HERITAGE INSTITUTE OF TECHNOLOGY

(An Autonomous Institution affiliated to MAKAUT, West Bengal)

DEPARTMENT

OF

APPLIED ELECTRONICS AND INSTRUMENTATION 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

In an era marked by rapid technological advancements and increasing reliance on automation, the field of Applied Electronics and Instrumentation Engineering plays a pivotal role in shaping the future. This dynamic discipline bridges the gap between Electronics, Electrical, Instrumentation, and Automation, facilitating innovations across various sectors, including manufacturing, healthcare, energy, communication, sensors, embedded systems, internet of things (IOT), signal processing and beyond. In recognition of these evolving demands and opportunities, the department of Applied Electronics and Instrumentation Engineering, Heritage Institute of Technology, Kolkata, proudly presents its revised B. Tech program in Applied Electronics and Instrumentation Engineering.

The department of Applied Electronics and Instrumentation Engineering, Heritage Institute of Technology, Kolkata, is committed to keeping its syllabi updated and globally relevant for the industry. The department has overhauled the curriculum and syllabus for the B. Tech. program that was initially suggested in 2018. The proposed curriculum for the B. Tech. AEIE program has been developed in compliance with the AICTE and UGC's framework for curricula under the guidelines of MAKAUT and considering the new education policy (NEP) under Academic Regulation 2022, and will come into effect for students enrolled in July 2023.

The proposed outcome-based curriculum (OBC) is created with a choice-based credit system (CBCS), which enables students to develop professional competency through a multidisciplinary approach that satisfies the requirements of leading societies like the Instrumentation Society of India (ISOI), the International Society of Automation (ISA), and IEEE as per the different Accreditation bodies of the NBA and NAAC. In higher education, Accreditation is the primary method of ensuring quality. In accordance with this, the curriculum and syllabi are revised in a structured manner by implementing Feedback Mechanism on Curriculum from various stakeholders, including potential employers, alumni, academia and professional bodies. In addition, students are being motivated to select and study MOOC subjects of their choice towards attaining the degree with honors. Apart from this, the course code is now changed from 4 letters to 3 letters from the session 2023 – 2024 as per the suggestions came from the office of the controller of examinations. This will help to distinguish the new courses from the old ones.

The B. Tech. program in Applied Electronics and Instrumentation Engineering is designed to equip students with a strong foundation in both electronics and instrumentation, fostering a comprehensive understanding of cutting-edge technologies and their applications. This syllabus embodies a forward-thinking approach, integrating theoretical knowledge with hands-on experience to prepare graduates who can address real-world challenges and contribute to the advancement of society.

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 develop skilled Electronics and Instrumentation Engineers by providing learning ambience for academics & research leading to global competence with high academic credentials and to make the department recognized by the industries and teaching community.

MISSION:

M1: To prepare the students competent in the field of sensors, measurement, instrumentation, control, automations, signal processing, communication and computational techniques, etc. which are essential for industries, research organizations or higher studies.

M2: To imbibe curiosity to students through industry-department interaction programs, workshops, seminars leading to better awareness about latest technology, research trends and to provide the students educational pathways for optional career choices.

M3: To motivate the students towards lifelong learning and towards betterment of society by imparting practical skills.

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

The graduate students with the B.Tech. degree in Applied Electronics and Instrumentation Engineering from Heritage Institute of Technology, Kolkata are expected to achieve the following qualities after a few years of getting this degree.

PEO1. The graduates of Applied Electronics & Instrumentation Engineering Program should be able to establish them as practicing professionals in industries /R&D laboratories / academic sectors, or have achieved higher educational qualifications.

PEO2. The graduates of Applied Electronics & Instrumentation Engineering Program should be able to adapt themselves with latest developments in the discipline, including application of modern technologies.

PEO3. The graduates of Applied Electronics & Instrumentation Engineering Program should be able to demonstrate their ability to work as leaders and team members at workplace.

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. in AEIE Programme

The graduates of AEIE will be able to:

PSO1. Gain the concepts of electronic circuits, sensors, measurements and instrumentation systems for industrial applications.

PSO2. Apply appropriate technique, hardware and software tools to develop microprocessor and microcontroller based instrumentation systems for process automation and control.

PSO3. Develop effective engineering solutions through execution of projects, better documentation and presentation skill sets, towards the improvement of society, environment and industries, by ethical means.

Credit Summary for B. Tech. Programme in AEIE with effect from 2023-2024

Sl. No.	Course Type	Credit
1.	Humanities and Social Sciences including Management Courses	12
2.	Basic Science Courses	19
3.	Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc.	28.5
4.	Professional Core Courses	63.5
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	16
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.
- 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 – A.

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 Lab	0	0	2	2	1
2	CSE1051	Programming for Problem Solving Lab	0	0	3	3	1.5
3	ELE1051	Basic Electrical Engineering Lab	0	0	2	2	1
4	HUM1051	English for Technical Writing Lab	0	0	2	2	1
Total Practical			**0**	**0**	**9**	**9**	**4.5**
Total of Semester			**15**	**2**	**9**	**26**	**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 Electronics Devices & 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 Lab	0	0	2	2	1
2	ECE1051	Introduction to Electronics Devices & Circuits Lab	0	0	2	2	1
3	MEC1051	Workshop / Manufacturing Practice	1	0	3	4	2.5
4	MEC1052	Engineering Graphics and 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	PHY2101	Physics II	3	0	0	3	3
2	AEI2101	Analog Electronics	3	0	0	3	3
3	AEI2102	Circuit Theory & Network Analysis	3	0	0	3	3
4	AEI2103	Electrical & Electronic Measurements	3	1	0	4	4
5	AEI2104	Sensors and Transducers	3	0	0	3	3
Total Theory			**15**	**1**	**0**	**16**	**16**
B. Practical							
1	AEI2150	Design Thinking & Idea Lab Workshop	0	0	2	2	1
2	AEI2151	Analog Electronics Lab	0	0	3	3	1.5
3	AEI2152	Circuits & Networks Lab	0	0	3	3	1.5
4	AEI2153	Electrical & Electronic Measurements Lab	0	0	3	3	1.5
5	AEI2154	Sensors and Transducers Lab	0	0	2	2	1
Total Practical			**0**	**0**	**13**	**13**	**6.5**
Total of Semester			**15**	**1**	**13**	**29**	**22.5**

