R. Isermann, *Mechatronic Systems Fundamental*, Springer, 2005.
5. Denny K. Miu, *Mechatronics*, Springer-Verlag, New York, 1993.

Course Outcome:

After the completion of the course, the students will be able to:

1. Select and apply the knowledge, techniques, skills and modern tools in mechatronics engineering technology.
2. Apply concepts of circuit analysis, analog and digital electronics, automation and controls, motors, electric drives, power systems, instrumentation, and computers to aid in the design, characterization, analysis, and troubleshooting of mechatronics systems.
3. Understand the different types of actuation units to activate real time systems.

Subject Name: MEASUREMENT AND SYSTEM DESIGN					
Paper Code: AEIE5132					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [4L]

Qualitative and Quantitative aspect of measurement; Input-Output configuration of Measuring Instruments and Instrument Systems; Methods of Correction for Interfering and Modifying Inputs; Standards & Calibration.

Module II - [8L]

Generalized Mathematical Model of Measurement System; Response of Instruments to Periodic and Transient Inputs, Dead-Time Elements, Characteristics of Random Signals, Requirements on Instrument Transfer Function to ensure accurate measurement, Experimental determination of measurement-system parameters, Loading effect under Dynamic conditions.

Module III-[6L]

Statistical Analysis: Band Diagrams, Specification Analysis, multi-parameter techniques. Computer-Aided Calibration and Measurement; Multiple Regression.

Module IV-[22L]

Manipulation of Data: Noise Problems, Shielding and Grounding, Filtering by Statistical Averaging, Dynamic Compensation, Function Generation and Linearization, Signal and System Analyzers, Microprocessor Applications;
Transmission of Data: Transmission of Analog Voltage and Current signals and Digital Data, FM/FM Radio Telemetry;
Recording of Data: DSO, Spectrum Analyzer;
Engineered Data Acquisition and Processing Systems: Versatile, modular system emphasizing analog signal processing, Sensor-based, computerized data systems.

References:

1. Measurement Systems – Application & Design, E. O. Doeblin, 6th Ed, McGraw Hill.
2. Instrumentation Design Studies, E. O. Doeblin, CRC Press, 2010.
3. Principles of Industrial Instrumentation (2e) , D. Patranabis, TMH, 1996.
4. Principles of Engineering Instrumentation – D. C. Ramsay, Wiley, NY, 1996.
5. Transducers in Electronic and Mechanical Design – H. L. Trithy, Mercal Dekker, 1986.
6. Transducers for Automation – M. Hordeski, Van Nostrand, 1987.
7. Industrial Instrumentation – Principles of Design – TR. Padmanavhan, Springer, International Ed.

Course Outcome:

After the completion of the course, the students will be able to:

1. Formulate the structure of generalized measurement system.
2. Develop the mathematical model of any measuring instrument.
3. Calibrate and give specification of any measurement system.
4. Analyze the measurement data.

Subject Name: OPTICAL INSTRUMENTATION					
Paper Code: AEIE5133					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [9L]

Optical Fibers and their Performances:
Principle of light propagation through fiber-different types of fibers and their properties-fiber characteristics-Absorption losses-scattering losses-dispersions-connectors and splicer-fiber termination-optical sources-optical detectors.

Module II - [9L]

LASER fundamentals:
Fundamental characteristics of lasers-Three level and four level lasers-Properties of lasers-laser modes-Resonator configuration-Q switching and mode locking- cavity damping-Types of lasers-gas lasers, liquid laser, solid lasers, semi-conductor lasers.

Module III - [9L]

Industrial applications of LASER:
Laser for measurement of distance, length, velocity, acceleration, current,voltage and atmospheric effect- Material processing -Laser Heating, Welding, Melting and trimming of material-Removal and vaporization.

Module V - [13L]

Optical Fiber, Hologram and Medical applications:
Fiber optic sensors-fiber optic Instrumentation system-Different types of modulators-Inferometric method of measurement of length-Moire fringes-Measurement of pressure, temperature, current, voltage, liquid level and strain.
Holography-Basic Principle-Methods-Holographic Inferometry and application, holography for non-destructive testing-holographic components-Medical applications of laser and tissues interactive.

References:

1. J.M. Senior, Optical Fiber Communication – Principles and Practice, Prentice Hall of India, 1985.
2. J. Wilson and J. F. B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2001.
3. Donald J. SterlingJr, Technicians Guide to Fiber Optics, 3rd Edition, Vikas Publishing House, 2000.
4. M. Arumugam, Optical Fiber Communication and Sensors, Anuradha Agencies, 2002.
5. John F. Read, Industrial Applications of Lasers, Academic Press, 1978.
6. Monte Ross, 'Laser Applications', McGraw Hill, 1968
7. G. Keiser, Optical Fiber Communication, McGraw Hill, 1995.
8. Mr. Gupta, Fiber Optics Communication, Prentice Hall of India, 2004.

Course Outcome:

After the completion of the course, the students will be able to:

1. Learn the techniques of communications using optical fiber.
2. Characterize structures and performance of LEDs and lasers.
3. Learn the structures and performance of photo detectors (like photo diode, PIN diode, APD etc).
4. Explain the techniques of measurement of distance, length, velocity, acceleration, current, voltage using laser. Formulate the structure of generalized measurement system.
5. Acquire knowledge on basic principle of holography and its uses in different fields such as nondestructive testing, medical field etc.

Subject Name: PROCESS CONTROL SYSTEM DESIGN					
Paper Code: AEIE5201					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [10L]

Mathematical Modeling of Processes: The System equations approach, Analytical Approximations, effect of parameter variation; Open loop step response method, frequency response, method, the parameter estimation technique-linear regression, least square regression technique.

Process Dynamics: characteristics of a few processes such as heat exchangers, boilers and condensers, Model analysis and control; System order reductions.

Module II - [16L]

Designing process control systems – different approaches: Supervisory, direct digital, Fuzzy logic, Distributed Computer, Adaptive and self-tuning.

Supervisory control using procedural model and/or economic model, process optimization, various aspects of direct digital control – Hierarchical, multilayer, multilevel etc. Comparison of design strategies and performances.

Control system design with distributed computer networks, local controller, communication data links, control information and display unit; redundancy, reliability, data transfer protocols, standard interfaces, real time languages.

Module III - [10L]

Fuzzy logic process control – main advantages, the approach, the controller design and applications to systems.

Adaptive control – the system identification technique, the model reference technique, self-adaptation, the predictive approach; Design of the self-tuning control systems: Based on (i) Transient response (ii) frequency response (iii) parametric models.

Module IV - [4L]

Variation of algorithm designs, comparisons. Case studies of specific control schemes such as temperature of oven and /or flatness of rolled metal sheets- design details of the algorithm developed and the complete scheme.

References:

1. Applied Digital Control – J. R. Leigh, Prentice Hall.
2. Elements of Computer Process Control – Deshpande & Ash, ISA.
3. Digital Computer Process Control – C. L. Smith, Intext Education Publishers, 1972.
4. Advanced Practical Process Control – B. Roffel and B. H. L Betlem.
5. Digital Computer Process Control - C. L. Smith, Intext Education Publishers, 1972.
6. Adaptive Control– Astrom, Pearson, 2nd Ed.
7. Supervision and Control for Industrial Processes – B. Sohlberg, Springer-Verlay, 1998.
8. Robust Process Control – Prentice Hall, 1989 – M. Murari& E. Zafirion.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Explain the importance of process mathematical modeling and study the techniques of modeling.
2. Understand the process dynamics in general and analyze it in few industrial applications.
3. Design process control system applying different linear, non-linear and soft-computing techniques.
4. Employ proper system identification technique to identify unknown system and acquire knowledge of computer control.

Subject Name: MICRO SENSOR SCIENCE AND TECHNOLOGY					
Paper Code: AEIE5202					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [13L]

Overview of Micro-Sensors Engineering Science for Design and Fabrication:

Principle of transduction; classification of micro-sensors; Chemical, thermal, pressure, acoustic, optical, electrical, mechanical, biological sensors, their calibration and determination of characteristics. Atomic structure of matter, Ions and ionization; Molecular theory of matter and intermolecular forces; Doping techniques of semiconductor; The diffusion process; Plasma Physics; ElectroChemistry: electrolysis, electrodynamics.

Module II - [12L]

Micro-Fabrication Process:

IC technology used in micro sensor system; Crystal growth and wafer making, different techniques of deposition; physical vapor deposition - evaporation, thermal oxidation, sputtering, epitaxy, Ion implantation and diffusion, LASER ablation; Chemical vapor deposition- LPCVD, APCVD, PECVD, spin coating, electrochemical deposition,

Pattern generation and transfer- masking, photolithography: Photoresists and application, light sources, photo resist development and removal; different types of etching: chemical and plasma; Overview of micro-manufacturing techniques: Bulk Micro-machining, Surface Micro-machining, LIGA.

Module III - [8L]

Materials for Micro-Sensors:

Substrates and Wafers; Silicon as substrate material; Silicon Compounds: Silicon dioxide, Silicon Carbide, Silicon Nitride and Polycystalline silicon, Silicon Piezo-resistors, Gallium Arsenide, Quartz, Piezoelectric crystals, Polymers, Langaur-Blodgett (LB) films, Packaging materials.

Module IV - [7L]

Testing and Packaging & Introduction to Smart Sensors:

Partitioning, Layout, Technology constraints, scaling, compatibility study; Scaling laws in Miniaturization. Examples of selected micro sensors. Introduction; Nature of semiconductor sensor output, information coding, integrated sensor principles, sensor networking, present trends.

References:

1. J. W Gardner, V. K. Varadan, Microsensors, MEMS And Smart Devices, Wiley, 2001.
2. Stephen Beedy, MEMS Mechanical Sensors, Artech House, 2004
3. N. P. Mahalik, *MEMS*, McGraw Hill, 2007
4. Jon Wilson, Sensor Technology Handbook, Elseiver, 2005.
5. Leondes, Cornelius T. (Ed.), Mems/Nems Handbook Techniques and Applications, Springer,
6. 2006
7. Mohamed Gad-el-Hak, *The MEMS Handbook*, CRC Press; 2nd edition, 2005.
8. B. G. Streetman and Sanjay Banerjee, Solid State Electronic Devices, Prentice Hall; 6th edition, 2005.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Application of concepts on IC fabrication in sensor and understand the role of various semiconductor material in fabrication steps.
2. Analysis of sensor structural stability and their performance index based on their diaphragms geometrical mechanics, ability to choose various material types for various micro-fabrication processes.
3. Understand various types of sensor signal conditioning circuitry in real time applied systems.

Subject Name: INSTRUMENTAL METHODS OF ANALYSIS					
Paper Code: AEIE5203					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [10L]

Classification of analytical instruments,
Basic Analysis Technique: Sample Handling System (SHS), Steam and Water Analysis System (SWAS),
Electro-Analytical methods: Electrochemical cells, Electrode potentials, Calculation of Cell potentials
Pollution Monitoring Analyzers: O2, CO, CO2, NOx, SOx measuring analyzers, Particulate Analyzer.

Module II - [8L]

Electromagnetic Radiation and Electromagnetic Spectrum.
Absorption Spectroscopy: transmittance and absorbance, Beer-Lambert law, principle of Infra-Red, Ultraviolet-Visible absorption spectrometry, effects of instrumental noise on analysis, quantitative determination of different analytes, applications in analytical chemistry, biochemistry, etc.
Flame scanner.

Module III - [10L]

Atomic spectroscopy: Introduction to spectrometric methods,
Atomic absorption and Atomic fluorescence spectrometry,
Mass spectrometry: types, principle, instrumentation, identifying elements present in a sample (Organic and inorganic),
X-Ray Spectrometry: fundamental principle, X-Ray absorption spectrometry, X-Ray fluorescence spectrometry, X-Ray monochromator, detectors, applications.

Module IV - [12L]

Gas Chromatography: fundamental of chromatographic separation, qualitative and quantitative analysis, chromatography column, instrumentation, Gas-Solid chromatography, application.
Liquid Chromatography: scope of HPLC, LC instrumentation. Applications in food, pharmaceutical, petrochemical, etc. industries.
Liquid Analyzer: Operating principle (chemistry) of liquid analyzer,
Silica, Hydrazine, TOC, Phenol, BOD and Effluent Treatment Plant (ETP) analyzer.

References:

1. Skoog, Holler and Crouch - Instrumental Analysis, Cengage Learning, India, 2007.
2. Braun R.D – Introduction of Instrumental Analysis, Pharma book syndicate, Hyderabad, 2006.
3. Khandpur R. S. – Handbook of Analytical Instruments, Tata McGraw Hill, New Delhi, 2010.
4. Willard, Merritt, Dean and Settle – Instrumental methods of Analysis, CBS publishers, New Delhi.
5. Patranabis D.- Principles of Industrial Instrumentation, Tata McGraw Hill, New Delhi

Course Outcomes:

After the completion of the course, the students will be able to:

1. Classify different spectroscopic methods and understand their use.
2. Identify different components of spectrometers and acquire knowledge about their functioning.
3. State the fundamental properties of different types of chromatography and able explain their working principle and application.
4. Give comprehensive idea about Electron microscopy.

Subject Name: EMBEDDED SYSTEMS					
Paper Code: AEIE5204					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [8L]

Introduction to Embedded Systems:
Embedded systems overview, design challenge, processor technology, IC technology, Design Technology, Trade-offs. Processors - Application Specific Instruction-Set Processors (ASIPs) – Micro Controllers and Digital Signal Processors, Special Purpose Processors, I/O devices

Module II - [8L]

Hardware and Communication Interface:
Interfacing and control - Analog I/O, Digital I/O, Bus I/O, Serial and Network I/O, Memory, Power and Display Device, Communication interfaces- RS232 / UART, RS422 / RS485, USB, Infrared, IEEE 1394 Firewire, Ethernet, IEEE 802.11, Blue tooth.

Module III - [12L]

Embedded Systems Software:
Introduction to Operating Systems, Device Drivers Timers, Memory Management, Priority inversion problem, Embedded operating systems- Embedded Linux, Real-time operating systems, RT Linux, Handheld operating systems, Debian.

Module IV - [12L]

Embedded Systems Application Design, Programming and case studies:
System Specification and Modeling, High level language descriptions in embedded system, Java based embedded system design - Simulation and Emulation of embedded systems- ARM processor based embedded boards, Raspberry- Pi, Arduino; Typical applications in Signal processing, instrumentation, control and actuation systems, etc.

References:

1. Embedded System Design: A Unified Hardware/Software Introduction – Frank Vahid, Tony D. Givargis, John Wiley, 2002.
2. Embedded Microcomputer Systems – Jonathan W. Valvano, Brooks / Cole, Thompson Learning.
3. Embedded Systems: Architecture, programming and design- Raj kamal, TMH, 2002.
4. An Embedded Software Primer – David E. Simon, Pearson Ed., 2005.
5. Embedded system design by Arnold S Burger, CMP.
6. Embedded / Real Time Systems – KVKK Prasad, Dreamtech Press, 2005.
7. Complete PCB Design using ORCAD Capture and Layout- Kraig Mitzner, Elsevier.
8. Embedded Signal Processing with the Micro Signal Architecture, Woon-Seng Gan and Sen M. Kuo, John Wiley & Sons, Inc., Hoboken, New Jersey 2007.
9. PIC Microcontroller and Embedded Systems- Mohammad Ali Mazidi, Rolind Mckinley and Danny Causey, Pearson Education.
10. Advanced PIC microcontroller projects in C- Dogan Ibrahim, Elsevier 2008.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Realize applications and design challenges of embedded systems.
2. Learn details of hardware and communication interface required in embedded systems.
3. Develop knowledge about embedded operating systems- Embedded Linux, Real-time operating systems and memory management, priority inversion problem etc. for an embedded system.
4. Learn embedded programming techniques using different processor and boards.

Subject Name: EMBEDDED SYSTEMS LAB					
Paper Code: AEIE5211					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	4	4	2

1. Introduction to MPLAB® IDE Basics
2. Experiments with GPIO devices:
   a) Input: Push Button, Push Button Interrupt, Interrupt-on-Change, Using Weak Pull Ups.
   b) Output: Light LEDs, Flash LEDs (Delay Loop), Simple Delays Using Timer0, Rotate LEDs.
3. Programming with Timers, Interrupts, Serial port.
4. Experiments with Comparator Peripherals
   a) Simple Compare
   b) Using the Comparator Voltage Reference
   c) Higher Resolution Sensor Readings Using a Single Comparator
   d) Generation of PWM.
5. Real time monitoring of voltage and displaying with LCD or seven segment display.
6. Interfacing of real time clock.
7. Program to transmit and receive a message from Microcontroller to PC serially using RS232.
8. Program to get analog input from Temperature sensor and display the temperature value on PC Monitor.
9. FIR Filter implementation in ARM/PIC Platform Design FIR filter, Implementation of FIR filter on hardware Testing and Parameter adjustment.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Design and conduct experiments with input and output devices using a microcontroller.
2. Perform programming with timers, interrupts, serial port interfacing of timers and comparators using microcontroller.
3. Interface a sensor with microcontroller and monitor its input by displaying the measured value in LCD or PC.
4. Implement PWM, FIR filter using PIC or ARM microcontrollers.

Subject Name: VIRTUAL INSTRUMENTATION LAB					
Paper Code: AEIE5212					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

1. Introduction to LabVIEW tool kit.
2. Simulation and Analysis of various signals using LabVIEW.
3. Real time data acquisition and signal conditioning (amplification, filtration etc.) from various sensors/Transducers using LabVIEW.
4. Time response analysis of a model using LabVIEW.
5. Frequency response analysis of a model using LabVIEW.
6. Root locus and Bode plots based analysis of a given system using LabVIEW.
7. Bio-signal processing using LabVIEW.
8. Study of pressure control using LabVIEW.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Handle the LabVIEW software for signal analysis.
2. Study and analyze time and frequency response of process model.
3. Acquire real time signal for processing and control.
4. Check stability by applying different stability criterion.

Subject Name: SEMINAR-II					
Paper Code: AEIE5221					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	1

The main objective of this course work is to encourage self-learning in the field of student's own interest among the emerging areas of technology. The student is expected to do an extensive literature survey in his subjects of interest and present seminar on a research problem, available methods in literature, future trends, etc. to a group of experts.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Enhance their presentation and communication skill.
2. Gain information on latest technological developments related to instrumentation, control, communication and other relevant areas related to instrumentation engineering.
3. Carry out literature survey and find out research problems.

Subject Name: DIGITAL IMAGE PROCESSING					
Paper Code: AEIE5231					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [10L]

Introduction to Digital Image Processing & Image Transforms:

Elements of digital image processing systems, Elements of visual perception, digital Image sensing, sampling and quantization, digital image representation, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals -RGB,HSI models.

2D transforms - DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD and Wavelet Transform.

Module II - [10L]

Image Enhancement and Restoration:

Basic gray level transformations, histogram processing, Smoothing and sharpening spatial filters, Image enhancement in frequency domain, Smoothing and sharpening frequency domain filters, Image restoration, Types of noises, noise reduction by spatial and frequency domain filtering, Homomorphic filtering. Image Restoration - degradation model, Unconstrained and Constrained restoration, Inverse filtering - removal of blur caused by uniform linear motion, Wiener filtering.

Module III - [10L]

Image Compression & Morphological Image Processing:

Need for data compression, Coding redundancy, Interpixel redundancy, Psycho visual redundancy, Image compression models, Error free compression, Huffman coding, Run Length coding, Shift coding, Arithmetic coding, Vector Quantization, Block truncation coding, Lossless predictive coding, Lossy predictive coding, Transform coding, Wavelet coding. Dilation and Erosion, Opening and Closing, Boundary extraction, Region filling, Convex hull, Thinning, Thickening, Skeletons, Pruning.

Module IV - [10L]

Image Segmentation, Representation, Description and Recognition:

Point Detection, Line Detection, Edge Detection, Edge linking and boundary detection. Image segmentation by region growing, region splitting and merging, edge linking. Image Recognition - Patterns and pattern classes, Feature extraction, Matching by minimum distance classifier, Matching by correlation, Cluster analysis, Overview of supervised classifiers like ANN and SVM in Image Processing.

References:

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Pearson Education, Inc., Second Edition, 2004.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall of India, 2002.
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, *Digital Image Processing using MATLAB*, Pearson Education, Inc., 2004.
4. William K. Pratt, *Digital Image Processing*, John Wiley, NewYork, 2002.
5. MilmanSonka,VaclavHlavac, Roger Boyle, *Image Processing, Analysis and Machine Vision*, Brooks/Cole, Vikas Publishing House, II ed., 1999.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Learn how images are formed, sampled, quantized and represented digitally and processed by discrete, linear, time-invariant systems.
2. Apply transformation algorithms such as DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD and Wavelet transform to any given image.
3. Compress a given image by applying lossy and loss less image coding techniques.
4. Perform image enhancement, restoration, morphological operation and segmentation of a given image.
5. Analyze a given image by extracting features from it and by using object recognition techniques.

Subject Name: INDUSTRIAL AUTOMATION TECHNOLOGY					
Paper Code: AEIE5232					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [6L]

Introduction:
Types of industrial processes and their associated control & operational requirements; Necessity and importance of automation in industry; Evolution of industrial automation – conventional and computer control of processes, control systems – elements and architecture.

Module II - [12L]

Programmable Logic Controllers:
Evolution, Function and Architecture; Modules – Types, Wiring and Interfacing; CPU and Memory; PLC Programming.
SCADA:
Elements, Features and Functions; Topology, Architecture and Communication Methods; Industry Specific (Power Transmission & Distribution / Manufacturing / Water & Sewage etc.,) Applications.

Module III - [10L]

Distributed Control Systems:
Evolution, Function and Architecture; Elements and Features; System Integration with PLC and 3rd party devices.
General Considerations:
Hierarchical Communication Model – Levels & Network Requirements; Network Access Protocols, Arbitration Methods, Transmission Media and Topology; FieldBus Technology (Profibus, Foundation Fieldbus, etc.,); Multi-level Redundancy – Concepts & Implementation.

Module IV - [12L]

Human Machine Interface:
Operator & Engineering Interface – Features, Functions and Requirements.
Trends & Practices:
Computer Integrated Manufacturing/Processing, Management Information Systems; Safety Instrumented Systems (SIS) – Risk analysis and reduction methods, SIF & SIL considerations, IEC 61508 requirements; Wireless Communication – Remote Networks, LAN, HART.

References:

1. B. G. Liptak, Instrument Engineers Handbook – Process Control, Chilton Book Co/ Butterworth-Heinemann.
2. B. G. Liptak, Instrument Engineers Handbook – Process Software & Digital Networks, CRC Press.
3. M. P. Lukas, Distributed Control Systems, Van Nostrand Reinhold Co.
4. W. Bolton, Programmable Logic Controllers, Elsevier.
5. Webb & Reis, Programmable Logic Controllers, PHI.
6. S. K. Singh, Computer Aided Process Control, PHI.

7. P. Bhatkar, Distributed Computer Control for Industrial Automation, Dekkar Publication.
8. Stuart A. Boyer, SCADA-Supervisory Control & Data Acquisition, ISA Publication.
9. Gruhn and Cheddie, Safety Shutdown Systems, ISA Publication.
10. Sunit Sen, Field Bus and Networking in Process Automation, CRC Press.

Course Outcomes:

After the completion of the course, the students will be able to:

1. List main types of industrial automation systems and industrial actuation and sensor systems.
2. Build up skills to adopt industrial control components to their automation design
3. Explore the theory of operation of SCADA and its applications
4. Learn about PLC, DCS and how they can be applied in industrial automation.
5. Develop knowledge about human machine interface, trends and practices in industries.

Subject Name: STATISTICAL AND BIO-SIGNAL PROCESSING					
Paper Code: AEIE5233					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [10L]

Introduction:

Concepts of Biostatistics. Basic statistical measures, measures of central tendency, measures of dispersion, variance, standard deviation,Analysis of variance. Biomedical signals – ECG,EEG, EMG etc., Stochastic and deterministic signals, concepts of stationary and periodicity. Discrete signals, the sampling theorem, Aliasing, Quantization error. Duality of time and frequency domain. Hypotheses testing:The null and alternative hypothesis, Types of tests.

Module II - [8L]

Regression and correlation:

Simple linear regression model, regression equation. Multiple regression and correlation model. The Autocorrelation and Auto-covariance Matrix Power Spectrum, Filtering Random Process, Special Types of Random Process-ARMV Process, AR Process, MA Process, Harmonic Process.

Module III - [14L]

Univariate signal:

Filters, Matched filters; Wiener filters Probabilistic models; Hidden Markov model; Kalman filter.

Multivariate signals:

Multivariate autoregressive model (MVAR); Formulation of MVAR model4;Formulation of MVAR model.

Module IV - [8L]

Case study-I: Application to biomedical signals

Analysis of continuous EEG signals, Single channel analysis; Multiple channel analysis: Mapping; Elimination of artifacts; sleep EEG analysis.

Case study-II: Application to biomedical signals:

Analysis of continuous ECG signals: Measurements, Processing of ECG, Artifact removal, Statistical methods and models for ECG; Heart rate variability: Time-domain methods of HRV analysis; Frequency-domain methods of HRV analysis.

References:

1. Stanton A. Glantz, Primer of Biostatistics, McGraw Hill, 2nd Ed.
2. A.K. Sharma ,Text Book of Biostatistics, DPH Mathematics series,2005
3. Monson H. Hayes, Statistical Digital Signal Processing & Modeling, John Wiley & Sons.
4. Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogon, Statistical and Adaptive Signal Processing, ARTECH HOUSE, INC., Norwood, 2005.
5. D.C. Reddy, Biomedical Signal Processing: Principles and techniques. TMH, NewDelhi,2005
6. Semmlow, Biosignal and Biomedical Image Processing, Marcel Dekker, 2004.
7. Bruce, Biomedical Signal Processing, Prentice Hall, 1993.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Calculate statistical measures such as central tendency, dispersion, variance, standard deviation, etc. of a given discrete ECG,EEG, EMG signal
2. Learn regression and correlation models and different random process such as –ARMV Process, AR Process, MA Process, Harmonic Process, etc.
3. Apply matched filter; Wiener and Kalman filter on bio-signals and develop probabilistic models, Hidden Markov models and multivariate autoregressive model (MVAR), etc.
4. Learn practical usage of ECG and EEG signal processing techniques.

7. A First Look at Graph Theory : John Clark and Derek Allan Holton (Allied Publishers Ltd.)
8. Linear Algebra : Seymour Lipschutz, Marc Lipson (SCHAUM'S Outlines, Mc Graw Hill)
9. Matrices and Linear Transformations : Charles G. Cullen (Dover)
10. Introductory Operations Research : H.S.Kasana, K.D.Kumar (Springer-Verlag)

Course Name: VLSI DEVICE & MODELLING					
Course Code : VLSI5101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Semiconductor Physics, p-n junction and BJT [8L]

Semiconductors , Conduction, Contact Potentials, P-N Junction, Modifying the simple diode theory for describing bipolar transistor, Effect of emitter and base series resistances, Effect of base-collector voltage on collector current, Bipolar device models for Circuit and Time-dependent analyses.

Module II: MOS Capacitors and MOSFETs [12L]

Band diagrams for accumulation, depletion and inversion, threshold voltage, weak, moderate and strong inversions, Pao-Sah drain-current model, Source of MOS Capacitance, Transient Response, Capacitance-Voltage curves.

Module III: Scaled MOS Transistors [12L]

Concept of scaling (field, voltage and generalized scaling), ITRS specifications, two-dimensional field patterns and Poisson's equation, charge sharing and barrier lowering, carrier mobility degradation, channel length modulation, velocity saturation, hot carrier effects (gate leakage, impact ionization)

Module IV: Compact Models [8L]

Definitions and types of compact models: physical, empirical and look-up table based models, threshold voltage-based, surface potential-based and charge-based compact models, Commercial compact models.

Text Book:

1. Fundamentals of Modern VLSI Devices by Yuan Taur & Tak H. Ning (Cambridge)

Reference Book:

2. The MOS Transistor (second edition) Yannis Ts ividi s (Oxford)
3. Compact MOSFET Models for VLSI Design by A.B. Bhattacharyya, John Wiley & Sons Pte. Ltd., IEEE Press, 2009.

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Course Name: DIGITAL IC DESIGN					
Course Code : VLSI5102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: VLSI Circuits & Physical Layout: [12L]

Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Logical Effort, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop, Pseudo NMOS Logic, Dynamic gate, Domino and NORA Logic

Unit2: CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm, Layout Legging.

Module II: VLSI Design Methodology: [8L]

Unit1: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node,

Unit2: Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX, VLSI Design Cycle, Y-Chart.

Module III: EDA Tools: High level Synthesis and HDL: [8L]

Unit1: High level Synthesis EDA Flow, Control and Data Flow Graph, Scheduling, Allocation, Binding, RTL

Unit2: Why HDL ? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), VHDL/Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, FSM Example: Mealy Machine and Moore Machine.

Module IV: EDA Tools: Logical Synthesis and Physical Design Automation: [12L]

Unit1: Combinational Logic Optimization: BDD: Binary Decision Diagram, OBDD, ROBDD, Technology Mapping: Pattern DAG, Subject DAG, Sequential Logic Optimization

Unit2: Physical Layout Automation EDA Flow, Partitioning: KL Algorithm, Floor-planning cost function, Placement, Detailed Routing: Channel Routing, Horizontal Constraint Graph, Vertical Constraint Graph, Cyclic Constraint, Left-edge Algorithm, Global Routing: Steiner Tree, Maze Routing.

