HERITAGE INSTITUTE OF TECHNOLOGY

(An Autonomous Institution affiliated to MAKAUT, West Bengal)

DEPARTMENT

OF

ELECTRICAL ENGINEERING

B.TECH. PROGRAMME

Curriculum and Detailed Syllabus

Release Version 1: JULY 2023

Release Version 2: June 2024

(Applicable from 2023 admitted batch)

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Preamble

The Department of Electrical Engineering commenced its journey in 2001-02 as a service-oriented department, focusing on instructing courses such as Basic Electrical Engineering, Circuit Theory, and Control System Engineering. Transitioning into a degree-awarding department in the academic year 2012-13, it admitted 60 undergraduate students and the department witnessed its inaugural graduating class in 2016. The B.Tech. program in Electrical Engineering has undergone revisions in accordance with the directives of AICTE and MAKAUT, aligning with the new educational policies outlined in the National Education Policy (NEP). These modifications, outlined in the Academic Regulation 2022, take effect from the academic session 2023-2024. Furthermore, the curriculum has been tailored to adhere to an Outcome-Based Education (OBE) framework, incorporating a Choice-Based Credit System (CBCS). This approach empowers students to cultivate professional competence through a diverse range of courses, ensuring alignment with industry standards, academic benchmarks, and accreditation criteria set forth by organizations such as NBA and NAAC. The department is equipped with ICT-enabled classrooms and several hardware laboratories covering a spectrum of subjects including Basic Electrical Engineering, Electrical Machines, Power Systems, Power Electronics, Electrical Drives, Microprocessors & Microcontrollers, Analog & Digital Electronics, Control Systems, and Electrical Measurements. These facilities are complemented by a range of professional software programs, fostering ample opportunities for students to engage in learning and innovation within their respective field of study. Students are inspired to pursue several MOOCs beyond their conventional curriculum which facilitate them to enhance their employability. Starting from the academic session 2023-2024, the course codes have been revised, transitioning from four letters to three letters based on recommendations from the Office of the Controller of Examinations. This adjustment aims to facilitate clear differentiation between the new and existing courses. Concurrently, the curriculum and syllabi have undergone structured revisions, incorporating feedback mechanisms on the curriculum from diverse stakeholders such as prospective employers, alumni, and parents.

Institutional Vision & Mission

VISION:

To prepare dynamic and caring citizens to meet the challenges of global society while retaining their traditional values.

MISSION:

- To prepare students with strong foundation in their disciplines and other areas of learning.
- To provide an environment for critical and innovative thinking, and to encourage life-long learning.
- To develop entrepreneurial and professional skills.
- To promote research and developmental activities and interaction with industry.
- To inculcate leadership qualities for serving the society.

Departmental Vision & Mission

VISION:

To prepare professionals having interest in academics, research, industry and sustainable technology that will create responsible citizens committed for the benevolence and welfare of the society.

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MISSION:

M1: To impart strong fundamental concepts to students and motivate them to find innovative solutions for various engineering problems independently.

M2: To develop engineers with managerial attributes capable of applying appropriate technology with responsibility.

M3: To create congenial atmosphere and adequate research facilities for faculty and students.

M4: To provide excellent technological services to industry for the benefit of society.

M5: Developing the spirit of entrepreneurship assimilated with the quality of moral, ethical and human values at all levels.

Program Educational Objectives (PEOs) of B.Tech in Electrical Engineering Programme

The graduate students with the B.Tech. Degree in Electrical Engineering from Heritage Institute of Technology, Kolkata are expected to achieve the following qualities after 5 to 7 years of getting this degree.

PEO1. To establish themselves as successful professionals of the society.

PEO2. To acquire the requisite knowledge for higher studies in India and abroad.

PEO3. To acquire the qualities of team work, leadership and entrepreneurship.

Program Outcomes (POs)

Engineering Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs) of B.Tech (EE) Programme

PSO1. Apply elementary knowledge of science, mathematics and electrical engineering to explore and resolve complex problems in electrical engineering and allied interdisciplinary areas to meet the demands of industry and to provide solutions to the current real time problems.

PSO2. Ability to pursue higher studies in engineering and management, conduct research and use research based knowledge to engage in independent and lifelong learning in the context of technological changes.

PSO3. Ability to communicate effectively and apply the principle of professional ethics for the benefit of society.

Credit Summary for B Tech (EE) with effect from 2023-2024

Sl. No.	Course Type	Credit
1.	Humanities and Social Sciences including Management Courses	12
2.	Basic Science Courses	20
3.	Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc.	22.5
4.	Professional Core Courses	67.5
5.	Professional Elective Courses relevant to chosen Specialization / Branch	12
6.	Open Subjects – Electives from other Technical and/or Emerging Subjects	12
7.	Project Work, Seminar and Internship in industry or elsewhere	17
8.	Mandatory Courses (Non-credit) [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	(NON-CREDIT)
	Total	**163**
9	Honours Courses (MOOCS or otherwise)	20
	Grand Total	**183**

Definition of Credit (as per National Credit Framework 2022):

- Total notional learning hours = 1200 Hours/ Year
- Minimum credits to be earned = 40/ Year
- 1 Credit = 30 notional learning hours

Range of Credits (as per AICTE):

- A student will be eligible to get B Tech degree with Honours if he/she completes an additional 20 credit points.
- These could be acquired through MOOCs. For details kindly refer to APPENDIX – A.
- A student will be eligible to get B.Tech. degree certificate, if he/ she acquires 100 MAR points in 4 years of their study.
- Lateral entry students must acquire 75 MAR points in their 3 years of study.
- For details kindly refer to APPENDIX – B.

Curriculum

1st Year 1st Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	CHM1001	Chemistry I	3	0	0	3	3
2	MTH1101	Mathematics I	3	1	0	4	4
3	CSE1001	Programming for Problem Solving	4	0	0	4	4
4	ELE1001	Basic Electrical Engineering	3	1	0	4	4
5	HUM1001	English for Technical Writing	2	0	0	2	2
Total Theory			**15**	**2**	**0**	**17**	**17**
B. Practical							
1	CHM1051	Chemistry I Laboratory	0	0	2	2	1
2	CSE1051	Programming for Problem Solving Laboratory	0	0	3	3	1.5
3	ELE1051	Basic Electrical Engineering Laboratory	0	0	2	2	1
4	HUM1051	English for Technical Writing Laboratory	0	0	2	2	1
Total Practical			**0**	**0**	**9**	**9**	**4.5**
Total of Semester			**15**	**2**	**9**	**25**	**21.5**

1st Year 2nd Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	PHY1001	Physics I	3	0	0	3	3
2	MTH1201	Mathematics II	3	1	0	4	4
3	ECE1001	Introduction to Electronic Devices and Circuits	3	0	0	3	3
4	HUM1002	Universal Human Values and Professional Ethics	2	1	0	3	3
Total Theory			**11**	**2**	**0**	**13**	**13**
B. Practical							
1	PHY1051	Physics I Laboratory	0	0	2	2	1
2	ECE1051	Introduction to Electronic Devices and Circuits Laboratory	0	0	2	2	1
3	MEC1051	Workshop/ Manufacturing Practices	1	0	3	4	2.5
4	MEC1052	Engineering Graphics & Design	1	0	3	4	2.5
Total Practical			**2**	**0**	**10**	**12**	**7**
Total of Semester			**13**	**2**	**10**	**25**	**20**

2nd Year 1st Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	ELE2101	Circuit Theory	3	1	0	4	4
2	ELE2102	Analog & Digital Electronics	4	0	0	4	4
3	ELE2103	Electrical & Electronic Measurements	3	0	0	3	3
4	ELE2104	Electromagnetic Field Theory	3	0	0	3	3
5	MEC2106	Mechanics for Engineers	3	0	0	3	3
Total Theory			**16**	**1**	**0**	**17**	**17**
B. Practical							
1	ELE2151	Circuit Theory Laboratory	0	0	2	2	1
2	ELE2152	Analog & Digital Electronics Laboratory	0	0	2	2	1
3	ELE2153	Electrical & Electronic Measurements Laboratory	0	0	2	2	1
4	ELE2154	Idea Lab & Design Thinking (EE)	0	0	2	2	1
Total Practical			**0**	**0**	**8**	**8**	**4**
Total of Semester			**16**	**1**	**8**	**25**	**21**

2nd Year 2nd Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	MTH2001	Mathematical Methods	3	1	0	4	4
2	ELE2201	Electrical Machines-I	3	1	0	4	4
3	ELE2202	Power System-I	3	1	0	4	4
4	ELE2203	Signals & Systems	3	0	0	3	3
5	ELE2204	Thermodynamics and Heat Power Engineering	3	0	0	3	3
6	EVS2106	Environmental Science	2	0	0	2	0
Total Theory			**17**	**3**	**0**	**20**	**18**
B. Practical							
1	ELE2251	Electrical Machines-I Laboratory	0	0	2	2	1
2	ELE2252	Power System-I Laboratory	0	0	2	2	1
3	ELE2253	Signals & Systems Laboratory	0	0	2	2	1
4	ELE2254	Thermodynamics and Heat Power Engineering Lab	0	0	2	2	1
Total Practical			**0**	**0**	**8**	**8**	**4**
Total of Semester			**17**	**3**	**8**	**28**	**22**

3rd Year 1st Semester

Sl.	Code	Subject	Contacts Periods/ Week L	T	P	Total	Credit Points
A. Theory							
1	ELE3101	Electrical Machines-II	3	1	0	4	4
2	ELE3102	Power System-II	3	1	0	4	4
3	ELE3103	Linear Control System	3	1	0	4	4
4	ELE3104	Power Electronics	3	0	0	3	3
5	ELE3131 ELE3132	**Professional Elective-I** Illumination Engineering Soft Computing Techniques	3	0	0	3	3
6	AEI3123 CSE3121 ECE3121 ECE3122 ECE3124	**Open Elective-I** Optical Instrumentation Fundamentals of OS Digital Image Processing & Pattern recognition Introduction to Machine Learning Introduction to VLSI Design	3	0	0	3	3
7	INC3016	Indian Constitution and Civil Society	2	0	0	2	0
		Total Theory	**20**	**3**	**0**	**23**	**21**
B. Practical							
1	ELE3151	Electrical Machines-II Laboratory	0	0	2	2	1
2	ELE3152	Power System-II Laboratory	0	0	2	2	1
3	ELE3153	Linear Control System Laboratory	0	0	2	2	1
4	ELE3154	Power Electronics Laboratory	0	0	2	2	1
		Total Practical	**0**	**0**	**8**	**8**	**4**
		Total of Semester	**20**	**3**	**8**	**31**	**25**

Open Elective-I Paper to be offered by Dept. of EE for Non-Departmental Students
ELE3121 Network Analysis

3rd Year 2nd Semester

Sl.	Code	Subject	Contacts Periods/ Week L	T	P	Total	Credit Points
A. Theory							
1	ELE3201	Microprocessor & Microcontroller	3	0	0	3	3
2	ELE3202	Electric Drives	3	0	0	3	3
3	ELE3203	High Voltage Engineering	3	0	0	3	3
4	HUM3201	Economics for Engineers	3	0	0	3	3
6	ELE3231 ELE3232	**Professional Elective-II** Digital Signal Processing Design of photovoltaic systems	3	0	0	3	3
7	*******	**Open Elective-II** **********	3	0	0	3	3
Total Theory			**18**	**0**	**0**	**18**	**18**
B. Practical							
1	ELE3251	Microprocessor & Microcontroller Lab	0	0	2	2	1
2	ELE3252	Electric Drives Laboratory	0	0	2	2	1
Total Practical			**0**	**0**	**4**	**4**	**2**
C. Sessional							
1	ELE3260	Electrical Machine Design	0	0	3	3	1.5
2	ELE3293	Term Paper and Seminar	0	0	4	4	2
Total Sessional			**0**	**0**	**7**	**7**	**3.5**
Total of Semester			**18**	**0**	**11**	**29**	**23.5**

4th Year 1st Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	HUM4101	Principles of Management	3	0	0	3	3
2	ELE4131 ELE4132	**Professional Elective-III** Advanced Power System Advanced Control System	3	0	0	3	3
3	ELE4141 ELE4142	**Professional Elective-IV** Transducers & Sensors Electric Vehicle Technology	3	0	0	3	3
4	BTC4124 BTC4126	**Open Elective-III** Biology for Engineers Bioenergy and other Non- conventional Energy	3	0	0	3	3
5	*******	**Open Elective-IV** **********	3	0	0	3	3
Total Theory			**15**	**0**	**0**	**15**	**15**
B. Sessional							
1	ELE4191	Industrial Training	0	0	0	0	2
2	ELE4195	Project Stage-I	0	0	8	8	4
Total Sessional			**0**	**0**	**8**	**8**	**6**
Total of Semester			**15**	**0**	**8**	**23**	**21**

4th Year 2nd Semester

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	ELE4295	Project Stage-II	0	0	14	14	7
2	ELE4297	Comprehensive Viva Voce	0	0	0	0	2
Total Sessional			**0**	**0**	**14**	**14**	**9**
Total of Semester			**0**	**0**	**14**	**14**	**9**

1ST YEAR 1ST SEMESTER

B Tech. Chemistry Syllabus for 1st Year

Subject Name: Chemistry I					
Subject Code: CHM1001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcome for the Subject Code CHM1001

The subject code CHM1001 corresponds to Chemistry Theory classes (**Chemistry-1**) for the first year B. Tech students, offered as Chemistry for Engineering and is common to all Branches of Engineering Disciplines. The course provides basic knowledge of theory and applications in the subjects like Thermodynamics, Quantum mechanics, Electrochemistry, & Energy conversion, Structure and reactivity of molecules. Spectroscopic techniques and their applications, Synthesis & use of Drug molecules. The Course Outcome for the subject code **CHM1001**, is furnished below:

CHM1001.1: Knowledge acquisition of bulk properties of materials and understanding of reaction processes using thermodynamic considerations.