2nd Year 2nd Semester

A. Theory							
Sl.	**Code**	**Subject**	**Contacts Periods/ Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	AEI2201	Digital Electronics	3	0	0	3	3
2	AEI2202	Industrial Instrumentation	3	0	0	3	3
3	AEI2203	Control Systems	3	1	0	4	4
4	AEI2204	Power Electronics & Drives	3	0	0	3	3
5	CSE2004	Data Structure and Basic Algorithms	3	0	0	3	3
6	EVS2016	Environmental Sciences (Mandatory)	2	0	0	2	0
Total Theory			**17**	**1**	**0**	**18**	**16**
B. Practical							
1	AEI2251	Digital Electronics Lab	0	0	2	2	1
2	AEI2252	Industrial Instrumentation Lab	0	0	3	3	1.5
3	AEI2253	Control Systems Lab	0	0	2	2	1
4	AEI2254	Power Electronics & Drives Lab	0	0	3	3	1.5
5	CSE2054	Data Structures and Basic Algorithms Lab	0	0	3	3	1.5
Total Practical			**0**	**0**	**13**	**13**	**6.5**
Total of Semester			**17**	**1**	**13**	**31**	**22.5**

3rd Year 1st Semester

A. Theory							
Sl.	**Code**	**Subject**	**Contacts Periods/ Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	AEI3101	Process Control	3	0	0	3	3
2	AEI3102	Microprocessor & Microcontroller	3	0	0	3	3
3	AEI3103	Digital Signal Processing & Applications	3	0	0	3	3
4	CSE3106	Basics of RDBMS	3	0	0	3	3
5	AEI3131- AEI3140	Professional Elective-I	3	0	0	3	3
	AEI3131 AEI3132 AEI3133	Opto Electronics & Fiber Optics Analytical Instrumentation Industrial Networking					
6	****	Emerging Areas / Open Elective-I	3	0	0	3	3
	AEI3121 CSE3121 ECE3124 MEC3124	Introduction to MEMS Fundamentals of OS Introduction to VLSI Design Industrial Engineering					
7	INC3016	Indian Constitution and Civil Society (Mandatory)	2	0	0	2	0
Total Theory			**20**	**0**	**0**	**20**	**18**
B. Practical							
1	AEI3151	Process Control Lab	0	0	3	3	1.5
2	AEI3152	Microprocessor & Microcontroller Lab	0	0	3	3	1.5
3	CSE3156	Basics of RDBMS Lab	0	0	3	3	1.5
Total Practical			**0**	**0**	**9**	**9**	**4.5**
Total of Semester			**20**	**0**	**9**	**29**	**22.5**

3rd Year 2nd Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	AEI3201	Embedded Systems	3	0	0	3	3
2	AEI3202	IoT & IIoT	3	0	0	3	3
3	AEI3203	Communication Techniques	3	0	0	3	3
4	HUM3201	Economics for Engineers	3	0	0	3	3
5	AEI3231- AEI3240	Professional Elective-II	2	0	0	2	2
	AEI3231 AEI3232 AEI3233	Discrete Control Techniques Machine Learning Techniques Digital Twin					
6	*****	Emerging Areas / Open Elective-II	3	0	0	3	3
	AEI3221	Power Plant Instrumentation					
Total Theory			**17**	**0**	**0**	**17**	**17**
B. Practical							
1	AEI3251	Embedded Systems Lab	0	0	3	3	1.5
2	AEI3252	IoT & IIoT Lab	0	0	3	3	1.5
3	AEI3261- AEI3270	Professional Elective-II Lab	0	0	2	2	1
	AEI3261 AEI3262 AEI3263	Discrete Control Techniques Lab/ Machine Learning Techniques Lab/ Digital Twin Lab					
Total Practical			**0**	**0**	**8**	**8**	**4**
C. Sessional							
1	AEI3293	Term Paper and Seminar	0	0	4	4	2
2	AEI3295	Mini Project/ Electronic Design Workshop	0	0	4	4	2
Total Sessional			**0**	**0**	**8**	**8**	**4**
Total of Semester			**17**	**0**	**16**	**33**	**25**

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	AEI4131-AEI4140	Professional Elective-III	2	0	0	2	2
	AEI4131 AEI4132 AEI4133	Soft Computing Fundamentals of Digital Image Processing Industrial Automation					
3	AEI4141-AEI4150	Professional Elective-IV	3	0	0	3	3
	AEI4141 AEI4142 AEI4143	Biomedical Instrumentation Non-Conventional Energy Sources Non-Destructive Testing					
4	****	Open Elective-III	3	0	0	3	3
5	****	Open Elective-IV	3	0	0	3	3
Total Theory			**14**	**0**	**0**	**14**	**14**
B. Practical							
1	AEI4151	Sensor Data Computing Lab	1	0	2	3	2
2	AEI4161-AEI4170	Professional Elective-III Lab	0	0	2	2	1
	AEI4161 AEI4162 AEI4163	Soft Computing Lab Digital Image Processing Lab Industrial Automation Lab					
Total Practical			**1**	**0**	**4**	**5**	**3**
C. Sessional							
1	AEI4191	Industrial Training Evaluation / Internship	-	-	-	-	2
2	AEI4195	Project-I	0	0	6	6	3
Total Sessional			**0**	**0**	6	6	**5**
Total of Semester			**15**	**0**	**10**	**25**	**22**

4th Year 2nd Semester

A. Sessional							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	AEI4295	Project-II	0	0	10	10	5
2	AEI4297	Comprehensive Viva-voce	-	-	-	-	2
Total Sessional			**0**	**0**	**10**	**10**	**7**
Total of Semester			**0**	**0**	**10**	**10**	**7**

DETAILED SYLLABUS

1st Year

Course Title: Chemistry-I					
Course Code: CHM1001					
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:

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 I: [9L]

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 II: [9L]

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 III: [9L]

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 IV: [9L]

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: MTH1001					
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:

MTH1001.1: Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.

MTH1001.2: MTH1101.2 Develop the concept of eigen values and eigen vectors.

MTH1001.3: Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.

MTH1001.4: MTH1101.4 Analyze the nature of sequence and infinite series.

MTH1001.5: MTH1101.5 Choose proper method for finding solution of a specific differential equation.

MTH1001.6: MTH1101.6 Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

Module I: [10L]

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

Module II: [10L]

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

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

Module III: [10L]

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

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

Module 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, Stoke's Theorem and Gauss Divergence Theorem.

Reference 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: [12L] 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: [12L] 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: [12L] 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: [12L] 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	0	0	4	4

Course Outcomes:

After completion of the course, 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: [11L]

DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion. [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: [11L]

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: [11L]

Three phase system: Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method. [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 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 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 environment.

HUM1001.3: Use various techniques of communication for multiple requirements of globalized 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: [6L]

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: [6L]

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: [6L]

Organizational Communication

- Business Letters
- Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular
- Organizing 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: [6L]

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 Lab					
Course Code: CHM1051					
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:

CHM1051.1: Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.

CHM1051.2: Estimation of ions like Fe^{2+}, Cu^{2+} and Cl- present in water sample to know the composition of industrial water.