Text Book:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. Algorithms for VLSI Physical Design Automation, Author: N. Sherwani, KLUWER ACADEMIC PUBLISHERS (3rd edition)

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Reference Book:

3. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006
4. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
5. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
6. VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011
7. Algorithms for VLSI Design Automation, Author: Gerez, Wiley, 2011
8. A VHDL Primer, J. Bhasker, Prentice-Hall, 2013

Course Name:	**MICROELECTRONICS TECHNOLOGY AND IC FABRICATION**				
Course Code	**: VLSI5103**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Clean Room Technology and Oxidation [12L]

Unit1: Clean room concept- growth of single crystal from melt, surface contamination, cleaning and etching by solvent method and RCA clean.

Unit2: Growth mechanism and kinetics of oxidation, oxidation techniques and systems, oxide properties, oxide induced defects, characterization of oxide films use of thermal oxide and CVD oxide, growth and properties of dry and wet oxides, dopant redistribution, oxide quality. Etching Technology, Different kind of Interconnects, Concept of VIA.

Module II: Diffusion and ion implantation [10L]

Unit1: Diffusion: Fick's equation, atomic diffusion mechanisms, measurement techniques, diffusion in polysilicon and silicon dioxide diffusion systems.

Unit2: Ion Implantation: Range theory, equipments, annealing, shallow junction, high energy implantation.

Module III: Lithography, Deposition and Metallization [12L]:

Unit1: Lithography: Optical lithography, some advanced lithographic techniques

Unit2: Physical vapor deposition: APCVD, Plasma CVD, MOCVD

Unit3: Metallization: different types of metallization, uses and desired properties

Module IV: Process Integration [6L]:

MOSFET technology and MESFET Technology, IC manufacturing, future trends and challenges, SOI fabrication,

Text Book:

1. Semiconductor Devices Physics and Technology, Author: Sze, S.M.; Notes: Wiley, 1985
2. VLSI Technology 2ND Edition, Author: Sze, S.M.; MCGRAW HILL COMPANIES

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Reference Book:

3. An Introduction to Semiconductor Microtechnology, Author: Morgan, D.V., and Board, K
4. The National Technology Roadmap for Semiconductors , Notes: Semiconductors Industry Association, SIA, 1994
5, Electrical and Electronic Engineering Series VLSI Technology, Author: Sze, S.M. Notes: Mcgraw-Hill International Editions

Course Name: EMBEDDED SYSTEMS					
Course Code : VLSI5131					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I : Introduction to embedded systems: [8L]

Embedded systems overview with various type of examples in different domains such as in communication systems, robotics application and in control application, Design challenge – optimizing design metrics, embedded processor technology, Difference between embedded computer systems and general purpose computer Systems, Design methodology.

Module II: Embedded system processor design: [12L]

Custom single-purpose processors design: using finite state machine model and RTL model.
Standard single-purpose processors design: Timers, and watchdog timers, LCD controller.
Interfacing of Embedded Processors: Hardware protocol basics, interfacing with a general-purpose processor, RS232, I2C, CAN protocol.

Module III: [10L]

Introduction to 8051 microcontroller: 8051 architecture, pin configuration, I/O ports and Memory organization. Instruction set and basic assembly language programming. Interrupts, Timer/Counter and Serial Communication in 8051, Introduction to PIC & ARM micro-controllers.

Module IV: [10L]

Interfacing with Memory & I/O Devices:

Different types of embedded memory devices and interfacing: SRAM, DRAM, EEPROM, FLASH, CACHE memory. Different types of I/O devices and interfacing: Keypad, LCD, VGA. Square wave and pulse wave generation, LED, A/D converter and D/A Converter interfacing to 8051.

Text Book:

1. Embedded System Design: A Unified Hardware/Software Approach – 2nd Ed Frank Vahid and Tony Givargis

Reference Book:

2. Computers as Components: Principles of Embedded Computing System Design – 2nd Ed Wayne Wolf.

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Course Name: DIGITAL COMMUNICATION TECHNOLOGY					
Course Code : VLSI5132					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: [10L]
Review of baseband digital signal transmission –PCM DM ADM ADPCM. Inter Symbol Interference (ISI), Nyquist criteria for no ISI in band limited channel, Eye Diagram & interpretation, Error Vector Magnitude, Error coding techniques, Viterbi decoding.
Parametric decoding: Sub band coding APC LPC voice excited vocoder
Synchronization – Symbol and Frame synchronization
Equalizer: Linear equalization Decision feedback equalizer iterative equalizer and decoding

Module II: [10L]
Digital Modulation:
Review of modulation schemes – BPSK DPSK QPSK M-ary PSK QASK MSK BFSK M-ary FSK - principles transmitters receivers signal space presentation bandwidth efficiency
GMSK Orthogonal frequency division multiplexing (OFDM) – principle generation and detection
Bit error performance of bandpass signal – Narrow band noise model Error performance of different shift keying techniques like BPSK, Comparison of bandwidth efficiency and error performance of modulation schemes

Module III: [9L]
Multiplexing and multiple access: TDM/TDMA FDM/FDMA Space DMA ALOHA – slotted ALOHA and reservation ALOHA CSMA-CD CSMA- CA basic techniques and comparative performances
Spread spectrum modulation: Principle of DSS, processing gain jamming margin single tone interference probability of error
Principle of frequency hopped spread spectrum (FHSS) – slow frequency and fast frequency hopping
Principle of CDMA Multiple access interference (MAI) and limit of simultaneous users
Digital cellular CDMA system – forward and reverse link error rate performance

Module IV: [9L]
Optimum Detection and Estimation:
Noise vector in signal space Bayes detection of received signal, optimum M-ary receiver design
Decision region and minimum error probability
Matched filter, Optimum detection of 16 QAM signal, MPSK signal orthogonal and bi orthogonal signal
Decision criterion: maximum likelihood Neyman Pearson and Minimax decision criterion
Estimation: Linear estimation – simple mean Linear mean squared error Wiener filter
Non linear estimation: Bayes estimation MAP ML estimates

Text Book:
1. Digital Communications 4th edition J G Proakis MGH international Edition

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Reference Book:
2. Principle of Communication Systems Taub and Schilling 7th edition TMH
3. Digital Communications :Fundamentals and Applications 2nd edn 2008 Bernard Sklar and Pabitra Kumar Ray Pearson Education
4. Principle of Digital Communications Simon Haykin Wiley Student Edition
5. Digital Communications Zeimer and Tranter CRC Press
6. Wireless Communication & Networks: 3G & Beyond Iti Saha Mishra, McGraw-Hill Education, 2nd Edition

Course Name: VLSI Frontend Design & CAD Tools					
Course Code : VLSI 5111					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

List of Experiments:

1. Introduction to **XILINX-ISE Simulator, VHDL Coding and Test Bench** Simulation
    a. Logic Design and Verification of a 15 bit Ripple-Carry Adder
    b. Logic Design and Verification of a universal shift register
    c. Logic Design and Verification of a Finite State Moore Machine
    d. Logic Design and Verification of a Finite State Mealy Machine
    e. Design of hand shake protocol to establish Communication between Master and Slave
2. **FPGA Programming Flow** using XILINX Kits: Implementing and verifying many of above experiments in FPGA hardware Kits.

Course Name: VLSI Backend Design & Technology CAD Tools					
Course Code : VLSI 5112					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

List of Experiments:
Sub Micron and Deep Sub Micron Technology based Experiments:

1) Introduction to **Tanner Design & Layout Tools** and **SPICE** Analysis
    a. Transient analysis of CMOS Inverter Circuit
    b. DC & Parametric analysis of CMOS Inverter
    c. Layout Design and Verification Using Tanner Tools
2) Introduction to **Cadence Virtuoso & Assura Tools**
    a. Transient, DC, Parametric analysis of CMOS Inverter
    b. Implementation of Various Logic gates using Advanced CMOS technology
    c. Layout design and Verification Using Cadence: Std Cell Layout
    d. Parasitic Extraction, Back-annotation and Post Layout Timing Analysis Using Cadence
3) Introduction to **TCAD Synopsys** Device and Process Simulator: Nano Technology

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1st Year 2nd Semester:

Course Name:	**VLSI PROCESSOR ARCHITECTURE**				
Course Code	**: VLSI5201**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Fundamentals: [8L]
Architecture organization, basic structure of instruction set architecture (ISA arch) and Flynn's taxonomy. Comparison of Von-Neumann and Harvard architecture, Microcoded and hardwired control architecture, scalar and Vector processors architecture, CISC and RISC architecture. Basic of pipelining, pipeline hazards and solutions.

Module II: The DSP and Its Impact on Technology: [12L]
Parallel computation using superscalar architecture, description of the very long Instruction word architecture (VLIW arch) , detail description of TI TMS320C5x DSP processor architecture.

Module III: Accelerator :[10L]
Need for accelerators, Accelerators and different types of parallelism, Processor architectures and different approaches to acceleration. General-Purpose Embedded Processor Cores: The ARM.

Module IV: Multiprocessor and multithreaded processor [10L]
Utilization of course-grain parallelism, chip-multiprocessors, multithreaded processors, SMT processor, A benefits analysis of processor customization, Using microprocessor cores in SOC design, Benefiting from microprocessor extensibility, how microprocessor use differs between SOC and board-level design

Text Book:
1. Computer Architecture: Pipelined and Parallel Processor Design – 2nd Ed Michael J. Flynn

Reference Book:
2. Digital Signal Processors: Architecture, Programming and Applications - B. Venkataramani, M. Bhaskar
3. ARM System-on-Chip Architecture – 2nd Ed Steve Furber
4. Computer System Design: System-on-Chip – 1st. Ed Michael J. Flyn, Wayne Luk

Course Name:	**VLSI DESIGN VERIFICATION AND TESTING**				
Course Code	**: VLSI5202**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: VLSI Memory Design: [12L]
Types of Memory, Memory Organization, Memory Folding Criteria, Memory Cell Design Method for Write and Read Operation, Critical Path Analysis & Memory Access Time, DRAM 4T, 3T, 1T Cell Design Method, SRAM 8T, 6T Cell Design Method, Sense Amplifier Operation, Multiport Register File Design Challenges, Mask ROM, ROM Programming Techniques, Flash ROM

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Module II: VLSI Interconnect Design: [6L]
Component of Interconnect, Interconnect Cross Section, Wire material, Interconnect Modelling, Interconnect Design Issues and WirePlan: Capacitance, Delay, Lumped Model vs Distributed Model, RC Scaling, Repeater, Interconnect Power, Interconnect Noise: Coupling, Cross Talk

Module III: VLSI Verification Flows and Static Timing Analysis: [12L]
Unit1: Logic Verification, Circuit Verification, Layout Verification (DRC, LVS), pre-layout simulation, parasitic Extraction and Back-annotation, post layout verification,
Unit2: Timing checks (set-up, hold), process variation study with PVT analysis, Library Cell characterization, Static Timing Analysis: Types of Path for Timing Analysis, Launch path, Capture Path, Longest Path, Shortest Path, Critical Path, Clock Skew

Module IV: Si-Testing: [10L]
Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Combinational Circuit Testing: Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, Path Delay Fault, Sequential Circuit Testing: DFT, Scan Design, SFF, LSSD-SSF, BIST

Text Book:
1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. VLSI Test Principles and Architectures, Design for Testability, Author: Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, The Morgan Kaufmann series in Systems on Silicon. 2006 Elsevier

Reference Book:
3. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
4. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall

Course Name: ANALOG IC DESIGN					
Course Code : VLSI5203					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: CMOS OPAMP Circuits: [12L]
Unit1: CMOS models for analog circuits - Small signal equivalent circuit, temperature effect and sensitivity, overview of electrical noise. Analog sub-circuits : CMOS switch, resistors, current source, sink, current mirror, voltage and current references.

Unit2: CMOS Amplifiers & CMOS Operation Amplifiers : Basic concepts , Performance Parameters , Single Stage OPAMP, Two stage OPAMP, Stability and Phase compensation, Cascode OPAMP

Unit3: Comparators: Characterisation, Two stage open loop comparators, Discrete time comparators , high speed comparator circuits , CMOS S/H circuits

Module II: RF Analog Circuits & Sub-circuits: [8L]
Capacitors and Inductor s in VLSI circuits , Bandwidth estimation techniques, Design of high frequency amplifiers , Design of low noise amplifiers ,Design of Mixers of RF power amplifiers , Architectures of RF receivers and transmitters.

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Module III: Data Converter Fundamentals & Architecture: [10L]
Ideal D/A converters, Ideal A/D converter, Serial and Flash D/A converters and A/D converters, Medium and High Speed converters, Over-sampling converters, performance limitations, Design considerations.

Module IV: Special Circuits: [10L]
Unit1: Switched Capacitor circuits: General considerations, Resistor simulation using different Switched Capacitor topologies, Switched Capacitor integrators, First and second order switched capacitor filter circuits.

Unit2: CMOS voltage controlled oscillators, Phase locked loops, Ring oscillators.

Text Book:
1. CMOS Analog Circuit Design (second edition) Phillip E. Allen and Douglas R. Holberg (Oxford)

Reference Book:
2. The MOS Transistor (second edition) Yannis Tsividi s (Oxford)

Course Name: ADVANCED MICRO AND NANO DEVICES					
Course Code : VLSI5231					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Leakage Current Mechanisms and Reduction (6+6=12L)
Unit 1: Sub-threshold leakage, band-to-band leakage, gate-oxide tunneling, gate-induced-drain leakage etc.

Unit 2: High-K gate dielectric and Metal-gate technology: Concept of EOT, leakage current control, use of various high-K oxides, work function engineering, Fermi-level pinning.

Module II: SOI MOSFETs [6L]

Partially-depleted SOI, Fully-depleted SOI, Advantages and disadvantages of SOI structure.

Module III: Multigate Structures [12L]

DG-MOSFETs, TRI Gate MOSFETs, FinFETs, Surround gate MOSFETs, Omega Gate MOSFETs, Volume inversion, Random Dopant Fluctuation, Concept of undoped body, Underlap device structure, Symmetry and asymmetry MOSFET structure.

Module IV: Hetero Structures and Quantum Well devices [10L]

Quantization and low-dimensional electron gas, band alignment in Si/SiGe hetero-structures, HEMTs, Carbon Nano-tube, Graphene device.

Text Book:
1. The MOS Transistor (second edition) Yannis Tsividis (Oxford)

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Reference Book:

2. Fundamentals of Modern VLSI Devices by Yuan Taur & Tak H. Ning (Cambridge)
3. FinFETs and Other Multi-Gate Transistors by J.P. Colinge, Springer, 2008.

Course Name : DSP ALGORITHMS FOR VLSI SYSTEM DESIGN					
Course Code : VLSI5232					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: **DSP Algorithms: [14L]**
Typical DSP Algorithms, Adaptive Filters, Discrete Cosine Transform, Vector Quantization, Viterbi Algorithm, Decimator & Expander, Wavelet Transform, Filter Banks.

Module II: **Iteration Bound: [8L]**
Signal-flow graph, Data-flow graph, Dependence graph, Critical path, Loop & Iteration bounds, Computation of iteration bound .

Module III: **Pipelining and Retiming Techniques: [8L]**
Fine-grain pipelining of FIR filter, Low power aspects for pipelining and parallel processing, Cutset retiming, Clock period and Register minimizations.

Module IV: **Unfolding Algorithms: [10L]**
SISO and MIMO systems, properties of unfolding, sample period reduction, word and bit level parallel processing.

Text Book:

1. VLSI Digital Signal Processing Systems: Design and implementation
Keshab K Parhi, Wiley India, 2008

Reference Book:

2. DSP Processor Fundamentals: Architectures and Features, Phil Lapsley, Jeff Bier, Amit Shoham, Edward Lee, Wiley – IEEE Press, Jan, 1997
3. Computer Architecture – A Quantitative Approach, John L Hennessy, David A. Patterson,, Elsevier, 2012.

Course Name: LOW POWER VLSI CIRCUIT AND SYSTEM					
Course Code : VLSI5241					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Dynamic Power Reduction: [12L]
Unit1: Introduction: Why Low Power ? Definition of dynamic power, Transition probability, Signal probability, Transition probability of basic gates, Glitch power, source of switching capacitance

Unit2: Dynamic Power reduction with Vdd, Delay vs Power Trade-off, Dual Vdd, Dynamic Voltage Scaling (DVS), Dynamic Power Management, Capacitance Scaling, Transistor sizing, Transition probability reduction by clock gating, Logic restructuring, Input Reordering, Glitch reduction

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Module II: Standby Power Reduction: [12L]
Unit1: Leakage power definition, Gate Leakage, Channel Leakage, Junction Leakage. Channel leakage issue with Threshold Scaling, Leakage vs Dynamic power

Unit2: Technology Solution of Gate Leakage reduction: High-K, FinFET, Channel leakage reduction techniques: Multiple Threshold Voltage, Long Channel Transistor, Device Downsizing, Stacking, Power Gating, Dual Vdd, Dynamic Body-Biasing, Technology Solution: FinFET

Module III: Short Circuit Power Reduction: [6L]
Definition, Dependency on Load Capacitance, Various reduction techniques

Module IV: Power **Reduction at Various Design Phase: [10L]**
System level, Algorithm level, Architecture Level (Parallel vs Pipeline), Gate level, transistor level, Power Analysis Tool, Low Power Memory Circuit Example on DRAM, SRAM, ROM, Power issue with Dynamic Gates: Floating node and Keeper Solution.

Text Book:

1. Practical Low Power Digital VLSI Design, Author: Gary Yeap, KLUWER ACADEMIC PUBLISHERS, 2010

Reference Book:

2. Low Power CMOS VLSI Circuit Design, Author: Kuashik Roy and Sharat Prasad, John Wiley & Sons, Inc. 2009

Course Name: SENSORS					
Course Code : VLSI 5242					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: [10L]
Principles of Physical and Chemical Sensors: Sensor classification, Sensing mechanism of Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological Sensors. Sensor Characterization and Calibration: Study of Static and Dynamic Characteristics, Sensor reliability, aging test, failure mechanisms and their evaluation and stability study.

Module II [10L]
Sensor Modeling: Numerical modeling techniques, Model equations, Different effects on modeling (Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological) and examples of modeling. Sensor Design and Packaging: Partitioning, Layout, technology constraints, scaling.

Module III [10L]
Sensor Technology: Thick and thin films fabrication process, Micro machining, IOC (Integrated Optical circuit) fabrication process, Ceramic material fabrication process, Wire bonding, and Packaging. Sensor Interfaces: Signal processing, Multi sensor signal processing, Smart Sensors, Interface Systems. Sensor Applications: Process Engineering, Medical Diagnostic and Patient monitoring,

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Module IV [10L]

MEMS: Introduction, Scaling, MEMS Markets and Applications MEMS materials and fabrication methods, with emphasis on silicon micromachining, Process simulation: basic lithography, deposition, and etching processes for MEMS.

Text Book:

1. AN INTRODUCTION TO MICROELECTROMECHANICAL SYSTEMS ENGG. BY NADIM MALUF & K WILLIAMS, ARTECH HOUSE

Reference Book:

2. RF MEMS THEORY DESIGN AND TECHNOLOGY BY G.M.REBEIZ, WILEY

Course Name: Analog VLSI Design Laboratory					
Course Code : VLSI 5213					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

List of Experiments:

Sub Micron and Deep Sub Micron Technology based Experiments:

1) **Cadence Virtuoso and Assura Tool** Based Analog Experiments
    a. MOS as Resistors, Current Source, Sink, Current Mirror
    b. DC, Transient and AC analysis of Single Stage Amplifier
    c. Layout Design and Verification of Single Stage Amplifier
    d. Circuit and Layout design of Differential Amplifier
    e. Circuit and Layout design of Operational Amplifier
    f. ADC/DAC Design
2) Introduction to **Texas Instruments Analog System Laboratory Starter Kits** (ASLK)

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1st Year 2nd Semester:

Course Name: VLSI PROCESSOR ARCHITECTURE					
Course Code : VLSI5201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Fundamentals: [8L]
Architecture organization, basic structure of instruction set architecture (ISA arch) and Flynn's taxonomy. Comparison of Von-Neumann and Harvard architecture, Microcoded and hardwired control architecture, scalar and Vector processors architecture, CISC and RISC architecture. Basic of pipelining, pipeline hazards and solutions.

Module II: The DSP and Its Impact on Technology: [12L]
Parallel computation using superscalar architecture, description of the very long Instruction word architecture (VLIW arch) , detail description of TI TMS320C5x DSP processor architecture.

Module III: Accelerator :[10L]
Need for accelerators, Accelerators and different types of parallelism, Processor architectures and different approaches to acceleration. General-Purpose Embedded Processor Cores: The ARM.

Module IV: Multiprocessor and multithreaded processor [10L]
Utilization of course-grain parallelism, chip-multiprocessors, multithreaded processors, SMT processor, A benefits analysis of processor customization, Using microprocessor cores in SOC design, Benefiting from microprocessor extensibility, how microprocessor use differs between SOC and board-level design

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Text Book:
1. Computer Architecture: Pipelined and Parallel Processor Design – 2nd Ed Michael J. Flynn

Reference Book:
2. Digital Signal Processors: Architecture, Programming and Applications - B. Venkataramani, M. Bhaskar
3. ARM System-on-Chip Architecture – 2nd Ed Steve Furber
4. Computer System Design: System-on-Chip – 1st. Ed Michael J. Flyn, Wayne Luk

Course Name: VLSI DESIGN VERIFICATION AND TESTING					
Course Code : VLSI5202					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: VLSI Memory Design: [12L]
Types of Memory, Memory Organization, Memory Folding Criteria, Memory Cell Design Method for Write and Read Operation, Critical Path Analysis & Memory Access Time, DRAM 4T, 3T, 1T Cell Design Method, SRAM 8T, 6T Cell Design Method, Sense Amplifier Operation, Multiport Register File Design Challenges, Mask ROM, ROM Programming Techniques, Flash ROM

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Module II: VLSI Interconnect Design: [6L]
Component of Interconnect, Interconnect Cross Section, Wire material, Interconnect Modelling, Interconnect Design Issues and WirePlan: Capacitance, Delay, Lumped Model vs Distributed Model, RC Scaling, Repeater, Interconnect Power, Interconnect Noise: Coupling, Cross Talk

Module III: VLSI Verification Flows and Static Timing Analysis: [12L]
Unit1: Logic Verification, Circuit Verification, Layout Verification (DRC, LVS), pre-layout simulation, parasitic Extraction and Back-annotation, post layout verification,
Unit2: Timing checks (set-up, hold), process variation study with PVT analysis, Library Cell characterization, Static Timing Analysis: Types of Path for Timing Analysis, Launch path, Capture Path, Longest Path, Shortest Path, Critical Path, Clock Skew

Module IV: Si-Testing: [10L]
Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Combinational Circuit Testing: Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, Path Delay Fault, Sequential Circuit Testing: DFT, Scan Design, SFF, LSSD-SSF, BIST

Text Book:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. VLSI Test Principles and Architectures, Design for Testability, Author: Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, The Morgan Kaufmann series in Systems on Silicon. 2006 Elsevier

Reference Book:

3. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
4. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall

Course Name: ANALOG IC DESIGN					
Course Code : VLSI5203					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: CMOS OPAMP Circuits: [12L]
Unit1: CMOS models for analog circuits - Small signal equivalent circuit, temperature effect and sensitivity, overview of electrical noise. Analog sub-circuits : CMOS switch, resistors, current source, sink, current mirror, voltage and current references.

Unit2: CMOS Amplifiers & CMOS Operation Amplifiers : Basic concepts , Performance Parameters , Single Stage OPAMP, Two stage OPAMP, Stability and Phase compensation, Cascode OPAMP

Unit3: Comparators: Characterisation, Two stage open loop comparators, Discrete time comparators , high speed comparator circuits , CMOS S/H circuits

Module II: RF Analog Circuits & Sub-circuits: **[8L]**
Capacitors and Inductor s in VLSI circuits , Bandwidth estimation techniques, Design of high frequency amplifiers , Design of low noise amplifiers ,Design of Mixers of RF power amplifiers , Architectures of RF receivers and transmitters.

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References :

1. Stochastic Processes : J. Medhi (New Age International)
2. Introduction to Stochastic Processes : Paul G. Hoel, Sidney C. Port, Charles J. Stone (Universal Book Stall)
3. Stochastic Processes : Sheldon M. Ross (Wiley Series in Probability and Mathematical Statistics)
4. Graph Theory with Applications to Engineering and Computer Science : N. Deo (PHI Learning Pvt. Ltd.)
5. A First Look at Graph Theory : John Clark and Derek Allan Holton (Allied Publishers Ltd.)
6. Linear Algebra : Kenneth M. Hoffman, Ray Kunze (Prentice-Hall)
7. Linear Algebra : Seymour Lipschutz, Marc Lipson (SCHAUM'S Outlines, Mc Graw Hill)
8. Matrices and Linear Transformations : Charles G. Cullen (Dover)
9. Engineering Optimization : Singiresu S. Rao (New Age International Publishers)
10. Introductory Operations Research : H.S.Kasana, K.D.Kumar (Springer-Verlag)

Course Name: ADVANCED DIGITAL COMMUNICATION					
Course Code : ECEN 5101					
Contact Hours	L	T	P	Total	Credit Points
per week	4	0	0	4	4

Module – I [10 L]
Review of random variables and random processes
Review of baseband digital signal transmission –PCM DM ADM ADPCM. Inter Symbol Interference (ISI)
Nyquist criteria for no ISI in bandlimited channel
Parametric decoding: Sub-band coding APC LPC voice excited vocoder
Synchronization – Symbol and Frame synchronization
Equalizer: Linear equalization Decision feedback equalizer iterative equalizer and decoding

Module – II [10 L]
Digital Modulation:
Review of modulation schemes – BPSK DPSK QPSK M-ary PSK QASK MSK BFSK M-ary FSK – principles transmitters receivers signal space presentation bandwidth efficiency
GMSK Orthogonal frequency division multiplexing (OFDM) – principle generation and detection
Bit error performance of bandpass signal – Narrow band noise model Error performance of BASK BPSK
BFSK MSK Comparison of bandwidth efficiency and error performance of modulation schemes

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Module – III [9 L]

Multiplexing and multiple access : TDM/TDMA FDM/FDMA Space DMA ALOHA –slotted ALOHA and
reservation ALOHA CSMA-CD CSMA- CA basic techniques and comparative performances
Spread spectrum modulation: Principle of DSS, processing gain jamming margin single tone interference
probability of error
Principle of frequency hopped spread spectrum (FHSS) – slow frequency and fast frequency hopping
Principle of CDMA Multiple access interference (MAI) and limit of simultaneous users
Digital cellular CDMA system – forward and reverse link error rate performance

Module – IV [9 L]

Optimum Detection and Estimation:
Noise vector in signal space Bayes detection of received signal, optimum M-ary receiver design
Decision region and minimum error probability
Optimum detection of 16 QAM signal, MPSK signal orthogonal and bi orthogonal signal
Decision criterion: maximum likelihood Neyman Pearson and Minimax decision criterion
Estimation: Linear estimation – simple mean Linear mean squared error Wiener filter
Non linear estimation: Bayes estimation MAP ML estimates
Introduction to source coding (Hofmann and Shanon).
Introduction to error control coding (Linear Block Code and Convolution).

References:

1. Digital Communications 4th edition J G Proakis MGH international Edition
2. Principle of Communication Systems Taub and Schilling 7th edition TMH
3. Digital Communications :Fundamentals and Applications 2nd edn 2008 Bernard Sklar and Pabitra Kumar Ray Pearson Education
4. Principle of Digital Communications Simon Haykin Wiley Student Edition
5. Digital Communications Zeimer and Tranter CRC Press
6. Analog and digital Communication, B.P. Lathi, Oxford University Press.

Course Name: ADVANCED DIGITAL SIGNAL PROCESSING (DSP)					
Course Code : ECEN 5102					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Prerequisite: The student must be conversant with frequency domain analysis of discrete time signals and systems. They will be familiar with the various kind of adaptive filter design technique. Multirate Signal Processing fundamentals and applications of Wavelet Transforms will be covered.

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Module I: [10 L]

Frequency Domain Analysis of Discrete Time Domain Signals and Systems: 6L
The concept of frequency in continuous time and discrete time signals. Fourier series for discrete periodic signals, Fourier Transform of discrete aperiodic signals, Power spectral densities of discrete aperiodic signals, Relationship between Fourier Transform and Z-Transform. Properties of Fourier Transform in discrete time domain; Time reversal, convolution, correlation, Wiener-Khintchine theorem, frequency shifting, modulation, windowing theorem, differentiation in digital frequency domain.
Symmetry property for various types of signals.

Module II: [10 L]
Frequency Domain Characteristics of LTI Systems
Response to complex exponential signals, steady state and transient response to sinusoidal signals, steady state response to periodic signals, response to aperiodic signals. Relation between system function H (z) and frequency response function h
(w). Input-output correlation function and spectra, correlation functions and power spectra for random input signals.
Invertibility of LTI systems, minimum/maximum/mixed phase systems, homomorphic systems and homomorphic deconvolution.
DFT & FFT
Computation of DFT and it's properties, computation of DFT via FFT, chirp z-transform.

Module III: [9 L]

Design of Digital Filters
Design of FIR filters, Effect of various windows, Effect of finite register length, statistical analysis, stability effect, frequency sampling, Optimization Algorithm.
Adaptive Filters design, Single input, multiple input, State-Space Kalman Filter, Extended Kalman Filter, Unscented Kalman Filter Sample-Adaptive Filters,
Recursive Least Square (RLS) Adaptive Filters, The Steepest-Descent Method, LMS Filter.
Power Spectrum
Estimation of Power Spectrum and Correlation, Non-parametric and Parametric methods, Minimum Variation Estimation methods, Eigen Analysis algorithm, Power Spectrum analysis using DFT, Maximum Entropy Spectral Estimation, Model-Based
Power Spectral Estimation.