CHM1001.2: Conception of energy conversion and its importance in clean energy scenario, the operating principles for batteries, fuel cells and the materials and reactions involved there in, their applications as sustainable energy devices, particularly in automobiles sectors to reduce environmental pollution.

CHM1001.3: Analytic view of microscopic chemistry in terms of atomic structure, molecular orbital and intermolecular forces to reinforce strong background on materials science and engineering.

CHM1001.4: Rationalize periodic trends of elements to explain various physico - chemical properties.

CHM1001.5: Understanding of the spectrum of electromagnetic radiation used for exciting different molecular energy levels in various spectroscopic techniques.

CHM1001. 6: Knowledge of stereochemistry and conception of the mechanism of major chemical reactions involved in synthesis of drug molecules.

MODULE 1

Thermodynamics

The 1st and 2nd laws of thermodynamics and thermodynamic functions like free energy, work function and entropy; Carnot cycle, Joule-Thomson effect, Gibbs-Helmholtz equation; Chemical Potential, Gibbs- Duhem Equation and Clausius-Clapeyron Equation.

5L

Electrochemical Cell

Generation of electromotive force in electrochemical cells and application of Nernst equation; Electrode potentials and the redox reactions; Cell configuration and half cell reactions; Standard Hydrogen Electrode, Reference electrode, evaluation of thermodynamic functions; Electrochemical corrosion.

Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells.

4L

MODULE 2

Molecular Structure

Molecular geometry, Hybridization, Ionic, dipolar and van Der Waals interactions; Molecular Orbital Theory and its application in diatomic molecule; Pi-molecular orbital of unsaturated system; Band structure of solids, intrinsic and extrinsic semiconductors and the role of doping on band structures.

5L

Periodic Properties

Effective nuclear charge, penetration of orbitals; variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes; ionization energies, electron affinity and electro-negativity, polarizability, oxidation states, coordination numbers and geometries; hard-soft acid base theory.

4L

MODULE 3

Atomic structure and Wave Mechanics

Brief outline of the atomic structure, wave particle duality, Heisenberg uncertainty principle, Introduction to quantum mechanics, Schrodinger wave equation for particle in one dimensional box.

5L

Spectroscopic Techniques & Applications

Electromagnetic spectrum: Interaction of EMR with matter; Principle and applications of Fluorescence & Phosphorescence, UV-Visible, , Infrared and NMR spectroscopy

4L

MODULE 4

Stereochemistry

Representations of 3- dimensional structures, structural isomers and stereo-isomers; configurations, symmetry and chirality; enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

5L

Organic reactions and synthesis of drug molecules

Introduction to reaction mechanism: substitution, addition, elimination and oxidation, reduction reactions. Synthesis of commonly used drug molecules.

4L

TEXT BOOKS

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

REFERENCE BOOKS

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

Course Title : Mathematics-I					
Course Code: MTH 1101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course Outcomes

MTH 1101.1: Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.

MTH 1101.2 Develop the concept of eigen values and eigen vectors.

MTH 1101.3 Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.

MTH 1101.4 Analyze the nature of sequence and infinite series

MTH 1101.5 Choose proper method for finding solution of a specific differential equation.

MTH 1101.6 Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

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 onthese 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.
5. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
6. S. L. Ross, Differential Equations", Wiley India, 1984.
7. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.
8. Vector Analysis(Schaum's outline series): M.R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
9. Engineering Mathematics: S. S. Sastry (PHI)
10. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP),Indian Edition.
11. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

Course Title: Programming for Problem Solving					
Course Code: CSE1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	0	0	4	4

Course Outcomes:

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

CSE1001.1: Remember and understand the functionalities of the different hardware and software components present in a computer system, the standard representations of various types of data in a computer system.

CSE1001.2: Illustrate how a computer system with one way of representation can be converted to one another equivalent representation.

CSE1001.3: Construct flow charts for any arithmetic or logical problems in hand.

CSE1001.4: Remember and understand the C programming development environment, writing, compiling, debugging, linking and executing a C program using that development environment, basic syntax and semantics of C programming language and interpret the outcome of any given C program.

CSE1001.5: Use loop constructs, conditional branching, iteration, recursion to solve simple engineering problems.

CSE1001.6: Apply pointers, arrays, structures, files to formulate simple engineering problems.

Learning Objectives: 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: [10L] 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. Basic Concepts of Assembly language, High level language, Compiler and Assembler.

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).

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

Module II: [10L] 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.

Flow of Control:

Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Module III: [10L]

Program Structures in C

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.

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.

Module IV: [10L]

Data Handling in C

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(), fseek(), ftell();

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 Title: Basic Electrical Engineering					
Course Code : ELE1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes

After attending the course, the students will be able to

ELE1001.1 Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.

ELE1001.2 Analyse DC Machines; Starters and speed control of DC motors.

ELE1001.3 Analyse magnetic circuits.

ELE1001.4 Analyse single and three phase AC circuits.

ELE1001.5 Analyse the operation of single phase transformers.

ELE1001.6 Analyse the operation of three phase induction motors.

Module-I: [11 L]

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. [6L]

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. [5L]

Module-II[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-III [11 L]

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. [4L]

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.[7L]

Module-IV [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 transformer.[6L]

Three-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.[4L]

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.

Course Title : English for Technical Writing					
Course Code : HUM1001					
Contact Hours per week	L	T	P	Total	Credit Points
	2	0	0	2	2

Course Outcomes:

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

HUM1001.1 communicate effectively in an official and formal environment.
HUM1001.2 use language as a tool to build bridges and develop interpersonal relations in multi-cultural environments.
HUM1001.3 use various techniques of communication for multiple requirements of globalised workplaces.
HUM1001.4 learn to articulate opinions and views with clarity.
HUM1001.5 write business letters and reports.
HUM1001.6 apply various communication strategies to achieve specific communication goals.

Module I (6hrs.)

Introduction to Phonology and Morphology

- Phonetics- Vowel and Consonant Sounds (Identification & Articulation)
- Word- stress, stress in connected speech
- Intonation (Falling and Rising Tone)
- Vocabulary Building-The concept of Word Formation

Module II (6hrs.)

Communication Skills

- The Basics of Business Communication- Process, types, levels
- Barriers to Communication Common obstacles to effective communication
- Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections
- Identify common audiences and design techniques for communicating with each audience

Module III (6hrs.)

Organizational Communication

- Business Letters
- Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular
- Organising e-mail messages, E-mail etiquette
- Techniques for writing precisely: Creating coherence, organizing principles –accuracy, clarity, brevity. Different styles of writing: descriptive, narrative, expository.

Module IV (6hrs.)

Principles, techniques and skills for professional writing

- Logic in writing, thinking and problem-solving; applying deductive and inductive reasoning; Use of infographics in writing.
- Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies. Interpreting data and writing reports
- Writing proposals and Statement of purpose

Text Books:

1 Kumar,S. &Lata, P. Communication Skills, OUP, New Delhi2011
2 Rizvi,Ashraf,M. Effective Technical Communication, Mc Graw Hill Education(India) Pvt. Ltd..Chennai,2018
3 Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Reference Books:

1. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
2. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.

Course Title : Chemistry I Laboratory					
Course Code : CHM1051					
Contact hrs per week :	L	T	P	Total	Credit points
	0	0	2	2	1

Course outcomes:

The subject code CHM1051 corresponds to chemistry laboratory classes for the first year B. Tech students. This course enhances the students' experience regarding handling of various chemicals along with various laboratory equipment. Hands on experiments increase the depth of knowledge that is taught in the theory classes as well as it increases research aptitude in students because they can see the direct application of theoretical knowledge in practical field. The course outcomes of the subject are

1. Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.
2. Estimation of ions like Fe^{2+}, Cu^{2+} and Cl^{-} present in water sample to know the composition of industrialwater.
3. Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.
4. Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.
5. Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.
6. Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

List of Experiments:

1. Estimation of iron using KMnO4: self indicator.
2. Iodometric estimation of Cu^{2+}.
3. Determination of Viscosity.
4. Determination of surface tension.
5. Adsorption of acetic acid by charcoal.
6. Potentiometric determination of redox potentials.
7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethylacetate.
9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
10. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Course Title: Programming for Problem Solving Lab					
Course Code: CSE1051					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

After completion of this course the students should be able:

CSE1051.1 To write simple programs relating to arithmetic and logical problems.

CSE1051.2 To be able to interpret, understand and debug syntax errors reported by the compiler.

CSE1051.3 To implement conditional branching, iteration (loops) and recursion.

CSE1051.4 To decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.

CSE1051.5 To use arrays, pointers and structures effectively in writing programs.

CSE1051.6 To be able to create, read from and write into simple text files.

Software to be used: GNU C Compiler (GCC) with LINUX NB: Cygwin (Windows based) may be used in place of LINUX

Topic 1: LINUX commands and LINUX based editors

Topic 2: Basic Problem Solving

Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)

Topic 4: Loops - Part I (for, while, do-while)

Topic 5: Loops - Part II

Topic 6: One Dimensional Array

Topic 7: Array of Arrays

Topic 8: Character Arrays/ Strings Topic

9: Basics of C Functions

Topic 10: Recursive Functions

Topic 11: Pointers

Topic 12: Structures

Topic 13: File Handling

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

Course Title : Basic Electrical Engineering Laboratory					
Course Code : ELE1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes: The students are expected to

ELE1051.1 Get an exposure to common electrical apparatus and their ratings.

ELE1051.2 Make electrical connections by wires of appropriate ratings.

ELE1051.3 Understand the application of common electrical measuring instruments.

ELE1051.4 Understand the basic characteristics of different electrical machines.

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.

Course Title : English for Technical Writing Laboratory					
Course Code : HUM1051					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcome:

Students will be able to

HUM1051.1 Communicate in an official and formal environment.
HUM1051.2 Effectively communicate in a group and engage in relevant discussion.
HUM1051.3 Engage in research and prepare presentations on selected topics.

HUM1051.4 Understand the dynamics of multicultural circumstances at workplace and act accordingly.
HUM1051.5 Organize content in an attempt to prepare official documents.
HUM1051.6 Appreciate the use of language to create beautiful expressions

Detailed Syllabus

Module- I (6hrs.)

The Art of Speaking

- Techniques for Effective Speaking
- Voice Modulation: Developing correct tone
- Using correct stress patterns: word stress, primary stress, secondary stress. Rhythm in connected speech
- Encoding Meaning Using Nonverbal Symbols,
- How to Improve Body Language
- Eye Communication, Facial Expression, Dress and Appearance
- Posture and Movement, Gesture, Paralanguage
- Encoding meaning using Verbal symbols: How words work and how to use words
- Volume, Pace, Pitch and Pause
- Structuring content for delivery in accordance with time, platform, and audience.

Module- II (6hrs)

Group Discussion

- Nature and purpose and characteristics of a successful Group Discussion
- Group discussion Strategies: Getting the GD started, contributing systematically, moving the discussion along, promoting optimal participation, Handling conflict, Effecting closure

Module- III (6hrs)

- Interviewing
  Types of Interviews, Format for Job Interviews: One-to-one and Panel Interviews, Telephonic Interviews, Interview through video conferencing.
- Cover Letter & CV
- Interview Preparation Techniques, Frequently Asked Questions, Answering Strategies, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews.

Module- IV (6hrs.)

Professional Presentation Skills

- Nature and Importance of Presentation skills
- Planning the Presentation: Define the purpose, analyze the Audience, Analyze the occasion and choose a suitable title.
- Preparing the Presentation: The central idea, main ideas, collecting support material, plan visual aids, design the slides
- Organizing the Presentation: Introduction-Getting audience attention, introduce the subject, establish credibility, preview the main ideas, Body-develop the main idea, present information sequentially and logically, Conclusion-summaries, re-emphasize, focus on the purpose, and provide closure.
- Improving Delivery: Choosing Delivery methods, handling stage fright
- Post-Presentation discussion: Handling Questions-opportunities and challenges.

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. R. Anand, Job Readiness For IT & ITES- A Placement and Career Companion, , McGraw Hill Education.2015
5. Malhotra, A., Campus Placements, McGraw Hill Education.2015

1ST YEAR 2ND SEMESTER

Course Name: Physics I					
Course Code: PHY1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcome:

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

PHY1001.1 Understanding physical systems in terms of their modelling of time evolution.
PHY1001.2 Comprehending wave interpretation of natural phenomena and implications of allied observations.
PHY1001.3 Understanding theoretical backgrounds associated to some experiments based on wave phenomena.
PHY1001.4 Grasping an analytic view of micro and macroscopic world.
PHY1001.5 Accessing the knowledge of the behaviour of a particle under the influence of different potential.
PHY1001.6 Understanding conservative systems based on their particle and wave nature.

DETAILED SYLLABUS:

Module –I [10L]

Mechanics:

Plane-polar coordinate system-velocity and acceleration of a particle-trajectory under central force-conservation principle-Kepler's laws -Rotating frame of reference-Five point acceleration formula-Coriolis effect-deflection of a moving particle.

Module – II [10L]

Oscillation:

Constitutive equation of damping-nature of solutions for large, critical and weak damping-relaxation time, logarithmic decrement, energy decay (qualitative discussion) -Forced oscillation-transient and steady state-amplitude and velocity resonance---power transfer theorem-quality factor-series LCR circuit with AC source.

Module –III [10L]

Optics:

Plane Progressive Wave-phase/wave-length/frequency-qualitative description of light as an electromagnetic wave-Huygens principle-polarization (state of polarization, general equation of ellipse, transformation of polarized lights)-interference (basic theory from superposition principle)-Division of wave front (Young's double slit experiment)-Division of amplitude (thin film, wedge, Newton's ring)-Diffraction (single slit, double slit, grating, Resolving Power).