CHM1051.3: Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.

CHM1051.4: Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer. Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.

CHM1051.5: Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

Experiments

1. Estimation of iron using $KMnO_4$ 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 ethyl acetate.
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)

Reference Books

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

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

Course Outcomes:

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

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

1. LINUX commands and LINUX based editors
2. Basic Problem Solving Topic
3. Control Statements (if, if-else, if-elseif-else, switch-case)
4. Loops - Part I (for, while, do-while)
5. Loops - Part II
6. One Dimensional Array
7. Array of Arrays Topic
8. Character Arrays/ Strings
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 Lab					
Course Code: ELE1051					
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:

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 Outcomes:

After completion of the course, 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.

Module I: [6L]

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: [6L]

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: [6L]

- 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: [6L]

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, introduces 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

Reference Books

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

Course Title: Physics-I					
Course Code: PHY1001					
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:

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.

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-tunneling.

Text 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 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:

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.

Module I: [10L]

Basic Probability: 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: [10L]

Basic Numerical Methods: 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 Method, Modified Euler's Method, Runge-Kutta Method of 4^{th} order.

Module III: [10L]

Basic Graph Theory: Graph, Digraph, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Sub-graph, Walk, Path, Circuit, Euler Graph, Cut sets and cut vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph, Graph isomorphism, Bipartite graph, Dijkstra's Algorithm for shortest path problem. Definition and properties of a Tree, Binary tree and its properties, Spanning tree of a graph, Minimal spanning tree, Determination of

spanning trees using BFS and DFS algorithms, Determination of minimal spanning tree using Kruskal's and Prim's algorithms.

Module IV: [10L]

Laplace Transformation: 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.

Reference 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 completion of the course, 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: [10L]

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, Einstein relation.

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 [8L]

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 [9L]

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 (for both n & p channel devices), drain & transfer characteristics.

MODULE IV [9L]

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.

Text Books

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

Reference Books:

4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
5. Millman & Halkias: Integrated Electronics.
6. Salivahanan: Electronics Devices & Circuits.
7. Albert Paul Malvino: Electronic Principle

Course Title: Universal Human Values and Professional Ethics					
Course Code: HUM1002					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	1	0	3	3

Course Outcomes:

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

HUM1001.1: Appreciate the essential complementarily between 'values and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

HUM1001.2: Develop a Holistic perspective towards life and profession.

HUM1001.3: Develop a correct understanding of the Human reality and the rest of existence.

HUM1001.4: Appreciate the relationship of values in terms of ethical human conduct.

HUM1001.5: Understand the importance of trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

HUM1001.6: Differentiate between the characteristics and activities of different orders and study the mutual fulfilment among them.

Module I: [6L]

Introduction to Value Education

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 to Fulfil the Basic Human Aspirations
Continuous Happiness and Prosperity – the Basic Human Aspirations

MODULE II [10L]

Harmony in the Family and Society

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 socialization.
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 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 III [10L]

Implications of the Holistic Understanding – a Look at Professional Ethics

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 IV [10L]

Harmony in the Nature/Existence

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

Text Books

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 Title: Physics I Laboratory					
Course Code: PHY1051					
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:

PHY1051.1: Applying practical knowledge using the experimental methods to correlate with the Physics theory.

PHY1051.2: Understanding the usage of electrical and optical systems for various measurements.

PHY1051.3: Applying the analytical techniques and graphical analysis to the experimental data.

PHY1051.4: Understanding measurement technology, usage of new instruments and real time applications in engineering studies.

PHY1051.5: Evaluating intellectual communication skills and discuss the basic principles of scientific concepts in a group.

MINIMUM OF SIX EXPERIMENTS TAKING AT LEAST 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:

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

ECE1051.1: The students will correlate theory with diode behavior.

ECE1051.2: They will design and check rectifier operation with regulation etc.

ECE1051.3: Students will design different modes with BJT and FET and check the operations.

ECE1051.4: 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 Title: Workshop/Manufacturing Practices					
Course Code: MEC1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	1	0	3	4	2.5

Course Outcomes:

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

MEC1051.1: Follow the various safety practices in workshop and personal protective elements.

MEC1051.2: Identify tools, work material and measuring instruments useful for fitting, carpentry and sheet metal practices.

MEC1051.3: Operate machine tools, components and processes to prepare jobs of specific shape and size.

MEC1051.4: Acquire knowledge of foundry process and casting of a product.

MEC1051.5: Perform welding, brazing and soldering processes.

MEC1051.6: Assemble a simple product.

Lectures [13L]

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

Workshop Practice [39 hr]

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

Text Books

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers 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" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House,2017

Course Title: Engineering Graphics and Design					
Course Code: MEC1052					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	1	0	3	4	2.5

Course Outcomes:

After completion of the course, 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.

Lectures [13L]

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

Laboratory Hours [39 hr]

Module 1: Introduction to Engineering Drawing (3hrs)
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 (9hrs)
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 Solids (6hrs)
Those axes inclined to both the Planes- Auxiliary Views.

Module 4: Sections and Sectional Views of Right Angular Solids (3hrs)
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 (6hrs)

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 (3hrs)

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, (3hrs)

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 (3hrs)

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 (3hrs)

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

Text Books

1. Bhatt, N. D., Panchal V. M. & Ingle P. R., (2014) “Elementary Engineering Drawing”; Charotan Publishing 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

DETAILED SYLLABUS

2nd Year

Course Title: Physics-II					
Course Code: PHY2001					
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:

PHY2001.1: Learn the modeling of physical systems relating to signals, sensors etc. in terms of differential equations and various tricks to solve them.

PHY2001.2: Address the question of stability/control etc. for systems meant for engineering applications.

PHY2001.3: Understand band structure and allied properties of electrons in crystalline solids.

PHY2001.4: Understand electromagnetic waves via Maxwell equation, conductors, dielectrics and wave guides

PHY2001.5: Grasp the behaviour of dielectrics and semiconductor from the perspective of material properties in real life scenario.

PHY2001.6: Learn basic physical aspects of nano-materials and nano-structures along with their technological aspects.

Module I: Mathematical Physics [10L]

Laplace transform---Linear Systems---stability and control. Fourier Trick and Integral Transform Method for Laplace, Heat flow and wave equation (homogeneous/nonhomogeneous equations in 1-D, 2-D, 3-D Cartesian systems).
Analytic and singular functions---Residue calculus----Application to differential equations (driven series LCR circuit, Vibrating system, Control theory) ---Finite difference.