Module IV: [9 L]

Multirate Signal Processing
Sampling Rate Conversion; Decimation and Interpolation; Time and Frequency Domain Characterization; Filters in Sampling
Rate Alteration Systems; Multi-rate Design of Decimator and Interpolator; Poly-phase Techniques; Poly-phase Down-sampler
and Interpolator; Poly-phase Filter Design; Two-channel QMF Banks. Alias free FIR and IIR QMF Banks; Perfect Reconstruction
Two-channel FIR Filter Banks; M-Channel Filter Banks Design; Cosine-Modulated M-channel Filter Banks Design;
Wavelet Transforms
Fourier Transform and its limitations, Short Time Fourier Transform, Continuous Wavelet Transform, Discretization of the Continuous Wavelet Transform, Multiresolution Approximations; Wavelet and Scaling Function Coefficients, Orthonormality of

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Compactly Supported Wavelets, Bi-orthogonal Decomposition, Harr Wavelets, The Daubechies Wavelets Construction, Fast Wavelet Transform and Image Compression, Denoising using Wavelets, Perfect Reconstruction Filter bank design using Wavelets.

References:

1. Discrete – Time Signal Processing by A.V. Oppenheim and R. W. Schafer, with J. R. Buck (Prentice- Hall, 1998)
2. Digital Signal Processing Using MATLAB by V. K. Ingle and J. G. Proakis (Books/Cole,2000)
3. Digital Signal Processing: A Computer Based Approach by S.K. Mitra (Second edition , McGraw-Hill, 2001)
4. Digital Signal Processing: Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis.
5. Digital Filter Design and Analysis, Antino, TMH.
6. Digital Signal Processing- Rabiner and Gold, PHI.

Course Name: ADVANCED MICROWAVE COMMUNICATION					
Course Code : ECEN 5103					
Contact Hours	L	T	P	Total	Credit Points
per week	4	0	0	4	4

Module1 I [10 L]

Microwave and millimeter wave devices:

- Limitations of microwave vacuum tubes.
- Advances in microwave and millimeter wave solid state devices, Gunn devices, oscillator using Gunn diode, and injection locked oscillators, IMPATT devices, and microwave and mm wave performance of IMPATT.
- Other solid state devices like Tunnel diode, BARITT and TRAPAT, MESFET.

Module II [10 L]

Microwave and mm wave circuits:

- Review of scattering matrix concept in the light of vector network analyzer, impedance matching network, couplers, power dividers, resonators and filters.
- Detectors, mixers, attenuators, phase shifters, amplifier and oscillator
- Ferrite based circuits.
- Switch, mixer circuits using PIN diodes.

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Module III [9 L]

Antennas:

- Hertzian dipole, loop antenna, helical antenna, frequency independent antenna: log spiral and log periodic dipole antenna array.
- Babinet principle, waveguide slot antenna, microstrip antenna, horn antenna, parabolic reflector.
- Antenna arrays and phased array antenna.

Module IV [9 L]

Microwave and mm wave propagation:

- Overview of basic radio wave propagation mechanisms, Friis transmission formula, plane earth propagation model, troposcatter systems, ionosphere propagation, duct propagation, microwave radio link and calculation of link budget.
- Effect on radio wave propagation due to rain, fog, snow, ice, atmospheric gases, Earth's magnetic field.

References:

1) P Bhartia & I J Bahl, Millimeter wave engineering and Applications, John Wiley & Sons
2) David M Pozar, Microwave Engineering, John Wiley & Sons
3) R E Collin, Antenna & Radio wave Propagation, McGraw Hill Book Co.
4) C A Balanis, Antenna Theory: Analysis and Design, John Wiley & Sons
5) U.S.N Raju, Antenna and Wave propagation- Pearson.
6) M.L.Sisodia, Microwave vacuum and semiconductor devices, New Age Publishers.

Course Name:	ADVANCED COMPUTER COMMUNICATION & NETWORKING				
Course Code	: ECEN 5131				
Contact Hours	L	T	P	Total	Credit Points
per week	4	0	0	4	4

Module I: [10 L]

Introduction - Motivation, goals, applications and classification of computer networks, common networks and standard organizations

Network Structure and Architecture- Network structure-concept of subnet, backbone and local access, Channel sharing techniques- FDM, TDM. Circuit and packet switching. Topological Design of a network.

Network architecture layering concept, OSI Reference Model, OSI Services and protocols

Physical layer - bit communication between DTE and DCE, RS232, transmission media, modems.

Module II: [12 L]

Data link layer - error detection and correction, retransmission strategies, stop and wait protocol, sliding window protocols, pure Aloha protocols, slotted Aloha protocol, CSMA protocols, CSMA / CD and CSMA / CA protocol, HDLC.

LANs and their Interconnection - Basic concepts and IEEE standards, Architecture, protocol, management and performance of Ethernet, token ring and token bus LANs, WLAN, Bluetooth, LAN interconnection - repeaters and bridges, Transparent and source routing bridges and their relative advantages and disadvantages.

Network layer - basic design issues, network layer services, connection oriented and connection less services, routing – static, dynamic, stochastic, flow based routing, optimal routing, Quality of service, congestion control, Leaky Bucket Algorithm

Transport layer- process to process delivery, TCP, UDP.

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Module III: [8 L]

Internetworking- motivation, goals and strategies, Routers and gateways, TCP / IP model, IP addressing, important features of IPv6.
Application layer – DNS, SMTP, FTP, HTTP, WWW

Module IV: [8 L]

Network security -Cryptographic principle, DES, AES, RSA, Digital signature, Security in internet, VPN, Firewalls.
Network management system - SNMP.
Advance Protocol-RTP, SIP.

References:

1. B. A. Forouzan, Data Communication and Networking, Tata Mc-Graw Hill.
2. W. Stallings, Data and Computer Communication, 5th Ed. PHI, 1998.
3. A. S. Tanenbaum, Computer Networks, Prentice-Hall India.
4. Miller, Data Communication and Networks, Vikas.
5. A. Leon-Garcia, Communication networks, Tata Mc-Graw Hill.
6. G. E. Keiser: Local Area Network, McGraw Hill. 1989.
7. D. Bertsekas and R. Gallagher: Data Networks, 2nd Ed. PHI, 1992.
8. F. Halshall: Data Communication, Computer Network and Open Systems, 3rd Ed. Addison Wesley, 1992.
9. D. Russell: The Principles of Computer Networking, Cambridge University Press, 1989.
10. M. Schwartz: Computer Communication network Design and Analysis, PHI, 1977

Course Name: TELECOMMUNICATION SYSTEMS & ENGINEERING					
Course Code : ECEN 5132					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: Telephone Network [12 L]

• Introductory terminology;
Grade of Service, QoS, Blocking Network, Lost call handling. Erlang and Poisson Traffic formulas one-way and both-way circuits.
• Local Networks – subscriber loop design, shape and size of a serving area, voice Frequency Repeaters, Tandem Routing, Dimensioning of Trunks
• Switching & Signaling for analog Telephone networks: Switching concepts – Cross-bar switching . Signaling concepts: Supervisory signaling – E & M signaling – In-band & out-of-band signaling
• Design of long distance links: Design essentials for LOS Microwave systems, Path analysis or Link Budget, Fading , Diversity and Hot stand-by operation, VSAT networks, concept of Last Mile
Broadband connectivity – ADSL & HDSL

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Module II: Digital Telephone Systems [12 L]

• PCM – PCM line Codes – Regenerative repeaters – Signal to noise ratio for PCM signals – North American DS1 – the European E1 digital hierarchy – Filter – distortion – echo – cross talk – SONET and SDH – PCM Switching :'Time – space – Time Switch – 'Space – Time – Space' Switch – Digital Network Synchronization – Digital loss

Module III: Local Area Networks [6 L]

• LAN topologies – overview of IEEE / ANSI LAN protocols – WLANS – different 802.11standards

Module IV: ISDN [8 L]

• ISDN - background & goals of ISDN – protocols – structures – ISDN and OSI
• ATM and B-ISDN – User-Network interface (UNI) configuration and architecture – ATM cell structure – cell delineation algorithm – ATM layering & B-ISDN . Advantages of BISDN

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References:

1. Wiley Series in Telecommunications and Signal Processing by Roger L. Freeman
2. Telecommunication System Engineering, By N. N. Deb.
3. Telecommunication Switching, Viswanathan.
4. Telecommunication, Fraser.

Course Name: STATISTICAL COMMUNICATION					
Course Code : ECEN 5133					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [10 L]

Revision of linear algebra:
Special matrix forms – diagonal matrix, exchange matrix, triangular matrix, Toeplitz matrix, Hankel matrix, symmetric matrix,
parametric matrix, centro symmetric matrix.
Eigen values, Eigen value solutions.

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Random process:
Definition and description of random processes with practical examples.
Time average, ensemble average, covariance, autocorrelation, cross correlation. Stationary process, ergodic process, WSS process, power spectrum of random processes. Filtering of random processes – filtering of white noise, spectral shaping filter, spectral factorization. Special random processes – Autoregressive moving average process, autoregressive process, moving average process, harmonic process.

Module II: [10 L]

Signal modeling:
Least square method, Pade approximation method, filter design using Pade approximation, Prony's method of signal modeling, filter design using Prony's method, FIR least square inverse filter, iterative prefilters,
Stochastic models – ARMA model, AR model, MA model.

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Module III: [9 L]

Binary symmetric channel:
Principle, properties, bit error properties.
Theories and hypothesis:

Decision theory, Bay's likelihood ratio, ideal observer strategy, Neyman-Pearson strategy, Bay's strategy for single and multiple sample values, optimum linear estimation composite hypothesis testing, optimum detection with incomplete knowledge of the signal, adaptive detection and estimation.

Module IV: [9 L]

Filters:
Principle of optimum filter, matched filter, achievable bit error rate.
FIR Wiener filter – principle and design.
Linear prediction in noise, noise cancellation
IIR Wiener filter – causal, non causal.Kalman filter.

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References:

1. Digital communication, 4th ed. - J. G. Proakis, MGH International edition.
2. Digital and Analog Communication Systems, 7th ed. – Leon W. Couch, PHI.
3. Digital Communication – Zeimer, Tranter.
4. Statistical digital signal processing and modeling, - Monson N. Hays – Wiley.

Course Name: MICROWAVE SYSTEMS AND APPLICATIONS					
Course Code : ECEN 5134					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [10 L]

Applications in satellite communication:
Evolution of communication satellites , orbital and altitude control , satellite transponder and other subsystems , satellite link design , system noise temperature , G/T ratio , downlink design , spectrum allocation and bandwidth consideration

Module II: [10 L]

Digital transmission modulation and demodulation , Multiple access techniques –FDMA , TDMA , VSAT , Coding : Error Detection and correction method ,Earth station technology .

Module III: [9 L]

Application in RADAR:
Introduction to basic radar system , radar equation , detection of signal in noise , receiver noise & SNR , Probability of detection & false alarm , Radar cross-section of target & its fluctuation

Module IV: [9 L]

MTI & Doppler radar , Tracking radar , Radar clutter & Radar antenna , Radar transmitter & receiver , Monopulse radar

References:

1. MONOJIT MITRA : Satellite communications , Prentice Hall of India
2. S. KINGLEY & S. QNEGAN: Understanding radar systems , Standard Publisher & Distribution .
3. SKOLNIK : Introduction to radar systems , TMH

Course Name: REMOTE SENSING TECHNIQUES AND APPLICATION					
Course Code : ECEN 5135					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [10 L]

Transmission of Solar Radiation through the Atmosphere : Solar radiation spectrum; Radio infrared and optical windows of the earth's atmosphere; Spectrum of solar radiation transmitted through the atmosphere, Emissions from the disturbed sun, Reflection, Absorption and Emission from Earth and Atmosphere.
Variation of the earth's reflectivity with angle of incidence, wavelength and geographical location

Module II: [10 L]

Seasonal variation of reflectivity; Solar radiation reflected from the earth; Absorption of solar radiation by the earth; Thermal radiation from the earth; Thermal radiation from the atmospheric constituents; Thermal emission from cloud, rain, snow and fog; Radio noise and interference at satellite heights.
Sensors and Cameras: Optical and infrared detectors and filters, Optical and infrared cameras; Microwave and Millimetrewave radiometers; Scanning systems, Mechanical and Electronic systems; Scatterometer; Altimeter.

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Module III: [9 L]

Remote Sensing Satellites: Orbits of remote sensing satellites; Remote sensing satellites – LANDSAT; Indian Remote Sensing (IRS) Satellites; INSAT, NOAA Series; NASA's Upper Atmosphere Research Satellites (UARS); TRMM satellite.
Remote Sensing of Atmosphere and Sea State: Passive and active remote sensing; Side Looking Airborne Radar (SLAR); Synthetic Aperture Radar (SAR); Along Track Scanning Radiometer (ATSR)

Module IV: [9 L]

Laboratory measurements of remote sensing parameters; Tropical rainfall measurements; Microwave sensing of sea surface.
Interpretation of Sensing Data : Photo-interpretation, image and pattern recognition; Spectral interpretation of remote sensing imagery; Interpretation of thermal maps; Colour coding and enhancement; Computer interpretation of images.

References:

1. Remote sensing of the environment: J.R.Jenson
2. Global Navigation Satellite systems: B.S. Rao
3. Remote sensing: R.A. Schowengerdt

Course Name: ADVANCED COMMUNICATION LABORATORY					
Course Code : ECEN 5111					
Contact Hours	L	T	P	Total	Credit Points
per week	0	0	3	3	2

Experiments on hardware/ kits in order to acquire sufficient knowledge and understand practical limitations/ implications of
various communication techniques.
Suggested topics are (not exclusive),
1. Detailed receiver and transmitter parameters of a typical radio communication system – SINAD, fidelity, image
rejection, modulation sensitivity, transmission bandwidth etc.
2. Data communication through fiber optic link – losses, power budget, stability etc.
3. Sampling, quantization, coding – sampling rate, quantization error, signal bandwidth etc.
4. QPSK, MPSK – signal bandwidth, distinguishability, effect of noise etc.
5. Binary symmetric channel – noise & Pe etc.
6. PC2PC communication – protocol standards, frame/ packet/ UDP structure etc.
7. Multiple channel DSSS – spreading, dispreading, decoding etc.
8. Important characteristics of different types of transmission lines.
9. Impedance measurement of microwave window applying Smith chart.
10. Microwave phase shifter – calibration.

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Course Name: DESIGN AND SIMULATION OF COMMUNICATION SYSTEMS LABORATORY					
Course Code	: ECEN 5112				
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

Designing graphical user interfaced models of various communication systems/ subsystems with the help of suitable
advanced software e.g. MATLAB/ LABVIEW/ NS/ PUFF/ IE3D/ ANSOFT/ HFSS/ CST/ QUALNET/ MICROWAVE OFFICE etc. for
detail study of their operating principle and their performance vis-a-vis practical limitations like, channel bandwidth, noise,
attenuation etc.

Suggested topics are

1. ADPCM – granular noise & quantization noise.
2. MPSK – signal bandwidth, PSD, distinguishability, scatter plot etc.
3. Digital filters – ripples in pass band & stop band, slope in transition band, poles & zeros etc.
4. Optimum filters for receiving base band random binary data – Pe vs. S/N.
5. Signal bandwidth and Pe vs. S/N in different modes of line coding.
6. Signal bandwidth and Pe vs. S/N in different modes of modulation.
7. Error rates in error control for different types of error control coding.
8. Throughput vs. input density in different MAC protocols.
9. DSSS – error rate due to different types of chip code.
10. Fading channel/ multipath transmission and Rake receiver.
11. Cellular architecture, WiFi, WiMAX using QUALNET.
12. OFDM using QUALNET.
13. Different routing algorithms & protocols.
14. Characterization of micro strip antenna.
15. Characterization of transmission lines.
16. Study of important parameters and practical considerations in microwave circuits.

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Well Ordering Principle, Weak & Strong Principles of Mathematical Induction, Fundamental Theorem7 of Arithmetic, Euclidean Algorithm, Properties of GCD,7 Linear7Congruences+7Residue7Classes&7 Fermat's little Theorem, Euler's Phi Function, Euler's Theorem on Congruences & Related Results, Chinese7Remainder7Theorem 7

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Pigeon Hole Principle, Permutations & Combinations, Binomial Coefficients, Recurrence Relations &7 Generating Functions, Properties of Fibonacci Numbers, Principle of Inclusion & Exclusion, Polya's Theory of Counting, Ramsey's Theorem.7

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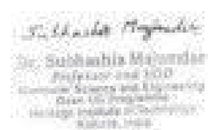

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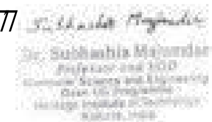
Temporal7Databases 7language7issues+storage and transaction management77



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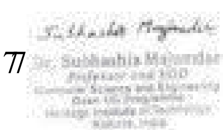

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Static7pipelines7 7reservation7tables+7scheduling7of7static7pipelines+7definitions7 7minimum7average7 latency+7minimum7achievable7latency+7greedy7strategy7etc +7Theoretical7results7on7latency7bounds7with7 proof+7Hardware intra-pipeline controller and scheduler.7Theoretical7results7on7Reservation7Table7 optimization7to7support7given7latency7cycle 7
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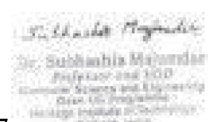

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Module	Lessons
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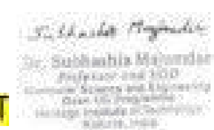
:	**PL/SQL Programming:** 9 Write a PL/SQL block to find factorial of a number : Write a PL/SQL block to GENERATE FIBONACCI SERIES UPTO 'n' NUMBERS Write a PL/SQL block to reverse a number Write a PL/SQL block to add two numbers Write a PL/SQL block to represent a palindrome, procedure to check for PALINDROME and to print the reverse of the string Write a PL/SQL block to reverse a string Write a PL/SQL program for odd or even Write a PL/SQL program for sum of digits Write a PL/SQL program to print EVEN numbers 1—100 98 Write a PL/SQL program to show the use of XOR (Exclusive OR) 99 Write a PL/SQL program to show the use of EXECUTE IMMEDIATE 9: Write a PL/SQL program to print ARMSTRONG NUMBER
	DML Enhancements  1. Inserting into Multiple tables using INSERT ALL|FIRST 2. MERGE statements 3. Sub queries, Correlated sub query (with CASE, Group BY Having, Decode)
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	l FxnGxdHon ConHFoV4q PxOWdVG
	kPWQACGPGG, PnH

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Cg mj kr kl j mCl mj r Af q q r l Awc r q kYc c ABmk g s
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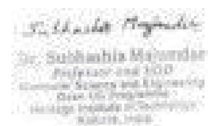
1. C Programs using Arrays, Strings and Pointers and Functions
2. Implementation of Sorting algorithms
3. Implementation of Linear search and Binary Search
4. Representation of records using Structures in C – Creation of Linked List – Manipulation of records in a Linked List
5. Recursive and non-recursive implementations of Towers of Hanoi,
6. Inorder, Preorder and Postorder Traversals
7. DFS using stacks, BFS using queues
8. C++ programs to use Objects, Classes, Inheritance, Polymorphism.



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t UnUg&AwIY2 bIYnX 7Central7concepts7of7automata7theory;7alphabets+7strings+77languages+7problems 7 Definition+7Recognition7of7a7language7by7an7automaton 77

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t UnUg&AwIY2 bIbX 7Deterministic Finite Automata. Extending Transition Function to strings. The7 language of a DFA.7

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P Yn f gIgG2 UnUHUN&t UnUg&AwIY2 bIbX 7Equivalence of DFA and NFA. Subset construction. Finite7 automata with epsilon-transitions. Epsilon Closures. Extended Transitions and languages for epsilon-NFAs. Eliminating epsilon-transitions.77

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k gSw0bG&s yDGgHHYnH&bnf &MbnSwbSgH 7 Operators of regular expressions. Building the regular7 expression for a DFA. Converting regular expressions to automata. Algebraic laws for regular7 expressions. Properties of regular languages.77

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The7pumping7lemmaand7its7applications 7Closure7properties7of7regular7languages 7Decision7properties7 of7regular7languages 7Applications7of7finite7automata 7

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p YnIgyI RGgg& Gb2 2 bGH 7Parse Trees. Ambiguity in Grammars and Languages. Pushdown Automata.7 Languages of a PDA. PDA and CFG equivalence. Deterministic pushdown automata. Normal forms of7 Context-Free Grammars. Pumping Lemma for CFLs. Closure properties of CFLs. Decision Properties77 of CFLs. Regular Languages and their grammars. Church's Thesis.7

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mwGnS&2 bNTUngHK 7 Extensions to the basic Turing Mahine. Restricted Turing Machines.7 Undecidability. Languages that are not recursively enumerable. Undecidable Problems. Post's Correspondence Problem.777

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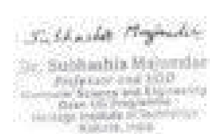

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1 7Introduction7to7Automata7Theory+7Languages7and7Computation 7
by7Hopcroft+7Motwani7and7Ullman 7

2 7Switching7and7Finite7Automata7Theory7by7Zvi7Kohavi7and7Niraj7Jha 7

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r UHGd wIgf & gbf 0YNW& gIgNUYn; 7The7system7model-7Resource7vs7Communication7Deadlocks-7Wait for7Graphs-7Deadlock7Handling7Strategies7in7Distributed7systems-7Issues7in7Deadlock7detection7(7 Resolution-7Control7organizations7for7distributed7deadlocks-7Ho Ramamoorthy's Centralized deadlock detection algorithm, Distributed deadlock detection algorithms, Obermark's, Chandy Sinha Natarajan-7 Chandy Misra Haas7algorithms 7

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r UHGd wIgf & Ug& dHg2 ; 7Architecture, Mounting, Caching, Naming and Name Resolution, Name7 Server, Cache Consistency, SUN Network File System, Stateful and Stateless Server, the SPRITE File7 System, the X-Kernel Logical File System7

7

r UHGd wIgf & TbGgf & g2 YGd; 7Central server, Migration, Multiple Read-Single Write, Multiple Read-Multiple Write, Memory Coherence and Consistency, Coherence Protocols, Design Issues, Case7 Studies (IVY)7

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r UHGd wIgf &l NTgf w0UiS; 7 Queuing Theory, Load Distributing, Load Balancing, Load Sharing,7 Preemptive vs Non-Preemptive transfers7

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e w0UDGYNgHHYG& h DgGbIUiS& l dHg2 H; 7 Difference between Multiprocessing and Distributed7 environments, Tightly coupled vs Loosely Coupled systems, UMA, NUMA, NORMA architectures,7 Interconnection networks for multiprocessor systems, BUS, Crossbar Switch, Multistage, Hypercube7 architectures, the separate supervisor, master slave, symmetric configuration, Threads, User-level and7 Kernel Level threads, Case Studies (MACH OS, MACH Kernel) 7

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s yb2 D0g& UHGd wIgf &h DgGbIUiS& dHg2 H& Major design decisions in typical systems such as Mach,7 Chorus, Amoeba and the OSF Distributed Computing Environment.77

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k gb0&nU2 g&h DgGbIUiS& dHg2 ; 7Definition, types of RTOS, A reference model of Real Time System,7 Commonly used approaches to Real Time Scheduling 7

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Subhashis Majumdar
Dr. Subhashis Majumdar
Professor and HOD
Computer Science and Engineering
Dean UG Programme
Heritage Institute of Technology
Kolkata, India

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A] Transmission7Media7and7its7properties& 7 7 [1L]7

B] Modulation7(7demodulation7–7Modems&7 7 [1L]7

C] Error7detection7(7correction7&CRC7codes& 7 [1L]7

D] Concept7of7Computer7Networks;7Two level7hierarchy7–7Hosts7(7subnet&Protocols7 (7Standards;7Reference7Model&OSI7seven7layer7reference7model&TCP/IP7reference7 model& 7 7 7 7 [2L]7

E] Physical7Layer;7Multiplexing&Switching&Data7transmission7over7Telephone7Line7–7 PCM/T17etc&**v USTK Dggf &e Yf g2 &NYnNgDIH&r l M&4&p bc0g&e Yf g2 H & DGgbf & l DgNGw2 &p r e A&bHgf &N2 2 wnUbIUYn** 7 [2L]7

F] Queuing7ModelsX7M/M/177(7M/G/17Queuing7system7–7average77 queue7length+7delay7and7waiting7times 77 7 7 [3L]7

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A] **r bIb&MuW&bdgG**;77Framing77Stuffing&Flow7Control7Protocols;7Stop and Wait77Go Back N77Selective7Repeat&7 7 7 7 [2L]7

B] **P gIx YGWuS&bdgG**;77 7 7 7 7 7 7

i]7**anIgGngIx YGWuS& &gKINgH**;7Transparent7Bridges77Source Route7Bridges77Ethernet7 Switches7&Backward7Learning7Algo&Construction7of7Spanning7Trees& 7 7 7 7 7 7 7 7 [2L]7

ii]7**k YwIUuS&DGYIYNYH**;7Desired7attributes&Centralized7routing&Distributed7routing7;7 Distance7vector77Link7state7algo&7 7 7 7 [2L]7

C] **e Ap &Hwc 0bdgG**;7 7 7 7 7 7 7

i]**s ITgGngI**7[IEEE7902 3]7;7Pure7ALOHA77Slotted7ALOHA77CSMA CD77Ethernet7 protocol&Hub7based7architecture&Frame7format&Collision7Resolution& 7 7 7 7 7 7 7 7 [2L]7 k gRgGgnNgHK&

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A] Transmission Media and its properties [1L]

B] Modulation (demodulation – Modems [1L]

C] Error detection (correction CRC codes [1L]

D] Concept of Computer Networks; Two-level hierarchy – Hosts & subnet; Protocols & Standards; Reference Model; OSI seven layer reference model; TCP/IP reference model; (2L)

E) Physical Layer: Multiplexing; Switching; Data transmission over Telephone Line – PCM/T1 etc; **High Speed Modem concepts (DSL / Cable Modems); Spread Spectrum / CDMA based communication;** (2L)

F] Queuing Models M/M/1 (M/G/1 Queuing system – average queue length, delay and waiting times [3L]

e Yf w0g&aXp Y2 DwIgG&P gIx YGWuS& ,6 M&

A) **Data Link Layer**: Framing / Stuffing; Flow Control Protocols: Stop-and-Wait / Go-Back-N / Selective Repeat; (2L)

B) **Networking Layer**:

i) **Internetworking & devices**: Transparent Bridges / Source-Route Bridges / Ethernet Switches ; Backward Learning Algo; Construction of Spanning Trees; (2L)

ii) **Routing protocols**: Desired attributes; Centralized routing; Distributed routing : Distance vector / Link state algos; (2L)

C) **MAC sub-layer**:

i) **Ethernet** (IEEE 802.3) : Pure ALOHA / Slotted ALOHA / CSMA-CD / Ethernet protocol; Hub based architecture; Frame format; Collision Resolution; [2L] ii] mYWgn&k UnS [IEEE 902 6]; Ring architecture & Role of Token & Frame format for various types of Frames & Delay calculations [2L]

D] mGbnHDYGI&MbdgG; [1L]

Process to process delivery; multiplexing

Congestion control algo; Leaky bucket; Token bucket

s ADDUUNbIUYn&MbdgGX [1L]

Cryptography & Network security elements; Firewalls;

e Yf w0g&aaX&nIgGngIx YGWnSX 6 M

A) Network Layer protocols: **(8L)**

IP: Packet format ; Classful addressing / subnetting / subnet mask; CIDR / supernetting / masks; Forwarding algorithms;

Address scarity problem & solution; (3L)

IPv6: addressing / packet format / differences with IP (v4); (1L)

ARP/RARP/DHCP : MAC and IP address conversion;

ProxyARP (2L)

Routing: RIP / OSPF / BGP (2L)

B) Transport Layer protocols: **(2L)**

TCP: Flow control mechanism; UDP; Difference between UDP and TCP;

C) Application Layer: **(2L)**

DNS / WWW /E-Mail / FTP; Telnet details; Security in the Internet; Secured Telnet using SSL / TLS;

e Yf w0g&1 X&k gNgnI&nYDUNK 66M

A] ISDN, Frame Relay (ATM [2L]

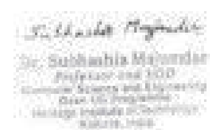
B] Wireless Technologies; Cellular Telephony, Wi Fi [IEEE 902 11amily], BlueTooth 3 l P [4L]

C) **Mobile IP & TCP protocols; Ad Hoc Routing;** [2L]

D) **High Speed Packet Processing in the Internet**: High speed router architecture; High Speed IP packet processing; High Speed Routing algorithms and its architecture implications;

Real Time Protocol [Basic ideas only] [2L]

E] Multimedia networking protocols [1L]



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4 William Stallings; ISDN and Broadband ISDN with Frame Relay and ATM

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	l SPs TMFkMGP, 9 l SP GTP) Sbu't Tn b _GTP0 nb? P/ : kTRnTQTdbndP oQI g N F wbsTbc;P l SP I o? P ETSPduosz . Operations on directories: a. Check the current directory. b. Change the current directory. c. Create new directory (s). d. Remove directory (s). Act o;vuP DbuSnb? Pt 4j P;buTwP DbuSnb? Pt p btP kuvOz l SP Wf JX GTP kztuP? **u xnOWhRg FOThxFMs TMG** 9 Display, create, copy, move, delete, and rename file. 2. Counting Lines, Words and Characters of file(s). 3. Comparing Two Files.) SbuT p o? ? on cPux PPn ux o QTPt/ p o? DsPttTnR4OPdo? DsPttTnR bnO bsdSTwTnR QTP_t 0 **BxGds TMF AHFy I HPG/ s TMPFG** 9 GTP g x nPst STD GTP hPs? TtTont : GTuPs p o? ? bnOt SPbO4ubT,4dvu4tosu4vnTr 4us4RsPD4tPO