Module – IV **[10L]**

Quantum Mechanics:

An informal discussion from Planck to de Broglie as the historical context of quantum mechanics-Quantum Mechanics of a particle-operator-eigenvalue problem- Unitary-Hermitian frame work-position and momentum operator-Canonical Commutation Relations (CCR)- Schrodinger equation-time dependent/time independent Schrodinger equation-wave function-stationary states-probability density-probability current density-normalization-expectation value-uncertainty-Bound state problem-particle in a one dimensional box-scattering state problem-potential step-reflection and transmission coefficients- tunnelling.

BOOKS

1. Theoretical Mechanics : M R Spiegel (Schaum Series) McGrow-Hill Book Company
2. Classical Mechanics : N C Rana and P S Joag Tata- McGrow-Hill Publishing Company Limited.
3. Vibrations and Waves : A P French, W W Norton and Company,
4. The Physics of Waves and Oscillations : N K Bajaj, Tata- McGrow-Hill Publishing Company Limited.
5. Optics : A Ghatak, Tata McGraw-Hill Publishing Company Limited.
6. Optics : E. Hecht, Addison Wesley
7. Fundamentals of Optics : F A Jenkins and H E White, McGrow-Hill Higher Education.
8. Atomic Physics (Modern Physics): S N Ghosal, S. Chand and Company.
9. Practical Quantum Mechanics : S Flugge, Springer (Reprint of the 1994 Edition)
10. Concepts of Modern Physics : A Baiser, Tata McGraw-Hill Publishing Company Limited.
11. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora.

Course Title: Mathematics II					
Course Code: MTH1201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes

MTH1201.1 Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.

MTH1201.2 Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.

MTH1201.3 Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.

MTH1201.4 Analyze certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.

MTH1201.5 Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.

MTH1201.6 Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily.

The objective of this course is to familiarize the students with numerical techniques, integral transforms, graph theory and probability. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Module-I Fundamentals of Probability [10L)

Random experiment, Sample space and events

Classical and Axiomatic definition of probability

Addition and Multiplication law of probability

Conditional probability

Bayes' Theorem

Random variables

General discussion on discrete and continuous distributions

Expectation and Variance

Examples of special distribution: Binomial and Normal Distribution

Module-II Numerical Methods [10L]

Solution of non-linear algebraic 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, Matrix Inversion Method.

Solution of Ordinary differential equations: Euler's and Modified Euler's Method , Runge-Kutta Method of 4th order.

Module-III Basic Graph Theory [10L]

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

Definition and properties of a tree

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-IV Laplace Transformation [10L]

Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.

Introduction to integral transformation

Functions of exponential order, Definition and existence of Laplace Transform(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

Suggested Books:

1. Advanced Engineering Mathematics , E.Kreyszig, Wiley Publications
2. Introduction to Probability and Statistics for Engineers and Scientists, S.Ross, Elsevier
3. Introductory methods of Numerical Analysis, S.S. Sastry, PHI learning
4. Introduction to Graph Theory, D. B. West, Prentice-Hall of India
5. Engineering Mathematics, B.S. Grewal, S. Chand & Co

Course Title : Introduction to Electronics Devices & Circuits					
Course Code : ECE1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

After going through this course, the students will be able to:

ECE1001.1 Categorize different semiconductor materials based on their energy bands and analyze the change in characteristics of those materials due to different types of doping.

ECE1001.2 Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode.

ECE1001.3 Design different application specific circuits using diodes.

ECE1001.4 Analyze various biasing configurations of Bipolar Junction Transistor.

ECE1001.5 Categorize different field-effect transistors and analyze their behavior.

ECE1001.6 Design and implement various practical electronic circuits.

Module I [10 L]
Basic Semiconductor Physics:
Crystalline materials, energy band theory, Conductors, Semiconductors and Insulators, Concept of Fermi energy level, intrinsic and extrinsic semiconductors, mass action law, drift and diffusion currents in semiconductor, Einsteinrelation.
Diodes and Diode Circuits:
Formation of p-n junction, energy band diagram, forward & reverse biased configurations, V-I characteristics,
DC load line, breakdown mechanisms - Zener and avalanche breakdown, voltage regulation using Zener diode.
Rectifier circuits: half wave & full wave rectifiers: ripple factor, rectification efficiency, rectifier output without and with filters. Light emitting diode.

Module II [8 L]
Bipolar Junction Transistors (BJT):
PNP & NPN BJT structures, different operating modes of BJT, current components in BJT, dc current gains in CE & CB configurations and their interrelation,input & output V-I characteristics of CE & CB configurations. Concept of Biasing: DC load line, Q-point, basic concept of amplification using BJT.

Module III [9 L]
Field Effect Transistors (FET):
Classification of FET, basic structure and operation of Junction Field Effect Transistor (n-channel)along with its V-I characteristics.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET): Enhancement & depletion type MOSFETs (forboth n & p channel devices), drain & transfer characteristics.

Module IV [9 L]
Feedback in amplifiers:
Concept of feedback, different feedback topologies using block diagram only, effects of negative feedback (qualitative), Barkhausen criteria for sustained oscillation.

Operational Amplifier:
Usefulness of differential amplifier over single ended amplifier, ideal OPAMP characteristics, transfer characteristics of OPAMP, CMRR, slew rate,offset error voltages and current, concept of virtual ground
Basic circuits using OPAMP:Comparator, inverting and non-inverting amplifiers, voltage follower, adder, subtractor, integrator, differentiator.

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

Course Title : Universal Human Values and Professional Ethics					
Course Code : HUM1002					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

1. appreciate the essential complementarity between 'values' and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. develop a Holistic perspective towards life and profession.
3. develop a correct understanding of the Human reality and the rest of existence.
4. appreciate the relationship of values in terms of ethical human conduct.
5. understand the importance of trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
6. differentiate between the characteristics and activities of different orders and study the mutual fulfilment among them.

Detailed Syllabus

Module 1 – Introduction to Value Education (6hrs.)

Understanding Values: Historical perspective to the development of values and its importance for the integration and harmony of the self and body
Understanding Human being as the Co-existence of the Self and the Body
Exploring Harmony of Self with the Body
Distinguishing between the Needs of the Self and the Body
Understanding and appreciating basic human aspirations-Maslow's Hierarchy of Needs Theory
Strategies, Methods toFulfil the Basic Human Aspirations
Continuous Happiness and Prosperity – the Basic Human Aspirations

Module 2 – Harmony in the Family and Society (10hrs.)

The self as a social being starting with the family as the smallest unit—the process of socialisation.
Development of the self in relation to the society – Cooley's and Mead's theories of socialisation.
Self and Integrated personality-Morality, Courage and Integrity
Conflict of interest at home and society and its resolution through the implementation of the Human Values
Societal Values – Justice, Democracy and Rule of law
Establishing harmony in the society with the help of ethical conduct based on values- Ethics of Rights and Duties, Ethics of care, Ethics of Justice and Fairness, Work Ethics and quality of life at work.
Value crisis- disharmony in relationships, understanding harmony in the society
Solutions - contribution of the individual in establishing harmony in the society.
'Trust' and 'Respect'--the Foundational Values in Relationship
Exploring the Feeling of Trust and Respect

Module 3 – Implications of the Holistic Understanding – a Look at Professional Ethics (10hrs.)

Ethics and Ethical Values

Principles and theories of ethics--Consequential and non-consequential ethics, Utilitarianism, Kant's theory and other non-consequential perspectives

Professional Ethics- Right understanding of Professional Ethics

Canons of professional Ethics

Technology – various perspectives-its use, overuse and misuse

Privacy, data security and data protection, Artificial intelligence-harmony or disharmony, misinformation, deep fake, cyber-crime - a sociological perspective.

Code of Ethics, Violation of code of ethics, Whistle blowing, Institutionalising Ethics

Vision for the Universal Human Order, Exploring Systems to fulfil Human Endeavours

Module 4 – Harmony in the Nature/ Existence (10hrs.)

Understanding Harmony in the Nature -Ecological Ethics
Sustainable development- Definition and Concept

Strategies for sustainable development- Small is beautiful, Slow is Beautiful Sustainable Development--- The Modern Trends

Sustainable Development Goals- Case studies and Best practices

Exploring the Four Orders of Nature -Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature

The Holistic Perception of Harmony in Existence

Suggested Readings:

1. A Foundation Course in Human Values and Professional Ethics, R.R. Gaur, R. Asthana, G.P. Bagaria, Excel Books Pvt. Ltd. New Delhi
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews

Course Name: PHYSICS– I LAB					
Course Code: PHY1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcome:

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

1. Applying practical knowledge using the experimental methods to correlate with the Physics theory.
2. Understanding the usage of electrical and optical systems for various measurements.
3. Applying the analytical techniques and graphical analysis to the experimental data.
4. Understanding measurement technology, usage of new instruments and real time applications in engineering studies.
5. Evaluating intellectual communication skills and discuss the basic principles of scientific concepts in a group.

MINIMUM OF SIX EXPERIMENTS TAKING ATLEAST ONE FROM EACH OF THE FOLLOWING FOUR GROUPS:

Group I: Experiments in Optics

1. Determination of dispersive power of the material of a prism
2. Determination of wavelength of a monochromatic light by Newton's ring
3. Determination of wavelength of the given laser source by diffraction method

Group II: Electricity & Magnetism experiments

1. Determination of specific charge (e/m) of electron by J.J. Thompson's method.
2. Determination of dielectric constant of a given dielectric material.
3. Determination of Hall coefficient of a semiconductor by four probe method.
4. To study current voltage characteristics, load response, areal characteristic and spectral response of a photovoltaic solar cell.
5. Determination of Magnetic Field Measurement for a current carrying coil.
6. Determination of unknown resistance using Carey Foster's bridge

Group III: Experiments in Quantum Physics

1. Determination of Stefan-Boltzmann constant.
2. Determination of Planck constant using photocell.
3. Determination of Lande-g factor using Electron spin resonance spectrometer.
4. Determination of Rydberg constant by studying Hydrogen spectrum.
5. Determination of Band gap of semiconductor.

Group IV: Miscellaneous experiments

1. Determination of Young's modulus of elasticity of the material of a bar by the method of flexure
2. Determination of bending moment and shear force of a rectangular beam of uniform cross section
3. Determination of modulus of rigidity of the material of a rod by static method
4. Determination of rigidity modulus of the material of a wire by dynamic method
5. To determine the moment of inertia of a body about an axis passing through its centre of gravity and to determine the modulus of rigidity of the material of the suspended wire
6. Determination of coefficient of viscosity by Poiseulle's capillary flow method

Course Title : Introduction to Electronics Devices & Circuits Laboratory					
Course Code : ECE1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

1. The students will correlate theory with diode behavior.
2. They will design and check rectifier operation with regulation etc.
3. Students will design different modes with BJT and FET and check the operations.
4. They will design and study adder, integrator etc. with OP-AMPs.

List of Experiments

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multi-metersetc.
2. Familiarization 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.

Course Name: WORKSHOP /MANUFACTURING PRACTICES					
Course Code: MEC1051					
Contact Hours	**L**	**T**	**P**	**Total**	**Credit Points**
per week	**1**	**0**	**3**	**4**	**2.5**

Course Outcomes:

On successful completion of the course, students will be able to

CO1: **Follow** the various safety practices in workshop and personal protective elements.

CO2: **Identify** tools, work material and measuring instruments useful for fitting, carpentry and sheet metal practices.

CO3: **Operate** machine tools, components and processes to prepare jobs of specific shape and size.

CO4: **Acquire** knowledge of foundry process and casting of a product.

CO5: **Perform** welding, brazing and soldering processes.

CO6: **Assemble** a simple product.

Syllabus:

(i) Lectures: (13 hours)

Detailed contents

1. Introduction on Workshop and familiarization with safety norms	**(1 lecture)**
2. Carpentry and Fitting	**(2 lectures)**
3. Sheet metal	**(1 lecture)**
4. Metal casting	**(1 lecture)**
5. Welding (arc welding & gas welding), brazing and soldering	**(2 lectures)**
6. Manufacturing Methods- machining (Lathe, Shaping and Milling)	**(4 lectures)**
7. Additive manufacturing	**(1 lecture)**
8**.** Assembling of a product	**(1 lecture)**

(ii) Workshop Practice:(39 hours)

1. Safety practices in workshop	**(3 hours)**
2. Carpentry shop	**(3 hours)**
3. Fitting shop	**(6 hours)**
4. Foundry shop	**(3 hours)**
5.Machine shop	**(9 hours)**
6. Welding shop-Arc welding	**(3 hours)**
7. Sheet metal shop and brazing	**(6 hours)**
8. Soldering operation	**(3 hours)**
9**.** Assembling of a product	**(3 hours)**

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements ofWorkshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters andpublishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" PearsonEducation, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice HallIndia, 1998.
5. 5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House,2017.

Course Name: ENGINEERING GRAPHICS & DESIGN					
Course Code: MEC1052					
Contacthours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	1	**0**	**3**	**4**	**2.5**

Course Outcomes:

After going through the course, the students will be able to

MEC1052.1 **Visualize** the basic concept of engineering drawing.

MEC1052.2 **Use** engineering drawing tools (conventional / modern tools).

MEC1052.3 **Apply** the various standards and symbols followed in engineering drawing.

MEC1052.4 **Implement** the concept of projections used in engineering graphics.

MEC1052.5 **Relate** the concept of sections to determine its true shape.

MEC1052.6 **Execute** the concept of isometric projections.

Lecture Plan (13 L)

1. Importance and principles of engineering drawing (1 L)
2. Lettering (1 L)
3. Concepts of Scale, dimensioning and Conic sections (3 L)
4. Introduction to concept of projection (Projections of points, lines and surfaces) (3 L)
5. Definitions of different solids and their projections (1 L)
6. Section of solids and sectional view (1 L)
7. Isometric projection (1 L)
8. Introduction to CAD (1 L)
9. Viva-voce (1L)

Detailed contents of Laboratory hours (39 hours)

Module 1: Introduction to Engineering Drawing covering, (3 hours)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lines, lettering & dimensioning, Conic sections like Ellipse (General method only); Involute; Scales – Plain, Diagonal.