Module II: Band theory of Solids [10L]

Free Electron Theory: Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well. Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory– Equation for electrical conductivity based on quantum free electron theory- Fermi-Dirac distribution- Density of states (3D) – Fermi energy.
Band theory of Solids: Bloch's Theorem (Qualitative) – Kronig – Penney model (Qualitative)-
E vs K diagram – v vs K diagram – effective mass of electron – Classification of crystalline solids– concept of hole.

Module III: E.M Theory [10L]

Maxwell's Four Equations and their physical Significance-- Poynting Theorem –Poynting Vector and its Significance. Classical Wave Equations –Uniform Plane Wave Motion in Free Space, Conductors and Dielectrics –Velocity, Wave Length, Intrinsic Impedance and Skin Depth –Wave guides.

Module IV: Materials of Technological Importance [10L]

Dielectric Materials: Electric field in presence of dielectric medium, concept of electric polarization, different types of polarizations, dielectric in A.C. field, concept of dielectric loss and loss energy.

Semiconducting Materials: Concept of energy bands in solids, carrier concentration and conductivity in intrinsic semiconductors and their temperature dependence, carrier concentration and conductivity in extrinsic semiconductors and their temperature dependence, Hall effect in semiconductors, compound semiconductors.

Nano Materials: Basic principles of nanoscience and technology, preparation, structure and properties of fullerene and carbon nanotubes, applications of nanotechnology

References:

1. Mathematical Methods for Physicists: A Comprehensive Guide by George, 7th Ed., B. Arfken, Hans J. Weber and Frank E. Harris.
2. Introduction to Solid State Physics- Charles Kittel.
3. Solid State physics- N. Ashcroft and N. Mermin.
4. Introduction to Electrodynamics- David J. Griffith
5. Materials Science and Engineering: An Introduction – W. D. Callister.
6. Introduction to Materials Science for Engineers- Madanapalli K. Muralidhara

Course Title: Analog Electronics					
Course Code: AEI2101					
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:

AEI2101.1: Learn different biasing methods of BJT and analyze small signal amplifiers.

AEI2101.2: Understand the basic functions of operational amplifier, ideal and practical characteristics and realize mathematical operations.

AEI2101.3: Apply OPAMP for different applications.

AEI2101.4: Implement different type of Oscillators to meet the specified needs with appropriate consideration.

AEI2101.5: Understand and analyze different type of multivibrators with and without using IC 555.

AEI2101.6: Analyze and design analog electronic circuits using discrete components with specified needs.

Module-I (10L)

Small signal analysis of transistor amplifier circuits with different biasing methods; Operational amplifier (Op-Amp) fundamentals, Characteristics of ideal and practical operational amplifiers; Op-Amp in open loop comparator mode, ZCD; Linear Op-Amp circuits- Basic (inverting/ non-inverting) Op-Amp circuits, V-I converter, constant current source, level shifter, current amplifier.

Module-II (9L)

Difference amplifier, instrumentation amplifier; Non-linear Op-Amp circuits- Schmitt trigger, precision rectifiers, peak detector, log/antilog amplifiers; Practical Op-Amp limitations: D.C. errors, slew rate, frequency response; Active integrator, Differentiator, and solution of differential equations.

Module-III (9L)

Oscillators- Barkhausen criterion, Colpitts, Hartley, Phase shift, Wien Bridge and Crystal oscillators; Triangular and sawtooth wave generator using op-amp, Active filters.

Module-IV (8L)

Multivibrators and its applications- Astable, Monostable using op-amp (IC741) and integrated circuit timer 555, voltage controlled oscillator and phase locked loop.

References:

1. Sedra & Smith-*Microelectronic Circuits*- Oxford UP
2. Franco—*Design with Operational Amplifiers & Analog Integrated Circuits*, 3/e, McGraw Hill
3. Boylested & Nashelsky- *Electronic Devices and Circuit Theory*- Pearson/PHI.
4. Coughlin and Driscol – *Operational Amplifier and Linear Integrated Circuits*–Pearson Education
5. Millman & Halkias – *Integrated Electronics*, McGraw Hill.
6. Schilling & Belove—*Electronic Circuit: Discrete & Integrated*, 3/e, McGraw Hill.
7. D. Chattopadhyay and P.C. Rakshit - *Electronics: Fundamentals and Applications*, New Age International Private Limited

Course Title: Circuit Theory & Network Analysis					
Course Code: AEI2102					
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:

AEI2102.1: Understand the behaviour of circuit elements in DC and AC circuits.

AEI2102.2: Apply circuit laws, analysis tools and network theorems to analyze the DC and AC networks.

AEI2102.3: Analyze two-port networks with series, parallel, cascade connections and evaluate port parameters and conditions.

AEI2102.4: Analyze the transient and steady state responses of DC circuits.

AEI2102.5: Use Laplace transform techniques for circuit analysis.

AEI2102.6: Understand and implement LP, HP, BP, BS passive and active filters.

Module I – [10L]

Circuit elements: ideal voltage and current sources, dependent sources, R, L and C elements, representing circuit elements in AC circuits, concept of phasors, parameters in the AC circuits: average, RMS, form factor, peak factor
Analysis tools: KCL, KVL, Node, and Mesh analysis
Network theorems (AC and DC circuits): Thevenin's, Norton's, Superposition, Maximum Power Transfer theorems, Millman's Theorem, and Reciprocity theorem.
Resonance in RLC series and parallel circuits.

Module II - [9L]

Magnetically coupled circuits: Self and mutual inductances, dot convention, coefficient of coupling, series and parallel coupling.
Two Port Network: open circuit, short circuit, transmission and hybrid parameters, relationships among parameters, reciprocity and symmetry conditions. T and π representations of 2-port networks; Interconnection of networks: Series, parallel and cascade connections.

Module III-[9L]

Transient analysis: Time domain analysis of R-L and R-C circuits- time constant, initial and final values, transient and steady state responses;
Time domain analysis of RLC circuits: Transient and steady state responses, effect of damping;
Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions, transfer function representation, poles and zeros, frequency response.

Module IV – [8L]

Basic filter circuit Design & Synthesis: Classifications, ideal and practical characteristics of filters, cutoff frequency, bandwidth, quality factor, Low-Pass, high pass and band-pass filters; Butterworth and Chebyshev approximations; Design of 1st order and 2nd order low-pass, high-pass, band-pass and band-reject filters; Elementary synthesis techniques.

References:

1. Franklin F. Kuo, Network Analysis and Synthesis, Wiley India Edition.
2. M. E. Van Valkenburg, Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi.
3. K. V. V. Murty and M S Kamth, Basic Circuit Analysis, Jaico Publishing house, London.
4. Reinhold Ludwig and Pavel Bretchko, RF Circuit Design, Pearson Education, Asia.
5. Joseph J. Carr, Secrets of RF Circuit Design, Tata McGraw-Hill, New Delhi.
6. William H. Hayt, Jack E. Kemmerly, Engineering Circuit Analysis, McGraw-Hill Higher Education.
7. D. Roy Choudhury, ―Networks and Systems‖, New Age International Publications
8. C. K. Alexander and M. N. O. Sadiku, ―Electric Circuits‖, McGraw Hill Education

Course Title: Electrical & Electronic Measurements					
Course Code: AEI2103					
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:

AEI2103.1: Understand the static and dynamic characteristics of measuring instruments.