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N l r Cu GH Yr Aj 4Cg N hml r j kCwr f Cr / r f t wf r r j wf t 4u wt

Shell Programming

1. How to read a File line by line in a Shell Script?
2. Write a shell script to calculate addition of two numbers.
3. Write a shell script to compare two numbers.
4. Write a shell script to calculate whether a given number is odd or even.
5. Write a shell script to calculate the sum of digits of any number entered through the keyboard.
6. Write a shell script to show the maximum of three numbers.
7. Write a shell script which displays the result of division of one integer by another integer and informs if the user tries to divide an integer by 0.
8. Write a shell script that takes a number from user and prints the reverse of the number.
9. Write a shell script to check whether a given number is prime or not.
10. Write a shell script which displays the message "welcome" and prints the date when you log in to your system.
11. Write a shell script which reports names and sizes of all files in a directory (directory should be supplied as an argument to the shell script) whose size exceeds 500 bytes. The filenames should be printed in decreasing order of their sizes. The total number of such files should also be reported.
12. Write a shell command that accepts a filename as argument and displays the last modification time, if the file exists and a suitable message if it does not.
13. Write a shell script that accepts two directories namely OS1 and OS2 as arguments and deletes those files in OS2 which are identical to their names in OS1.
14. Write a shell script to list the names of files under the current directory started with vowels.
15. Write a shell script to drop the lines which are matched with a given word.
16. Write a shell script that shows the names of all the non-directory files in the current directory and calculates the sum of the size of them.
17. Write a shell script to find the total number of words, characters, lines in the given file (supplied as command line argument).

h FodPGG

9 Creation of a process.

2. Write a program to get the PID of parent and child process.
3. Implement an orphan process using fork.
4. Implement a zombie process using fork.
5. Write a program with a local variable and a global variable. Initialize both of them. The program should fork a child process and the child should increment both the variables by 1. After this operation, both the parent and the child should print the values of the variable.
6. Write a program that creates three child processes. The first child process executes the command "who", the second child process executes the command "ls –l" and the

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N l r Cu [CH]Yr Aj 4Cg N hml r j kCwr f Cr / r f t wf r r j wf t 4u wt

	third child process executes the command "date". The parent process waits for all the child processes to finish and prints the termination status of the child. Display the process in the system every thirty seconds but five times.
	l SFPxOG 9) sTiP b DsoRsb? uo dsPbuP b uSsPbOuSbuOTfD,bzt b) FMp g N F ? Pt t bRP :) sTiP b DsoRsb? uSbudsPbuPt ? v;uTD,P uSsPbOt bnOuPs? TnbuP uSot P 1 SP DsoRsb? t Sov;OdsPbuP uSsPbOt x TiS uSP DuSsPbO7dsPbuP_0sovuTnP FbdS uSsPbODsTnut b "I P;;o) os;O" ? Pt t bRP bnOuSPn uPs? TnbuPt x TiS b db;; uo DuSsPbO7PyTu_0) sTiP b DsoRsb? x STdS T? D,P? Pnut uSsPbOx TiS bsRv? Pnut bnOuSsPbOUsTnTnR) sTiP b ? v;uTuSsPbOPODsoRsb? x SPsP uSP ? bTn uSsPbORPut bn TnuPRPs nv? cPs sbnRP Qo? uSP vt Ps bnOuSPn dsPbuPt ux o dSTjOuSsPbOt, onP uSsPbOQnOt oOOnv? cPst Tn uSP sbnRP bnODsTnuuSP? 4bnOuSP t PdonOuSsPbOQnOt PwPn nv? cPst Tn uSP sbnRP bnO DsTnut uSP? 1 SP dSTjOuSsPbO? vtuuPs? TnbuP cz sPuvsnTnR b wb;vP 1 SP DbsPnuuSsPbO ? vtux bTuQos uSP dSTjOuSsPbOt uo QnTtS bnOTu? vt ub;to DsTnuuSP sPuvsn wb;vPt oQuSP dSTjOuSsPbOt
	kTRnxWG 9) sTiP b DsoRsb? uo dsPbuP b dSTjODsodPt t uSbut PnOt b kJHp I ME t TRnb; uo uSP DbsPnu DsodPt t :) sTiP b DsoRsb? uo DsTnuuSP OPQbv;u? Pt t bRP oQkJHJf 1 t TRnb; bnOb;to DsTnuuSP vt Ps) sTiP b DsoRsb? uo RPubn TnuPssvDuQo? ? bdSTnP bnOOTfD,bz uSP wb;vP oQuSbut TRnb;

Cg mj kr kl j mCl mj r Af q q r l Awr q kYc c ABmk g s
N l r Cu [CH]Yr Aj 4Cg N hml r j kCwr f Cr / r f t wf r r j wf t 4u wt

kI y UPdHf x, P Co, pI HPFf PHKoFVGc xy					
hxpPF CoOP Ckr f					
ConHdH u oI FGpPF KPPV	**c**	**l**	**h**	**l oHW**	**CFPOHoTnHG**

f PHKoFV hFoRFx, , TnRr LPFdTCPG _l o cP T? D,P? PnuPODsPQsbc;z Tn abwb os p !p 330

1. Getting familiar with the Networking (Socket) API and associated data structures.

2. Implement Simple TCP Client Server Application.
3. Implement TCP Echo Server Client Application.
4. Implement TCP Chat Server Client Application.

5. Implement a File Server Client application.
6. Implement UDP Echo Server Client Application.
7. Implement UDP Time Server Client Application.

8. Implement multithreaded chat program.

9. Implement Web based protocol (looking up URLs, retrieving & examining content, posting a form etc.etc.).

98 Jmplement Multicasting / Broadcasting socket I/O.

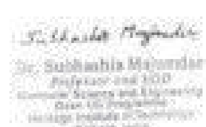
99 J? D,P? Pnuk;TOTnR) TnOox hsouodo; vt TnR f on6B;odmTnR J!g _usz uSP kP;PduTwP j PDPbu0

9: J? D,P? PnukPdvsPO1 p h PdSo Dsouodo;

9 FyDPsT? PnuTnR on dsott6D,buQos? nPux osmcbtPOdo? ? vnTdbuTon Tt vPt

f PHKoFV u xFOKxFP kT, I WHTon r LPFdTCPG

9 Use of QualNet for Network Modeling. (Basic ideas / demonstration only)
15. Use of Wireshark for Network packet capturing.
16. Creating a small LAN by an Ethernet switch
17. Creating a Wireless LAN using an Access Point



Subject Name: ADVANCED MATHEMATICAL METHODS					
Paper Code: MATH5101					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [10L]

Linear Algebra I:
Definition of Field, Vector Spaces, Subspaces, Linear Dependence, Basis and Dimension, Inner Product Space, Concept of Norm, Gram-Schmidt Orthogonalization Process, QR Decomposition.

Module II - [10L]

Linear Algebra II:
Eigen Values and Eigen Vectors, Singular Value Decomposition, Concept of Positive Semidefinite Matrices, Linear Transformations, Kernels and Images, Rank-Nullity Theorem, Matrix Representation of Linear Transformations, Change of Basis.

Module III-[10L]

Classical Optimization:
Classification of Optimization Problems, Single Variable Optimization, Multivariate Optimization without Constraints: Semidefinite Case, Saddle Point, Multivariate Optimization with Equality Constraints: Method of Constrained Variation and Lagrange Multipliers, Multivariate Optimization with Inequality Constraints: Kuhn- Tucker Conditions.

Module IV-[10L]

Optimization Algorithms:
Simplex Method, Big-M Method, Concept of Duality in LPP, Interior-Point Methods, Basic Descent Methods.

Sandip Chatterjee

References:

1. Linear Algebra : Kenneth M. Hoffman, Ray Kunze (Prentice-Hall)
2. Linear Algebra : Seymour Lipschutz, Marc Lipson (SCHAUM'S Outlines, Mc Graw Hill)
3. Matrices and Linear Transformations : Charles G. Cullen (Dover)
4. Engineering Optimization : Singiresu S. Rao (New Age International Publishers)
5. Introductory Operations Research : H.S.Kasana, K.D.Kumar (Springer-Verlag)
6. Linear and Nonlinear Programming: D.G. Luenberger , Yinyu Ye (Springer)
7. Introduction to Linear Algebra : Gilbert Strang (Wellesley-Cambridge Press)
8. Linear Algebra and its Applications: Gilbert Strang (Thomson Brooks/Cole Cengage Learning)
9. Matrix Computations : Gene H. Golub, Charles F. Van Loan (JHU Press)

Course Outcome:

After the completion of the course, the students will be able to:

1. Apply Gram-Schmidt Orthogonalization, QR decomposition etc. to different relevant engineering problems.
2. Apply the concept of semi-definite matrices, linear transformation etc. to relevant physical problems.
3. Model and solve non-constrained and constrained optimization problems by classical optimization techniques (e.g. Lagrange Multiplier Method, Gradient Descent Methods etc.).
4. Model and solve engineering optimization problems using different algorithms (e.g. Simplex Method, Big-M Method etc.).

M. Tech. in Electronics & Communication Engineering
Specialization- Communications
First Year Syllabus

1st year 1st Semester:

Course Name: ADVANCED MATHEMATICS					
Course Code : MATH5103					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [4 L]

Probability and Stochastic Process: Recapitulation of basic Probablity concepts - Bayes theorem, Random variables, probability mass function and probability density function, Specific distributions: Binomial, Poisson, Normal.
Definition of Discrete Time Markov Chain. Examples Including Random Walk, Ehrenfest Chain and Birth-Death Chain, Transition Matrix, Chapman-Kolmogorov Equation and its application.
Module II: [10 L]

Graph Theory : Tree, Binary Tree, Spanning Tree, Steiner Tree,Greedy, Divide and Conquer, Walk, Path, Cycle, Hamiltonean Graph ,The Travelling Salesman Problem, Euler Graph, The Chinese Postman Problem , Planar Graph, Euler's Formula for Planar Graph and Related Problems, Matchings and Augmenting Paths, Hall's Marriage Theorem and Related Problems, Vertex Colouring, Chromatic Polynomial.

Module III: [10 L]

Linear Algebra : Definition of Field, Vector Spaces, Subspaces, Linear Dependence, Basis and Dimension, Inner Product Space, Gram-Schmidt Orthogonalization Process, Linear Transformations, Kernels and Images, Matrix Representation of Linear Transformations, Change of Basis, Eigen Values and Eigen Vectors

Module IV: [10 L]

Optimization : Classification of Optimization Problems, Single Variable Optimization, Multivariate Optimization Without Constraints : Semidefinite Case, Saddle Point, Multivariate Optimization with Equality Constraints: Method of Constrained Variation and Lagrange Multipliers, Solution of LPP using Simplex Method.

Sandip Chatterjee

Detailed Syllabus of 3rd Semester

Subject Name: Software Engineering					
Paper Code: CSEN6101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Software Engineering:

1. Introduction to Software Engineering (4L)	• Define System, Software and Engineering: Representation of a System, Characteristics of Software and Attributes of good software, Types of Information Systems, Define Software Engineering and its objective, System Engineering vs. Software Engineering • Software Life Cycle and brief introduction to different phases of life cycle • Introduction to Software Analysis and Design • Software Life Cycle models (Methodology or Paradigm): Waterfall Model, Prototyping Model, Spiral Model, Briefly describe iterative and integrative approach and other methodologies used in industry
2. Requirement Phase (3L)	• Describe different steps: Requirement Elicitation, Requirements Analysis, Requirement Specification, General Structure of SRS • Requirement Validation and Requirement Management • Various Methods of Information Capture • Case Study • Capturing the Requirement as Use Cases: Use Case Model, Different artifacts of Use Case Diagram, Use Case Specification, Some Example / Case Study
3. Modeling Technique (3L)	• Developing Data Flow Diagram for describing Process Model: The components of a DFD, Different Notations, Guidelines for constructing DFDs, Steps to construct DFD • Case Study • Creation of Data Model using Entity-Relationship (ER) Diagram
4. Software Estimation (5L)	• Different technique of estimating effort and cost • Constructive Cost Model (COCOMO): Basic COCOMO, Intermediate COCOMO (COCOMO 81), Detailed COCOMO (COCOMO II) • Calculating effort required at different stages using this model with examples

	• Objectives of Function Point Analysis • What is a ``Function Point" and its benefits • A simple five step counting process • Case Study to count function points
5. Software Design (5L)	• Overview: Introduction to design and translating the analysis model into software design, Similarities and Differences between Requirement Analysis and Design, Attributes of Good Design • Classical Design Methods • Structured Design Methodology (SDM): Module design or high level design, Detail design or logical design • Functional Decomposition / Modularity: Abstraction, Various types of Cohesion, determining module cohesion, Various types of Coupling • Define various design approaches: Functional, Object Oriented • Functional: Functional Oriented design using DFD, Design Heuristics, Transaction Analysis, Structure Chart • Detailed Design: PDL /Structured English • Design Verification and various Metrics
6. Coding or Programming Activity (1L)	• Programming Principles and Guidelines: Structured Programming, Some Programming Practices, Coding Standards • Coding Process: An Incremental Coding Process, Test Driven Development, Pair Programming • Source Code Control and Build • Refactoring – Basic Concept, Refactoring using an example, Bad Smells
7. Software Review and Testing (7L)	• Self Review / Peer Review • Testing Overview: Objective, Definition, Static and Dynamic Testing, Functional vs. Non-functional Testing • Define Testing artifacts : Test Cases and Test Suites, Test Plan, Traceability Matrix , Test Data , Test Harness • Testing Process: Test Plan, Test Case Design, Test Case Execution • Testing Methods : White Box Testing (Different approaches of white box testing: Control Flow based criteria, Statement Coverage Criterion, Branch Coverage, Basis Path Testing, Data Flow based testing, Mutation Testing), Black Box Testing (Equivalence Class Partitioning, Boundary Value Analysis, Cause Effect Graphing) , Grey Box Testing • Testing Level: Unit Testing, Integration Testing, Regression Testing, System Testing, Acceptance Testing, Non-functional Testing

	• Defect Logging and Tracking • Test Automation: available tools, techniques, and metrics
8. Software Maintenance (1L)	• Different types of maintenance • Change Management and Maintenance Process
9. Project Management (5L)	• Goal • Project Management Process: Planning, Staffing, Execution, Monitoring and Control • Responsibilities of Project Manager • Scheduling: WBS and Activity Network, Gantt Charts, PERT/CPM, Drawing the CPM Network, Scheduling of Activities Using a Gantt Chart, Calculating the slack and finding the critical path • What is PERT (probabilistic approach) and how does it work? • Trend analysis by Earned Value Analysis: assessing the value of work scheduled, the value of work performed and value that has been earned
10. Software Configuration Management (1L)	• Configuration Identification, Configuration Control, Configuration Status Accounting, Configuration Audits • Concept of Baseline, Versioning of CIs, Some Configuration Management Tools
11. Risk Management (1L)	• Software Risks • Risk Management Activities: Risk Assessment, Risk Control
12. Object Oriented Analysis and Design (5L)	• Some basic concepts : Class & Object, Generalization, Polymorphism • Basic concepts of OOAD • UML and different types of diagrams • Class diagram, different types of relationships between classes with examples • Sequence diagram : Different artifacts of sequence diagram, drawing sequence diagram with examples

Text Books:
1. Roger Pressman, “Software Engineering”, TMH
2. Rajib Mall,“ Fundamentals of Software Engineering ”, PHI Learning Private Limited
3. Pankaj Jalote, “An Integrated Approach to Software Engineering”, Narosa

Reference Books:
1. IEEE Standards on Software Engineering

Second Semester

1[st] Year 2[nd] Semester:

Course Name: PHOTONICS AND OPTICAL COMMUNICATION					
Course Code : ECEN 5201					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: Photonics: [12 L]

o Introduction to Photonic materials and Photonic Devices.
o Optical waveguides., Optical Fiber Modes and Configurations
o Optical fibers - application specific optical fibres, Photonic Bandgap Optical Fibers.
o Graded Index and Single Mode Fibers.
o Optical couplers;
o Fiber.Bragg gratings
o Electro-optic devices
o Semiconductor lasers and light-emitting diodes
o Photodetectors PIN, Photodiodes and Avalanche Photodiodes.
o Optical Amplifiers- doped fiber amplifier.

Module II: Optical Communication: [8 L]

o Analog and Digital Optical Transmitters and Receivers concepts,
o Loss- limited and dispersion- limited lightwave systems,
o Long-haul systems with In-Line Amplifiers,
o Dispersion compensation techniques in optical communication systems,
o Power budget and rise-time.

Module III: Coherent lightwave systems: [8 L]

o Modulation and Demodulation schemes for coherent communication,
o System performance issues.
Multichannel Lightwave systems:
o WDM components and devices,
o Multiplexing techniques and system performance considerations.

Module IV: Optical Networks: [10 L]

o Network topologies,
o SONET/SDH,
o Broadcast-and- Select WDM Networks- single-hop networks, multihop Networks,
o Wavelength routed networks,
o Photonic packet switching
o Soliton Communication

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References:

1. Keiser, G. , Optical Fiber Communications, Mcgraw Hill
2. John Senior, Optical Fiber Communications: Principles and Practice, Prentice Hall
3. Ajoy Ghatak & K. Thyagarajan, Cambridge University Press
4. Govind R. Agrawal, Fiber Optic Communication Systems, Wiley

Course Name: ERROR CONTROL AND CODING					
Course Code : ECEN 5202					
Contact Hours	L	T	P	Total	Credit Points
per week	4	0	0	4	4

MODULE – I: [12 L]

Brief description of a digital communication system. Role of Information Theory on digital communication system. Cause of digital signal error and need for error control coding for detection and correction of errors.
Information Theory : Review of topics : Measure of Information Self and Mutual Information Entropy Huffman coding Shannon-Fano coding Channel capacity Shannon's theorem on source coding and channel coding. Relation between Information Theory and error Control Coding
Linear algebra:
Groups – Definition Order of a group modulo-m addition and multiplication table, modulo-m subtraction and division
Fields – Definition Binary field and Galois field
Polynomials– Concept of polynomial expression, addition/subtraction/multiplication/division of polynomials over GF(2). Irreducible polynomials, primitive polynomials. Vector space, sub space, dual space – their properties and interrelations.

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MODULE-II: [10 L]

Block Code:
Linear Block Code Generator matrix Generator polynomial Syndrome calculation and error detection Standard array Hamming code Bit error rate performance of Block code Cyclic code Cyclic encoder
Syndrome circuit Decoding of Cyclic code Cyclic redundancy check code Golay code Shortend cyclic code Burst error correcting code
BCH code – Construction of Galois field GF(2m), properties of GF(2m) field conjugate roots, minimal polynomials Description of BCH code encoding parity check matrix error hopping and decoding

MODULE – III [8 L]

Reed Solomon (RS) code: RS code in systematic form Syndrome decoding of RS code Barlekamp – Massey algorithm practical application (compact disk)
Convolutional code: Convolutional encoder generator sequence generator matrix, code rate, constraint length Distance properties of convolutional code Finite state machine analysis of coder code tree trellis and state diagram
Principle of maximum likelihood decoding of convolutional code Viterbi algorithm

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MODULE – IV [8 L]

Trellis coded modulation (TCM) :
TCM code construction by set partitioning TCM decoder TCM performance analysis
Turbo code :
Turbo encoder Distance properties, BCJR decoding algorithm Interleavers performance analysis of
Turbo code
Low Density Parity Check (LDPC) code :
Description and construction of LDPC code LDPC decoder performance analysis of LDPC code

References:

1. Error Control Coding Fundamentals and Applications Shu Lin and Daniel J Costello Jr Prentice Hall
2. Introduction to Error Control Codes Salvatore Gravano Oxford University Press.
3. Information Theory Coding and Cryptography Ranjan Bose THM Publications
4. Digital Communications 2nd 2008 Bernard Sklar and Pabitra Kumar Ray Pearson Education
5. Essentials of Error Control Coding J C Moreira and P G Farrel Wiley Student Edition
6. Digital Communication, S. Haykin, Wiley Student Edition.

Course Name: MOBILE COMMUNICATION					
Course Code : ECEN 5203					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [10 L]

Introduction - evolution of mobile radio communications, mobile radio systems around the world, trends in cellular radio and personal communication, first generation (1G), second generation (2G), third generation (3G) and 4G mobile cellular networks, Concept of SDR and UMTS.
Cellular concept – Limitations of conventional mobile system, Introduction to mobile cellular communication, concept of frequency reuse, cluster size, cellular system architecture, channel assignment strategies, call handoff strategies - hard
handoff and soft handoff, prioritizing handoff; interference and system capacity, improving capacity in cellular systems – cell splitting, sectoring, microcell zone concept.

Module II: [12 L]

Different mobile communication systems – GSM services and features, system architecture, GSM radio subsystem, GSM channel types, location updating and call setup, WAP, SCSD, GPRS, EDGE, 3G W-CDMA; CDMA digital cellular standard, comparison between GSM and CDMA, 3G CDMA 2000, IMT-2000.

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Module III: [10 L]

Radio Channels and their Characterisation – Different propagation models – Hata , Okimura models, Free space propagation, Multipath propagation, diversity techniques, Co-channel interference, Propagation effects - scattering, ground reflection, fading, Log-normal shadowing.
Wireless networks – Advantages and applications of Wireless LAN, WLAN technology – RF and IR wireless LAN, diffuse, quasi diffuse and point-to-point IR wireless LAN, IEEE802.11 and its architecture, Physical layer, MAC layer, Introduction to WIFI, HIPERLAN2, Bluetooth – Bluetooth architecture.

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Module IV: [6 L]

Mobile network and transport layer – Introduction to Mobile IP, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile adhoc networks – Routing, Destination sequence distance vector, Dynamic source routing and Alternative metrics; Traditional TCP – Congestion control, Slow start, Fast retransmit / fast recovery, Implications of mobility; classical TCP improvements – Indirect TCP, Snooping TCP, Mobile TCP,Fast retransmit.
Future of mobile communication – 3G to 4G.

References:

1. Theodore S. Rappaport, Wireless communications: principles and practice, PHI / Pearson education.
2. J. Schiller, Mobile communications, Addison-Wesley.
3. William C. Y. Lee, Mobile cellular telecommunication – analog and digital systems, McGraw Hill, 2nd ed.
4. Wang, Wireless communication System, Pearson Education
5. Talukdar, Mobile computing, TMH
6. J.W.Mark, W. Zhuang, Wireless Communication and Networking, PHI
7. A. Santamaria et al, Wireless LAN systems, Artech House.
8. Stallings, Wireless Communication & Networks, Pearson Education
9. K. Feher, Wireless digital communications, Prentice Hall of India.
9. Roy Blake, Wireless communication technology, Thomson Delmer.

Course Name: CRYPTOGRAPHY AND NETWORKING SECURITY					
Course Code : ECEN 5231					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [12 L]

Introduction: Principles of security, Overview of network security and cryptography, OSI Security architecture, model for network security, classification of attacks (Reply, Reflection, Man – in – the – middle), Virus, Worm, Trojan Horse, Spam etc.
Symmetric ciphers: Algorithm types and modes, classical encryption techniques, block ciphers and Data Encryption Standard (DES), Advanced Encryption Standard (AES), Contemporary Symmetric Ciphers, and confidentiality using symmetric encryption

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Module II: [9 L]

Public Key Cryptography: Public key Infrastructure (PKI), RSA, key management, Diffe-Hellman key exchange, elliptic curve arithmetic, elliptic curve cryptography.
Message Authentication and Hash Functions: Authentication requirements, authentication functions, message authentication codes

Module III: [9 L]

Hash functions, security of Hash functions and MACs.Hash Algorithms: MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signature Algorithm, Digital Signature Standard. Network Security Applications: Authentication Applications (Kerberos), Electronic Mail Security (SMIME), IP Security (IPSec)

Module IV: [8 L]

Web Security (SSL and TLS), E – cash and Secure Electronic Transaction (SET), System security using Firewalls and VPNs. Advance Applications of Network Security: Smart cards and security, Enterprise Application Security, Biometric Authentication, Database Access Control, Security and Privacy Issues in RFIDs

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.
References:

1. William Stallings, Cryptography and Network Security—Principles and Applications, Pearson Edu.
2. Atul Kahate, Cryptography and Network Security, Tata McGraw Hill.
3. Trappe & Washington, Introduction to Cryptography with Coding theory, Pearson Education.
4. William Stallings, Network Security Essentials, Pearson Education.
5. Kaufman, Perlman & Speciner, Network Security, Pearson Education.
6. Behrouz A. Forouzan, , Cryptography and Network Security, McGraw – Hill Education.

Course Name: ARTIFICIAL INTELLIGENCE AND SOFT COMPUTING					
Course Code : ECEN 5232					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [10 L]

Introduction: Definition of AI, The disciplines of AI, Application of AI techniques.
General Concepts of Knowledge: Definition and importance of knowledge, components of a knowledge-based system.
Dealing with Inconsistencies and Uncertainties: Nonmonotonic reasoning, Truth Maintenance System (TMS), Default Reasoning and closed world assumption, Fuzzy Logic and natural language computation, Fuzzy sets, various operations, reasoning with Fuzzy logic.

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Module II: [10 L]

Problem solving by intelligent search: General problem solving approaches: Breadth first search, Depth first search, Hill
climbing, Simulated Annealing Learning: Supervised Learning-Inductive learning, unsupervised learning-Reinforcement learning, learning automata.
Basics of pattern recognition: Concept of a pattern: feature, feature vectors and classifiers. Importance of pattern recognition. Fuzzy pattern recognition.
Classifiers: Classifiers based on Baye's decision theory: Bayesian classification for normal distribution, Bayesian inference.

Module III: [9 L]

Estimation of unknown probability distributions. Baye's error. Linear classifiers: linear discriminant functions and decision hyperplanes. The peceptron algorithm. Suport Vector Machine (SVM): separable and nonseparable classes. An introduction
to nonlinear classifiers: the XOR problem, the two layer perceptron and radial basis function (RBF) network. Context dependent classification.
Clusterings: Basic concept of cluster analysis. Applications of cluster analysis. Proximity measures: between two points, Proximity function: between a point and a set. Different clustering algorithms: Sequential, Hierarchical, Schemes based on
function optimization . Cluster validity.

Module IV: [9 L]

Evolutionary algorithms: Genetic Algorithm: Cycle of genetic algorithms, crossover, mutation, fitness function, schema, fundamental theorem of GA (Schema theorem). Differential Evolution (DE), Modified Differential Evolution(MoDE). Multiobjective optimization using evolutionary algorithms. Hybridization with clustering. Genetic programming.
Application Areas: Qualitative discussions on different application areas of A.I and Soft Computing e.g. Image pattern recognition: Image classification using clustering (hard and fuzzy). etc.

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References:

1. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India.
2. Nils J. Nilsson, Artificial Intelligence: A new Synthesis, Harcourt Asia PTE Ltd., Morgan Kaufmann

Course Name: INTEGRATED CIRCUITS AND DESIGN					
Course Code : ECEN 5233					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [10 L]

Integrated circuit devices and modeling: Semiconductors and p-n junction, advanced MOS modeling, bipolar junction transistors MOS devices in weak inversion.

Basic current mirrors and single stage amplifiers: Simple CMOS current mirror, common source amplifier, source follower, common gate amplifier, source generated current mirrors, high output impedance current mirrors, cascade gain stages, MOS differential pairs, bipolar current mirrors, bipolar gain stages, class AB output stages.

Module II: [10 L]

Internal amplifiers: Switched capacitor amplifiers, switched capacitor integrators. 6 L
Non linear circuits: Phase locked loop. MOS inverter: Switching characteristics, static and dynamic behaviors delay.
Combinational MOS logic circuits: pseudo NMOS, dynamic logic, domino logic, NORA, differential CMOS gates, X-gate and pass transistors.

Module III: [9 L]

Sequential MOS logic circuits: CMOS clocked latches, static and dynamic CMOS latches, D, SR, JK, T and edge triggered SR flip-flop.

Digital integrated system building blocks: Multiplexers and decoders, barrel shifters, counters, digital adders, modified booth multipliers

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Module IV: [9 L]

CMOS timing and I/O considerations: Delay of CMOS circuits, junction capacitors, interconnect capacitors, delay of CMOS logic gates, input protection circuits, output circuits and driving large capacitors, three state outputs.

Noise in integrable circuits: Noise in circuits, types of noise, time domain analysis, frequency domain analysis, noise models for circuit elements – resistors, capacitors, diode, BJT and MOSFET.