Module 2: Orthographic Projections covering, (9 hours)

Principles of Orthographic Projections - Conventions - Projections of Points and lines inclined to both planes; Projections on Auxiliary Planes. Projection of lamina.

Module 3: Projections of Regular Solidscovering, (6 hours)

Those axes inclined to both the Planes- Auxiliary Views.

Module 4: Sections and Sectional Views of Right Angular Solids covering, (3 hours)

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Sectional orthographic views of geometrical solids.

Module 5: Isometric Projections covering, (6 hours)

Principles of Isometric projection -Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

Module 6: Overview of Computer Graphics covering, (3 hours)

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

Module 7: Customization& CAD Drawing, (3 hours)

Consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

Module 8: Annotations, layering & other functions covering, (3 hours)

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through

modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation.

Module 9: Demonstration of a simple team design project that illustrates (3 hours)

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame.

References:

1. Bhatt, N.D., Panchal V.M. & Ingle P.R., (2014) "Elementary Engineering Drawing"; CharotanPublishing House

2. Narayana, K.L. and Kannaaiah P "Engineering Graphics"; TMH

3. Lakshminarayanan, V. and Vaish Wanar, R.S "Engineering Graphics" Jain Brothers.

4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Edication.

5. Agarwal B. & Agarwal C. M. (2012), Engineering graphics, TMH Publications.

2ND YEAR 1ST SEMESTER

Course Title: Circuit Theory					
Course Code: ELE2101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

COURSE OUTCOMES:

The students will be able to

ELE2101.1 apply network theorems to solve electrical circuits having both dependent and independent sources.
ELE2101.2 analyse magnetically coupled circuits.
ELE2101.3 apply Laplace transform technique in solving transient problems of electrical circuits.
ELE2101.4 apply the concept of graph theory to electrical circuits.
ELE2101.5 obtain the equivalent representation of electrical circuits using two- port network parameters.
ELE2101.6 analyse and synthesize filters.

Module-I

Network equations: Formulation of Node & Mesh equations. Loop and node variable analysis of transformed circuits. Network theorems: Superposition, Thevenin's, Norton's and maximum power transfer theorem applied to circuits containing dependent sources. **[8L]**
Coupled Circuits: Coefficient of coupling, Dot convention, Analysis of coupled circuits. **[4L]**

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, Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Treatment of mutual couplings in t & s domain. Concept of natural frequency and damping. Sketching of transient response. **[12L]**

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. **[6L]**
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. **[6L]**

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 and Chebyshev filters. **[12L]**

Total: 48L

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

Course Name: Analog & Digital Electronics					
Course Code: ELE2102					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes

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

ELE2102.1: Recall basic principles of diodes, transistors, OPAMPs and number systems.

ELE2102.2: Understand basic principles of OPAMP based circuits for linear and nonlinear operations and analyze their implications.

ELE2102.3: Acquire knowledge about different waveform generators, 555 timers, ADCs and DACs and their applications.

ELE2102.4: Recall number systems and Boolean algebra.

ELE2102.5: Understand Boolean algebra based realisation of logic gates and design of various arithmetic and combinational circuits.

ELE2102.6: Design and analyse various sequential circuits like synchronous and asynchronous counters, shift registers using flip flops.

Module-I: [10L]

Semiconductor devices:

Review of diodes, transistors.

Recall Transistor amplifiers: Biasing and Equivalent circuit.

Review of Operational amplifiers (OPAMP). Basic building blocks of OPAMP, Ideal OPAMP characteristics, Specifications of OPAMP.

Concept of feedback. Analysis of practical feedback amplifiers.

Realization of different OPAMP based practical circuits: integrators, differentiators etc.

Non-linear applications of operational amplifiers:

Comparators, zero crossing detectors, Schmitt triggers, precision rectifiers, peak detectors.

Module-II: [10L]

Waveform generators using operational amplifiers:

Oscillators: Barkhausen criteria; Phase shift oscillator, Wien Bridge oscillator, Colpitts oscillator, Hartley oscillator**,** crystal oscillator.

Multivibrators: Astable, monostable and bistable multivibrators.

Triangular and saw-tooth wave generator, voltage controlled oscillator (VCO).

555 timer:

Functional diagram of 555 timer, design of astable and monostable multivibrators using 555 timer.

Module-III: [10L]

Data, Number Systems: Concept of digital data, Review of number systems and codes.

Boolean Algebra: Elementary logic gates (NOT, AND, OR, NOR, NAND, XOR and XNOR), their truth tables and circuits, Universality of NOR and NAND gates, Boolean

algebra, De-Morgan's Theorem and applications, Representation of logical statement into Boolean expression and realization using logic gates, Representation of logical expression in SOP and POS forms, Minimization of logic expressions by algebraic method, K-map method. **Combinational Circuits:** Adder, Subtractor, Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer, Parity Generator and Code Converters.

Module-IV: [10L]

Sequential Circuits: Basic memory elements, Latch and Flip Flop, S-R, J-K, D, and T Flip flop, Conversion of one flip flop into other flip flops.

Counters & Their Design: Asynchronous and Synchronous counters and their realization using flip flops, Mod N counter, Ring Counters.

Registers: Shift registers, parallel load and serial load.

Converters: Basic idea of A/D and D/A conversion techniques.

Logic families: TTL, ECL, MOS & CMOS, their operation and specification.

Text Books:

1. Adel S. Sedra & Kenneth Carless Smith, Microelectronic Circuits, Oxford University Press
2. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Prentice Hall of India Private Limited
3. H. Taub, D. Schilling, "Digital Integrated Electronics", McGraw-Hill Kogakusha Ltd.
4. Fundamental of Digital Circuits, A. Anand Kumar, PHI.
5. Digital Circuits and Design, 4th Edition, S. Salivahanan & S. Arivazhagan, Vikas Publishing House Pvt Ltd.

References:

1. Robert L. Boylestad, Electronic Devices and Circuit Theory, Prentice Hall
2. Millman & Halkias: Integrated Electronics.
3. Modern Digital Electronics, 2nd Edition, R.P. Jain. Tata McGraw Hill Company Limited
4. S. Salivahanan and V.S. Kanchana Bhaaskaran. Linear Integrated Circuits, Tata McGraw Hill Company Limited

Course Title: Electrical & Electronic Measurements					
Course Code: ELE2103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

COURSE OUTCOMES:

The students will be able to

ELE2103.1: Understand the mechanism and operating principles of various deflecting type measuring instruments and extension of their ranges.

ELE2103.2: Define and classify various errors in measurement.

ELE2103.3: Acquire knowledge of various power and energy measuring devices

ELE2103.4: Understand the operating principles and applications of instrument transformers and potentiometers

ELE2103.5: Acquire knowledge about and analyze various ac and dc bridges for measuring different electrical parameters and their applications.

ELE2103.6: Acquire knowledge about various electronic and digital instruments like average reading AC voltmeters, peak reading AC voltmeters, true RMS voltmeter, electronic multi-meter, digital voltmeter.

Module-I: [10L]

Electrical Instruments:

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

Errors in Measurement:

Definition of accuracy, precision, speed of response, Instruments' hysteresis, classification of errors, Absolute Error and Limiting Error.

Module-II: [10L]

Measurement of Power:

Power measurement by Electrodynamometer type wattmeter, construction, principle of operation, shape of scale, wattmeter connections and errors.

Measurement of Energy:

Induction type energy meter: Principle of operation, errors and their compensation.

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.

Module-III: [8L]

Measurement of Resistance:

Wheatstone Bridge, Low resistance measurement by Kelvin double Bridge, High resistance measurement, Megger.

Measurement of Inductance, Capacitance and Frequency:
Maxwell's Bridge, Anderson Bridge, Owen's Bridge, De Sauty's Bridge, Schering Bridge and Wien Bridge.

Potentiometer:
Principle of operation and application of Crompton's DC potentiometer, Polar and Co-ordinate type AC potentiometer & Application.

Module-IV: [8L]

Localization of cable fault: Murray loop test, Varley loop test.

Electronic Instruments:
Average reading AC voltmeters, peak reading AC voltmeters, true RMS voltmeter, Electronic multi-meter.

Digital Voltmeter: Integrating type using voltage to time and voltage to frequency conversion techniques and Successive approximation type.

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.

Reference Books

1. Modern Electronic instrumentation & Measuring instruments, A.D. Heltric & W.C. Copper, Wheeler Publication.
2. Electrical and Electronic Measurement, N.K.Dutta

Course Title: Electromagnetic Field Theory					
Course Code: ELE2104					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completion of the course students will be able to
ELE2104.1: Apply knowledge of different co-ordinate systems for field analysis problems.
ELE2104.2: Apply different techniques of vector calculus to analyze electromagnetic fields to reach substantiated conclusions.
ELE2104.3: Solve static electric field problems for different engineering applications by using vector calculus.
ELE2104.4: Solve static magnetic field problems for different engineering applications by using vector calculus.
ELE2104.5: Apply the knowledge of Maxwell's equation in solving wave propagation problems.
ELE2104.6: Understand and analyze the concepts of electromagnetic waves.

Module 1: [7L]
Introduction: Curvilinear coordinate system, Cartesian coordinates, Cylindrical coordinates, Spherical coordinates & their transformation. Differential length, area and volume in different coordinate systems. **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.

Module 2: [10L]
Coulomb's law and Electric field intensity: Coulomb's law, Electric field intensity E & Potential Φ, field due to line charge, field due to sheet charge, field due to continuous volume charge distribution.
Electric flux density and Gauss's Law: Electric flux density, Gauss's law, Maxwell's first equation, Application of Gauss's law.
Energy and potential: Relationship between E and V, Polarization and Dipole moment, Energy density in electrostatic field.
Dielectrics and Capacitance: Electric boundary conditions between dielectrics and conductor–dielectric, capacitance.
Poisson's and Laplace's equation: Poisson's and Laplace's equation, Application of Poisson's and Laplace's equation for solving Electrostatic problems.
Current and conductors: Ohm's law and law of conservation of charge and continuity equation.

Module 3: [11L]
The Steady Magnetic Field : Biot-Savart's law, Ampere's circuital law both differential and Integral form, Magnetic flux density, Magnetic field intensity, Magnetic Vector and Scalar Potential.
Magnetic materials and boundary condition: Magnetization in material and permeability, Boundary conditions between two magnetic media, Magnetic circuits.

Inductance and Energy: Self and Mutual inductance, Inductance of solenoid, Inductance of coaxial cable, Inductance of two wire transmission lines, Energy stored in magnetic field.
Magnetic Forces: Force on a moving charge and current carrying conductor due to magnetic field, Torque developed in current carrying coil in a magnetic field, magnetic moments, forces on magnetic materials.

Module 4: [8L]
Time-Varying Electromagnetic Fields and Maxwell's equation: Faraday's law, Transformer and motional emf, Displacement current, Loss tangent, Maxwell's equations for time varying fields, Time varying Potential, Time harmonic fields.

Electromagnetic wave propagation: 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, Poynting's Theorem and Poynting vector, and it's application.

Text Books:
1. Engineering Electromagnetics by W.H.Hayt
2. Principles Of Electromagnetics by Matthew N.O. Sadiku and S.V. Kulkarni
3. Electromagnetics by Kraus & Carver
4. Electromagnetic Theory and application by P.Mukhopadhyay
5. Electromagnetics by A.Pramanik
6. Electromagnetics by Joseph Edminister
7. Electromagnetic fields by Griffiths.

Course Title: Mechanics for Engineers					
Course Code: MEC2106					
Contact Hours 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:

MEC2106.1: Understand basic concepts of vector algebra and apply in engineering mechanics.

MEC2106.2: Explain the force systems and draw free body diagrams to analyse rigid body equilibrium.

MEC2106.3: Comprehend the principles of coulomb's friction and apply to engineering mechanics problems.

MEC2106.4: Compute the centroid of plane areas.

MEC2106.5: Explain and solve numerical problems on basic dynamics of engineering mechanics.

MEC2106.6: Describe the mechanical behaviours of materials and compute the stress-strain induced on deformable bodies.

Module I: [10L] Fundamentals of Engineering Mechanics

Importance of Mechanics in Engineering, Definition of Mechanics, Concepts of particles & rigid bodies.

Vector and scalar quantities: Vector algebra —definition and notation, Types of vectors — equal, equivalent, free, bound, sliding; Addition, subtraction of vectors.
Parallelogram law, triangle law, vector polygon, Scalar multiplication of vectors, Resolution of vectors in Cartesian coordinate system, Unit vector, unit coordinate vectors (i, j, k), Direction cosines, Addition, subtraction of vectors in components form.
Dot product, cross product and the application, Important vector quantities (position vector, displacement vector, velocity vector, acceleration vector, force vector).

Force and Moment: Type of forces - collinear, concurrent, parallel, concentrated, distributed, active and reactive forces, different types of reaction forces, Moment of a force about a point and about an axis, moment of a couple, Representation of force and moments in items of i, j, k, Principle of transmissibility of force (sliding vector), Varignon's theorem for a system of concurrent forces, Resolution of a force by its equivalent force-couple system, Resultant of forces.

Module II: [10L] Equilibrium of Forces and Friction

Free Body Diagram: Free body concept and diagram, Concept and equilibrium of forces in two dimensions, Equations of equilibrium, Equilibrium of three concurrent forces - Lami's theorem.

Concept of Friction: Laws of Coulomb's friction, Angle of friction, angle of repose, coefficient of static and kinetic friction.

Module III: [10L] Distributed Force System and Force Dynamics

Concept of Centroid and Centre of Gravity: Centre of gravity; Centre of mass & centroid, Centroid of an arc, Centroid of plane areas - triangle, circular sector, quadrilateral and composite area consisting of above figures.