AEI2103.2: Learn the operation of analog measuring instruments and choose the suitable one for measurement of electrical parameters.

AEI2103.3: Apply appropriate method/instrument for measurement of resistance, capacitance, inductance and frequency.

AEI2103.4: Select appropriate electronic instrument for measurement of voltage, current, frequency and phase.

AEI2103.5: Explain the construction and working principle of different types of oscilloscopes.

AEI2103.6: Understand the working principles of digital voltmeters, digital frequency meter and digital display units.

Module I – [14L]

Classification of analog instruments, types of torques in indicating instruments, construction and principle of operation of permanent magnet moving coil, moving iron, electrodynamometer and electrostatic type instruments, extension of instrument ranges: shunts, multipliers and instrument transformers.
Measurement of energy by single phase induction type meter.

Module II - [11L]

Measurement of medium resistance: ammeter-voltmeter methods, Wheatstone bridge method; measurement of low resistance by Kelvin double bridge; 4-terminal resistance.
Measurement of high resistance: loss of charge method, megger;
Measurement of self inductance: Maxwell's inductance bridge, Maxwell's inductance capacitance bridge, Anderson's bridge;
Measurement of capacitance: DeSauty's bridge, Schering bridge;
Measurement of frequency by Wien's bridge.
Localization of cable faults using Murray and Varley loop methods.

Module III-[11L]

DC and AC voltmeters with operational amplifiers, true RMS voltmeter and chopper stabilized amplifiers for measurement of very low voltage,
Cathode ray oscilloscope: cathode ray tube, sweep generator, oscilloscope automatic time base, waveform display, dual-trace oscilloscopes, Digital Storage oscilloscope, applications.
Introduction to Spectrum Analyzer

Module IV – [12L]

Digital voltmeters: characteristics, types- ramp type, dual slope integrating type, successive approximation type, microprocessor based ramp type; basic digital displays, LEDs and LCD panels, display drivers; Design and implementation of a simple digital frequency meter, errors in frequency measurement – possible remedies, pulse time period and width measurement, frequency ratio measurement.
Digital Multimeter.

References:

1. Golding & Widdis, Electrical Measurements & Measuring Instruments ; Wheeler
2. Forest K. Harris, Electrical Measurement; Willey Eastern Pvt. Ltd. India
3. M.B. Stout, Basic Electrical Measurement; Prentice Hall of India
4. David Bell, Electronic Instrumentation & Measurement; Reston Publishers.
5. H.S. Kalsi, Electronic Instrumentation; Tata McGraw Hill.
6. A.D. Helfrick & W.D. Cooper , Modern Electronic Instrumentation & Measuring Instruments; Wheeler
7. D.C. Patranabis, Principles of Electronic Instrumentation; PHI

Course Title: Sensors and Transducers					
Course Code: AEI2104					
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:

AEI2104.1: Understand the operating principle of mechanical, electromechanical, thermal, acoustic, and optical sensors.

AEI2104.2: Identify and classify the sensors based on type of measurand such as strain, force, pressure, displacement, temperature, flow, etc.

AEI2104.3: Apply the knowledge of Sensors and Transducers for different industrial applications.

AEI2104.4: Sketch the working diagram of sensors used in various industrial applications.

AEI2104.5: Implement signal conditioning circuits for different sensors.

AEI2104.6: Gain knowledge on industrial automation and smart technologies.

Module I – [10L]

Fundamentals: Definition, principle of sensing and transduction, classification of transducers, static and dynamic characteristics of Transducers.
Resistive Transducers: Potentiometric transducer- Theory, type, symbol, materials, error calculations due to loading effects, sensitivity, and specifications.
Strain gauge- Theory, type, symbol, materials, gauge factor, temperature compensation and dummy gauge, Strain measurement circuit- quarter, half and full bridge configuration, and specifications.
Inductive Transducers: Principle, Reluctance change type, Mutual inductance change type, transformer action type. LVDT- Construction, working principle, characteristics (modulated and demodulated).
Magnetostrictive Transducer

Module II - [8L]

Capacitive sensors: Parallel plate type- Variable distance, variable area, variable dielectric constant type, calculation of sensitivity, response characteristics, specifications, and applications.
Piezoelectric transducers: Piezoelectric effect, type, charge and voltage co-efficient and relationships, crystal model, materials, charge amplifier; Ultrasonic sensors- Liquid velocity and level measurements.
Hall sensors and applications: Open & Closed loop current measurement & sensitivity

Module III-[10L]

Contact type Thermal Sensors:
Resistance change type:

Resistance Temperature Detector (RTD) - materials, temperature range, R-T characteristics, configurations, specifications, and applications. Thermistors- materials, temperature range, R-T characteristics, applications and specification.

Thermo-emf sensor:

Thermocouple- Thermo electric laws, types, temperature ranges, series and parallel configurations, cold junction compensation, compensating cables.

Introduction to semiconductor type temperature sensors.

Non-Contact type Thermal Sensors:

Thermal Radiation sensors- types, constructions, working, temperature ranges and comparison.

Module IV- [8L]

LDR, photodiodes, Photovoltaic cells, photo emissive cell types, LED, materials, construction, response, applications, ionization chamber, Proportional counter, Geiger counters, Scintillation detectors.

Introduction to smart sensors, accelerometer, Gyroscope, magnetometer

References:

1. A. K. Ghosh, Introduction to transducers, PHI, 2015
2. E. A. Doebelin, Measurement Systems: Application and Design, Mc Graw Hill, New York
3. H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta.
4. S. Renganathan, Transducer engineering, Allied Publishers Limited, 2003.
5. D. V. S. Murty, Transducer and instrumentation, PHI, second edition, 2008.
6. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs and applications, Third edition, Springer International, 2010.
7. D Patranabis, Sensors and Transducers, PHI, 2nd ed.

Course Title: Design Thinking & Idea Lab Workshop					
Course Code: AEI2150					
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:

AEI2150.1: Understand new ways of creative thinking and learn the innovation cycle of Design Thinking Process for developing innovative products

AEI2150.2: Design different instrumentation system using CAD

AEI2150.3: Handle basic measurement instruments.

AEI2150.4: Design electronics circuitry through PCB.