References:
1. Analog integrated circuit design, David Johns and Ken Martin, John Wiley and sons (UK), 2002
2. Digital integrated circuit design, Ken Martin, Oxford University Press, New York, 2000
3. Analysis and Design of Analog Circuits, Paul Grey, Paul Hurst, Stephen Lewis and Robert Mayer, John Wiley and Sons (UK), 4th edition.
4. Digital Integrated Circuits - A Design Perspective, Rabaey, Chandrakasan and Nokolic, PHI (2nd Edition), 2008
5. CMSO Digital Integrated Circuits - Analysis and Design, Sung-Mo Kang & Yusuf Lablebici, Tata McGraw Hill, (New Delhi), 2003

Course Name:	MICROWAVE MEASUREMENT AND INSTRUMENTATION				
Course Code	: ECEN 5234				
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

MODULE I : [10 L]

Introduction to Radio Frequency and Microwave Measurement.
: Microwave Detectors and Sensors. Different types of microwave detectors, their functions and applications. Microwave sensors – working principles and applications
Microwave Power Measurement- Low Power Measurement- Bolometer technique. High Power Measurement – Calorimetric method

MODULE II : [10 L]

Microwave Attenuation Measurement
Microwave Frequency Measurement. Slotted Line technique. Wave meter method - Absorption and Transmission type wave meter
Microwave Impedance Measurement – Slotted Line technique to measure VSWR and unknown Load Impedance. Application of Smith chart in transmission line measurement

MODULE III : [9 L]

Microwave Cavity parameter measurement. – Cavity Q measurement by Slotted Line technique. Swept Frequency method Decrement methodMeasurement of Dielectric constant of a solid and liquid at microwave frequency by Waveguide method.
Cavity perturbation method

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MODULE IV : [9 L]

Introduction to Microwave Instrumentation:
Spectrum Analyzer ; Block diagram of a spectrum analyzer – operational features of functional units and applications of Spectrum Analyzers.
Vector Network Analyzer (VNA) : Block diagram of VNA operational aspects of different functional units comprising VNA. Measurement of Scattering parameters and other applications.
Time Domain Reflectometer (TDR) : Block diagram of TDR and its working principle
Reflection coefficient measurement and interpretation of Time domain Reflected waveform.
Industrial applications of TDR.

References:

1. G.H.Bryant- Principles of Microwave Measurements- Peter Peregrinus Ltd.
2. T.S.Laverghetta- Hand book on Microwave Testing
3. S.F.Adam- Microwave Theory & Application- Prentice Hall, Inc
4. A.E. Bailey, Ed. Microwave Measurements- Peter Peregrinus Ltd
5. Annapurna Das and S K Das Microwave Engineering TMH Publications
6. HP Application Notes

Course Name: SATELLITE COMMUNICATION					
Course Code : ECEN 5241					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

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Module I: [10 L]
Introductory topics:

A brief history of satellite communication, future scope and present scenario..
Orbital Mechanism: Orbits, look angle, orbital period and velocity, azimuth and orbital inclination, coverage angle, orbital perturbation, mechanism of satellite placement in geostationary orbit. Indian Satellite scenario.
Satellite Subsystems:
Communication, telemetry, tracking & command, power, attitude & orbital control, antenna subsystems.

Module II: [10 L]

Earth Station: Fundamentals & general system architecture, Earth station antenna, gain, pointing loss, G/T variation and it's measurement, antenna tracking, power amplifier, low noise amplifier, up converter, down converter, transponder hopping, polarization hopping, redundancy configuration.
Satellite transponder: transponder model, transponder channelization, Transponder frequency plans, Effect of fading.
Satellite Link Design: Basic link analysis, interference analysis and attenuation due to rain, link with and without frequency reuse.

Module III: [9 L]

Multiple Access Techniques:
Frequency Division Multiple Access: SPADE, FDM-FM-FDMA, Companded FDM-FM-FDMA and SSB-AM-FDMA, intermodulation products in FDMA, optimized carrier-to-intermodulation plus noise ratio.
Time division Multiple Access: Principle, TDMA frame structure, TDMA Burst structure, TDMA Superframe structure, Frame acquisition and synchronization. TDMA timing. Demand Assignment Multiple Access and Digital Speech interpolation. ERLANG B Formula. Type of demand assignment, DAMA characteristics, Real time frame reconfiguration, DAMA interfaces, SCPC-DAMA, Digital Speech interpolation. Satellite packet communication.

Module IV: [9 L]

Propagation effects: Propagation effects and their impact on satellite earth link.

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Introduction to VSAT systems: low earth orbit and non-geostationary satellite systems. Direct broadcast Television and Radio. Satellite Navigation and the global positioning system. Network configuration, multi-access and networking, network error control, poling VSAT network.
Mobile satellite network: Operating environment. MSAT network concept, CDMA MSAT relink.

References:

1. Tri T. Ha, Digital Satellite Communication, TMH.
2. Timothy Pratt, Charles Bostian, Teremy Allnutt, Satellite Communication, John Wiley & Sons.
3. J. J. Spilker, Jr., Digital Communication by Satellite, Prentice Hall.
4. Bruce R. Elbert, Satellite Communication Applications Hand Book, Artech House.

Course Name: IMAGE PROCESSING AND PATTERN RECOGNITION					
Course Code : ECEN 5242					
Contact Hours	L	T	P	Total	Credit Points
per week	4	0	0	4	4

Module I: [10 L]

Image Processing Basics: Image definition, a simple image formation model, basic concepts of image sampling and quantization, representing a digital image, concept of pixel/ pel, spatial and gray level resolution, some basic relationships between pixels : Neighbors of a pixel, Adjacency, Connectivity, Path, Connected component, Connected component labeling. Distance measures: the three essential properties, Euclidean, City-Block and Chess-Board distance, concept of image operations on a pixel basis.
Popular image processing methodologies: Spatial domain technique : contrast stretching, basic point processing, thresholding function, concept of mask/ sub image, mask processing/ filtering, gray-level slicing, bit-plane slicing.
Basics of spatial filtering : convolution mask/kernel, concept of sliding mask throughout the image-space, smoothing(averaging) filter/ low pass filter. Image segmentation by global and local gray level thresholding, region growing, region splitting and merging techniques. Morphological algorithms: thinning, thickening, skeletons.
Color image processing: Perception of color: color fundamentals. Two popular color models: RGB & HSI, concept of RGB & HSI space and their conceptual relationships, mathematical conversion from RGB to HSI space and vice versa.

Module II: [10 L]

Pattern Recognition
Basics of pattern recognition: Concept of a pattern: feature, feature vectors and classifiers. Importance of pattern recognition. Basic concept of fuzzy pattern recognition, linearly separable and inseparable classes, classes with some overlapping regions, convex and non-convex paradigm in this aspect.
Clustering: Basic concept of cluster analysis. Similarity (Proximity) metrics (indices) and clustering criteria. Partitional clustering: Extraction of natural groups that are inherent in some data set by hard c-means (k-means), fuzzy cmeans.
Concept of getting stuck to a local optimum (in objective functional space) by k-means and fuzzy c-means due to their initiation/ starting point. Fuzzy cluster validity index: Xie-Beni index.
Classification and prediction: Definition of classification and prediction. Basic task of a classifier. Concept of training & testing data and overfitting. Bayes classification: Bayes' Theorem, Naïve Bayesian classification. Classification by Backpropagation: Multilayer Perceptron (MLP) neural network and Backpropagation algorithm.

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Global optimization techniques: Genetic Algorithms (Gas): Cycle of genetic algorithms, selection (Roulette wheel and Tourment) crossover, mutation, evaluation of fitness function, incorporation of elitism in GAs. Multi-objective optimization using GAs. Simulated Annealing (SA): Analogy with physical annealing process, concept of energy and mechanism of energy minimization using SA, Necessity of an uphill movement during the process. Hybridization with partitional clustering techniques.

Module III: [9 L]

Image clustering applications: Mechanism of extracting pixel-patterns from a gray-scale image in various ways: e.g. forming feature space (like a two column matrix) treating the gray-value of center-pixel (of a local window) as the first feature and averaged value over a square-shaped local window (3x3 or 5x5 or like that) as the second feature, construction of high-dimensional feature space: e.g. treating all the pixel-gray-values of a local window as features (i.e. for 3x3 window 9-dimensional feature space will result). Application of partitional clusterings in the above mentioned feature-space to recognize the objects in the concerned image.

Module IV: [9 L]

Applications in multispectral and multitemporal remotely sensed imagery: Identification of different land cover types from multispectral remote image data using supervised/ unsupervised classification: Clustering by Histogram peak selection & and its limitation in this context (i.e. remote image analysis). Unsupervised Change Detection using squared-error clustering methodologies: The algorithm, process, key challenges, error estimations like missed alarms, false alarms and overall error, need of ground truth.
Image mining: Need, Image search and retrieval. Bottleneck of Text based image mining/ retrieval, Visual feature based image mining: Content-based image retrieval (CBIR).
Image based face recognition: Basic technique for Eigen face generation & recognition.

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References:

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Pearson Education Asia, 2004
2. S.K. Pal, A.Ghosh, and M.K. Kundu, Soft Computing for Image Processing, Physica
3. Verlag, (Springer), Heidelberg,1999.
4. R. O. Duda, P.E. Hart and D. G. Stork, Pattern Classification, John Wiley & Sons (Low Priced Edition).
5. Anil K. Jain and R.C.Dubes, Algorithms for Clustering Data, Prentice Hall.
6. S. Theodoridis and K. Koutroumbus, Pattern Recognition, Elsevier.
7. A. Ghosh, S. Dehuri, and S. Ghosh (editors). Multi-Objective Evolutionary
8. Algorithms for Knowledge Discovery from Databases. Springer, Berlin,
9. 2008.
10. Anil K. Jain, Fundamentals of Digital Picture Processing, Prentice Hall.

Course Name: MULTIMEDIA COMMUNICATION					
Course Code : ECEN 5243					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [10 L]

Multimedia Introduction: Media and Data Streams, Classification of media and Properties of multimedia system. Sound, Images & Video : Speech synthesis, Speech Recognition, Raster display, Image recognition, TV, HDTV, Speech transmission, Image transmission.

Module II: [10 L]

Compression : Huffman Coding, Runlength coding, JPEG, MPEG, DVI, H.261
Storage Media : CDDA, CDROM, CDROM (XA)
Multimedia Operating system: Resource Management, Process Management: EDF

Module III: [9 L]

Rate monotonic Algorithms. System Architecture: Quick Time, MDBMS.
Synchronization: Lip & Pointer Synchronization, Synchronization Reference Model, Case Study.

Module IV: (9 L)
Multimedia Communications: Delay compensation, QoS negotiation protocols, Architectures and Issues for Distributed Multimedia Systems, Prototype Multimedia systems: Video-on-Demand, Video conferencing. Multimedia Information: Delay-sensitive and Time-based Media data Modeling

References:

1. Ralf Steinmetz and KlaraNahrstedt, “Multimedia: Computing, Communications and Applications”, Prentice Hall PTR, 1995.
2. Franklin Kuo, Wolfgnag and J.J. Garsia, “Multimedia Communications, Protocols and Applications”, Prentice Hall PTR 1998.

Course Name: ADVANCED ANTENNA ENGINEERING					
Course Code : ECEN 5244					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I: [10 L]
Antenna:
Wire antennas, Aperture Antennas, Antenna gain, Antenna Temperature and other Antenna parameters. Relationships between antenna parameters. Reciprocity, Review of microwave antennas-Parabolic Reflector, Cassigrain feeds, Horn Antennas, Open-ended wave guides, lens antennas, Dielectric rod Antennas, Antennas for mobile communication. Applications of

reaction concept and vocational principles in antennas and propagation, Frequency-independent antennas, Scattering and diffraction. Selected topics in microwave antennas, Internal-equation methods, current distribution: Self and mutual impedances: arrays: design and synthesis.

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Module II: [10 L]

Full wave analysis of Microstrip Antenna(MSA),Active Integrated MSA, Compact MSA with enhanced gain, Broadband Antenna(MSA), Dual frequency & Dual polarized MSA Application of broadcasting, microwave links, satellite communication and radio astronomy.

Module III: [9 L]

Antenna Measurements: Standardization and characterization of antennas, Anechoic Chamber, Open-air test range.
Propagation:
Review of modes of propagation: Surface wave, Ground wave, Sky wave, Space wave, Troposphere propagation.
Propagation over plane-Earth, Spherical Earth, Refraction, Anomalous Propagation, Diffraction, Modified refractive index- Its effects on wave propagation, Duct and other nonstandard propagation. Environmental noise

Module IV: [9 L]

EMI - EMC, Radiation Hazards.
Microwave & millimeter wave propagation, Effects on atmospheric precipitations: Rain, Fog, Snow, Ice, and other atmospheric gases.
Low frequency propagation, Propagation through seawater, Sea clutter, Land clutter, Surface clutter, Radar equation, o Microwave link considerations- multi-path Fading, its characteristics- Techniques for more link availability, Earth space systems
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References:

1. R.E Collin, Antennas & Radio wave propagation (McGraw-Hill Book Co.)
2. Jordan and Balmain, Electromagnetic Waves and Radiating Systems (PrenticeHall of India)
3. M.L Skolink, Introduction to radar systems (McGraw-Hill Book Co.)
4. P Bhartia and I.J. Bhal, Millimeter wave Engineering & Applications
5. Albart Smith, Radio Engineering Principle and Applications
6. M. Dolukhanov, Propagation of Radio Waves (Mir Publication)
7. R.Garg,P.Bhartia,Indu Bhal,A.Ittipibom ; Microstrip Antenna Design hand book –Artech House
8. Girish Kumar & K.P.Roy—Broad band Microstrip Antenna-=Artech. House
9. Kin. Lu. Wong ; Compact and Broadband Microstrip Antenna—John Willey & Sons.

Course Name: COMMUNICATION SYSTEMS LABORATORY					
Course Code : ECEN 5211					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

Experiments on complete systems to acquire an overall knowledge about the system architecture, its important GOS parameters and its detail working principle.

Suggested topics are (not exclusive),

1. GPS
2. ISDN
3. Satellite communication system
4. GSM system
5. CDMA mobile system
6. Optical data communication system
7. Bluetooth communication system
8. Wireless channels.

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Project Management by S Choudhury, TMH

Projects: Planning, Analysis, Selection, Implementation & Review by Prasanna Chandra, TIvll-I.

Course Name : EMI/EMC					
Course Code : ECEN 6131					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course outcomes:

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1.An ability to understand the concept and importance of EMI/EMC.

2.An ability to analyze circuits like SMPS from the perspective of EMI.

3.An ability to design proper shielding and grounding mechanism for circuits like RC filter

4.An ability to apply the concepts of EMI/EMC in measurement of radiation from system like PCB board using reverberating chamber, anechoic chamber etc.

5.An ability to set EMC standards for a particular circuit based on EMI/EMC measurements.

Module I **(8L)**

Introduction: History and concept of EMI, Definitions of EMI/EMC, Electro magnetic environment, Practical experiences and concerns, frequency spectrum conservations.

Natural and manmade sources of EMI/EMC: Sources of Electromagnetic noise, typical noise paths, modes of noise coupling, designing for EM compatibility, lightening discharge, electro static discharge (ESD), electromagnetic pulse (EMP), electromagnetic interference due to radiation.

Module II **(10L)**

EMI from circuits:

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a) *Analog Circuits:*
EMI in analog circuits, basic noise entry modes for the analog circuits, noise calculation in each case with examples, ground loop problems with examples.

b) *Digital Circuits:*
EMI issues in digital circuits, power distribution in digital circuits, power rail equivalent circuit, frequency response of power rail.

c) *Power Circuits:*
EMI issues in power circuits, conducted noise emission from SMPS, reduction methods, conducted noise emission, calculation in frequency domain using graphical methods, conducted noise emission standards, power supply induced noise and the design of RC filter for the circuits with examples.

Module I V **(16L)**

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Signal Integrity:

a) PCB design:
Power distribution issues in PCB using different converters. Filtering techniques, Reflection and cross talk issues in PCB for high speed circuits. Cross talk calculations. Issues due to reflections. Calculation of induced noise. Calculation of PCB track impedance.

b) *Shielding and Bonding:*
effectiveness of shielding, near and far fields / impedances, methods of analysis, use of instrumentation amplifier for ground noise reduction, use of shielded cable for the instrumentation amplifier, circulating current reduction techniques, use of Isolation amplifier, noise reduction characteristics, example with bio-medical amplifier.

c) *Grounding and cabling:*
Safety and signal grounds, low and high frequency grounding methods, grounding of amplifiers and cable shields, isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding, types of cables, mechanism of EMI emission / coupling in cables.

Module V **(4L)**

EMC Standards and test equipment~~s~~: EMI standards and regulations, anechoic chamber, TEM cell, reverberating chamber, GTEM cell, comparison of test facilities,

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Reference Text books:

1. Engineering Electromagnetic Compatibility by Dr. V.P. Kodali, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
2. Electromagnetic Interference and Compatibility IMPACT series, IIT-Delhi, Modules 1-9.
3. Introduction to Electromagnetic Compatibility, Ny, John Wiley, 1992, by C.R. Paul.
4. Radar hand book by Skolink.
5. Ott. H.W. Noise reduction techniques in Electronic system, 2nd edition, John Wiley Interscience, New York (1988).
6. Electromagnetic Interference & Electromagnetic Compatibility, Tata McGraw Hill, New Delhi (1996) by G K Dev.

Course Name : AD HOC AND SENSOR NETWORKING					
Course Code : ECEN 6132					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course outcomes:

1. An ability to apply knowledge of mathematics, science and engineering in the areas of communication engineering.

2. An ability to analyze a situation and interpret a data in ad hoc networks.

3. An ability to learn and apply modelling based approach through the extensive use of simulator tools.

4. An ability to understand and participate in new path breaking research work in new areas of communication engineering.

5. Imbibement of a passion to pursue new areas of research.

Module I: [12 L]

Ad hoc wireless Network: Introduction, Basic concept on ad hoc network, static and mobile ad hoc network, transmitter-receiver constraints, Applications.
MAC protocol: Hidden terminal, Exposed terminal, IEEE802.11 in ad hoc mode.
Routing protocols: Proactive, Reactive and hybrid routing protocol, Destination sequenced distance vector algorithm, Dynamic source routing, Ad hoc on-demand routing, Location aided routing, Link reversal routing.

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Module II: [10L]

Analysis of TCP performance in wireless ad hoc network: TCP window management and problems, different solution schemes, QoS in wireless ad hoc network – analysis of degradation of receiver sensitivity, practical solutions.
Achieving energy efficiency in wireless ad hoc network: Different schemes to increase the lifetime of the node in ad hoc network – MAC layer protocol, Routing protocol.

Module III: [8 L]

Localization Management: Location acquisition technique, location sensing technique, location aware routing protocol. Primary and secondary source , Different principles like weighted centriod algorithm to locate sources. Security for wireless ad hoc network: Security goals, threats and challenges, Different schemes of security in ad hoc network, routing security. Spectrum utilization – Generic Access Network (GAN) and other methods

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Module IV: [6 L]

. Sensors- sensor networking, WSN, hardware and software platforms, OS for WSN, distributed sensor network, healthcare monitoring, environmental sensing, industrial monitoring, smart city concept.

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Reading:

1.”Ad Hoc Wireless Networks – Architectures and Protocols” - C.Siva Ram Murthy and B.S. Manoj – Pearson Education

2.Mobile Ad Hoc Networking – Stefano Basagni, Marco Conti, Silvia Giardano, Ivan Stojmenovic – Wiley India

3.”Ad Hoc Mobile Wireless Networks : Principles Protocols and Applications” – Basavaraju – Aurbach Publications

4.Security and Quality of Service in Ad Hoc Wireless Networks – Amitabh Misra – Cambridge University Press

5.”Ad Hoc Mobile Wireless Networks – Protocols and Systems” - Chai K. Toh – Prentice Hall

Course Name : CONVERGENCE IN COMMUNICATION TECHNOLOGY					
Course Code : ECEN 6133					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course outcomes:

1.High speed links using new technologies
2.concepts about routing protocols
3. concepts about cloud computing etc

Module I: [8 L]

Human – Machine Interfaces – Embedded devices, EM spectrum, Multiplexing media – carrier vice twisted pair, co-ax cable, microwave, satellites, Fiber optics. Circuit switching, Packet switching, PDH & SDH/SONET, SS7 & intelligent networks.

Module II: [10 L]

Data Communication Traffic, Data transmission, OSI & TCP/IP models, LAN Transport and standard, LAN access, switches, VLANs & Bridges, ISDN, X.25, Frame Relay & ATM, Internet & Routing protocols, sub netting: IPV4, IPV6, DNS, QoS – VoIP call signaling protocols, IP Voice & IPTV, Telepresence.

Module III: [10 L]

Digital TV standards, Broadband infrastructure, Cloud computing, optical networking elements, switches, edge, core, DSL, Cable TV, Packet Cable, Wireless Broadband, HAN, PANs, CANs, MANs, Broadband PLT, Antennas, Spread spectrum.

Module IV: [10 L]

Cellular – 26, 2.5G, 3G, 4G, WiMAX, mobile security, Digital cellular Radio, UMTS, TD – SCDMA, BFWA, WLANs, IEEE 802.11 a,b,g,n, IEEE 802.16 WiMAX, Interpration of WLANs & cellular networks, RFID, IP multimedia subsystem, Mobile Video, Mobile TV.

Rea ding:

1. "Telecommunications Essentials elearning" by Lillian Goleniewski, ISBN, 13: 9780970741202
2. "Telecommunications Essentials" by Lillian Goleniewski, 2nd edition, Addison-Wesley Professional ISBN 13 : 9780321427618.
3. "Network & Guide to Networks" – Tamera Dean, March 2009. Publisher: Course Technology. ISBN 13 : 9781423902454
4. Telecommunications and Signal Processing – Roger L. Freeman, Wiley Series.
5. Telecommunication- Fraser.

Course Name : COGNITIVE RADIO TECHNOLOGY					
Course Code : ECEN 6141					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

The following outcomes (COs) are expected from the students after completion of the course – ECEN6141.

a) An ability to apply knowledge of mathematics, science and engineering in the emerging areas of RF communication.

b) An ability to analyze a situation.

c) An ability to learn and apply modular approach.

d) An ability to understand research work in new areas of cognitive radios and spectrum hole sensing.

e) Development of a passion to pursue next generation wireless communication.

Module I: [10 L]

INTRODUCTION TO SOFTWARE DEFINED RADIO

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications. Differences between software enable radio and software defined radio. Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

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Module II: [8 L]

COGNITIVE RADIO TECHNOLOGY

Introduction – Radio flexibility and capability – Aware – Adaptive – Comparison of Radio capabilities and Properties – Available Technologies – IEEE 802 Cognitive Radio related activities – Application, position awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

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Module III: [10 L]

COGNITIVE RADIO DESIGN AND CHALLENGES

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture. Design Challenges associated with CR – Hardware requirements – Hidden primary user problem – detecting spread spectrum primary users – sensing duration and frequency – security **Module IV:**

[8 L] SPECTRUM

SENSING

Spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design, applications of cognitive radios to optimize spectrum utilization, to reduce transmit power reduction and to improve data rate even in noisy conditions. Matched filter – waveform based sensing – cyclostationary based sensing – Energy detector based sensing – Radio Identifier – Cooperative sensing-other sensing methods.

TOTAL: 36 PERIODS

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Reading:

1. Joseph Mitola III, “Software Radio Architecture: Object-Oriented Approaches to wireless system Engineering”, John Wiley & Sons Ltd. 2000
2. Thomas W. Rondeau, Charles W. Bostain, “Artificial Intelligence in Wireless communication”, ARTECH HOUSE. 2009.
3. Bruce A. Fette, “Cognitive Radio Technology”, Elsevier, 2009.
4. Ian F. Akyildiz, Won- Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, “Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey” Elsevier Computer Networks, May 2006
5. Simon Haykin, “Cognitive Radio: Brain-Empowered Wireless Communication”, IEEE Journal on selected areas in communications, Feb 2005.
6. Markus Dilinger, Kambiz Madani, Nancy Alonistioti, “Software Defined Radio”, John Wiley, 2003
7. Huseyin Arslan,”Cognitive Radio, SDR and Adaptive System”, Springer, 2007.
8. Bruce A. Fette, “Cognitive Radio Technology”, Elsevier, 2009.

Course Name : DESIGN OF COMMUNICATION EQUIPMENTS AND SYSTEMS					
Course Code : ECEN 6142					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

The following outcomes (COs) are expected from the students after completion of the course – ECEN6142.

a) An ability to apply knowledge in designing electronics for communication engineering.

b) An ability to analyze and interpret data.

c) An ability to learn and apply modelling based approach through the extensive use of simulator tools.

d) An ability to pursue research work in new areas of communication equipments and systems.

Module I: [10 L]

Design Considerations of Communication equipments and systems: Implementing Radio Link, Path profile, RF path loss calculations, Transmitter / Receiver parameters and their significance – SNR, SINAD, sensitivity, Hum and Noise, Quieting, Distortion, Rated RF power, RF power, Fade Margin.
Study and evaluation of Performance parameters for data communication like Bit and symbol error rates, Spectral Bandwidth calculations.

Module II: [10 L]

Design of various blocks of communication equipments such as PLL, Equalizer, Interleaver, Interference consideration in processor / controller enabled radios-desensitization problem, means to mitigate the problem – detailed study of clock speed & shape, PCB design.

Module III: [10 L]

PCB Design and EMI/EMC
PCB design practices for Analog and Mixed signal circuits- Ground loops, Precision circuits, supply isolation, shielding and guarding – different techniques. PCB design practices for High Speed Digital circuits, signal integrity and EMC. EMI/EMC testing standards and compliance.

Module IV: [8 L]

Types of antenna – selection procedure for correct antenna, measurement of the network performance – different techniques.
Emulation of testing procedure in laboratory, test procedures for Receiver / Transmitter parameters with different standards like CEPT, EIA.

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Rea ding:

1. “High-speed Digital Design- A Handbook of Black Magic” – Howard Johnson, Martin Graham- Prentice Hall.
2. “EMC for Product Designers” – Tim Williams – Elsevier 2007.
3. “Digital Communication” – B. Sklar – Pearson Ed.
4. “Circuit Design for RF Transceiver” – D. Leenaerts, Johan van dar Tang, Cicero S. Vaucher – kluwer Academic Publishers, 2003
5. “Practical Radio Engineering & Telemetry for Industry“ – David Bailey – Elsevier, ISBN 0750658037.

Course Name: RF IC Design and MEMS Technology					
Course Code : VLSI6101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course outcome:

1.Design of RF system blocks in VLSI
2.MEMS – technology and fabrication
3.MEMS for RF applications

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Module I: [10L]

Prerequisite:
RFIC design tradeoffs; Fading,Diversity; Multiple Access Schemes; S and ABCD parameters; Resonance in LC circuit; Concept of transmission lines-Reflection Coefficient; Impedance transformation and matching;
Unit1: RF Devices:
Design of RF passive devices- capacitor, inductors; Design of RF MOS devices; Spectre RF ,BJT, MOS spice modeling in RF.
Unit2: RF Systems basics:
Nonlinearity in RF Systems; IIP3, SFDR; Classical two port network theory of Noise; Noise in MOSFETs; Testing of RF System – Noise, Distortion Measures and Mitigation Methods;

Module II: [12L]

Unit1: RF System Blocks:
Wideband amplifier design; LNA Design; Mixer Design, Gilbert mixer; Linearization techniques; Design Overview of oscillator and Mixer, Frequency Synthesizer; VCO design; power amplifier design – A,B,AB,C,D,E,F;
Unit2: Transmitter Architecture- PLL/**C**DR Loop, Frequency Divider
Unit2: Receiver architectures- direct conversion, heterodyne, image reject architectures;
Unit3: Applications- GSM,CDMA architectures.

Module III: [9L]

Unit1: Introduction to MEMS technology:
Basics of MEMS; Areas of application; Silicon as Design material; Important Material Properties and Physical Effects;Other design materials (GaAs,Quartz, SiC, Polymer etc.,)
Unit2: MEMS Fabrication:
Bulk micromachining; Surface micromachining; Different types of etchants and etching methods; Nonlithographic Microfabrication Technologies;

Module IV: [9L]

Unit1: MEMS Structures and Systems for sensors and actuators:
Sensing and Actuation methods; Sensors of different types with example of each type (Mechanical, temperature, chemical , Lab on Chip, microfluidic, bio-sensors);micro pump; 3D Accelerometer, Digital Light Projector;

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Unit2: MEMS structure and systems for RF applications:
Passive Electrical Components: Capacitors and Inductors; Surface-Micromachined Variable Capacitors;Bulk-Micromachined Variable Capacitors ;Micromachined Inductors; Microelectromechanical Resonators; Microelectromechanical Switches;

Text Books:

1. The Design of CMOS Radio-Frequency Integrated Circuits -Thomas H. Lee, Cambridge University Press; 2 edition
2. MEMS- NPMahalik, Mc Graw Hills Publishers.

Referense books:

1. An introduction to microelectromechanical systems –Nadim Maluf, Kirt Williams, Artech House 2nd Edition
2. Mems & Microsystems: Design & Manufacture-Tai-Ran Hsu, Mc Graw Hills Publishers, 1st Edition
3. RF Microelectronics- Behazad Razavi, Pearson Education, 2nd Edition
4. VLSI for Wireless Communication- Bosco Leung, Springer, 2nd Edition
5. Microsystem Design, Senturia,Kluwer Academic Publishers.
6. Fundamentals of Micro Fabrication, Madou, CRC Press.