Introduction to Dynamics: Kinematics & kinetics, Newton's laws of motion, Law of gravitation and acceleration due to gravity, Rectilinear motion of particles with uniform & non - uniform acceleration. Plane curvilinear motion of particles, Rectangular components (projectile motion). Principle of work, Principal of conservation of energy.

Module IV: [9L] Basic Concepts of Strength of Materials

Concept of simple stress and strain, normal stress, shear stress, normal strain, shear strain, Hooke's law, Poisson's ratio, stress- strain diagram of ductile and brittle material, proportional limit, elastics limit, yield point, ultimate stress, breaking point, modulus of elasticity, Factor of safety for design calculations.

Recommended Books:

1. Engineering Mechanics:- Statics and Dynamics by Meriam &Kreige , Wiley india
2. Engineering Mechanics:- Statics and Dynamics by I.H. Shames, P H I
3. Engineering Mechanics by Timoshenko , Young and Rao , TMH
4. Fundamentals of Engineering Mechanics by Nag & Chanda – ChhayaPrakashani.

Course Title: Circuit Theory Laboratory					
Course Code: ELE2151					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

COURSE OUTCOMES:

The students are expected to

ELE2151.1 Learn simulation of electrical circuits.

ELE2151.2 Gain knowledge of transient and frequency response of electrical circuit.

ELE2151.3 Find out open circuit impedance parameter and short circuit admittance parameter of two port network experimentally.

ELE2151.4 Design and synthesize filters.

List of Experiments:

1. Determination of Laplace transform, Inverse Laplace transform and representation of Poles and Zeros in s-plane, determination of partial fraction expansion from cascade form and vice versa in s-domain using MATLAB/OCTAVE.
2. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB/OCTAVE in analog form.
3. Transient response of R-L and R-C network.
4. Transient response of R-L-C series and parallel circuit.
5. Verification of Network theorems.
6. Determination of Impedance (Z) and Admittance (Y) parameter of a two port network.
7. Design of Butterworth Low Pass and High Pass filters: Simulation and Hardware implementation.
8. Design of Band Pass and Band Reject filters using Butterworth Low Pass and High Pass filters: Simulation and Hardware implementation.

Course Title: Analog & Digital Electronics Laboratory					
Course Code: ELE2152					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes

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

ELE2152.1: Identify various integrated circuits and understand their operation.

ELE2152.2: Develop skills in building and testing analog and digital circuits on breadboards, including power supplies, amplifiers, oscillators, and waveform generators in analog and digital trainer kit.

ELE2152.3: Utilize electronic test equipment such as multimeters, digital storage oscilloscopes, and power supplies for accurate measurement, troubleshooting, and validation of analog and digital circuit performance.

ELE2152.4: Develop skills in documenting their laboratory work, including circuit diagrams, truth tables, measurements, observations, analysis, conclusions, and recommendations in formal lab reports.

List of Experiments:

1. Transfer characteristics of an inverting and non-inverting amplifier using operational amplifier.
2. Realization of adder, subtractor, integrator and differentiator using operational amplifier.
3. Transfer characteristics of zero crossing detector, comparator with hysteresis using operational amplifier.
4. Realization of astable and monostable multivibrator using operational amplifier.
5. Realization of astable and monostable multivibrator using 555.
6. Realization of basic gates and logic statement using universal logic gates.
7. Design of simple arithmetic circuits: Adder, Subtractor.
8. Design of decoder and encoder using logic gates.
9. Realization of MUX and DMUX using logic gates.
10. Realization of RS, JK and D Flip Flops using universal logic gates.

Course Title: Electrical & Electronic Measurements Laboratory					
Course Code: ELE2153					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

COURSE OUTCOMES:

The students will be able to

ELE2153.1: calibrate analog ammeter, voltmeter and wattmeter using dc potentiometer.

ELE2153.2: measure unknown resistance, inductance, capacitance and frequency using different dc and ac bridges.

ELE2153.3: use instrument transformer for measuring power consumption of connected load using standard available measuring meters.

ELE2153.4: calculate energy consumption of single phase system and power measurement of three phase system.

List of Experiments:

1. Calibration of moving iron and electrodynamometer type ammeter/voltmeter by potentiometer.
2. Calibration of dynamometer type wattmeter by potentiometer.
3. Calibration of AC energy meter.
4. Measurement of resistance by Kelvin double bridge.
5. Measurement of Power and use of Instrument transformer to extend the range of power measuring instruments.
6. Measurement of power in Three-phase circuits.
7. Measurement of frequency by Wien Bridge.
8. Measurement of Inductance by Anderson Bridge.
9. Measurement of capacitance by De-Sauty Bridge.
10. Measurement of capacitance by Schering Bridge.

Course Title: Idea Lab & Design Thinking					
Course Code: ELE2154					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

After completion of the course, students will be able to

ELE2154.1: acquire knowledge of different electronics components
ELE2154.2: acquire knowledge of simulation electronics circuit
ELE2154.3: acquire knowledge of making electronics circuit
ELE2154.4: Acquire knowledge about the electrical wiring

List of Experiments:

1. Familiarization with different electronics components.
2. Practice different electronics circuit making on breadboard.
3. Practice soldering on Vero board to make simple electronics circuit.
4. Electronics circuit simulation.
5. Design and Fabrication of a DC voltage supply.
6. Design and Fabrication of a variable AC voltage supply.
7. Electrical wiring: Planning, design and estimation.
8. Familiarisation with basic software programming.

2ND YEAR 2ND SEMESTER

Course Title: MATHEMATICAL METHODS					
Course Code: MTH2001					
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:

MATH2001.1 Construct appropriate mathematical models of physical systems.

MATH2001.2 Recognize the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems.

MATH2001.3 Generate the complex exponential Fourier series of a function and make out how the complex Fourier coefficients are related to the Fourier cosine and sine coefficients.

MATH2001.4 Interpret the nature of a physical phenomena when the domain is shifted by Fourier Transform e.g. continuous time signals and systems.

MATH2001.5 Develop computational understanding of second order differential equations with analytic coefficients along with Bessel and Legendre differential equations with their corresponding recurrence relations.

MATH2001.6 Master how partial differentials equations can serve as models for physical processes such as vibrations, heat transfer etc.

MODULE I : [12L]

Functions of Complex Variables:

Complex numbers and its geometrical representation.

Functions of a complex variable – Limits, Continuity, and 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 : [12L]

Fourier Series , Integrals and Transforms:

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.

MODULE III : [12L]

Series Solutions to Ordinary Differential Equations and Special Functions:

Series solution of ODE: Ordinary point , Singular point and Regular Singular point, series solution when $=$ 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 : [12L]

Partial Differential Equations:

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

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

Course Title: Electrical Machines-I					
Course Code: ELE2201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

COURSE OUTCOMES:

After completion of the course, students will be able to

ELE2201.1: Understand the fundamental principle of electromechanical energy conversion.

ELE2201.2: Acquire knowledge about the constructional details, principle of operation, excitation types in dc machines.

ELE2201.3: Understand the working of dc machines and acquire knowledge about testing on dc machines.

ELE2201.4: Acquire knowledge about the constructional details, principle of operation, performance analysis and testing of single phase transformers.

ELE2201.5: Understand different types of connections of three phase transformers.

ELE2201.6: Understand and analyze the performance of three phase transformers.

Module-I

Principles of Electromechanical Energy Conversions:

Conversion of Energy: Introduction, Production of EMF, Production of Force, Flow of Energy in Electromechanical devices, Energy stored in Magnetic Systems.

Singly Excited Machine: Determination of Mechanical Force, Mechanical Energy, Torque Equation.

Doubly Excited Machine: Determination of Mechanical Force, Mechanical Energy, Torque Equation.

Fundamentals of DC Machine:

Working Principle: Introduction, Production of EMF in Elementary DC Generator, Production of Torque in Elementary DC Motor.

Construction of DC Machine: Basic idea of Yoke, Poles, Armature, Commutator and brush, Armature Windings, Materials used.

EMF and Torque in DC machine: Generation of EMF in DC machine, Torque developed in DC Machine, Counter torque and Counter EMF.

Methods of Excitations: Shunt, Series and Compound excitation.

[9L]

Module-II

Flux density waveform in DC machine: Armature reaction & its effects, Methods of limiting the Armature reaction, Commutation Process, Methods of commutation.

DC Generator: Voltage build-up of dc shunt generator, Characteristics with different excitation systems, Voltage regulation, Parallel Operation.

DC Motor: Characteristics and applications of Separate, Shunt, Series and Compound motors, Methods of starting, speed control, equivalent circuit. Series-parallel operation of motors, Braking in DC Motor.

Testing of DC Machine: Brake test, Swinburne test, Hopkinson's test.

[11L]

Module-III

Basic Principle of Transformer: Faraday's law of electromagnet induction, Basics idea of magnetic circuits, Mutual and Leakage Flux, Concept of ideal Transformer and its assumptions.

Construction of Transformer: Magnetic Circuit, Windings, Insulation, Different types of cooling, Tank and radiator construction, Transformer oil, Transformer accessories, eg. conservator, breather, Bucholtz relay, bushing, etc. Tap changer.

Performance of Transformer: Operation of real Transformer under load, Equivalent circuit and phasor diagram, per unit system of representation, Voltage regulation, Efficiency, Effects of changes of frequency and voltage on transformer performance, Rating of Transformer.

Testing of Transformer: OC and SC test, separation of losses, determination of equivalent circuit parameters.

Parallel Operation of Transformers: Conditions, Load sharing.

Single phase Auto Transformer: Principle of operation, phasor diagram. Comparison of weight, Copper loss equivalent reactance with 2-winding transformer.

[11L]

Module-IV

3-ph Transformer:

Different Connections: Introduction, Different Vector groups, 3-phase to 6-phase conversion, 3-phase to 2-phase conversion, Open delta, Grounding Transformer.

Performance of 3-phase Transformer: Production of Harmonics in Transformer and its suppression, Effect of harmonics on different types of 3-phase Transformer, Unbalanced loading on 3-phase transformer.

[9L]

Text Books:

1. Electrical Machinery by Dr. P.S. Bimbhra.
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.

Reference Books:

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.
3. A Textbook of Electrical Machines by K. R. Siddhapura &D. B. Raval.
4. Electrical Machines by Prithwiraj Purkait & Indrayudh Bandyopadhyay.

Course Title: Power System-I					
Course Code: ELE2202					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcome

After completion of the course students will be able to

ELE2202.1: Demonstrate the basic structure of power system, various methods of conventional power generation and tariff.

ELE2202.2: Explain the mechanical design of power transmission system.

ELE2202.3: Explain the electrical design of power transmission system.

ELE2202.4: Analyze the performance of different type of transmission lines.

ELE2202.5: Learn about the underground cables.

ELE2202.6: Learn about different type of distribution systems and power factor correction techniques.

Module I: [9L]

Introduction: Structure of a power system-Generation, transmission and distribution configuration. Choice of voltage and frequency.

Generation of Electric Power: General layout of a typical coal fired power station, Hydro electric power station, Nuclear power station, their components and working principles, comparison of different methods of power generation.

Load Characteristics & Tariff

Module II: [12L]

Mechanical design of transmission line: Line supports, Towers, Poles, 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.

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.

Module III: [10L]

Transmission System: Short, Medium (nominal T and π) and Long transmission lines (equivalent T and π) and their representation. ABCD constants, Ferranti effect, Surge Impedance Loading, Active and reactive power flow through transmission lines, Power Circle diagram.

Corona: Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona, methods of reduction of Corona.

Module IV: [9L]

Power Cables: Types of cables, insulation Resistance, stress and capacitance of single and multi-core cables, grading of cables, sheath effects, dielectric loss. Comparison of cable and overhead line.

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

Text Books:

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

Reference Books:

1. Power System Analysis by Grainger & Stevenson, Tata McGraw Hill
2. Power System Analysis by H.Cotton

Course Title: SIGNALS & SYSTEMS					
Course Code: ELE2203					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

COURSE OUTCOMES:

Students will be able to

ELE2203.1	Understand the concept of signals and analyze the spectral content in periodic and aperiodic signals.
ELE2203.2	Understand the impulse response of a system, convolution of two signals and its application to dynamic systems.
ELE2203.3	Understand the concept of sampling of a signal; obtain the output of a system using z – transform.
ELE2203.4	Describe the mathematical model of physical systems and understand the concept of BIBO stability.
ELE2203.5	Possess a basic understanding of the concept of frequency response and time response of dynamic systems and analyze their implications.
ELE2203.6	Describe the mathematical model of dynamical systems in state-space form and its time domain solution using the concept of "state transition matrix".

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 randomsignals, 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. **[5L]**

Fourier Series & Transform: Dirichlet's conditions, Fourier series-trigonometric and exponential.Gibbs Phenomenon, Fourier transform of aperiodic functions. Generalized Fourier transform. Properties of Fourier transform. **[5L]**

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 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. Concept of BIBO stability of a system. Time and frequency response of first and second order systems. **[5L]**

Modeling of Dynamic Systems: Mechanical systems (translational systems and rotary systems) electromechanical systems (DC Servo motor and PMMC). Electrical analogous systems. **[5L]**

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. **[8L]**

Text Books:

1. Signal Processing & Linear Systems, B.P.Lathi, Oxford
2. Signals and Systems, A.NagoorKani, 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

Course Title: Thermodynamics and Heat Power Engineering					
Course Code: ELE2204					
Contact Hours 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:

ELE2204.1 Analyze a thermodynamic system and calculate work transfer in various quasi- static processes, Understand the difference and correlation between heat transfer and work transfer

ELE2204.2 Read and interpret the values of properties of water/steam from steam table and Mollier chart for evaluation of heat transfer and work transfer in processes involving steam**.**

ELE2204.3 Understand the basics of thermal power generation and calculate the efficiencies of Rankine cycles with reheat and regeneration.

ELE2204.4 Understand various types of boilers used in thermal power plants and draw up a heat balance sheet and design the chimney height based on various conditions.