AEI2150.5: Write a technical document on their project work

Experiments:-

1. Concept of Design Thinking: Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test.
2. Familiarization with Electronic components, Understanding electronic system design flow.
3. Familiarization with Schematic design of electronic circuits and PCB layout
4. Concepts of Instrumentation system design using CAD: Basic 2D and 3D designing using CAD tools.
5. Familiarization and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal, function generator and bench power supply;
6. Learn the basics of Circuit prototyping using (a) breadboard, (b) Zero PCB and (c) custom PCB.
7. Gather knowledge about Electronic circuit building blocks including common sensors, actuators, Arduino and motor drives etc.
8. Discussion and implementation of a mini project with proper documentation.

Course Title: Analog Electronics Lab					
Course Code: AEI2151					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

AEI2151.1: Identify different components of electronic circuits.

AEI2151.2: Analyze the performance characteristics of electronic circuits.

AEI2151.3: Design different kind of electronic circuits to apply in different electronic systems.

AEI2151.4: Understand possible causes of discrepancies in practical/ experimental observations in comparison to theory.

AEI2151.5: Practice different types of wiring and instruments connections for efficient operation.

AEI2151.6: Apply the computer-based analysis tool to review the performance of electronic circuit.

List of experiments:

Students will perform the following experiments using hardware/software tools-

1. Design a Zener regulated power supply.
2. Study of frequency response of single stage small signal amplifier.
3. Implementation of zero crossing detector using operational amplifier.
4. Implementation of voltage level shifter circuit using operational amplifier.
5. Design and Implementation of Inverting and Non-inverting amplifier with specified voltage gain.
6. Design and Implementation of Instrumentation amplifier with specified voltage gain.
7. Design and Implementation of Schmitt trigger with specified hysteresis voltage.
8. Study of half wave and full wave precision rectifiers.
9. Study of Multivibrators (Astable/ Monostable) using IC 555.
10. Design and Implementation of an oscillator circuit (Wien Bridge) to generate specified audio frequency.
11. Study the performance of single phase full bridge inverter circuit operating in square wave mode.

References:

1. Sedra & Smith-*Microelectronic Circuits*- Oxford UP
2. Boylested & Nashelsky- *Electronic Devices and Circuit Theory*- Pearson/PHI.
3. Coughlin and Driscol – *Operational Amplifier and Linear Integrated Circuits*–Pearson Education
4. Schilling & Belove—*Electronic Circuit: Discrete & Integrated*, 3/e, McGraw Hill.
5. Manish K. Mukherjee - Foundation of Electron Devices and Circuits- Pune Everest Pub

Course Title: Circuits & Networks Lab					
Course Code: AEI2152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

AEI2152.1: Apply network theorems to analyze the experimental results using hardware circuits.

AEI2152.2: Use simulation tools to carry out time & frequency domain measurements on elementary RL, RC & RLC circuits.

AEI2152.3: Analyze RL, RC, and RLC circuits in time domain using hardware components.

AEI2152.4: Analyze the frequency response of 1^{st} & 2^{nd} order passive and active (LP, HP, BP, BR) filters.

AEI2152.5: Design passive and active (LP, HP, BP, BR) filters of 1^{st} & 2^{nd} order.

AEI2152.6: Use simulation tools for different types of signal generation.

List of Experiments:

1. Transient analysis of RC and RL circuits (simulation based).
2. Over damped, under damped, critically damped analysis of a 2nd order system (simulation based).
3. Transient response in RC, RL & RLC circuits (hardware based).
4. Leading and lagging analysis for RC and RL circuits (simulation based).
5. Verification of Thevenin's and Norton's theorems (hardware based).
6. Verification of Superposition theorem (hardware based).
7. Frequency response of 1^{st} & 2^{nd} order systems by applying different inputs (simulation based).
8. Frequency response of passive (LP, HP, BP, BR) filters of 1^{st} & 2^{nd} order (hardware based).
9. Frequency response of active (LP, HP, BP, BR) filters of 1^{st} & 2^{nd} order (hardware based).
10. Different types of periodic signals, e.g., sinusoidal, square, triangular, etc. generation.

Course Title: Electrical & Electronic Measurements Lab					
Course Code: AEI2153					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

AEI2153.1: Measure electrical energy and power using single phase AC energy meter and instrument transformer respectively.

AEI2153.2: Choose appropriate bridge for measurement of unknown low resistance, capacitance, self inductance & frequency.

AEI2153.3: Examine static and dynamic characteristics of measuring instrument.

AEI2153.4: Design voltage to current and current to voltage converter circuits.

AEI2153.5: Analyze the signal using voltage controlled oscillator, phase locked loop.

AEI2153.6: Learn the operation of analog to digital and digital to analog converters.

List of Experiments:

1. Calibration of Single Phase A.C. Energy Meter.
2. Measurement of Power using Instrument Transformer.
3. Measurement of low resistance using Kelvin's Double Bridge.
4. Measurement of Inductance by Anderson's Bridge.
5. Measurement of Capacitance by De Sauty's Bridge.
6. Measurement of Capacitance by Wien's Bridge.
7. Study of voltage to current and current to voltage converter circuits.
8. Study of VCO (voltage controlled oscillator) and PLL (phase locked loop).
9. Study of analog to digital converter and digital to analog converter.

Course Title: Sensors and Transducers Lab					
Course Code: AEI2154					
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:

AEI2154.1: Compare various temperature sensors and select the appropriate sensor for a specific application.

AEI2154.2: Select suitable transducers for measuring linear and angular displacements.

AEI2154.3: Study the performance of various pressure and stress sensing elements.

AEI2154.4: Measure rotational speed using non-contact type sensors/instruments.

AEI2154.5: Study the characteristics of optical sensors.

AEI2154.6: Design sensing system based signal-conditioning circuits.

List of Experiments:

1. Comparative characteristics studies of some temperature measuring sensors like AD590 IC sensor, RTD and thermistor.
2. Study of a gang capacitive transducer and hence angular displacement measurement using it.
3. Study of I/O characteristics of LVDT and hence measure pressure & displacement using it.
4. Study of a load cell with tensile and compressive loads.
5. Rotational speed measurement using an inductive proximity sensor.
6. Measurement of rotational speed measurement using stroboscopic principle.
7. Comparative characteristics studies of some optical sensors like LDR, photo diode and photo transistor.
8. Design of a suitable signal conditioning circuit for a given sensor.

Course Title: Digital Electronics					
Course Code: AEI2201					
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:

AEI2201.1: Understand the conversion mechanism of different number systems.

AEI2201.2: Learn the application of different logic gates.

AEI2201.3: Analyze, design and implement combinational logic circuits.

AEI2201.4: Analyze, design and implement sequential logic circuits.

AEI2201.5: Learn the nomenclature and technology in the area of memory devices: ROM, PROM, PLD etc. and different kind of ADCs and DACs.