Course Name:	**Digital VLSI Design Laboratory**				
Course Code	**: VLSI6111**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**0**	**6**	**4**

List of Experiments:
Sub Micron and Deep Sub Micron Technology based Experiments:

1) Combinational Circuit Example (**Cadence Virtuoso and Assura Tools**)
    a. Circuit Design,
    b. Critical Path Timing Analysis,
    c. Layout Design and Verification,
    d. Parasitic Extraction, Back-annotation and Post Layout Timing Analysis
2) Sequential Circuit Example (**Cadence Virtuoso and Assura Tools**)
    a. Circuit Design,
    b. Setup and Hold Analysis,
    c. Layout Design and Verification,
    d. Parasitic Extraction, Back-annotation and Post Layout Timing Analysis

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Kolkata

3) **Cadence Semi Custom Design** Flow

   a. **Incisive Logic Simulation**: Verilog Coding and Test Bench Verification
   b. **Encounter RTL Compiler**: Logic Synthesis
   c. **Encounter Physical Design Implementation**: Floor-planning, Power-planning, Placement, CTS, Routing, Static Timing Analysis
   d. **ASIC views -** .lib, .lef, .gds, .sdf
   e. **Std. cells-** Design, layout, characterization
   f. **Logical Equivalence checking**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Subject Name: DISSERTATION PART-1					
Paper Code: AEIE6121					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	16	16	8

Dissertation should be on any topic having relevance with Instrumentation, Electrical or inter-disciplinary field of engineering. The same should be decided by the student and concerned supervisor. Dissertation should consist of research work done by the student in the selected topic with comprehensive and significant review of recent developments in the same field.

Dissertation Part- I shall consist of the following division(s) whichever applicable:

1. Introduction
2. Goal of the work
3. Extensive literature survey
4. Data collection from experimental set-ups, websites, R&D organizations, industries, etc.
5. Study of the viability, applicability and scope of the dissertation
6. Detailed design (hardware or software as applicable)
7. Partial implementation with results
8. Future work

A candidate should prepare the following documents for examination:

1. A detailed report in the prescribed format based on the work related to dissertation.
2. Every candidate should present himself (for about 20-30 min.) for evaluation before the panel of examiners consisting of Head of Department, M. Tech. Coordinator, Supervisors and examiners from outside of the department.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Improve in skills to apply knowledge of sensor selection, circuit design, signal processing, conduct experiments, analyze and interpret data.
2. Implement existing or new technology for a proposed project work by applying programming and computing skills using technical software like MATLAB, LAB VIEW, etc.
3. Identify, formulate an engineering problem and implement through a scientific manner.
4. Develop ethical and social responsibilities by finding and implementing the needs of society for betterment of life and engage themselves in life-long learning.

Subject Name: MICRO-ELECTROMECHANICAL SYSTEM DESIGN					
Paper Code: AEIE6131					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I: [5L]

Overview of Microsystems Design:
Glimpses of Microsystems; Typical MEMS and Micro-system products, Evaluation of Micro-fabrication, Micro systems and Micro-electronics; The multidisciplinary nature of micro system design and manufacturing; Applications of Microsystems in Automotive, health care, aerospace, telecommunication industries.

Module II: [12L]

Engineering Mechanics for Micro-system Design:
Static bending of thin plates: Bending of circular plates with edge fixed, Bending of rectangular plates with all edge fixed, Bending of square plates with all edge fixed; Mechanical Vibration: General Formulation, resonant Vibration, Micro-accelerometers, Design Theory of accelerometers, Damping coefficient, Resonant Micro-sensors; Thermo Mechanics: Thermal effects on mechanical strength of materials, creep deformation, thermal stresses; Fracture Mechanics: Stress Intensity Factors, Fracture Toughness, Interfacial Facture Mechanics; Thin Film Mechanics; Overview of Finite Element Method.

Module III: [11 L]

Microfluidic System Design:
Introduction to Fluid Mechanics: Viscosity of fluids, Streamlines and Stream Tubes, Control Volumes and control surfaces, Flows patterns; Basic Equations in Continuum Fluid Dynamics: Continuity, momentum equations and equations of motion; Laminar Fluid Flow in Circular Conduits: Computational Fluid dynamics; Incompressible Fluid Flow in Microconduits: Surface Tension, Capillary Effect, Micro-pumping; Fluid flow in submicrometer and nanoscale: The Rarefied gas, Kudsen and Mach Number, Modelling of Micro-gas Flow; Heat Conduction Mechanics- Fourier Law of Heat Conduction, Heat conduction Equations with Cooling Law, Solid-Fluid Interaction, Boundary Conditions.

Module IV: [12L]

Microsystems Design:
Design Considerations: Constraints of Design, Material Selection, manufacturing process selection, Signal Transduction Selection, Electromechanical System, Packaging; Process Design: Photo-Lithography, Thin film Fabrications, Geometry Shaping, Mechanical Design: Thermo-mechanical loading, Thermomechanical Stress Analysis, Dynamic Analysis, Interfacial Facture Analysis, Mechanical Design Using Finite Element Method: Finite element Formulation, Simulation of Micro-fabrication Process; Design of Silicon Die for a Micro-pressure Sensor; Design of Microfluidic Network Systems: Fluid Resistance in Micro channels, Mathematical Modeling of Capillary electrophoresis network systems.

References:

1. G.T.A. Kovacs, *Micromachined Transducers Sourcebook*, WCB McGraw-Hill, 1998.
2. J.W. Gardner, *Microsensors: principles and applications*, John Wiley & Sons, 1994.
3. M. Madou, *Principles of Microfabrication*, CRC Press, 1998.

4. Kubby, *A Guide to Hands- on MEMS Design and Prototyping*, Cambridge, 2011
5. *MEMS and Nanotechnology*, Volume 6: Proceedings of the 2012 Annual Conference on Experimental and Applied Mechanics: 42 (Conference Proceedings of the Society for Experimental Mechanics Series), Gordon A. Shaw (Author, Editor), Barton C. Prorok (Author, Editor), LaVern A. Starman ,Kindle Edition.2012.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Design MEMS-based diaphragm type devices analytically.
2. Fabricate the whole MEMS system with the help of simulation software.
3. Develop micro-fluidic system for biomedical applications.
4. Develop skill on engineering mechanics for micro-system design.

Subject Name: VLSI TECHNOLOGY					
Paper Code: AEIE6132					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I: [12L]

Digital VLSI Circuits:

MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Logical Effort, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop, Pseudo NMOS Logic, Dynamic gate, Domino and NORA Logic.

Module II: [8L]

***Physical Layout of VLSI Circuits*:**

CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs. Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm, Layout Legging.

Module III: [12L]

VLSI Design Methodology:

Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node, VLSI Design Cycle, Y-Chart, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX.

Module IV: [8L]

Hardware Description Language:

Introduction to HDL, VHDL/Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed Mode with various examples of combinational and sequential circuits, FSM Example: Mealy Machine and Moore Machine.

References:

1. Neil Weste, *Principles of CMOS VLSI Design*, A Systems Perspective, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. Sung-Mo Kang, *CMOS Digital Integrated Circuits*, Analysis and Design, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006
3. Neil Weste, David Harris, *CMOS VLSI Design, A Circuits and Systems Perspective* Pearson,3rd Edition, 2011
4. Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, *VLSI Design and EDA TOOLS*, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011
5. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, McGraw Hill
   J. Bhasker, *A VHDL Primer*, Prentice-Hall, 2013.

Course Outcome:

After the completion of the course student will be able to

1. Analyze CMOS digital electronics circuits including logic components and their interconnection.

2. Develop models of moderately sized CMOS circuits that realize specified digital functions.
3. Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.
4. Learn VLSI design methodologies - the various steps and tools, the implementation choices, and good architecture practices.

Subject Name: ROBOTICS ENGINEERING					
Paper Code: AEIE6133					
Contact hrs per week:	L	T	P	Total	Credit Points
	4	0	0	4	4

Module I [9L]

Introduction to Robotics, Elements of robots – links, joints, actuators, and sensors:

Introduction – brief history, types, classification and usage, Science and Technology of robots.

Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms.

Types of transmissions, Purpose of sensors, internal and external sensors, common sensors, encoders, tachometers and strain gauge based force-torque sensors, proximity & distance measuring sensors, vision sensors.

Module II [7L]

Kinematics of serial and parallel robots:

Direct and inverse kinematics problems, Examples of kinematics of Common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination.

Degrees-of freedom of parallel mechanisms and manipulators, Direct Kinematics problem, Mobility of Parallel manipulators, Inverse kinematics of parallel manipulators and mechanisms.

Module III [10L]

Static and Dynamic analysis of robot manipulators:

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.

Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, Joint and Cartesian space trajectory planning and generation.

Module IV [14L]

Motion planning and control of robots:

Classical control concepts using the example of control of a single link, Independent joint, PID control, Control of a multi-link manipulator, nonlinear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control. Modeling and Analysis of Wheeled Mobile robots: Introduction, Kinematics of contact, Kinematics of a single wheel, Kinematic modeling of a three-wheeled mobile robot, equations of motion of a three-wheeled mobile robot, algorithm for solving the equations of motion.

References:

1. A. Ghosal, *Robotics: Fundamental Concepts and Analysis*, Oxford University Press, 2nd reprint, 2008.
2. K. Fu, R. Gonzalez and C.S. G. Lee, *Robotics: Control, Sensing,* Vision and Intelligence, McGraw- Hill, 1987.
3. R.D. Klafter, T. A. Chimielewski and M. Negin, *Robotic Engineering – An integrated approach*, Prentice Hall of India, New Delhi, 1994.
4. Nagrath and Mittal, *Robotics and Control*, Tata McGraw- Hill, 2003.
5. Spong and Vidhyasagar, *Robot Dynamics and Control*, John Wiley and sons, 2008.

Course Outcomes:

After the completion of the course students will be able to

1. Explain the roles of links, joints & Identify sensors and actuators required in robotic control.
2. Solve direct and inverse kinematics problem of serial and parallel manipulators.
3. Illustrate the degrees of freedom of manipulators.
4. Solve basic robotic dynamics, path planning and control problems.
5. Model robot links and joints and integrate sensor technology and other external devices into the robot system to design multilink flexible robot.

Subject Name: APPLIED SOFT COMPUTING					
Paper Code: AEIE6141					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [8L]

Introduction to Soft Computing:

Introduction, Benefits and application scope of Fuzzy Logic, Neural Network and Stochastic algorithms. Introduction to different hybrid systems:-Fuzzy-conventional, Neuro-Fuzzy, Neuro-Genetic, Genetic-Fuzzy Systems.

Stochastic Algorithm:

Biological background, Basics of Stochastic algorithms and its applications

Module II - [10L]

Fuzzy Logic -I:

Basic concepts of Fuzzy Logic- Probability and possibility theorem, Fuzzy sets and crisp sets, properties of Fuzzy sets, Fuzzy relations, Compositional rule of inference, Fuzzy implications.

Module III-[10L]

Fuzzy Logic-II:

Membership functions, Choice of scaling factors- normalization and de-normalization, Fuzzification procedure, Inference engine- Mamdani and TSK FIS, Choice of defuzzification procedures, Design of Fuzzy controllers, Industrial applications.

Module IV-[12L]

Neural Network-I:

Biological Neural Network, Evolution of Neural Network, Basic models of ANN, Activation functions, McCulloch-Pitts Neural Network model, Single layer and Multi-layer feed forward Neural Network, Hebb Network, Numerical problems.

Neural Network-II:

Supervised learning network- BPNN, Radial Basis Function Network. Unsupervised learning network- Kohonen Self-Organizing Feature Map.

References:

1. J. S. R. Jang, C. T. Sun and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 2004, Pearson Education 2004.
2. Dirankov, Hellendoorn and Reinfrank, *An Introduction to Fuzzy Control*, Narosa Publishing House.
3. Davis E. Goldberg, *Genetic Algorithms: Search, Optimization and Machine Learning*, Addison Wesley, N.Y., 1989.
4. S. Rajasekaran and G. A. Vijaylakshmi Pai, *Neural Networks Fuzzy Logic, and Genetic Algorithms*, Prentice Hall of India.
5. J. Yen and R. Langari, *Fuzzy Logic, Intelligence, Control and Information*, Pearson Education.
6. S. Haykin, *Neural Netowrks*, Prentice Hall of India.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Classify the soft-computing into the different computing methods based on their application, knowledge-base, mode of operation, construction, etc.
2. Explain the functions and properties of different fuzzy sets and compare with crisp set, explain different fuzzy relations and implications.
3. Design and analyze the different components of fuzzy controller appropriately to obtain the best possible fuzzy controller that can be applied to any process control systems.
4. Identify different component of biological and artificial neural network, and acquire knowledge of different ANN terminologies to apply in solving simple ANN problems.
5. Analyze and design algorithms for different supervised and unsupervised learning networks.
6. Illustrate biological background and give idea about basics of stochastic algorithm.

Paper Name: WIRELESS SENSOR NETWORKS					
Paper Code: AEIE 6142					
Contact hrs. per Week :	L	T	P	Total	Credit points
	4	0	0	4	4

Module I - [8L]

Introduction & Architecture:

Brief historical survey of sensor networks, WSN types and Architecture : Single-node architecture - hardware components, design constraints, energy consumption of sensor nodes, operating systems and execution environments, types of sources and sinks – single hop vs. multi hop networks, multiple sources and sinks – mobility, optimization goals and figures of merit, gateway concepts, design principles for WSNs, service interfaces for WSNs. Introduction to MANETs (Mobile Ad-hoc Networks), Comparative study of WSNs with MANETs.

Module II – [12L]

Communication Protocols:

Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs : low duty cycle protocols and wakeup concepts, Contention-based protocols, Schedule-based protocols, Traffic-adaptive medium access protocol (TRAMA), WSN Standards : IEEE 802.15.4, Zigbee; Address and name management, assignment of MAC addresses; Routing challenges and design issues in Wireless Sensor Networks, Flooding and Gossiping, Data centric routing (SPIN), Directed Diffusion, Energy efficient routing, Gradient-based routing, Hierarchical routing (LEACH), Location based routing, Real time routing; Data aggregation - data aggregation operations, aggregate queries & techniques.

Module III – [8L]

Topology and Synchronization:

Topology control, flat network topologies, hierarchical networks by clustering, time synchronization, properties, protocols based on sender-receiver and receiver-receiver synchronization, LTS, TPSN, RBS, HRTS, localization and positioning, properties and approaches, single-hop localization, positioning in multi-hop environment, range based localization algorithms – location services, sensor tasking and control.

Module IV – [12L]

Network Platforms:

Operating Systems for Wireless Sensor Networks : Introduction & Design Issues - Tiny OS – Mate – Magnet OS; Introduction to Tiny OS – NesC: Interfaces and Modules, Configurations and Wiring, Generic Components, Programming in TinyOS using NesC; Network Simulation / Emulation using NS2, TOSSIM.

Applications: Industrial & Building Automation, Bio-Medical Applications, Highway Monitoring, Military Application, Civil and Environmental Engineering Applications, Nanoscopic Sensor Applications.

References:

1. Holger Karl & Andreas Willig, *Protocols and Architectures for Wireless Sensor Network*, John Wiley, 2005.

2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, *Wireless Sensor Networks- Technology, Protocols, and Applications*, John Wiley, 2007.
3. Feng Zhao & Leonidas J. Guibas, *Wireless Sensor Networks- An Information Processing Approach*, Elsevier, 2007.
4. Anna Hac, *Wireless Sensor Network Designs*, John Wiley, 2003.

Course Outcomes:

After completing the course, the students will be able to:

1. Familiar with common wireless sensor node architecture.
2. Acquire knowledge of MAC protocols developed for WSN.
3. Carry out simple analysis and planning of WSN.
4. Apply routing protocols on the developed WSN.
5. Work on some WSN standards, platforms and tools.

Subject Name: REMOTE SENSING					
Paper Code: AEIE6143					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [8L]

Remote Sensing Foundations:

Introduction to Remote Sensing: Definitions, Milestones in the History of Remote Sensing, Overview of the Remote Sensing Process, Key Concepts of Remote Sensing, Components of Ideal and Real Remote Sensing Systems, Advantages and Limitations of Remote Sensing, Remote Sensing data collection- Active and Passive Remote Sensing systems, Sensor Resolution- Spectral Resolution, Spatial Resolution, Temporal Resolution and Radiometric Resolution. Electromagnetic Radiation (EMR) Models- Wave model and Particle model, Interaction of EMR with the Earth surface- Reflection, Transmission, Spectral Signature; Energy-Matter Interactions with the Terrain- Scattering, Absorption, Refraction and Reflectance, Radiance and Irradiance.

Module II - [12L]

Image Acquisition and Photogrammetry:

Arial Photography- Vertical and Oblique Aerial Photography; Aerial Cameras- Focal plane and Focal length, f/stop ratio, Shutter Speed; Types of Aerial Cameras, Flight lines of Vertical Aerial Photography, Flight planning; Thermal Infrared Remote Sensing- Thermal Properties of Terrain, Thermal Infrared Data Collection and its Geometric Correction; Active Microwave Imagery System- Components, wavelength, Frequency and Pulse Length, Azimuth and Range Direction, Depression Angle, Incident angle and Polarization, Slant-Range versus Ground-Range RADAR image geometry- Computation of Range and Azimuth Resolution, Radar Equation, Synthetic Aperture Radar System; Light Detection and Ranging (LIDAR)- LIDAR Imaging, Types of Imaging LIDAR, Accuracy of LIDAR Measurements; Photogrammetry- Scale and Height measurement on single Vertical Aerial Photograph- Over Level Terrain and Variable Terrain, Stereoscopic Measurement of Object Height or Terrain Elevation, Area Measurement of well known Geometric Shapes and Irregularly Shaped Polygons.

Module III-[10L]

Essential Image Processing for Remote Sensing:

Introduction to Monochromatic and Colour Image, Image Rectification and Restoration – Radiometric correction, Geometric correction and Noise removal; Image Enhancement-Contrast Manipulation, Spatial Feature Manipulation, Multi-Image Manipulation; Histogram modification, Image Filtering- Concepts of convolution for image filtering, Low-pass filters (smoothing), Gaussian filter, The k-nearest mean filter, Median filter, Mode (majority) filter, High-pass filters (edge enhancement), Gradient filters, Laplacian filters, Edge-sharpening filters, Local contrast enhancement; Arithmetic operations - Image addition, subtraction (differencing), multiplication, Image division (ratio), Index derivation and supervised enhancement, Vegetation indices, Iron oxide ratio index, TM clay (hydrated) mineral ratio index, Standardization and logarithmic residual, Simulated reflectance, Analysis of solar radiation balance and simulated irradiance, Simulated spectral reflectance image.

Module IV-[10L]

Remote Sensing Data Classification and Analysis:

Machine Learning Techniques of Remote Sensing data analysis- challenges, General concept of Machine Learning- Unsupervised classification, Supervised classification; Paradigms in Remote Sensing-Feature Extraction and Selection, Classification, Clustering; Unsupervised classification (iterative clustering)- Iterative clustering algorithms, Feature space iterative clustering, Seed selection, Cluster splitting along PC1; Supervised classification- Bayesian classification strategy, Neural Networks, Support Vector Machines (SVM), Decision rules: dissimilarity functions, Box classifier, Euclidean distance: simplified maximum likelihood, Maximum likelihood; Post-classification processing- smoothing and accuracy assessment, Class smoothing process, Classification accuracy assessment.

References:

1. John R. Jensen, *Remote Sensing of the Environment: An Earth Resource Perspective*, Prentice Hall press, Second edition, 2007.
2. James B. Campbell and Randolph H. Wynne, *Introduction to Remote Sensing*, The Guilford Press, New York, Fifth edition 2011.
3. Thomas M. Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, *Remote Sensing and Image Interpretation*, Wiley, 2004.
4. George Dr. Joseph, *Fundamentals of Remote Sensing*, Universities Press; Second edition, 2005.
5. Basudeb Bhatta, *Remote Sensing and GIS*, Oxford, Second edition, 2011.
6. Jian Guo Liu and Philippa J. Mason, *Essential Image Processing and GIS for Remote Sensing*, Wiley-Blackwell, UK, 2009.
7. Robert A. Schowengerdt, *Remote Sensing: Models and Methods for Image Processing*, Academic Press, Elsevier Inc., Third edition, 2007.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Explain how remotely sensed images are acquired from satellites and aircraft.
2. Interpret the cause of different spectral responses and the significance of spectral signatures in optical, thermal infrared and microwave remote sensing.
3. Develop skills to address an environmental monitoring problem by selecting an appropriate remotely sensed data set and applying the relevant image analysis and interpretation techniques.
4. Perform basic remote sensing image interpretation including spectral ratios, histogram stretching, filtering, supervised and unsupervised classification algorithms.

Subject Name: MEDICAL INSTRUMENTATION					
Paper Code: AEIE6151					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [08L]

Transduction Principles:
Resistive Transducers; Strain gauge type blood pressure transducers, Thermo resisfive transducer, Capacitive Transducer, Piezoelectric Transducer; Flow transducers, measurement errors; definitions: accuracy, precision, sensitivity, resolution, threshold.

Module II - [12L]

Bio-potentials and electrodes:
Origin of Bio-potentials- structure , types and electrical activity of Cells, Resting and action potentials of cells , Different models, Electrodes-surface, needle and micro electrodes and their electrical models; half cell potential, Electrode-Electrolyte interface, Off-set potentials , Polarization- polarizable and non-polarizable electrodes, Ag/AgCl electrodes, motion artifact.

Module III-[12L]

Biomedical signal processing:
Signal conditioners- OP-AMP -CMRR, ECG, EMG, EEG –Lead systems and typical waveforms. Image processing techniques- X-Ray Imaging, IR imaging, Ultrasonic imaging, CAT, MRI, Biotelemetry and patient monitoring.

Module IV-[08L]

Electrical safety:
Model of Electrical Danger, Physiological Effects of Current, Ground Shock Hazards, Schemes of Accident Prevention. Assisting and therapeutic instruments-Pacemakers, defibrillators, Hearing aids, Diathermy.

References:

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, *Biomedical Instrumentation and Measurements*, Second edition, Prentice-Hall India, 1997.
2. R.S. Khandpur, *Handbook of Biomedical Instrumentation*, 2 Edition, Tata McGraw Hill New Delhi, 1987.
3. John G. Webster, *Medical Instrumentation application and design*, Third edition, Wiley, 1997.
4. S. K. Venkata Ram, *Biomedical Electronics and Instrumentation*, Galgotia Publication Pvt. Ltd., New Delhi.
5. Geddes L.A and Baker L.E, *Principles of Applied Biomedical Instrumentation*, Third edition, Wiley-Interscience, 1989.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Explain the fundamental principles and applications of different transducers used for body parameter measurements.

2. Understand the physiology of biomedical systems and different methods in the design of biomedical instruments.
3. Learn the different methods of medical imaging systems, concepts related to the operations and analysis of biomedical instruments.
4. Aware of the importance of electrical safety and apply it in the design of different assisting therapeutic and diagnostic medical devices.

Subject Name: ADVANCED DIGITAL CONTROL					
Paper Code: AEIE6152					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [10L]

Review of Z- transform, inverse Z-transform, Mapping from s-plane to Z-plane, Initial value theorem, final value theorem etc. Discrete-time Systems: Sampled signals, Sampling frequency consideration and selection of optimum sampling period, quantization effects, the zero and first order holds, linear difference equations and discrete transfer functions, block diagrams, stability analysis techniques- Jury's stability test, bi-linear transformation, Computer Oriented Mathematical Models: Mathematical representation of sampling process, Pulse transfer function and data holds, Development of pulse transfer function of various block configurations.

Module II - [10L]

Digital Control Designs using Classical Methods: digital PID controller, Deadbeat controllers, Dahlin controller, ringing and pole-placement, Predictive controller design, Internal-Model control.

Module III-[10L]

Tools for designing: root locus method, frequency response based designs, introduction to direct design methods, State variable model , canonical forms , characteristic equation, solution to discrete state equation,, controllability and observability of discrete state space models.

Module IV-[10L]

Adaptive Control and Self Tuning: Gain scheduling, Model reference adaptive control, Self-tuning regulators, Cascade control, Feedforward control – Introduction and design fundamentals, and applications.

References:

1. K. Ogata, *Discrete Time Control Systems*, Prentice Hall, 2/e, 1995.
2. B. C. Kuo, *Digital Control Systems*, Oxford University Press, 2/e, Indian Edition, 2007.
3. M. Gopal, *Digital Control and State Variable Methods*, Tata Mcgraw Hill, 2/e, 2003.
4. G. F. Franklin, J. D. Powell and M. L. *Workman, Digital Control of Dynamic Systems*, Addison Wesley, 1998, Pearson Education, Asia, 3/e, 2000.
5. K. J. Astroms and B. Wittenmark, *Computer Controlled Systems - Theory and Design*, Prentice Hall, 3/e, 1997.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Understand Transformation technique from continuous to discrete domain.
2. Realize the fundamental principles for design of Digital Control system and will gain knowledge of implementing for industrial applications.
3. Developing algorithms for applications based various digital controllers and analysis of discrete control systems using various time and frequency domain tools.
4. Aware of advanced understanding of adaptive and self tuning principles and applications.

Mchatterji

Subject Name: NONLINEAR CONTROL					
Paper Code: AEIE6153					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [13L]

Linear versus Nonlinear Control System:

Introduction to nonlinear control, Examples of nonlinear models and nonlinear phenomena: Pendulum equation, Mass-spring system, Negative-resistance oscillator, Common nonlinearities.

Second Order Systems:

Qualitative behavior of linear systems, Phase plane method, Multiple equilibria, Qualitative behavior near equilibrium points, Limit Cycles, Numerical construction of phase portraits, Existence of periodic orbits, Bifurcation.

Module II-[10L]

Describing Function and Stability Analysis:

Describing function method- Calculation of Describing function for different non-linearities, Stability analysis using Describing function and Nyquist criterion- Concept of Limit Cycle.

Module III-[10L]

Nonlinear Stability:

Lyapunov stability, Autonomous systems, Invariance principle, Linear systems and linearization, Comparison functions, Nonautonomous systems, Linear time-varying systems and linearization, Converse theorems, Boundedness and ultimate boundedness, Input-to-state stability.

Module IV-[7L]

Feedback Linearization:

Feedback control, Control problems, Stabilization via linearization, Integral control, Integral control via linearization, Gain scheduling, Feedback linearization, Input-output linearization, Full-state linearization, State feedback control, Stabilization.

References:

1. H. Khalil, *Nonlinear Systems,* Third Edition, 2002.
2. S. Sastry, *Nonlinear Systems: Analysis, Stability, and Control*, Springer, 1999.
3. W. E. Dixon, A. Behal, D. M. Dawson, and S. Nagarkatti, *Nonlinear Control of Engineering Systems: A Lyapunov-Based Approach*, Birkhäuser Boston, 2003.
4. Jean-Jacques Slotine and Weiping Li, *Applied Nonlinear Control*, Pearson Education, 1990.
5. Miroslav Kristic, Ioannis Kanellakopoulos and Petar Kokotovic, *Nonlinear and Adaptive Control Design*, John Wiley and Sons, 1995.
6. S. H Zak, *Systems and Control*, Oxford University Press.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Identify linear and nonlinear systems from mathematical model, and acquire knowledge of different nonlinear systems and their models.

2. Explain some of the basic ideas of nonlinear systems and look at the behavior of a nonlinear system near equilibrium points, the phenomenon of nonlinear oscillation, and bifurcation.
3. State Describing function method for stability analysis and get idea of limit cycle.
4. Analyze and determine the stability of nonlinear systems using Lyapunov Stability criterion.
5. Give idea about feedback control explain model uncertainties and linearization techniques.
6. Employ the most appropriate tools to solve the complexity of nonlinear feedback control challenges and come up with systematic design procedure to meet the control objectives and design specifications.

Subject Name: POST-SUBMISSION DEFENSE OF DISSERTATION					
Paper Code: AEIE6221					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	0	0	4

The student has to continue the thesis work done in third semester. At the end of fourth semester the student will appear in examination (viva-voce) before the panel of examiners to defense his/her work done in dissertation.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Represent and communicate a project work very efficiently to the audience.
2. Interpret experimental data and note down observations competently.
3. Respond to all types of questions from audience based on their presentation topic.

Subject Name: DISSERTATION (COMPLETION)					
Paper Code: AEIE6222					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	24	24	12

The Dissertation (Completion) is an extension of Dissertation Part - I. It shall be assessed internally by a panel of examiners (similar to the one formed in dissertation part- I) before submission to the Institute. The candidate shall submit the dissertation in triplicate in the prescribed format to the Head of the department/ M. Tech coordinator, duly certified that the work has been satisfactorily completed.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Manifest themselves in industrial and research ambiences by growing skills and confidence.
2. Solve, analyze and execute technical projects in specified time frame.
3. Develop ethical and social responsibilities by fulfilling the needs of society for betterment of life and engage themselves in life-long learning.
4. Develop confidence for self-learning attitude for lifelong learning.

Subject Name: COMPREHENSIVE VIVA VOCE					
Paper Code: AEIE6223					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	0	0	4

Every student should appear before a panel duly constituted by the members of internal faculties of the department in order to evaluate his/her knowledge in various subjects learned during the two years of study of the M. Tech AEIE course.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Appear interview elegantly and confidently.
2. Judge themselves about their domain knowledge.
3. Develop habits of learning.

Subject Name: Energy Resources					
Paper Code: REEN5101					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Module 1: [10L]
Energy: Basic concepts and various forms; Fundamental of Renewable and Non- Renewable Energy Sources; Energy and Environment; Renewable Energy Resources and Present Energy Scenario in India; Sustainability of Development with Renewable Energy Resources; Basic Heat Transfer Mechanisms, Energy and Momentum Conservation Principles and Bernoulli's equation.
Inter-conversion of various forms of Energy and their utilisation in the appropriate perspective.