ELE2204.5 Calculate power output, blading efficiency , staging efficiency from Impulse and Reaction turbines and appreciate the importance of compounding and governing of turbines.

ELE2204.6 Calculate the water requirement for power plant, power required to drive fans, condenser efficiency.

Module I: [10L] Review of fundamentals;

Basic concepts of Thermodynamics: Introduction; Definition of Thermodynamic systems; System boundary, universe; Open, closed and isolated systems; Control mass and control volume; State; Definition of properties: intensive, extensive & specific properties.

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

Heat & Work: Definition and units of Thermodynamic work; Work transfer-displacement work for a closed system, path function, Pdv work in various quasi-static processes(isothermal, isobaric, adiabatic, polytropic, isochoric); Free expansion; Net work done by a system in a cycle. Definition and unit of heat; Heat transfer-a path function; Similarities and dissimilarities between heat and work.

First law of Thermodynamics: 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; Definition of enthalpy, Cp, Cv; 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, heat exchanger, throttling device); PMM-I.

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. PMM-II

Reversible process; Irreversible process; Factors for irreversibility; Carnot cycle and Carnot efficiency; Carnot theorem, corollaries; Reversible heat engine and heat pump

Module II: [10L]

Entropy: Clausius Inequality: Entropy as a property; T-s plot for reversible isothermal, adiabatic, isochoric & isobaric processes. Tds equation and calculation of entropy change of ideal gases for various processes; entropy change of solids; Concept and uses of entropy, Entropy principle.

Pure substance: Definition, properties of pure substance; Phases of pure substance; 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

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.

Module III: [10L]

Nozzles; Types of nozzles: Flow through nozzles under dry saturated and superheated condition; exit velocity calculation, condition for maximum mass flow rate; relationship between area, velocity, pressure.

Turbines: Steam turbine classification, Impulse Turbine velocity diagram, Blading efficiency, staging efficiency ,condition for maximum blading efficiency, Reaction turbine , degree of reaction , Parson's reaction Turbine, Condition for maximum blading efficiency of Parson's reaction turbine , Reheat factor, carry over efficiency, blade height calculation.

Governing: Governing of steam turbine and Losses

Module IV: [9L]

Boilers: Types of boilers ; fire tube boilers , water tube boilers, economiser, evaporator and superheater efficiency, overall efficiency of boiler , natural circulation , forced circulation , Boiler draught, Induced draught , Forced draught , Calculation of chimney height, Efficiency of chimney , Power required to drive fan , Boiler performance and testing, Boiler operation and safety practices.

Condenser: Types of condensers, vacuum efficiency, condenser efficiency, cooling water and cooling ponds,

Text Books

1. Engineering Thermodynamics- 5e, Nag, P.K. – TMH.
2. Power Plant Engineering – P.K.Nag – McGraw Hill Education (India) Pvt. Ltd.
3. Thermal Engineering – R.K.Rajput – Laxmi Publication Pvt. Ltd.

Reference Books

1. Thermal Engineering – Domkundwar – Dhanpat Rai & Co.

Course Title: Environmental Sciences					
Course Code: EVS2016					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	0	0	2	0

Module 1

Socio Environmental Impact **6L**

Basic ideas of environment and its component
Population growth: exponential and logistic; resources; sustainable development. 3L
Concept of green chemistry, green catalyst, green solvents
Environmental disaster and social issue, environmental impact assessment, environmental audit, environmental laws and protection act of India. 3L

Module 2 **6L**
Air Pollution
Structures of the atmosphere, global temperature models
Green house effect, global warming; acid rain: causes, effects and control. 3L
Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution. 3L

Module 3 **6L**
Water Pollution
Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts.
Biochemical effects of heavy metals; eutrophication: source, effect and control. 2L
Water quality parameters: DO, BOD, COD.
Water treatment: surface water and waste water. 4L

Module 4 **6L**
Land Pollution
Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal. 3L
Noise Pollution
Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control. 3L

Text/Books

1. GourKrishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.
2. A. K. De, "Environmental Chemistry", New Age International.
3. A. K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd

References/Books

1. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
2. D. De, D. De, Fundamentals of Environment & Ecology, S. Chand & Company Ltd.

Course outcome for the subject code EVSC2016

The subject code EVS2016 corresponds to basic environmental chemistry for the 2nd year B.Tech students, which is offered as Environmental Sciences and is mandatory for all branches of engineering. The course provides basic knowledge of various environmental pollutions as well as its impact and ways to curb it. The course outcomes of the subject are

1. Understand the natural environment and its relationships with human activities.
2. Characterize and analyze human impacts on the environment.
3. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
4. Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
5. Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
6. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Course Title: Electrical Machines-I Laboratory					
Course Code: ELE2251					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcome:

After completion of the course, students will be able to

ELE2251.1: Understand the operation of DC machines by studying its characteristics.

ELE2251.2: Evaluate the performance of a DC machine by calculating its efficiency.

ELE2251.3: Apply the knowledge to correlate theory with experimental efficiency and regulation calculation in single phase transformer and learn about parallel operation in single phase transformers.

ELE2251.4: Learn to make several connections in a three phase transformer.

List of Experiments:

1. Study of the characteristics of a DC shunt generator.
2. Study of the characteristics of a DC compound motor.
3. Study of methods of speed control of DC shunt motor.
4. Study of the characteristics of a compound DC generator.
5. Study of the characteristics of a DC series motor.
6. Determination of efficiency of a DC machine by Swinburne's test.
7. Determination of efficiency of a DC machine by Hopkinson's test.
8. Determination of efficiency and regulation of a single phase transformer by open circuit and short circuit test.
9. Study of different connections of 3-phase transformer.
10. Parallel operation of single phase transformers.

Correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Title: Power System – I Laboratory					
Course Code: ELE2252					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes

After completion of the course students will be able to

ELE2252.1: Estimate generalized ABCD parameters of a transmission line.

ELE2252.2: Determine the breakdown strength of solid and liquid insulating material.

ELE2252.3: Analyze dc distribution system by network analyzer.

ELE2252.4: Measure earth resistance by megger.

ELE2252.5: Understand the concept of Constant Current Source and Phase Sequence of a three phase supply.

List of Experiments

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 Earth-Tester
5. Determination of Phase Sequence Test of a given Three Phase Supply
6. Design of a Constant Current Source
7. Simulation of DC distribution by network analyzer for Single-end fed system
8. Simulation of DC distribution by network analyzer for Double-end fed system
9. Study of different types of insulators

Course Title: SIGNALS & SYSTEMS LABORATORY					
Course Code: ELE2253					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

COURSE OUTCOMES
Students will be able to:

ELE2253.1 Understand the elementary concept of various types of signal.
ELE2253.2 Study and analyze the time domain response of various system.
ELE2253.3 Analyze a system from its frequency response.
ELE2253.4 Model a system in state variable approach and study the response of it.

List of Experiments:

1. The generation of different type of continuous and discrete signals using MATLAB.
2. Study ongraphical convolution.
3. Time response of first and second order systems for step, ramp and impulse input.
4. Study of performance indices of second order system excited by step input.
5. Frequency response of first and second order systems.
6. Determination of z- transform and inverse z transform using MATLAB.
7. Obtain Transfer Function of a given system from State Variable model and vice versa using MATLAB.
8. Obtain the step response and initial condition response of SISO and MIMO systems in SV form by simulation.

Course Title: Thermodynamics and Heat Power Engineering Lab					
Course Code: ELE2254					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

ELE2254.1: Understand the practical operation of 2 stroke and 4 stroke I.C engines using valve timing diagram and cut model

ELE2254.2. Understanding the practical functioning of fire and water tube boilers through the use of a cut model.

ELE2254.3. Determining the calorific value of engine fuels.

ELE2254.4. Estimate the steam dryness fraction using both throttling and separating calorimeters.

ELE2254.5. Analyze the performance of single cylinder engines with the variation of various performances like load and speed.

ELE2254.6. Estimate the constituents of combustion products for emission characteristics related to public safety

List of Experiment.

1 Study of Two stroke petrol and Four Stroke Diesel and Petrol engines through cut models

2 Study of various types of water tube and Fire tube boilers through cut models

3 To find the calorific value of diesel fuel using Bomb Calorimeter

4 To find the Flash Point and Fire Point of Diesel Fuel using Pensky Marten's Apparatus.

5 To find the dryness fraction of steam by Separating and Throttling Calorimeter

6 To find the valve timing diagram of a 4 stroke petrol engine

7 To carry out volumetric efficiency test on 4 stroke single cylinder diesel engine.

8 To carry out the fuel consumption test on 4 stroke single diesel engine.

9 Exhaust gas emission test.

3RD YEAR 1ST SEMESTER

Course Title: Electrical Machines-II					
Course Code: ELE3101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

COURSE OUTCOMES:

After completion of the course, students will be able to

ELE3101.1: Have an idea about the general terms of rotating machines.

ELE3101.2: Accrue the knowledge about the construction, operating principle, characteristic and commissioning of Alternators.

ELE3101.3: Accrue the knowledge about the construction, operating principle and characteristic of Synchronous Motor.

ELE3101.4: Understand operating principle and analyze the performance of Three Phase Induction Motors.

ELE3101.5: Able to analyze the performance and starting of Single Phase Induction Motor with their uses depending on their torque speed characteristics.

ELE3101.6: Apply the knowledge of special motors for solving engineering problems related to various applications.

Module-I

Basic concept of rotating machine:

Electrical & Mechanical degree, Pole pitch, Coil, Generated EMF in full pitched coil, Generated EMF in a short pitched coil, Distribution factor, Pitch factor, MMF produced by Distributed Windings, MMF of a coil, MMF of single phase distributed Winding, Rotating magnetic field, **[3L]**

Synchronous Generator:

Synchronous Generator: Construction and operating principle, Different excitation systems, Armature reaction, Theory for salient and non-salient pole machine, Two reaction theory, Transient and Sub-transient reactance's 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, MMF 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. **[9L]**

Module-II

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, **[8L]**

Module-III

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-IV

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]**

Total: 40L

Text 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.

Reference Books:

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.

Course Title: Power System-II					
Course Code: ELE3102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

COURSE OUTCOME

Student will be able

ELE3102.1: To analyze different types of power system faults.
ELE3102.2: To analyze the load flow problems in power system.
ELE3102.3: To analyze the stability in power system.
ELE3102.4: To discuss the basic principles of Power System relaying and the different protection schemes for various power system components.
ELE3102.5: To examine the basic construction and working principle of Circuit Breaker.
ELE3102.6: To distinguish the different types of grounding.

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 scheme 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]

Text Books:

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

Reference Books:

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

Course Title: LINEAR CONTROL SYSTEM					
Course Code: ELE3103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

COURSE OUTCOME

Students will be able to

ELE3103.1 Know the fundamental concepts of Control systems and mathematical modeling of the system.

ELE3103.2 Examine a system's time domain response in relation to its time domain performance indices.

ELE3103.3 Understand stability and apply it to various systems by grasping its concept.

ELE3103.4 Investigate frequency response of the system and examine the relative stability by various approach.

ELE3103.5 Design and realize control systems using classical methods.

ELE3103.6 Analyze and realize control 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: 42L

Text Books:

1. Control system Engineering: I.J. Nagrath& M. Gopal, New Age International.
2. Digital Control & State Variable Methods: M. Gopal, 2nd Edition, TMH
3. Automatic Control Systems, B.C. Kuo& F. Golnaraghi, 8th Edition, PHI
4. Control System Engineering: D. Roy Chowdhuri, PHI

Reference books:

1. Control Systems: Principles and Design, M Gopal, TMH
2. Control system Engineering, Ananda Natarajan , P. Ramesh Babu, Scitech
3. Modern Control Engineering, Ogata;Katsuhiko, PHI

Course Title: Power Electronics					
Course Code: ELE3104					
Contact Hours 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

ELE3104.1: Understand the basic theory and characteristics of power semiconductor devices.

ELE3104.2: Describe the firing circuits and commutation techniques of SCR.

ELE3104.3: Acquire knowledge about the operation of single-phase and three-phase thyristorized rectifiers and learn to design them.

ELE3104.4: Analyze and design various DC-DC converter topologies.

ELE3104.5: Understand the underlying principles and analyse the performance of various DC-AC converter topologies.

ELE3104.6: Learn the operation of various AC-AC converters and understand the role of Power Electronics in utility-related applications.

Module-I: [9L]

Introduction:

Need for power conversion; Power electronic converters: classifications and scope.

Power Semiconductor Devices:

Power diode: Structure, V-I characteristics, switching characteristics, types, ratings and applications.

SCR: Basic structure, two transistor model, V-I characteristics, switching characteristics, gate characteristics, protection, ratings and applications. Gate triggering methods – R, RC and UJT firing circuits. Series and parallel operation of SCR. Different commutation techniques.

DIAC: Structure, V-I characteristics.

TRIAC: Structure, V-I characteristics.

GTO: Structure, V-I characteristics, switching characteristics.

BJT: Structure, characteristics, ratings.

Power MOSFET: Structure, characteristics, ratings.

IGBT: Structure characteristics, ratings.

Module-II: [10L]

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-wheeling diode. Semi-converters. Performance parameters of two-pulse converters. Three-phase half-wave and full-wave controlled rectifiers with R, RL load (effects of continuous and discontinuous current on converters). Power quality aspects in converters. Effect of source inductance in controlled rectifier and loss of voltage due to commutation. Dual Converters.

Module-III: [10L]

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.

Inverters:

Definition and classification of inverters: VSI and CSI, SPWM.

Principle of operation of 1-phase VSI and 3-phase VSI (180°, 120°) modes. PWM inverters.

Power quality aspects of inverters, Improvement of power quality.

Module-IV: [7L]

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.

Applications:

HVDC transmission, SMPS, UPS, Static Circuit Breakers.