AEI2201.6: Understand the basic operation of integrated logic circuits.

Module I - [9L]

Data and number systems- Binary, Octal, Hexadecimal, BCD, ASCII, Gray codes representation and their conversions; Boolean algebra- Various Logic gates with truth tables and circuits; Binary arithmetic- Signed binary number representation with 1's and 2's complement methods; Combinational Logic Design- Definition, Truth Table, SOP and POS realization, Logic minimization using K-map, Minimization with don't care terms.

Module II - [9L]

Combinational circuits- Adder / Subtractor circuit, Comparator circuit, Parity generator/checker circuit, Binary to Gray and Gray to Binary conversion circuits, Encoder, Decoder, Demultiplexer and Multiplexer, Function realization using decoder and multiplexer.

Module III - [9L]

Sequential Circuits- Basic Concepts of Flip-Flop, SR, JK, Master Slave, T and D Flip-Flops; Synchronous and asynchronous Up/Down counters, Arbitrary counter, Shift Registers and their applications- Johnson counter, Ring counter.

Module IV - [9L]

S/H circuit, Aanalog to digital converters- Successive approximation, Integrating, Flash, and sigma-delta; Digital to analog converters- Weighted R, R-2R ladder; Characteristics of ADC and DAC- Resolution, Quantization, Significant bits, Conversion/Settling time; Introduction to Various Logic Families- TTL, CMOS; Programmable Logic Devices– PROM, PLA, and PAL.

References:

1. Malvino & Brown, *Digital Computer Electronics*, TMH

2. H. Taub & D. Shilling, *Digital Integrated Electronics*, Mc Graw Hill
3. M. Mano, *Digital Logic and Design*, PHI
4. A. Anand Kumar, *Fundamentals of Digital Circuits*, PHI
5. Kharate, *Digital Electronics*, Oxford
6. Floyed & Jain, *Digital Fundamentals*, Pearson.

Course Title: Industrial Instrumentation					
Course Code: AEI2202					
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:

AEI2202.1: Analyse the working of various pressure measuring industrial devices.

AEI2202.2: Understand the operating principles of industrial flow measuring devices tailored to a particular application.

AEI2202.3: Demonstrate and select different level measuring instruments for various applications.

AEI2202.4: Illustrate various analytical instruments to measure moisture, viscosity, density, pH, etc.

AEI2202.5: Explain the selection criteria and installation procedures for pressure, flow and level measuring instruments.

AEI2202.6: Gain knowledge of hazardous area and intrinsically safe measurement systems.

Module I - Measurement of Pressure [10L]

Units and Terminologies;
Manometer types – u-tube, inclined tube and well type;
Elastic types - Bourdon Tube, Bellows, diaphragms and diaphragm seal, capsules and force balance mechanism;
Working principle of Dead weight tester, pressure regulator, air compressor;
DP transmitter - capacitive, piezo - resistive and resonating wire type;
Installation and calibration of pressure gauge, DP transmitter and valve manifolds;
Flapper nozzle system & basic operation, pneumatic relay, amplifier, pneumatic transmitter
Vacuum measurement- Mcleod gauge, Pirani gauge, thermal conductivity gauge and ionization gauge.

Module II - Measurement of Flow [10L]

Units and Terminologies; Types of tapping; installation guide, flange, snubbers;
Head type flow meters– orifice plate and types, venture tube, pitot tube, flow nozzle, analysis and calculation;
Variable area flowmeters – glass and metal tube rotameters;
Electromagnetic flow meter;
Ultrasonic flow meter – Transit time, Doppler frequency shift;
Turbine flowmeter;
Coriolis mass flow meters, thermal mass flowmeter;
Vortex flowmeter;
Positive displacement meter;

Solid flow measurement.

Module III - Measurement of Level [9L]

Units and Terminologies.
Direct measurement: sight glass, float, displacer;
Indirect measurement: Air Purge/Bubbler type, Capacitive, Resistive, Inductive;
Ultrasonic and radar type; nucleonic gauge, Electronic remote sensor.
Boiler drum Level Measurement – Thermal level sensors, measurement using differential pressure transmitter, zero suppression and zero elevation;
Liquid interface Level measurement.
Solid level measurement.

Module IV - Miscellaneous Measurements and Hazardous area instrumentation [7L]

Units and Terminologies;
Humidity and Moisture measurement - Dry & wet bulb Psychrometer, Hair Hygrometer, Dew point hygrometers;
Introduction to pH measurement.
Density measurement – Hydrometer, differential pressure cells;
Viscosity measurement – Capillary viscometers, Saybolt viscometers;
Hazardous area instrumentation: basic concepts, zone and division classification- intrinsically safe and explosion proof, NEMA and IP codes, intrinsically safe measurement system.

References:

1. Donald P. Eckman, “Industrial Instrumentation”, CBS publishers and distributors, 2004.
2. Murthy, D.V.S., “Transducers and Instrumentation”, 2nd ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
3. Ernest O. Doebelin, “Measurement systems Application and Design ǁ”, Tata McGraw- Hill Book Company, fifth ed., 2010
4. Patranabis D., “Principles of industrial Instrumentation”, Tata McGraw Hill, 3rd ed., New Delhi, Reprint 2010
5. John P. Bentley, “Principles of Measurement Systems”, Pearson education, 3rd ed., 2009
6. Gregory K. McMillan and Douglas M Considine, “Process/ Industrial Instruments and Controls Handbook ǁ”, Tata Mc-Graw Hill, 5th ed., 2009
7. M.M.S. Anand, “Electronics Instruments and Instrumentation Technology”, Prentice Hall of India Pvt. Ltd., New Delhi, 2004
8. NPTEL video lectures on “Industrial Instrumentation” by Prof. Alok Barua, IIT Kharagpur

Course Title: Control Systems					
Course Code: AEI2203					
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:

AEI2203.1: Develop mathematical model of physical systems in terms of differential equation and transfer function.

AEI2203.2: Describe the systems using block diagram and signal flow graph models.

AEI2203.3: Investigate the time response of linear systems with performance indices.

AEI2203.4: Learn the concept of stability in s-domain and apply Routh-Hurwitz stability criterion and root locus technique.

AEI2203.5: Analyze frequency response and stability of a system using polar, Nyquist and Bode plot.

AEI2203.6: Understand the concept of state variable analysis and compensation techniques.

Module I: [12L]

Mathematical Modeling and Control:
Introduction – Importance of control engineering in industry; Mathematical model of physical systems – representation in terms of differential equation, transfer function, block diagram and signal flow graph – overall transmittance by Mason's gain formula; Concept and applications of open loop and closed loop systems; Advantages of feedback control system.