Module 2: [10L]
Solar Energy: Solar Radiation and its viable Magnitude of Energy Harvesting. Solar Energy Conversion Techniques to Heat and Electricity; Solar Radiation: flat Plate Collector; Solar Air Collector Solar Concentrator; Evacuated Tube Collector; Solar Water Heating system Solar Distillation; Solar Cooker; Non-convective Solar Pond; Solar House;
Photo-Voltaic (PV) Systems: : Introduction; Intrinsic and Extrinsic semiconductors and their role in PV Solar Cell development; Photo-Voltaic Materials and Photo-Voltaic Modules and their Applications

Module 3: [10L]
Biomass; Biofuels and Biogas: Introduction; Renewability and Sustainability of Bio- Energy Resources; Origin of Biomass: The photosynthetic process; Biomass Resources; Direct Use as Energy Resources, Biofuel production Processes; Biogas Production Processes; Alcoholic Fermentation and Alcohol blending with Gasoline for saving fossil fuel; Biodiesel Production through Transesterification of Vegetable oils and Fats;Hydro Power generation: Introduction; Classification of Water Turbine; Theory of Turbo- Machineries; Jet Velocity.
Angular Velocity; Hydroelectric Systems: Essential Components and their Overall efficiencies; Merits and Demerits of Hydroelectric Systems; Hydraulic Machines; Status of Hydro-Power in the Indian Scenario.
Wind Power: Introduction; Origin and Global Distribution of Wind; Turbine Types and Terminologies, Aerodynamic principles in Wind Power Generation; and Wind Turbine Generators and their Applications;

Module 4: [10L]
Geo-Thermal Energy: Introduction: Origin and Renewability of Geo-Thermal Energy; Dry Rock and Hot Aquifier Analysis; Geo-Thermal Exploration and Energy Recovery Process; Geo- Thermal Heat Pump and Geo-Thermal Energy Scenario in India;
Ocean Thermal, Tidal & Wave Energy, Human & Animal Power Conversion Systems Environmental Impact of Renewable Energy Harvesting Processes and Natural Energy Cycle- Contradictions
Energy Analysis from different types of Energy Resources, both Renewable and Fossil
Economic Analysis: Introduction; Cost Analysis, ash Flow Analysis Diagram, Cost Comparison of different Renewable Energy Resources; Payback period, Cost-Benefit Analysis.

Text Books:

1. Renewable Energy Resources, Basic Principle and Applications by G. N. Tiwari, M. K. Ghosal; Narosa Publishing House, 2005.

Reference Books:

1. Solar Energy: Fundamentals, Design, Modelling & Applications, by G. N. Tiwari; 2002. Narosa Publishing House, New Delhi.
2. Solar Engineering of Thermal Processes, by Duffie , . A. and Beckman, D. A., (1991.); John Wiley and Sons. New York.
3. Hand Book of Solar Radiation Data for India; Manni, A., (1980). Allied Publisher Pvt. Ltd., India.
4. Biogas Systems; principles and Applications, by Mittal K. M. ; 1996. New Age International (p) Ltd. Publishers, New Delhi, India

Subject Name: Renewable Energy I					
Paper Code: REEN5102					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Introduction: Sources of renewable energy –solar Energy. Earth sun energy flux diagram, overview of renewable energy, energy conversion, energy resource assessment: solar, solar thermal collectors, low temperature systems, solar heat pumps & refrigeration, concentrating collectors, overview of solar thermal power systems, photovoltaic energy conversion.

Module 2: [10L]
Solar Energy Resources: Solar radiation: spectrum of electromagnetic radiation, solar radiation data requirements, sun structure and characteristics, solar constant, spectral distribution, sun earth geometric relationship, solar angles, sun's trajectories in different seasons, zenith solar time, air mass, beam, diffuse and total solar radiation, irradiance, solar radiation on different surfaces at different angles, extraterrestrial radiation. Attenuation of solar radiation by the atmosphere, beam and diffuse components of hourly and daily radiation, clearness index.
Measurement of solar radiation: Instruments-sunshine recorder, pyranometer, pyrheliometer, albedometer. Radiation measurement stations in India, solar radiation data, graphs.

Module 3: [10L]
Prediction of available solar radiation: models and methods for estimating solar radiation, estimation of global radiation, estimation of diffused components, solar mapping using satellite data, TMY(Typical meteorological year) data. Solar PV power plant: Basic of Solar Cell, Solar Module manufacturing Engineering, Solar PV Systems, Design of Standalone and Grid connected solar PV power plant, solar PV applications, and International test procedures for Photovoltaic Modules, Solar Thermal Systems, and Environmental Impact.

Module 4: [10L]
Solar thermal applications: Temperature & choice of collectors, swimming pool heating, domestic and process heat, characteristic equation, mathematical modelling, simulation, storage tank; (pressurized vs. non pressurized), storage with stratification, storage tank with gas as auxiliary, heat exchangers, corrosion and antifreeze, dimensioning, connecting pipe circuit, expansion tank sizing, concentrating collectors, process heat, air heating collectors, solar drying, solar distillation.

Text Books:

1. Renewable Energy Engineering and Technology – A Knowledge Compendium, ed. VVNKishore (TERI Press*, 2008*).
2. CS Solanki: Solar Photovotaics – Fundamentals, Technologies and Applications,(PHI Learning)
3. D.Y. Goswami, F. Kreith and J.F. Kreider, Principles of solar Engineering, Tyalor andFrancis, Philadelphia,2000.
4. A.Rabi, Active Solar Collectors and their applications, Oxford University Press, NewYork,1985

Reference Books:

1. JA Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition (JohnWiley & Sons)
2. S Sukhatme and J Nayak: Solar Energy: Principles of Thermal Collection and Storage,Third Edition (Tata McGraw Hill, 2008)

Subject Name: Materials for Energy Conversion Systems					
Paper Code: REEN5104					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Device fabrication technology: Diffusion, Ion Implantation, Etching, oxidation, photolithography, sputtering, physical vapour deposition (PVD), Chemical Vapor deposition(CVD), Plasma enhanced CVD (PECVD), Hot wire CVD (HWCVD), etc. Spectral response of solar cells, quantum efficiency analysis, dark conductivity, crystalline silicon deposition techniques, I-V characterization. Introduction to material characterization: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), X-ray diffraction (XRD), Raman spectroscopy, Atomic force microscopy (AFM).

Module 2: [10L]
Introduction to physics of semiconductor devices and basics of solar cells, semiconductors as basis for solar cells materials and properties, P-N junction, sources of losses and prevention, Concepts on high efficiency solar cells, III-V high efficiency solar cells, tandem and multi- junction solar cells, Solar PV concentrator cells and systems, III-V, II-IV compound materials thin film solar cells, Nano, micro and poly-crystalline Si for solar cells, mono-micro silicon composite structure, material and solar cell characterization, PERL (passivated emitter with rear locally diffused) Si solar cell.

Module 3: [10L]
Advanced solar cell concepts and technologies (Porous Si layer transfer, metal induced crystallization etc.) Amorphous silicon thin film technologies, multi junction tandem solar cells,stacked solar cells. HIT Solar cells, 3rd Generation Solar cells based on Nano- materials.

Module 4: [10L]
Organic/ Inorganic / Plastic / Flexible solar cells, Polymer composites for solar cells. Dye sensitised solar cell. Perovskite and its application to the solar cell. Characterization of materials and devices for energy storage: Batteries, Carbon Nano Tubes (CNT), Ultra Capacitorfor energy storage.

Text / Reference Books:

1. Solar cells: Operating principles, technology and system applications, by MartinA.Green, Prentice- Hall Inc, Englewood Cliffs, NJ, USA, 1981.
2. Semiconductor for solar cells, H.J. Moller, Artech House Inc, MA, USA, 1993.
3. Carbon nanotubes and related structures: New material for twenty-first century,P.J.F.Harris, Cambridge University Press, 1999.
4. Thin film crystalline silicon solar cells: Physics and technology, R.Brendel, Willy-VCH Weinheim 2003.
5. Clean electricity from photovoltaics, M.D.Archer, R. Hill, Imperial college press, 2001.

6. Organic photovoltaics: Concepts and realization, C. Barbec, V.Dyakonov,J.Parisi, N.S.Saricittci, Springer-Verlag 2003.
7. Battery technology handbook, edited by H.A. Kiehne, Marcel Dekker, New York,1989.

Subject Name: Solar Laboratory					
Paper Code: REEN5111					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**6**	**6**	**2**

Experiments:

At least any five experiments are to be carried out by students

1. Solar radiation measurement
2. Figure of Merit measurement of solar cell
3. Impact of Figure of Merit on energy output of solar cell
4. Characteristics of storage battery
5. Characteristics of power conditioning unit
6. Development of material for energy storage component
7. Development of black coating for solar thermal application

Subject Name: Energy Devices Laboratory					
Paper Code: REEN5112					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**6**	**6**	**2**

Experiments:

At least any five experiments are to be carried out by students

1. Introduction to material characterization: Scanning electron microscopy (SEM)
2. Transmission electron microscopy (TEM)
3. X-ray diffraction (XRD),
4. Chemical vapor deposition (CVD),
5. Fabrication of Solar cell in virtual wafer fabrication lab
6. Study of 100KW PV power plant, (Roof top of A & B Building)
7. Measurement of emissivity, reflectivity, transitivity of Solar irradiation.

Subject Name: Design of Heat Transfer Equipments					
Paper Code: REEN5141					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module1: [10L]

Fundamentals of heat transfer: steady state heat conduction through plane wall, composite wall, heat transfer resistance in series and parallel, conduction with heat generation, convective resistance, critical insulation thickness, steady state heat conduction through extended surface, fin efficiency, dimensionless number for convection, empirical correlation for free and forced convection. Correlation of heat transfer coefficient for condensation and boiling

Module 2: [10L]

Classifications of heat exchangers, overall heat transfer coefficient, LMTD and LMTD correction factor, fouling factors, Effectiveness and number of transfer unit of heat exchangers, sizing and rating problems of heat exchanger design. Flow and stress analysis: Effect of turbulence, friction factor, pressure loss, stress in tubes, header sheets and pressure vessels design, thermal stresses, shear stresses - types of failures.

Module 3: [10L]

Kern method of Heat Exchanger Design: Double-pipe heat exchanger, shell and tube heat exchanger, condenser and boiler design. Details of shell and tube heat exchanger construction. Design and construction of furnace, recuperator, regenerator and economiser. Heat exchanger network and its optimization.

Module 4: [10L]

Types of Compact heat exchanger, merits and demerits, design of compact heat, exchangers, plate type heat exchangers, performance influencing parameters, limitations, Design of surface and evaporative condensers, cooling tower, performance characteristics.

Text/ Reference Book:

1. Process Heat transfer by D.Q. Kern Tata McGraw-Hill Education, 1997
2. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1988

Subject Name: Renewable Energy II					
Paper Code: REEN5203					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Wind Energy: Sources and potential; Wind turbines-Site location, aerodynamics, types and construction fundamentals; Wind Energy Conversion Systems; Wind-Diesel hybrid systems; Wind-energy storage; Environmental aspects
Geothermal Energy: Sources and potential; Origin and Distribution; Hydrothermal Resources- Vapour dominated System, Liquid dominated system, Geo-pressured resources, Hot Dry Rock Resources; Analysis of geothermal resources-Hot Dry Rock Resource, Hot Aquifer Resource; Exploration and development; Environmental aspects; Potential in India.

Module 2: [10L]
Tidal Energy-Origin and Nature; Limitations; Tidal Range Power; Conversion Schemes; Present status; Environmental impacts Wave Energy-Power in waves; Wave Energy Technology-Heaving Float type, Pitching type, Heaving and Pitching-float type; Present status and Environmental impacts Ocean Thermal Energy-Origin and characteristics; Ocean Thermal Energy Conversion technology; Present status and Environmental impacts

Module 3: [10L]
Macro Hydel Power - Characteristics of hydropower plants ; Demand profiles and System considerations; Mathematical modelling of hydropower systems; Theory of hydraulic design and hydraulic turbines —Selection of turbine types , Francis turbines, Pelton turbines, Kaplan turbines; Efficiency measurements, Regulators and load control, Valves and gates, Auxiliary equipment; Design strategies for hydraulic structures— Headworks and intakes, Spillways and outlets, Penstocks and conduits
Mini Hydel Power - Advantages and disadvantages; Layout of a Micro-Hydro Scheme; Water turbines-classification, characteristics and selection; Generators; Present status and environmental impacts

Module 4: [10L]
Magneto-Hydrodynamic (MHD) Power Conversion-Basic principle; MHD generator; MHD systems; Present status and Potential
Thermo-electric and Thermionic Power Conversion Systems-Basic principle; Present status and Potential Fuel Cell (FC)-potential applications; Classification; Types-PAFC, AFC, PEMFC, MCFC, SOFC; Fuel Cell development stages and relative performance; Fuels for FC; Efficiency and VI characteristics; FC power plant; Present status and environmental Impacts Hydrogen Energy-potential applications; Production methods: thermo-chemical, electrolysis, thermolysis, bio-photolysis; Storage and Delivery; Conversion; Safety Issues; Present status

Text Book:
1. Non-Conventional Energy Sources-G.D. Rai, Khanna Publishers

2. Renewable Energy Resources Twidell & Wier, CRC Press (Taylor & Francis)

Reference Book:

1. Renewable Energy Resources-Tiwari & Ghosal, Narosa Publishers
2. Renewable Energy Technologies-Ramesh & Kumar, Narosa Publishers
3. Non-Conventional Energy Systems-K Mittal, Wheeler
4. Renewable Energy Sources and Emerging Technologies-Kothari & Singhal, Prentice Hallof India
5. Non-Conventional Energy Resources-B.H. Khan, McGraw Hill Education (India) PrivateLimit
6. Hydro-electric and Pumped Storage Plants – M G Jog, New Age InternationalPublishers Foundation

Course on Finance, Economics and Marketing

Subject Name: Non-Solar Laboratory					
Paper Code: REEN5211					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**6**	**6**	**2**

Experiments:

At least any five experiments are to be carried out by students

1. Experiments on biomass gasification
2. Extraction of Bio-oil from biomass feedstock
3. Development of fuel characteristics from bomb calorimeter.
4. Characterization of energy from waste
5. Experiments on biomass resource assessment
6. Measurement of figure of merit of Wind Energy

Subject Name: Measurement and Control for Energy System					
Paper Code: REEN5241					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Introduction to measurements, Errors in measurements, Statistical analysis of data, Regressionanalysis, correlation, estimation of uncertainty and presentation of data, design of experiments
– Experimental design factors and protocols

Module 2: [10L]
Basic Electrical measurements, Transducers and its types, Signal conditioning and processing
- Measurement of temperature, pressure, velocity, flow rate, thermo-physical and transport properties of solids liquids and gases, radiation properties of surfaces, vibration and noise -Computer assisted data acquisition, data manipulation and data presentation

Module 3: [10L]
Introduction, Open and closed loop control systems, Transfer function. Types of feedback and feedback control system characteristics – Effect of disturbances – dynamic characteristics Designing of temperature, pressure, flow and liquid level measurement and control system – Performance – Steady state accuracy – Transient response – Frequency response – Fault finding– Computer based controls

Module 4: [10L]
Process characteristics, Control system parameters – DC and AC servomotors, servo amplifier, potentiometer, synchro transmitters, synchro receivers, synchro control transformer, stepper motors - Continuous, Discontinuous and Composite control modes – Analog and Digital controllers

Text/ Reference Book:
1. Holman, J.P. Experimental methods for Engineers, McGraw – Hill, 2008
2. W. Bolten, Industrial Control and Instrumentation, University Press, 2004
3. Alan S Morris, Reza Langari, Measurements and Instrumentation – Theoryand Application, Elsevier Inc, 2012.
4. S.P. Venkateshan, Mechanical Measurements, Ane Books Pvt Ltd, 2010
5. Curtis D Johnson, Process Control Instrumentation Technology, PHI LearningPrivate Limited,2011.

Subject Name: Energy & Environmental Impact Analysis					
Paper Code: REEN5242					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Basics of environmental problems associated with Renewable Energy Engineering. Sustainable technology and Renewable Energy Engineering, Genesis of environmental statutory body in India (Water act 1974). Legislative aspects, Environmental clearance for Renewable Energy Industries—Consent to Establish, Consent to Operate. Environmental standards and Threshold limits, EPA 1986
Air pollution aspects from conventional power plants, Sampling and analysis of air pollutants, Green house effect and global warming, Carbon foot print, general discussion on its reduction by the use of renewable energy devices.

Module 2: [10L]
Problems of water pollution in renewable energy industries. Effluent treatment plant, tricklingfilter, RBDC and RBRC, oxidation ditches, WSP, Root zone and Reed bed treatments. Combined Sewage & Effluent treatment plant along with canteen waste for bio-gas generation.

Module 3: [10L]
Solid waste & E-waste management in Renewable Energy Industries: Sources and classification, public health aspects, Methods of collection and disposal methods. Recycling and reuse of components of renewable energy devices. Hazardous aspects associated with solar PV, Solar thermal, Hydro-power, Nuclear Power, Wind mill, OTEC, Geothermal energy, Bio-energy –case studies.

Module 4: [10L]
Environmental Impact Assessment for renewable energy industries– Rain water harvesting,structural hazards.hazards associated with illumination engineering – CFL versus LED lights.
Energy analysis and energy efficiency compliances.
Case studies on use of renewable energy devices for reducing carbon foot print- Analysis of energy saving using solar PV and hybrid system—desalination, hot water production, sewage treatment in vehicular system, solar passive architecture and green building. Carbon trading, sequestration and carbon credit.

Text/ Reference Book/ Literature:

2. Renewable Energy Resources—Basic Principles and Applications, Tiwari, G N &Ghosal, M K , Narosa Publishing House, New Delhi 2006
3. Standard Methods: APHA & AWWA, 21st edition, 2005
4. CPHEEO Manual 2015, GOI Publications
5. www.wbpcb.gov.in
6. Solar Energy Materials and Solar Cells, Volume 94, Issue 9, Pages 1429-1552,September 2010, Bibek Bandyopadhyay and K L. Chopra, Elsevier

Subject Name: Energy Resources					
Paper Code: REEN5101					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	1	0	4	4

Module 1: [10L]
Energy: Basic concepts and various forms; Fundamental of Renewable and Non- Renewable Energy Sources; Energy and Environment; Renewable Energy Resources and Present Energy Scenario in India; Sustainability of Development with Renewable Energy Resources; Basic Heat Transfer Mechanisms, Energy and Momentum Conservation Principles and Bernoulli's equation.
Inter-conversion of various forms of Energy and their utilisation in the appropriate perspective.

Module 2: [10L]
Solar Energy: Solar Radiation and its viable Magnitude of Energy Harvesting. Solar Energy Conversion Techniques to Heat and Electricity; Solar Radiation: flat Plate Collector; Solar Air Collector Solar Concentrator; Evacuated Tube Collector; Solar Water Heating system Solar Distillation; Solar Cooker; Non-convective Solar Pond; Solar House;
Photo-Voltaic (PV) Systems: : Introduction; Intrinsic and Extrinsic semiconductors and their role in PV Solar Cell development; Photo-Voltaic Materials and Photo-Voltaic Modules and their Applications

Module 3: [10L]
Biomass; Biofuels and Biogas: Introduction; Renewability and Sustainability of Bio- Energy Resources; Origin of Biomass: The photosynthetic process; Biomass Resources; Direct Use as Energy Resources, Biofuel production Processes; Biogas Production Processes; Alcoholic Fermentation and Alcohol blending with Gasoline for saving fossil fuel; Biodiesel Production through Transesterification of Vegetable oils and Fats;Hydro Power generation: Introduction; Classification of Water Turbine; Theory of Turbo- Machineries; Jet Velocity.
Angular Velocity; Hydroelectric Systems: Essential Components and their Overall efficiencies; Merits and Demerits of Hydroelectric Systems; Hydraulic Machines; Status of Hydro-Power in the Indian Scenario.
Wind Power: Introduction; Origin and Global Distribution of Wind; Turbine Types and Terminologies, Aerodynamic principles in Wind Power Generation; and Wind Turbine Generators and their Applications;

Module 4: [10L]
Geo-Thermal Energy: Introduction: Origin and Renewability of Geo-Thermal Energy; Dry Rock and Hot Aquifier Analysis; Geo-Thermal Exploration and Energy Recovery Process; Geo- Thermal Heat Pump and Geo-Thermal Energy Scenario in India;
Ocean Thermal, Tidal & Wave Energy, Human & Animal Power Conversion Systems Environmental Impact of Renewable Energy Harvesting Processes and Natural Energy Cycle- Contradictions
Energy Analysis from different types of Energy Resources, both Renewable and Fossil
Economic Analysis: Introduction; Cost Analysis, ash Flow Analysis Diagram, Cost Comparison of different Renewable Energy Resources; Payback period, Cost-Benefit Analysis.

Text Books:

1. Renewable Energy Resources, Basic Principle and Applications by G. N. Tiwari, M. K. Ghosal; Narosa Publishing House, 2005.

Reference Books:

1. Solar Energy: Fundamentals, Design, Modelling & Applications, by G. N. Tiwari; 2002. Narosa Publishing House, New Delhi.
2. Solar Engineering of Thermal Processes, by Duffie , . A. and Beckman, D. A., (1991.); John Wiley and Sons. New York.
3. Hand Book of Solar Radiation Data for India; Manni, A., (1980). Allied Publisher Pvt. Ltd., India.
4. Biogas Systems; principles and Applications, by Mittal K. M. ; 1996. New Age International (p) Ltd. Publishers, New Delhi, India

Subject Name: Renewable Energy I					
Paper Code: REEN5102					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Introduction: Sources of renewable energy –solar Energy. Earth sun energy flux diagram, overview of renewable energy, energy conversion, energy resource assessment: solar, solar thermal collectors, low temperature systems, solar heat pumps & refrigeration, concentrating collectors, overview of solar thermal power systems, photovoltaic energy conversion.

Module 2: [10L]
Solar Energy Resources: Solar radiation: spectrum of electromagnetic radiation, solar radiation data requirements, sun structure and characteristics, solar constant, spectral distribution, sun earth geometric relationship, solar angles, sun's trajectories in different seasons, zenith solar time, air mass, beam, diffuse and total solar radiation, irradiance, solar radiation on different surfaces at different angles, extraterrestrial radiation. Attenuation of solar radiation by the atmosphere, beam and diffuse components of hourly and daily radiation, clearness index.
Measurement of solar radiation: Instruments-sunshine recorder, pyranometer, pyrheliometer, albedometer. Radiation measurement stations in India, solar radiation data, graphs.

Module 3: [10L]
Prediction of available solar radiation: models and methods for estimating solar radiation, estimation of global radiation, estimation of diffused components, solar mapping using satellite data, TMY(Typical meteorological year) data. Solar PV power plant: Basic of Solar Cell, Solar Module manufacturing Engineering, Solar PV Systems, Design of Standalone and Grid connected solar PV power plant, solar PV applications, and International test procedures for Photovoltaic Modules, Solar Thermal Systems, and Environmental Impact.

Module 4: [10L]
Solar thermal applications: Temperature & choice of collectors, swimming pool heating, domestic and process heat, characteristic equation, mathematical modelling, simulation, storage tank; (pressurized vs. non pressurized), storage with stratification, storage tank with gas as auxiliary, heat exchangers, corrosion and antifreeze, dimensioning, connecting pipe circuit, expansion tank sizing, concentrating collectors, process heat, air heating collectors, solar drying, solar distillation.

Sulagna Chatterjee

Text Books:

1. Renewable Energy Engineering and Technology – A Knowledge Compendium, ed. VVNKishore (TERI Press*, 2008*).
2. CS Solanki: Solar Photovotaics – Fundamentals, Technologies and Applications,(PHI Learning)
3. D.Y. Goswami, F. Kreith and J.F. Kreider, Principles of solar Engineering, Tyalor andFrancis, Philadelphia,2000.
4. A.Rabi, Active Solar Collectors and their applications, Oxford University Press, NewYork,1985

Reference Books:

1. JA Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition (JohnWiley & Sons)
2. S Sukhatme and J Nayak: Solar Energy: Principles of Thermal Collection and Storage,Third Edition (Tata McGraw Hill, 2008)

Sulagna Chatterjee

Subject Name: Materials for Energy Conversion Systems					
Paper Code: REEN5104					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Device fabrication technology: Diffusion, Ion Implantation, Etching, oxidation, photolithography, sputtering, physical vapour deposition (PVD), Chemical Vapor deposition(CVD), Plasma enhanced CVD (PECVD), Hot wire CVD (HWCVD), etc. Spectral response of solar cells, quantum efficiency analysis, dark conductivity, crystalline silicon deposition techniques, I-V characterization. Introduction to material characterization: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), X-ray diffraction (XRD), Raman spectroscopy, Atomic force microscopy (AFM).

Module 2: [10L]
Introduction to physics of semiconductor devices and basics of solar cells, semiconductors as basis for solar cells materials and properties, P-N junction, sources of losses and prevention, Concepts on high efficiency solar cells, III-V high efficiency solar cells, tandem and multi- junction solar cells, Solar PV concentrator cells and systems, III-V, II-IV compound materials thin film solar cells, Nano, micro and poly-crystalline Si for solar cells, mono-micro silicon composite structure, material and solar cell characterization, PERL (passivated emitter with rear locally diffused) Si solar cell.

Module 3: [10L]
Advanced solar cell concepts and technologies (Porous Si layer transfer, metal induced crystallization etc.) Amorphous silicon thin film technologies, multi junction tandem solar cells,stacked solar cells. HIT Solar cells, 3rd Generation Solar cells based on Nano- materials.

Module 4: [10L]
Organic/ Inorganic / Plastic / Flexible solar cells, Polymer composites for solar cells. Dye sensitised solar cell. Perovskite and its application to the solar cell. Characterization of materials and devices for energy storage: Batteries, Carbon Nano Tubes (CNT), Ultra Capacitorfor energy storage.

Text / Reference Books:

1. Solar cells: Operating principles, technology and system applications, by MartinA.Green, Prentice- Hall Inc, Englewood Cliffs, NJ, USA, 1981.
2. Semiconductor for solar cells, H.J. Moller, Artech House Inc, MA, USA, 1993.
3. Carbon nanotubes and related structures: New material for twenty-first century,P.J.F.Harris, Cambridge University Press, 1999.
4. Thin film crystalline silicon solar cells: Physics and technology, R.Brendel, Willy-VCH Weinheim 2003.
5. Clean electricity from photovoltaics, M.D.Archer, R. Hill, Imperial college press, 2001.

6. Organic photovoltaics: Concepts and realization, C. Barbec, V.Dyakonov,J.Parisi, N.S.Saricittci, Springer-Verlag 2003.
7. Battery technology handbook, edited by H.A. Kiehne, Marcel Dekker, New York,1989.

Subject Name: Solar Laboratory					
Paper Code: REEN5111					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**6**	**6**	**2**

Experiments:

At least any five experiments are to be carried out by students

1. Solar radiation measurement
2. Figure of Merit measurement of solar cell
3. Impact of Figure of Merit on energy output of solar cell
4. Characteristics of storage battery
5. Characteristics of power conditioning unit
6. Development of material for energy storage component
7. Development of black coating for solar thermal application

Subject Name: Energy Devices Laboratory					
Paper Code: REEN5112					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**6**	**6**	**2**

Experiments:

At least any five experiments are to be carried out by students

1. Introduction to material characterization: Scanning electron microscopy (SEM)
2. Transmission electron microscopy (TEM)
3. X-ray diffraction (XRD),
4. Chemical vapor deposition (CVD),
5. Fabrication of Solar cell in virtual wafer fabrication lab
6. Study of 100KW PV power plant, (Roof top of A & B Building)
7. Measurement of emissivity, reflectivity, transitivity of Solar irradiation.

Subject Name: Design of Heat Transfer Equipments					
Paper Code: REEN5141					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module1: [10L]

Fundamentals of heat transfer: steady state heat conduction through plane wall, composite wall, heat transfer resistance in series and parallel, conduction with heat generation, convective resistance, critical insulation thickness, steady state heat conduction through extended surface, fin efficiency, dimensionless number for convection, empirical correlation for free and forced convection. Correlation of heat transfer coefficient for condensation and boiling

Module 2: [10L]

Classifications of heat exchangers, overall heat transfer coefficient, LMTD and LMTD correction factor, fouling factors, Effectiveness and number of transfer unit of heat exchangers, sizing and rating problems of heat exchanger design. Flow and stress analysis: Effect of turbulence, friction factor, pressure loss, stress in tubes, header sheets and pressure vessels design, thermal stresses, shear stresses - types of failures.

Module 3: [10L]

Kern method of Heat Exchanger Design: Double-pipe heat exchanger, shell and tube heat exchanger, condenser and boiler design. Details of shell and tube heat exchanger construction. Design and construction of furnace, recuperator, regenerator and economiser. Heat exchanger network and its optimization.

Module 4: [10L]

Types of Compact heat exchanger, merits and demerits, design of compact heat, exchangers, plate type heat exchangers, performance influencing parameters, limitations, Design of surface and evaporative condensers, cooling tower, performance characteristics.

Text/ Reference Book:

1. Process Heat transfer by D.Q. Kern Tata McGraw-Hill Education, 1997
2. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1988

Subject Name: Renewable Energy II					
Paper Code: REEN5203					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Wind Energy: Sources and potential; Wind turbines-Site location, aerodynamics, types and construction fundamentals; Wind Energy Conversion Systems; Wind-Diesel hybrid systems; Wind-energy storage; Environmental aspects
Geothermal Energy: Sources and potential; Origin and Distribution; Hydrothermal Resources- Vapour dominated System, Liquid dominated system, Geo-pressured resources, Hot Dry Rock Resources; Analysis of geothermal resources-Hot Dry Rock Resource, Hot Aquifer Resource; Exploration and development; Environmental aspects; Potential in India.