Total: 36L

Text Books:

1. Power Electronics, Mohan, Undeland & Robbins, Wiley India.
2. Power Electronics, M.H. Rashid, PHI.
3. Power Electronics, M.D Singh and K.B. Khanchandani, Tata McGraw Hill.
4. Power Electronics, P.S. Bimbhra, Khanna Publishers.
5. Power Electronics, Dr. P.C Sen, McGraw Hill Education.

Reference Books:

1. Modern Power Electronics and AC Drives, B.K Bose, Prentice Hall.
2. Element of Power Electronics, Phillip T Krien, Oxford.
3. Analysis of Thyristor power conditioned motor, S.K. Pillai, University Press.
4. Power Electronics: Principles and applications, J.M. Jacob, Thomson.

Course Title: Illumination Engineering					
Course Code: ELE3131					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

COURSE OUTCOMES

ELE3131.1 Understand the principles of operation of different photometers

ELE3131.2 Apply the laws of photometry for calculation of photometric quantities for different lighting applications

ELE3131.3 Understand the principles of operation of different lamps and their accessories

ELE3131.4 Understand the parameters of indoor lighting schemes

ELE3131.5 Design energy efficient installations complying with lighting codes

ELE3131.6 Understand the parameters of energy efficient road lighting and floodlighting installations in conformity with lighting codes

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 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, LASER. Ballast- function, electromagnetic and electronic types, principles of operation.

Module – III [9L]

Indoor 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 and zonal cavity method in accordance with lighting code. Emergency lighting concept.

Module – IV [9L]

Outdoor Lighting: Road and Flood Lighting Design

Basic concepts of outdoor lighting design- objectives, design parameters, qualitative & quantitative evaluation of outdoor lighting systems. High mast lighting design. Basic concepts of sports lighting.

Text/ 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
6. Lighting- What everyone should know - M.S.N. Swamy, MSN Marketing
7. Applications of light and energy management - O.N.Awasthi, Narosa Publishing House

Course Title: Network Analysis					
Course Code: ELE3121					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

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

ELE3121.1: Develop foundational concepts of circuit analysis by employing various mathematical methods.

ELE3121.2: Utilize network theorems to solve electrical circuits that contain both dependent and independent sources.

ELE3121.3: Learn about various electrical waveforms and signals, and their applications in analyzing electrical circuits.

ELE3121.4: Apply Laplace Transform technique for solving transient problems of electrical circuits.

ELE3121.5: Analyze electrical circuits using the concept of graph theory.

ELE3121.6: Obtain the equivalent representation of electrical circuits using two-port network parameters.

MODULE-I: [8L]

Network equations: Formulation of Node & Mesh equations. Loop and node variable analysis of electrical circuits.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer theorem applied to circuits containing dependent sources.

MODULE-II: [8L]

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. Transient and steady state response of switching circuit containing RL, RC, LC and RLC with or without stored energy.

MODULE-III: [8L]

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.

MODULE-IV: [8L]

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

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.

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 Title : **Indian Constitution and Civil Society**					
Course Code : INC3016					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	0	0	2	0

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

- analyse the historical, political and philosophical context behind the Indian Constitution-making process
- appreciate the important principles characterizing the Indian Constitution and institute comparisons with other constitutions
- understand the contemporaneity andapplication of the Indian Constitution in present times
- critique the contexts for constitutional amendments in consonance with changing times and society
- establish the relationship between the Indian Constitution and civil societyat the collective as well as the individual levels
- consciously exercise the rights and the duties emanating from the Indian Constitution to one's own life and work

Module 1- 6L
Introduction to the Constitution of India- Historical Background
Making of Indian Constitution -the process of framing the constitution, the constituent assembly

Module II- 6L
Salient Features of the Indian constitution
Comparison with the constitutions of other countries

Module III- 6L
Relevance of the Constitution of India
Constitution and Governance
Constitution and Judiciary
Constitution and Parliament- Constitutional amendments

Module IV-6L
Constitution and Society-democracy, secularism, justice
Constitution and the individual citizen- Fundamental Rights, Directive Principles of state policy and Fundamental Duties

Reference Books

1. C.M.Elliot, (ed.), Civil Society and Democracy, OUP, Oxford, 20012..
2. David Held et.al (ed),The Idea of the Modern State, Open Univ. Press, Bristol, 1993
3. NeeraChandoke, State and Civil Society, Sage, Delhi, 19953

Course Title: Electrical Machines-II Laboratory					
Course Code: ELE3151					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcome:

After completion of the course, students will be able to

ELE3151.1: find the different characteristic, equivalent circuit and losses of 3-ph and 1-ph induction motor.

ELE3151.2: acquire the knowledge of winding connection.

ELE3151.3: acquire the knowledge about the induction motor working as generators.

ELE3151.4: learn the different testing on synchronous machine.

ELE3151.5: perform the parallel operation of two alternators.

List of Experiments:

1. Different methods of starting of a 3phase Cage Induction Motor & their comparison [DOL, Auto transformer & Star-Delta].
2. Determination of equivalent circuit parameters of 3ph induction machine
3. Load test on wound rotor Induction motor to obtain the performance characteristics.
4. To make connection diagram to full pitch & fractional slot winding of 18 slot squirrel cage Induction motor for 6 poles & 4 pole operation.
5. To study the performance of Induction generator.
6. Determination of equivalent circuit parameters of a single phase Induction motor.
7. Load test on single phase Induction motor to obtain the performance characteristics.
8. Parallel operation of 3phase Synchronous generators.
9. V-curve of Synchronous motor
10. Determination of regulation of Synchronous machine by
    (a) Impedance method.
    (b) Potier reactance method.

Course Title: Power System-II Laboratory					
Course Code: ELE3152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcome

After completion of the course students will be able to

ELE3152.1: Test on CT and PT for power system protection.

ELE3152.2: Perform experiment with different types of relay.

ELE3152.3: Test different types of protection schemes using ETAP software.

ELE3152.4: Analyze load problems using ETAP software.

List of Experiments

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 the Performance of Over-Current Relay using ETAP software simulation. 9.

To Study the Performance of Under-Voltage Relay using ETAP software simulation.

10. To Study the Performance of Differential Relay for Transformer Protection using ETAP software simulation.
11. To Study the Load Flow analysis by Gauss-Seidel & Newton-Raphson method using ETAP or MATLAB software simulation

Course Title: LINEAR CONTROL SYSTEM LABORATORY					
Course Code: ELE3153					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

COURSE OUTCOME

Students will be able to

ELE3153.1 familiarize with Control system and Simulink toolbox in MATLAB.
ELE3153.2 understand the time and frequency domain performance of different systems.
ELE3153.3 realize and design controller to improve time response of a system.
ELE3153.4 recognise and develop a compensator to improve system performance.

1. Familiarization with MATLAB control system tool box, MATLAB Simulink tool box
2. Simulation of Step response & Impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB**.**
3. Study of Step response for first order & Second order system & determination of control system specification like Time constant, rise time, % peak overshoot, settling time etc. from the response.
4. Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box & different control system specification from the plot.
5. Determination of approximate transfer functions from the Bode plot.
6. Study of P, PI, PD and PID control action.
7. Tuning of P, PD, PI and PID controller for first order plant with dead time using Z-N method.
8. Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin with the addition of Lead & Lag compensator.
9. Design of Lead and Lag compensation circuit for the given plant transfer function. Analyze step response of the system by simulation.

Course Title: Power Electronics Laboratory					
Course Code: ELE3154					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

COURSE OUTCOMES:

After completion of the course, students will be able to

ELE3154.1: set up testing strategies and select proper instruments to evaluate performance characteristics of power devices and power electronics circuits and analyze their operation.

ELE3154.2: use the knowledge of making electrical and device connections by wires keeping in mind the technical, economical, safety issues.

ELE3154.3: learn to do computer simulations for verification of circuit behavior of different power electronics circuits and compare it to theory.

ELE3154.4: engage students into team based laboratory activities will enhance their ability to interact effectively on a social and interpersonal level with fellow students, and also demonstrate the ability to divide up and share task responsibilities to complete assignments.

List of Experiments:

1. Study of the characteristics of SCR.

2. Study of the characteristics of DIAC & TRIAC.

3. Study of converter firing circuit of 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 the operation of a single phase AC Voltage controller.

7. Study of single phase controlled converter with and without source inductance (Simulation).

8. Study of step down, step up, step up-down dc-dc converter (Simulation).

9. Study of single phase voltage source inverter (Simulation).

10. Study of AC voltage controller (Simulation).

Subject Name: Optical Instrumentation					
Paper Code: AEI 3123					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [9L]

Optical Fibers and their Performances: Basic concept of optics, block diagram of fiber optics communication system, different types of optical fiber (ray propagation and material), ray propagation in step index fiber (meridional and skew rays), concept of dispersion- multipath time dispersion and material dispersion, modes of fiber, attenuation in single mode fiber, construction of optical fiber cables, optical fiber connections and related losses, optical fiber connectors and splices.

Module II - [9L]

LED: Basic concept of semiconductor, density of state, injection efficiency, selection of material for LEDs, internal quantum efficiency, external quantum efficiency calculation, structure of LED and its characteristics, hetero-junction, concept of SLED and ELED.

Optical detectors: Basic principle of optoelectronics detection, optical absorption coefficient and photo current relation, responsivity, types of photodiode-p-i-n diode, avalanche photo diode, and equivalent model of optical receiver.

Module III-[9L]

LASER: Fundamental characteristics of lasers-Three level and four level lasers- Einstein relations, concept of population inversion, condition of LASER action, electrical and optical confinement, LASER modes, differential quantum efficiency and relation with loss coefficient, temperature effects on LASER, properties of semiconductor LASER, semiconductor LASER-density of state analysis in k-space, source fiber coupling, other types of bulk LASERS.

Industrial applications of LASER: LASER application-healthcare and military; in measurement-distance, length, velocity, acceleration, current, voltage and atmospheric effect; in material processing -Laser Heating, Welding, Melting and trimming of material-Removal and vaporization.

Module IV- [9L]

Optical Fiber sensors: Fiber optic sensors- classification, intensity modulated sensors, phase modulated sensors, application of optical coupler, fiber –optic Mach-Zehnder interferometric sensor, fiber optic sensor for the measurement of pressure, temperature, current, voltage, liquid level and strain, electro-optic modulators-longitudinal and transverse electro-optic modulator.

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. R.P Khare, Fiber optics and optoelectronics, Oxford
4. M. Arumugam, *Optical Fibre Communication and Sensor;* Anuradha Agencies, 2002.
5. G. Keiser, *Optical Fibre Communication*; McGraw Hill, 1995.
6. S.M Zse, *Physics of Semiconductor Devices;* Wiley; Third edition , 2008
7. Ajay Ghatak, *Optics*;TMH,2012.
8. NPTEL course on opto-*electronics by M. R Shenoy, IIT Delhi.*

Course Outcomes:

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

COs	Statements	Bloom's Level
AEI 3123.1	Study Optical Fibers and their performances.	**L1**
AEI 3123.2	Understand the basic concepts of LED and photo detector, properties and industrial applications	**L2**
AEI 3123.3	Understand the LASER and application.	**L2**
AEI 3123.4	Study Fiber-optic sensor and application	**L3**
AEI 3123.5	Acquire the knowledge optical fibers.	**L4**
AEI 3123.6	Gain the fundamentals of opto-electronics	**L5**

Course Name: Fundamentals of Operating Systems					
Course Code: CSE3121					
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:
CSE3121.1 Understand the underlying technologies and features of memory management and storage management.
CSE3121.2 Understand the various design issues in process management.
CSE3121.3 Apply knowledge of mathematics, science and engineering in the areas of process management, memory management and storage management.
CSE3121.4 Analyze operating system operations, structures.
CSE3121.5 Judge the primitive operations of operating systems.
CSE3121.6 Assemble the concepts learned here which are used in their own field of work.

Module1 [7L]
Introduction of General Operating System: Introduction: What do OS do? Computer System Organization, Interrupt Driven System, Storage Structure, I/O Structure, Operating System Functions, OS Services, Dual Mode Operations, Kernel, System Calls, Types of System Calls
Types of Operating Systems: Computer System Architecture (Monolithic, Microkernel, Layered, Hybrid), Different types of O.S.(Batch, Multi-programmed, Time-sharing, Real-time, Distributed, Parallel, for Mobile Unit, Single Processor System, Multiprocessor Systems), Virtual Machines, System Boot.

Module2 [9L]
Process Concept: What is process, Operations on Process (Process States), Process Control Block, Process Scheduling, Scheduling Queues,
Cooperating Process: Co-operating Processes, Inter-process Communication. IPC, Examples in IPC, Communication in Client-Server Systems
Threads: Threads, Benefits of Threads, User and Kernel Threads.
CPU Scheduling: Scheduling Criteria, Pre-emptive & Non-pre-emptive Scheduling, Scheduling Algorithms (FCFS, SJF, RR, priority).

Module3 [10L]
Process Synchronization: Critical Section Problem, Critical Region, Synchronization Hardware. Petersons Solution, Classical Problems of Synchronization, Semaphores, Monitors, Synchronization examples, Atomic Transactions.
Deadlock: Deadlocks: System model, Deadlock characterization, Method of handling Deadlock, Deadlock Prevention, Avoidance, Detection, Recovery from deadlock.

Module4 [10L]
Memory Management Strategies: Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation, Demand Paging, Copy-on-Write, Swapping, Page Replacement, Allocation of Frames, Thrashing, Memory Mapped Files, Allocating Kernel Memory, Operating System examples.
File Management: File System: File Concept, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection.

2. Textbooks

1. Silberschatz, P B Galvin, G Gagne, Operating systems, 9th edition/10th edition, John Wiley and sons.

3. ReferenceBooks:

1. William Stalling, "Operating Systems: Internals and Design Principles", Pearson Education, 1st Edition, 2018.
2. Andrew S Tanenbaum, Herbert BOS, "Modern Operating Systems", Pearson Education, 4th Edition, 2016.