Module 2: [10L]
Tidal Energy-Origin and Nature; Limitations; Tidal Range Power; Conversion Schemes; Present status; Environmental impacts Wave Energy-Power in waves; Wave Energy Technology-Heaving Float type, Pitching type, Heaving and Pitching-float type; Present status and Environmental impacts Ocean Thermal Energy-Origin and characteristics; Ocean Thermal Energy Conversion technology; Present status and Environmental impacts

Module 3: [10L]
Macro Hydel Power - Characteristics of hydropower plants ; Demand profiles and System considerations; Mathematical modelling of hydropower systems; Theory of hydraulic design and hydraulic turbines —Selection of turbine types , Francis turbines, Pelton turbines, Kaplan turbines; Efficiency measurements, Regulators and load control, Valves and gates, Auxiliary equipment; Design strategies for hydraulic structures— Headworks and intakes, Spillways and outlets, Penstocks and conduits
Mini Hydel Power - Advantages and disadvantages; Layout of a Micro-Hydro Scheme; Water turbines-classification, characteristics and selection; Generators; Present status and environmental impacts

Module 4: [10L]
Magneto-Hydrodynamic (MHD) Power Conversion-Basic principle; MHD generator; MHD systems; Present status and Potential
Thermo-electric and Thermionic Power Conversion Systems-Basic principle; Present status and Potential Fuel Cell (FC)-potential applications; Classification; Types-PAFC, AFC, PEMFC, MCFC, SOFC; Fuel Cell development stages and relative performance; Fuels for FC; Efficiency and VI characteristics; FC power plant; Present status and environmental Impacts Hydrogen Energy-potential applications; Production methods: thermo-chemical, electrolysis, thermolysis, bio-photolysis; Storage and Delivery; Conversion; Safety Issues; Present status

Text Book:
1. Non-Conventional Energy Sources-G.D. Rai, Khanna Publishers

2. Renewable Energy Resources Twidell & Wier, CRC Press (Taylor & Francis)

Reference Book:

1. Renewable Energy Resources-Tiwari & Ghosal, Narosa Publishers
2. Renewable Energy Technologies-Ramesh & Kumar, Narosa Publishers
3. Non-Conventional Energy Systems-K Mittal, Wheeler
4. Renewable Energy Sources and Emerging Technologies-Kothari & Singhal, Prentice Hallof India
5. Non-Conventional Energy Resources-B.H. Khan, McGraw Hill Education (India) PrivateLimit
6. Hydro-electric and Pumped Storage Plants – M G Jog, New Age InternationalPublishers Foundation

Course on Finance, Economics and Marketing

Subject Name: Non-Solar Laboratory					
Paper Code: REEN5211					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**6**	**6**	**2**

Experiments:

At least any five experiments are to be carried out by students

1. Experiments on biomass gasification
2. Extraction of Bio-oil from biomass feedstock
3. Development of fuel characteristics from bomb calorimeter.
4. Characterization of energy from waste
5. Experiments on biomass resource assessment
6. Measurement of figure of merit of Wind Energy

Subject Name: Measurement and Control for Energy System					
Paper Code: REEN5241					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Introduction to measurements, Errors in measurements, Statistical analysis of data, Regressionanalysis, correlation, estimation of uncertainty and presentation of data, design of experiments – Experimental design factors and protocols

Module 2: [10L]
Basic Electrical measurements, Transducers and its types, Signal conditioning and processing - Measurement of temperature, pressure, velocity, flow rate, thermo-physical and transportproperties of solids liquids and gases, radiation properties of surfaces, vibration and noise -Computer assisted data acquisition, data manipulation and data presentation

Module 3: [10L]
Introduction, Open and closed loop control systems, Transfer function. Types of feedback and feedback control system characteristics – Effect of disturbances – dynamic characteristics Designing of temperature, pressure, flow and liquid level measurement and control system – Performance – Steady state accuracy – Transient response – Frequency response – Fault finding– Computer based controls

Module 4: [10L]
Process characteristics, Control system parameters – DC and AC servomotors, servo amplifier, potentiometer, synchro transmitters, synchro receivers, synchro control transformer, stepper motors - Continuous, Discontinuous and Composite control modes – Analog and Digital controllers

Text/ Reference Book:

1. Holman, J.P. Experimental methods for Engineers, McGraw – Hill, 2008
2. W. Bolten, Industrial Control and Instrumentation, University Press, 2004
3. Alan S Morris, Reza Langari, Measurements and Instrumentation – Theoryand Application, Elsevier Inc, 2012.
4. S.P. Venkateshan, Mechanical Measurements, Ane Books Pvt Ltd, 2010
5. Curtis D Johnson, Process Control Instrumentation Technology, PHI LearningPrivate Limited,2011.

Subject Name: Energy & Environmental Impact Analysis					
Paper Code: REEN5242					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]

Basics of environmental problems associated with Renewable Energy Engineering. Sustainable technology and Renewable Energy Engineering, Genesis of environmental statutory body in India (Water act 1974). Legislative aspects, Environmental clearance for Renewable Energy Industries—Consent to Establish, Consent to Operate. Environmental standards and Threshold limits, EPA 1986

Air pollution aspects from conventional power plants, Sampling and analysis of air pollutants, Green house effect and global warming, Carbon foot print, general discussion on its reduction by the use of renewable energy devices.

Module 2: [10L]

Problems of water pollution in renewable energy industries. Effluent treatment plant, tricklingfilter, RBDC and RBRC, oxidation ditches, WSP, Root zone and Reed bed treatments. Combined Sewage & Effluent treatment plant along with canteen waste for bio-gas generation.

Module 3: [10L]

Solid waste & E-waste management in Renewable Energy Industries**:** Sources and classification, public health aspects, Methods of collection and disposal methods. Recycling and reuse of components of renewable energy devices. Hazardous aspects associated with solar PV, Solar thermal, Hydro-power, Nuclear Power, Wind mill, OTEC, Geothermal energy, Bio-energy –case studies.

Module 4: [10L]

Environmental Impact Assessment for renewable energy industries– Rain water harvesting,structural hazards.hazards associated with illumination engineering – CFL versus LED lights.

Energy analysis and energy efficiency compliances.

Case studies on use of renewable energy devices for reducing carbon foot print- Analysis of energy saving using solar PV and hybrid system—desalination, hot water production, sewage treatment in vehicular system, solar passive architecture and green building. Carbon trading, sequestration and carbon credit.

Text/ Reference Book/ Literature:

2. Renewable Energy Resources—Basic Principles and Applications, Tiwari, G N &Ghosal, M K , Narosa Publishing House, New Delhi 2006
3. Standard Methods: APHA & AWWA, 21st edition, 2005
4. CPHEEO Manual 2015, GOI Publications
5. www.wbpcb.gov.in
6. Solar Energy Materials and Solar Cells, Volume 94, Issue 9, Pages 1429-1552,September 2010, Bibek Bandyopadhyay and K L. Chopra, Elsevier

Paper Name: DIGITAL LOGIC DESIGN					
Paper Code: MCAP1101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**0**	**0**	**3**	**3**

Module I [10L]

Number System

Data and number systems; Binary, Octal and Hexadecimal representation and their conversions; BCD, ASCII, EBDIC, Gray codes and their conversions; Fixed point representation of fractional number. Signed binary number representation with 1's and 2's complement methods, Binary arithmetic.

Module II [10L]

Logic gates- truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, Kmap method, Quine Mc Clusky'sMethod.

Module III [10L]

Combinational Circuits and Memory

Combinational circuits- Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Multiplexer, De-Multiplexer and Parity Generator. Overview of Memory Systems. Design of combinational circuits-using ROM. Overview of Programming logic devices and gate arrays (PLAs and PLDs).

Module IV [10L]

Sequential Circuits

Sequential Circuits - Basic memory element - S-R, J-K, D and T flip flops; Registers and counters and their design, Irregular counter, State table and state transition diagram; Sequential circuits design methodology.

Text Books:

1. Digital Logic and Computer Design - M. Morris Mano, Pearson.
2. Digital Logic Design, MansafAlam-Bashir Alam, PHI.

Reference Books:

1. Digital Design: Basic Concepts and Principles - Mohammad A. Karim, CRC Press.
2. Digital Logic Design Principle - Bradley Carlson, Norman Balabanian, Wiley India.

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Paper Name: INTRODUCTION TO PROGRAMMING					
Paper Code: MCAP1102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction
History of Computing, Evolution of Programming Languages, Compilers, Familiarization with UNIX.

Problem Solving Method
Algorithm, Flowchart, Problem-Solving Methodology- Tools, Pseudocode.

Overview of C language
C Standards, Structure of a C Program, C Libraries, Steps of Compilation of a C Program.

Expressions
Basic Data Types, Variables, Type Qualifiers, Storage Class Specifiers, Variable Scopes, Constants, Operators, Operator Precedence, Expression Evaluation, Type Conversion in Expressions, Type Casting.

Console I/O
Reading and Writing Characters, Reading and Writing Strings, Formatted Console I/O.

Module II [10L]

Control Statements
Selection Statements (if, switch-case), Iteration Statements (for loop, while loop, do-while loop), Jumping Statements (return, goto, break, exit, continue).

Function:
Functions and Modular Programming, General Form, Function Prototypes, Library Functions, Parameter Passing Mechanisms, Storage Classes, Recursive function.

Module III [10L]

Arrays and Strings
Single Dimension Arrays, Two Dimension Arrays, Multidimensional Arrays, Strings, Arrays of Strings, String Library Functions.

Pointer
Pointers and Memory Addressing. Pointer Variables, Pointer Arithmetic, Pointer Expressions, Pointers and Arrays, Functions and Pointers, Dynamic Memory Allocation, Command Line Arguments.

Module IV [10L]

Structures, Unions, Enumerations
Structures, Arrays of Structures, Structure and Pointers, Unions, Bit Fields, Enumerations, typedef keyword**.**

File I/O
Concept of Files, File operations, Text Files and Binary Files.

The Preprocessor
Preprocessor Directives, Macros, File Inclusion.

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Text Books:

1. Programming with C - Gottfried, TMH.
2. Programming in C - Balagurusamy, Tata McGraw Hill.

Reference Books:

1. C Programming Made Easy - Raja Ram, SCITECH.
2. The C Programming Language - Kernighan Ritchie, PHI.

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Paper Name: NUMERICAL AND STATISTICAL TECHNIQUES					
Paper Code: MCAP1103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Probability
Random Experiment, Sample Space, Random Events, Probability of Events, Probability of Non-disjoint Events (Theorems), Counting Techniques Applied to Probability Problems, Conditional Probability, Independent Events, Bayes' Theorem and Related Problems.

Random Variable and Probability Distribution
Probability Mass Function, Probability Density Function and Distribution Function, Distributions: Binomial, Poisson and Normal Expectation and Variance, Moment Generating Function, Reproductive Property of Binomial, Poisson and Normal Distribution (proof not required), Chebychev's Inequality (statement) and Problems.

Module II [10L]

Sampling and Estimation
Population, Sample; Statistic, Estimation of Parameters (consistent and unbiased), Sampling Distribution of Sample Mean and Sample Variance (proof not required), Point Estimation.
Overview of Testing of Hypothesis, Type I and Type II errors.

Module III [10L]

Numerical Analysis and Errors
Introduction, Sources of Errors, Significant Figures: Absolute, Relative and Percentage Errors.

Interpolation
Introduction, Lagrange's Interpolation Formula, Divided Differences and Properties, Newton's Forward & Backward Interpolation Formula, Newton's Divided Difference Formula, Error in Difference Table, Problems and Solutions.

Numerical Differentiation and Integration
Differentiation based on Newton's Forward and Backward Interpolation Formula. Trapezoidal Rule and Simpson's $1/3^{rd}$ Rule, Errors in Numerical Integration Formulae, Problems and Solutions.

Module IV [10L]

Solution of System of Linear Equations
Introduction, Gauss Elimination Method and Gauss-Seidel Method, Problems and Solutions.

Solution of Algebraic and Transcendental Equation
Introduction, Bisection Method, Regula-Falsi Method, Newton-Raphson Method, Problems and Solutions.

Solution of Ordinary Differential Equations
Introduction, Euler's Method, Runge-Kutta Method (2nd and 4th order), Modified Euler's Method, Problems and Solutions.

Text Books:

1. Statistical Methods (Volume 1 and 2) – N. G. Das, TMH.
2. Introductory Numerical Analysis – Dutta and Jana, Shreedhar Prakashani.

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Reference Books:

1. Mathematical Statistics – S.C. Gupta and V. K. Kapoor, S. Chand.
2. Engineering Mathematics: Volume IIIA – B. K. Pal & K. Das, U. N. Dhur & Sons Pvt. Ltd.
3. Numerical Analysis and Computational Procedures - S. Ali Mollah, Books & Allied Ltd.
4. Numerical Mathematical Analysis - James B. Scarborough, Oxford & Ibh.

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Paper Name: DISCRETE MATHEMATICS					
Paper Code: MCAP1104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**0**	**0**	**3**	**3**

Module I [10L]

Abstract Algebra
Overview of Discrete Mathematics, Set, Relations, Mappings, Poset, lattice, Hasse diagram, Vector Space.

Boolean algebra
Definition of Boolean algebra, Boolean function Simplification.

Mathematical Logic
Propositions, Connectives, Conditionals and Biconditionals, Well Formed Formulas (WFF), Tautologies, Equivalence formulas, duality law, Normal Forms, Predicate Calculus, free and bound variables.

Module II [10L]

Permutation and Combination
Concepts of Permutations and Combinations, Pigeon-hole principle, Euclidean algorithm for Linear Diophantine Equation, Basic Counting Concepts, problems, solutions.

Generating- function and Recurrence- relation
Generating Function, Recurrence relations, Linear recurrence relations with constant Coefficients, Solution by Generating Function.

Module III [10L]

Graph Theory
Basic Concepts of Graphs, Trees, Forest, Adjacency and Incidence Matrices, Minimum Spanning Tree (Prim's and Kruskals Algm), Shortest Path (Dijkstra's Algm), Planar Graph. Various applications of Graph Theory in Computer Science.

Module IV [10L]

Mathematical Computing
Finite Automata, Finite Automata - Construction, DFA, NFA, State minimization, Mealy M/C, Moore M/C, problem and solution.

Definition Of Grammars – Unrestricted grammar, Context-sensitive grammar, Context-free grammar, Regular grammar.

Text Books:

1. Discrete Mathematics and Its Applications - K.H. Rosen, TMH.
2. Elements of Discrete Mathematics - C.L. Liu, McGraw-Hill.
3. Discrete Mathematical Structures - Kolman, Busby and Ross, PHI.

Reference Books:

1. Discrete Mathematics Theory, Problems and Solutions – Dipendra Nath Ghosh, Academic Publishers.
2. Graph Theory with Applications to Engineering and Computer Science - N. Deo, PHI.
3. Theory of Computer Science - K.L.P Mishra and N. Chandrasekaran, PHI.

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Paper Name: MANAGEMENT INFORMATION SYSTEM					
Paper Code: MCAP1105					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**0**	**0**	**3**	**3**

Module I [10L]

Introduction to systems and Basic systems concepts, Types of systems, The systems Approach, Information systems-Definition and characteristics, types of Information, role of Information in Decision Making.

Introduction to Information Analysis and Design Tools-Decision Tree, Decision Table, Structured Analysis, Dataflow Analysis, Data dictionary, Structured Flow Chart, HIPO, Warnier/ORR diagram

Module II [10L]

An overview of Management Information System: Definition and Characteristics, Components of MIS, Hierarchy of Management Activity. Information requirements and Levels of Management, Model of decision making, structured Vs un-structured decisions, Formal vs Information systems

Module III [10L]

Storage and retrieval of data -transaction processing, office automation and information processing, Virtual office system, control functions, Decision making process, phases in the decision making process, Intelligence and design phases, concepts of decision making, Behavioral models of the decision maker/decision making

Module IV [10L]

Planning & implementation of Information Systems, Executive information Systems, Decision Support Systems, Expert Systems, Knowledge Based System. Introduction to Computer crime, Security & ethical challenges.

Text Books:

1. Management Information System - W.S.Jawadekar, TMH.
2. Management Information Systems - Loudon and Loudon, Pearson/Prentice Hall.
3. Analysis & Design of Information System - James A. Senn, McGraw Hill Education.

Reference Books:

1. Management Information Systems – Conceptual foundations, Structure and Development - Gordon B. Davis, Margrethe H. Olson.
2. Management Information System – Oz, Thomson Learning.
3. Management Information System - James O'Brien, TMH.
4. Information Systems: Foundation of E-Business - Steven Alter, Pearson Education.

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Paper Name: DIGITAL LOGIC LAB					
Paper Code: MCAP1111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	0	**0**	**4**	**4**	**3**

Problems related to

- Basic skills lab in using Personal Computer and common software tools
- Realization of Logic Gates
- Realization of Flip- Flop using logic gates
- Realization of Multiplexer
- Realization of Coder & Decoder
- Realization of Adder and Subtractor using logic gates

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Subject Name: PROGRAMMING LAB					
Paper Code: MCAP1112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	0	**0**	**4**	**4**	**3**

Programs related to

- Control Structures
- Array (1-d, 2-d)
- Functions
- Dynamic Memory Allocation
- String Handling
- Structures, Union
- File Handling

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Paper Name: OBJECT ORIENTED PROGRAMMING WITH JAVA					
Paper Code: MCAP1201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction to Object Oriented Programming
Genesis of Object Oriented Programming. Problems with Procedural Programming, Object Oriented Concepts – Objects & Classes, Abstraction, Encapsulation, Message Passing, Access Specifier, Relationships, Aggregation, Links & Associations, Generalization & Specialization, Inheritance, Abstract Classes, Meta-Class, Grouping Constructs. Comparison of Procedural & OOP.

Introduction to Java
Introduction and Overview, Virtual machines - concept and hierarchy of virtual machines. Basic Language Constructs, Arrays. String Class, String Methods, String Arrays, Command Line Arguments, StringBuffer Class, StringBuffer Methods.

Module II [10L]

Classes and Objects
Defining a Class, Creating Objects, Assigning Object Reference Variables, Introducing Methods, Array of Objects, Constructors, Method Overloading, Passing and Returning Objects, “this” Keyword, Static Members, Introducing Access Control, Inner and Nested Classes.

Module III [10L]

Inheritance
Inheritance and Code Reusability, Types of Inheritance, Dealing with “super”, Multilevel Inheritance, Method Overriding, “final” Keyword, Object Class, Abstract Classes.

Interface
Defining Interfaces, Implementing Interfaces, Extending Interfaces, Interfaces and Multiple Inheritance.

Package
Using Packages, Java API, User Defined Packages, Classpath, Access Control.

Module IV [10L]

Exception Handling
Exception and Exception Handling, Exception Types, Built-in Exceptions, “throw”, “throws”, “finally”, Creating User Defined Exceptions, Chained and Unchained Exceptions.

Multithreading
Multitasking & Multithreading, Java and Multithreading, Creating Threads, Life Cycle of a Thread, Thread Methods, Thread Priorities, Synchronization and Deadlock.

Excerpts from java.util and java.lang
Garbage Collection, String Tokenizer, Collections API.

Text Books:

1. JAVA: The Complete Reference – Herbert Schildt, TMH.
2. Core Java I and II – Horstmann and Cornell, Oracle Corporation.

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Reference Books:

1. Object Oriented Modeling & Design -James R. RumBaugh, PHI.
2. The Java Programming Language – James Gosling, Addison Wesley.
3. Java – How to Program – Deitel and Deitel, PHI.
4. A Programmer’s Guide to Java SCJP Certification - Khalid A. Mughal and Rolf W. Rasmussen, Addison Wesley.

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Paper Name: DATA STRUCTURES					
Paper Code: MCAP1202					
Contact hrs. per week	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [8L]

Introduction
Concepts: Datatype and data structure, Abstract Data Type. Classification.
Algorithms concepts. Analysis: space and time analysis of algorithms – Big O, Θ, Ω notations.

Array
Different representations – row major, column major. Sparse matrix – its implementation and applications. Array representation of polynomials.

Linked List
Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module II [8L]

Stack and Queue
Stack - implementation using array and linked list. Applications.
Queue, circular queue, deque - implementation using array and linked list. Applications.

Recursion
Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi.

Module III [12L]

Graphs
Graph representations / storage – using adjacency matrix, adjacency list.

Trees
Basic Terminologies, tree representation – using array and linked list. Binary trees: traversal (pre-, in-, post-, level- order). Threaded binary trees. Huffman trees. Heaps – implementation of priority queue. Binary Search trees, AVL tree (insertion, deletion with examples only), B-tree (insertion, deletion with examples only), Trie (insertion, deletion with examples only).

Module IV [12L]

Searching
Sequential, Binary. Complexity analysis and comparison.

Sorting
Introduction – idea about internal and external sorting, in-place sorting, stability, adaptivity. Sorting algorithms - Bubble, Insertion, Selection, Shell, Quick, Merge, Heap, Radix.Complexity analysis (Average case analysis not required), and comparison.

Hashing
Hash Functions. Collision resolution – open and closed hashing.

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Text Books:

1. Classic Data Structures –Debasis Samanta, PHI Learning.
2. Data Structures and Program Design in C -Robert L Kruse, Bruce P. Leung, Pearson Education.
3. Data Structures using C -Aaron M Tenenbaum, Moshe J Augustein, Pearson Education.

Reference Books:

1. Data Structures -Seymour Lipshutz, McGraw Hill.
2. Fundamentals of Data Structures in C -Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed,Universities Press.

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Paper Name: DATABASE MANAGEMENT SYSTEMS I					
Paper Code: MCAP1203					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction to DBMS

Basic Concepts of Operational Data, Data vs Information, Introduction to Database and DBMS, Importance of Database Design, Files and File Systems, Problems with File System Data Management, Database Systems, Views of Data, Three-Level Architecture, Instances and Schemas, Database Administrator, Database Users, Advantages and Disadvantages of DBMS.

Data Model

Data Modeling and Data Models, Importance of Data Models, Data Model Basic Building Blocks, The Evolution of Data Models, Degree of Data Abstraction.

Entity-Relationship Modeling

Entity and Entity Instances, Attributes, Entity Relationships, Cardinality of Relationships, Strong and Weak Entity, Generalization, Specialization, Aggregation, Developing an ER Diagram, Entity Integrity and Primary Key, Translating ER Model into Relational Model

Module II [10L]

Relational Model

A Logical View of Data, Keys, Integrity Rules, Relational Set Operators, Data Dictionary and the System Catalog, Relationships within the Relational Database, Data Redundancy Revisited, Indexes, Codd's Relational Database Rules.

Relational Database Design

Functional Dependency (FD) –Definition, Trivial and Non-Trivial FD, Closure of Set of FD, Closure Of Attribute Sets, Irreducible Set of FD, Canonical Cover, Normalization – 1NF, 2NF, 3NF,BCNF, Decomposition using FD, Lossless Decomposition, Dependency Preservation.

Module III [10L]

Relational Algebra

Select Operation, Project Operation, Join Operation, Division Operation, Cross Product Operation, Set operations.

Relational Calculus

Introduction, Tuple Relational Calculus, Operators used in TRC, Example queries using TRC, Domain Relational Calculus, Operators used in DRC, Example queries using DRC, Comparison of TRC, DRC, RA

Structured Query Language (SQL)

Introduction to SQL, DDL, DML, DCL, Basic Structure, Basic Queries, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, Assertions, Views, Joining Database Tables, Commit, Rollback.

Module IV [10L]

Advanced SQL

Subqueries and Correlated Queries, SQL Built in Functions - Numeric, Date, String Functions, Updatable Views.

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Storage structure
Sequential and indexed file organization, B+ tree - creation, insertion &deletion.

Indexing
Primary, Secondary& Multi Level.

Text Books:

1. Database System Concepts - Korth, Silberschatz, S. Sudarshan, TMH.
2. Fundamentals of Database Systems - Elmsari and Navathe, Addison-Wesley.

Reference Books:

1. An Introduction to Database Systems - Date C. J, Addison-Wesley.
2. SQL-PL/SQL - Ivan Bayross, BPB.

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Paper Name: OPTIMIZATION TECHNIQUES					
Paper Code: MCAP1204					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**0**	**0**	**3**	**3**

Module I [10L]

Introduction
The nature of Optimization Techniques, History, Meaning, Models, Principles Problem solving with mathematical models, optimization process.

Linear Programming
Basic LPP and applications, various components of LP problem formulation, Graphical Method, Simplex Method, Big-M method, Duality in linear programming.

Integer programming
Concepts, Formulation, Solution and Applications (Branch & Bound method).

Module II [10L]

Transportation Problem
Formulation, Initial solution - North-West corner method, Least cost method, Vogel's approximation method (VAM). Optimal solution – Economic interpretation of ui's and v_j's, MODI method, Properties of closed-loop. Unbalanced transportation problems, Degeneracy and its resolution, Alternate optimal solution, Prohibited transportation route. Maximization transportation problems.

Assignment Problem
Formulation, Optimal solution - Hungarian method. Multiple optimal solution, Maximization problem, Unbalanced assignment problem, Restriction on assignment problem. Travelling salesman problem.

Module III [10L]

Game theory
Introduction, Decision making under risk, Decision making under uncertainty. Two person Zero Sum game (Pure Strategy and Mixed Strategy), Properties of a game, Maximin and Minimax principles, Method of solving game - Saddle point, Principle of dominance, Algebraic method, Graphical method, Linear Programming method.

Network Optimizations
PERT/ CPM – Introduction, Significance of use, Network components and precedence relationship (AOA and AON diagram), Critical path analysis- Forward pass, Backward pass, Float(slack) of Activity and Event.

Module IV [10L]

Queuing Theory
Introduction, Basic definitions and notations, Structure of a Queuing system, Axiomatic derivation of the arrival & departure distributions for Poisson Queue, M/M/1 Queuing Model.

Sequencing Model
Introduction, Notation, Terminology and Assumption. Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of n jobs through m machines, Processing of two jobs through m machines.

Text Books:
1. Operations Research: Theory and Applications - J K Sharma, MacMillan.
2. Operation Research – Kanti Swarup, Gupta P K, Man Mohan, Sultan Chand & Sons.

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Reference Books:

1. Operations Research: An Introduction - H. Taha, Prentice' Hall.
2. Operations Research - Hillier & Lieberman, TMH.

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Paper Name: COMPUTER ORGANIZATION AND ARCHITECTURE					
Paper Code: MCAP1205					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**0**	**0**	**3**	**3**

Module I [12L]

Introduction to basic structures and operational concepts, Instruction formats, Instruction execution, sequencing, Addressing modes Control unit – Concepts, Fetching and storing word from/in main memory, Register transfers, Operations, execution of a complete instruction, Hardwired control, Microprogrammed control.

Module II [8L]

Fixed point Arithmetic - Arithmetic and logical operations of signed numbers and their implementation, Hardware Multiplier, Booths' multiplier, Booth pair multiplier, Binary Division restoring and non-restoring. IEEE-754 representation of floating point numbers, overflow and underflow.

Module III [10L]

Memory – Basic concepts, RAM, ROM – different types, Characteristics, Memory design (Linear addressing, interleaved memory) Cache memories, Performance (memory interleaving, hit rate etc.), Memory hierarchy - virtual memory – address translation, Secondary memories Data transfer through programmed I/O, interrupt and DMA, I/O processors.

Module IV [10L]

Input/output organization: memory mapped, standard (isolated) and linear selection techniques of I/O addressing.

Pipelining - arithmetic & instruction, speedup, vector processing, array processor, Introduction to RISC processor and parallel processing, Bit-Slice processors.

Text Books:

1. Computer Organization – C. Hamacher, Z. Vranesik, S. Zaky, McGraw Hill.
2. Computer Architecture and Organization – John P. Hayes, McGraw Hill.

Reference Books:

1. Computer System Architecture-Morris Mano, PHI.
2. Computer Organization and Architecture-Williams Stallings.

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<table>
<tr><td colspan="6">Paper Name: OBJECT ORIENTED PROGRAMMING LAB</td></tr>
<tr><td colspan="6">Paper Code: MCAP1211</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Point</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>4</td><td>3</td></tr>
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Programs related to

- Language Features
- Arrays in Java and String Handling
- Classes and Objects
- Inheritance
- Interface and Package
- Exception Handling
- Multithreading
- java.util and java.lang
- Applet

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Paper Name: DATA STRUCTURES LAB					
Paper Code: MCAP1212					
Contact hrs. per week	**L**	**T**	**P**	**Total**	**Credit Point**
	0	**0**	**4**	**4**	**3**

Programs related to

- 1-D and 2-D array
- Linked List (Singly linked list, Circular Linked List, Doubly Linked List)
- Stack and Queue implementation using array and linked list
- Implementation of different recursive algorithms
- Implementation of Binary Search Tree (insertion, deletion, searching, traversals)
- Different searching and sorting algorithms

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<table>
<tr><td colspan="6">Paper Name : DBMS I LAB</td></tr>
<tr><td colspan="6">Paper Code: MCAP1213</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Point</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>4</td><td>3</td></tr>
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Problems related to

1. Database Creation
   - Creating a Database
   - Creating a Table
   - Specifying Relational Data Types
   - Specifying Constraints
   - Creating Indexes

2. Table and Record Handling
   - INSERT statement
   - Using SELECT and INSERT together
   - DELETE, UPDATE, TRUNCATE statements
   - DROP, ALTER statements

3. Retrieving Data from a Database
   - The SELECT statement
   - Using the WHERE clause
   - Using Logical Operators in the WHERE clause
   - Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING

4. Clause
   - Using Aggregate Functions
   - Combining Tables Using JOINS
   - Subqueries

5. Database Management
   - Creating Views
   - Creating Column Aliases
   - Creating Database Users
   - Using GRANT and REVOKE

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