Course Name: Digital Image Processing and Pattern Recognition					
Course Code: ECE3121					
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:
ECE3121.1: Understand fundamentals of digital image processing and representation of images in spatial domain.
ECE3121.2: Image transformation, segmentation, compression and enhancement techniques and their applications for interpretation of images.
ECE3121.3: Understand and develop algorithms for feature extraction from images.
ECE3121.4: Gain knowledge about the fundamentals of Pattern Recognition, such as recognition, decision-making, and statistical learning problems.
ECE3121.5: Identify parametric and non-parametric techniques, as well as supervised, unsupervised, and semi-supervised learning of pattern recognition.
ECE3121.6: Design systems and algorithms for Image Processing and Pattern Recognition to solve real-world problems.

Digital Image Processing
Module 1 [12L]
Digital Image Fundamentals- Analog vs Digital Image Processing, Elements of visual perception, computer vision, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighbor hood, adjacency, connectivity, distance measures.
Image Enhancement and filtering:
Spatial domain Processing-Pixel point processing: linear and piecewise linear transformations, log and power law transformations, Image Histogram and histogram equalization. Pixel Group Processing**:** Convolution in spatial domain, low frequency and high-frequency filtering, mean and median filters,
Frequency Domain Processing-Introduction to the Fourier transform, Filtering in the frequency domain, Image smoothing and sharpening.
Module 2 [8L]
Colour Image Processing: RGB and HSI colour models and interrelation.
Image Compression Standards: Lossy and lossless compressions, BMP, TIFF & JPG image formats.
Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation, dilation and erosion, etc.
Video Segmentation: Temporal segmentation – shot boundary detection, hard-cuts and soft-cuts; Spatial segmentation – motion-based; Video object detection and tracking.

Module 3 [10L]
Introduction to the Pattern Recognition System: Components of Pattern Recognition System, Learning and adaptation, Supervised Learning (Classification), Unsupervised Learning

(Clustering)and Semi-Supervised Learning, Bayesian Decision Theory: classifiers, discriminant functions, decision surfaces, Discriminant functions for Normal density, Error bounds for Normal density, Maximum Likelihood, Random Forest and Bayesian Parameter Estimation, Fisher Linear Discriminant, Hidden Markov Models.

Module 4 [10L]

Non-parametric Techniques &Feature Extraction: Parzen window estimation, k-nearest neighbour classification, Logistic regression, Perceptron classifier, Support Vector Machines, Decision Tree based classifiers. Feature extraction – discrete cosine and sine transform, Principal Component analysis, Kernel Principal Component Analysis, clustering: K-means, Agglomerative, DBSCAN.

Textbooks:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Pearson.
2. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley.
3. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press.
4. C. M. Bishop, Pattern Recognition and Machine Learning, Springer.

References:

1. C. Solomon, T. Breckon, Fundamentals of Digital Image Processing: A Practical Approach with Examples, Wiley
2. K. Fukunaga, Statistical Pattern Recognition, Academic Press.

Course Name : Introduction to Machine Learning					
Course Code : ECE3122					
Contact Hours per week		T	P	Total	Credit Points
	3	0	0	0	3

Course outcomes:

After completing the course the student will be able to:

ECE3122.1: Apply fundamental engineering knowledge for analyzing data in a given feature space.

ECE3122.2: Explain the fundamental concepts of different Machine learning models and can evaluate a machine learning problem.

ECE3122.3: Apply machine learning techniques for classification and regression approaches in real-world applications.

ECE3122.4: Distinguish between supervised and unsupervised learning and able to apply machine learning tools for clustering approaches.

ECE3122.5: Analyze a machine learning problem with ensemble and reinforcement learning techniques.

ECE3122.6: Understand different techniques to create application using deep learning algorithms.

Introduction to Machine Learning

Module 1 **[9L]**

Introduction: Foundations for ML: What is Machine Learning, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces and Candidate Elimination Algorithm, Data Normalization, Feature Reduction/Dimensionality reduction, Validation Techniques (Cross-Validations), Bias-Variance Trade-off.

Feature Selection and Dimensionality Reduction: Principal Components Analysis (PCA), Independent Component Analysis (ICA), and Linear Discriminate Analysis (LDA).

Module 2 **[11L]**

Supervised Learning:

Classification: Learning from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Regression and Classification Trees, Decision tree, Naïve Bayes, k-Nearest Neighbor. Support vector machines: Linear and Non-Linear, Kernel Functions. Artificial neural networks: Introduction, Introduction, Perceptron, Multilayer Perceptron, Backpropagation algorithm

Regression: Ordinary Least Squares, Linear Regression, Multiple Linear Regression: Ridge Regression, Lasso Regression, Non-Linear Regression: Logistic Regression.

Module 3 **[7L]**

Unsupervised Learning:

Introduction to clustering, A Categorization of Major Clustering Methods, Partitioning Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models.

Module 4 **[8L]**

Ensemble Learning: Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost.

Reinforcement Learning:

Introduction to reinforcement learning, Learning Framework and Markov Decision Process with some examples.

Deep Learning: Autoencoder, Convolutional Neural Networks, Recurrent Neural Networks-with some real life examples.

Text Books:

1) Ethem Alpaydin, 'Introduction to Machine Learning", MIT Press, Prentice Hall of India.
2) R.O. Duda, P.E. Hart, and D.G. Stork, "Pattern Classification", John Wiley.
3) M. Bishop, "Pattern Recognition and Machine Learning", Springer.
4) "The Elements of Statistical Learning" by Jerome H. Friedman, Robert Tibshirani, and TrevorHastie.

5) Andreas C. Mueller ,Sarah Guido , "Introduction to Machine Learning with Python: A Guide for Data Scientists" ,O'Reilly.

6) Sebastian Raschka, "Python Machine Learning".

References:

1) T. M. Mitchell, "Machine Learning", McGraw Hill Education.

2) Murphy, Kevin, "Machine learning: a probabilistic perspective", MIT press.

3) Stuart Russell, and Peter Norvig, "Artificial intelligence: a modern approach", Prentice Hall.

4) "Deep Learning" by Ian Goodfellow, YoshuaBengio, Aaron Courville.

5) Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", SecondEdition, MIT Press.

Course Title: Introduction To VLSI Design					
Course Code : ECE3124					
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:
ECE3124.1: Learn about VLSI Technology Growth as driven by Moore's law
ECE3124.2: Understand Various VLSI Design Methodologies
ECE3124.3: Design Digital Combinational logic, Circuits and Layout using CMOS Technology
ECE3124.4: Design Digital Sequential logic and Circuits using CMOS Technology.
ECE3124.5: Learn RTL Design using Verilog Hardware Description Language
ECE3124.6: Learn Basic Building Blocks of Analog Circuit using CMOS Technology

Module I- [4L] VLSI Design Methodology: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node, VLSI Design Trend and Challenges. VLSI Design Cycle, Y-Chart, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD: PLA, PAL, FPGA

Module II- [14L] Digital VLSI Circuits: **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, Concept of Logical effort, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits (Latch and Flip flop), Read and write operations of 1T DRAM and 6T SRAM cell.
Unit2: CMOS Cross Section, Inverter Layout, Lambda Rule vs Micron Rule, Stick Diagram, Euler Path Algorithm

Module III-[6L] Hardware Description Language: Introduction to Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed Mode. Frontend Design Flow using Verilog (Behavioral, RTL and Gate Level), Combinational and sequential circuits with various examples, FSM Example: Mealy Machine and Moore Machine.

Module IV- [10L] Analog VLSI Circuits: MOS large signal model, Transconductance gain, MOS small signal model, MOS switch, MOS Diode, MOS Resistor, CMOS Current Source/Sink, Active Load, Voltage Dividers, CMOS Current Mirror.

Text Book:

1. CMOS VLSI Design, A Circuits and Systems Perspective (4th Edition) Author: Neil Weste, David Harris. Addison-Wesley, Pearson
2. Design of Analog CMOS Integrated Circuit, B. Razavi, Mc. GrawHill
3. Fundamentals of Digital Logic with Verilog Design, 3rd Edition, Brown and Vranesic, Mc. GrawHill

Reference Book:

4. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, 2nd Ed., Oxford.
5. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
6. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006

APPENDIX – A

Point Description for Mandatory Additional Requirement (MAR)

Sl. No.	Name of the Activity	Points	Maximum Points allowed
1	MOOCS (SWAYAM/NPTEL/Spoken Tutorial) (per course)	20	40
2	Tech Fest / Teachers Day / Freshers Welcome		
	(i) Organizer	05	10
	(ii) Participants	03	06
3	Rural Reporting	05	10
4	Tree Plantation (per tree)	01	10
5	Participation in Relief Camps	20	40
6	Participation in Debate/Group Discussion/ Tech quiz	10	20
7	Publication of Wall magazine at Institutional level (magazine/article/internet)	10	20
8	Publication in News paper, Magazine & Blogs	10	20
9	Research Publication (per publication)	15	30
10	Innovative Projects (other than course curriculum)	30	60
11	Blood donation camp		
	(i) Donor	08	16
	(ii) Camp Organizer	10	20
12	Participation in Sports/Games		
	(i) College Level	05	10
	(ii) University Level	10	20
	(iii) District Level	12	24
	(iv) State Level	15	30
	(v) National / International Level	20	40
13	Cultural programme (Dance, Drama, Elocution, Music etc.)	10	20
14	Member of Professional Society	10	20
15	Student Chapter Activities / Seminars		
	(i) Participant	05	20
	(ii) Presentation	10	20
	(iii) Organizer	10	20
16	Relevant industry visit & report	10	20
17	Activities in different clubs at HIT (Photography Club, Cine Club etc.)	05	10
18	Participation in Yoga Camp	05	10
19	Self-Entrepreneurship programme	20	20
20	Adventure sports	10	20
21	Training to under privileged / Physically challenged	15	30
22	Community Service & Allied Activities	10	20
23	Hackathon (State / National Level)		
	(i) Participation in Hackathon	10	20
	(ii) Qualifier for final round (not prize winner) in Hackathon	20	40
	(iii) Prize Winners of Hackathon	30	60

Format for Report Submission

Name :

Department :

Year/Semester :

Title of the Activity :

Date :

Name of the organization :

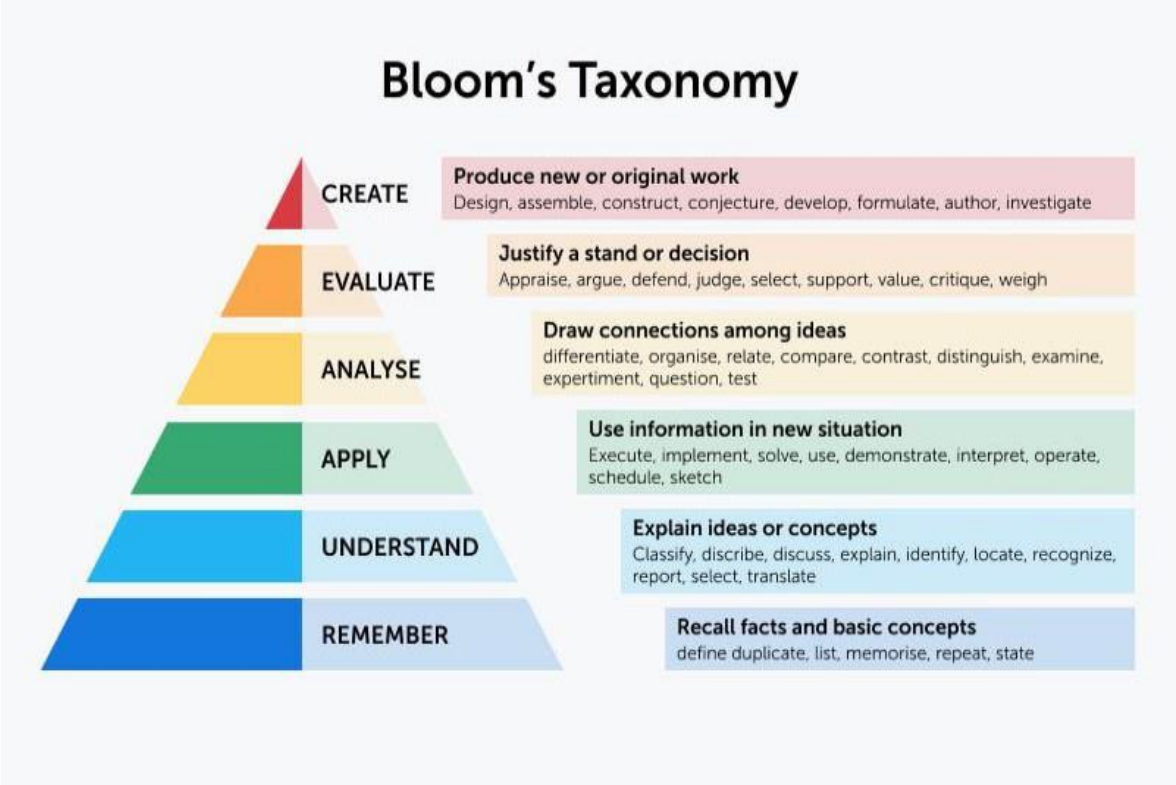
Report :

Signature
(Coordinator / Competent Authority)

Points earned:

Signature of the Mentor

APPENDIX – B


Bloom's Taxonomy
CREATE
Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate
EVALUATE
Justify a stand or decision
Appraise, argue, defend, judge, select, support, value, critique, weigh
ANALYSE
Draw connections among ideas
differentiate, organise, relate, compare, contrast, distinguish, examine, expertiment, question, test
APPLY
Use information in new situation
Execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch
UNDERSTAND
Explain ideas or concepts
Classify, discribe, discuss, explain, identify, locate, recognize, report, select, translate
REMEMBER
Recall facts and basic concepts
define duplicate, list, memorise, repeat, state