Module II - [12L]

Time Response and Stability Analysis:
Standard input test signals – step, ramp, impulse and parabolic functions; Time response of first order system and steady state error; Time response of second order system and derive performance indices – rise time, peak time, peak overshoot, settling time and static error coefficients;
Stability analysis of first and second order systems from pole-zero map; stability analysis using Routh- Hurwitz criteria for higher order systems; Root locus techniques and stability analysis from root locus plot

Module III-[12L]

Frequency Response and Stability Analysis:
Polar plot; Nyquist plot – principle of argument, Nyquist stability criteria, mapping between s plane and G(s) H(s) plane, stability analysis from the Nyquist plot, Bode plot – gain plot, phase plot, gain margin, phase margin, stability analysis from the Bode plot.

Module IV- [12L]

State Space Analysis and Compensation Techniques
Concept of state, state variables, state matrix, input matrix, output matrix and transmission matrix, state equation, output equation, state space representation of linear time invariant system; Determination of observability and controllability of a system; Control components – DC servomotor, AC servomotor and Synchro; Basic concept of lead compensation, lag compensation and lead-lag compensation.

References:

1. K. Ogata, *Modern Control Engineering*, 4th ed., Pearson Education.
2. I. J. Nagrath and M. Gopal, *Control System Engineering*, 5th ed., New Age International Private Ltd Publishers.
3. B. C. Kuo, *Automatic Control System*, TMH, 2nd Edition, 2010.
4. R. Anandanatarajan, P. Ramesh Babu, *Control Systems Engineering*, 5th Edition, Winners Wisdom Scitech

Course Title: Power Electronics & Drives					
Course Code: AEI2204					
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:

AEI2204.1: Acquire knowledge on power semiconductor devices.

AEI2204.2: Describe single phase power converter circuits and understand their applications.

AEI2204.3: Understand the principle of inverter and chopper circuits with their applications.

AEI2204.4: Analyse three phase power converter circuits and understand their applications.

AEI2204.5: Understand the working of DC drives and their applications in industry.

AEI2204.6: Learn the principle of AC drives and their industrial applications.

Module I: [9L]

Power Semiconductor devices

Power diodes, UJT, Power BJT, Power MOSFET, DIAC, TRIAC and IGBT: Construction, Characteristics, Working principles, Applications

Thyristor or SCR:

Principle of operation of SCR, Static characteristics, two-transistor analogy, SCR construction, Gate characteristics of SCR, Turn-on methods of SCR, Dynamic turn-on switching characteristics, Turn-off mechanisms, SCR ratings, Comparison between SCR and Transistor.

Module II - [9L]

Phase controlled rectifiers:

Single phase converters: Half controlled and fully controlled converters, Evaluation of input power factor and harmonic factor, continuous and Discontinuous load current, single phase dual converters, power factor Improvements, Extinction angle control, symmetrical angle control, PWM ,single phase sinusoidal PWM ,single phase series converters ,Three Phase Converters, Applications.

Inverters:

Single phase and three phase (both 120^0 mode and 180^0 mode) inverters, PWM techniques, Sinusoidal PWM, modified sinusoidal PWM, multiple PWM ,Voltage and harmonic control , Series resonant inverter ,Current and voltage source inverter.

Module III-[8L]

Choppers:

Step-down and step-up chopper, Time ratio control and current limit control, Buck, boost and buck- boost converter.

Module IV- [9L]

DC drives:

Basic machine equations, schemes for D.C Motor speed control, Single phase separately excited drives, Braking Operation of Rectifier Controlled Separately Excited Drives, D.C Chopper Drives, Phase-Locked Loop (PLL) Controlled of D.C drives.

AC drives:

Basic Principle of operation, Speed Control of induction motor, Stator voltage control, Variable frequency control, Rotor resistance control, Slip power recovery scheme, Synchronous motor drives.

References:

1. K. B. Khanchandani, *Power Electronics*, McGraw Hill .
2. K. Hari Babu, *Power Electronics*, Schitech.
3. M. H. Rashid, *Power Electronics*, Pearson Education.
4. P. C. Sen, *Modern power electronics,* S. Chand.
5. Lander*, Power Electronics*, McGraw Hill.

Course Title: Data Structure and Basic Algorithms					
Course Code: CSE2004					
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:

CSE2004.1: Identify and select appropriate data structures as applied to specified problem definition.

CSE2004.2: Implement operations like searching, insertion, deletion, traversal etc. on linear data structures like array, stack and queue.

CSE2004.3: Implement operations like searching, insertion, deletion, traversal etc. on nonlinear data structures like tree and graph.

CSE2004.4: Apply appropriate sorting/searching technique for given problem.

CSE2004.5: Analyse and compare the different sorting algorithms.

CSE2004.6: Design advanced data structure using nonlinear data structures.

Module I: Linear Data structures I [8L]

Introduction **[2L]**

Concepts of data structures (Data, data structure, Abstract Data Type), Need of data structure, Basic idea of pseudo-code, algorithm analysis and Big O notation.

Array **[2L]**

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

Linked List **[4L]**

Singly linked list, Circular linked list, Doubly linked list (Creation, insertion at different positions, deletion from different positions of the list), Linked list representation of polynomial and applications.

Module II: Linear Data structures II [6L]

Stack and Queue **[4L]**

Stack and its implementation (using array, using linked list), applications
Queue, circular queue, deque (using array and linked list)

Recursion **[2L]**

Principles of recursion – Design of recursive algorithms, differences between recursion and iteration, merits and demerits of recursion, Tail recursion

Module III: Non-linear Data structures [12L]

***Trees* [9L]**

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

***Graphs* [3L]**

Basic Terminologies and definitions

Graph representations/ storage implementations (using adjacency matrix and adjacency list)

Graph traversal and connectivity – Depth-first search (DFS) , Breadh-first search (BFS)

Module IV: Searching, sorting, Hashing [10L]

***Sorting Algorithms* [6L]**

Bubble sort, Insertion sort, Selection sort, Merge sort, Quick sort, Heap sort and their comparisons

Searching [1L]

Linear search, binary search and their comparisons

Hashing [3L]

Basic terminologies, different hashing functions, collision resolution techniques (Open addressing and Chaining).

References:

1. 'Data Structures and Program Deign in C', 2nd Edition by Robert L. Krus, Bruce P. Leung
2. 'Fundamentals of Data Structures of C' by Ellis Horowiz, Sartaj Sahni, Susan Anderson
3. "Classic Data Structures" by D. Samanta.
4. 'Data Structures in C' by Aaron M. Tenenbaum
5. 'Data Structures' by S. Lipschutz

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

Course Outcomes:

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

EVS2016.1: Understand the natural environment and its relationships with human activities.

EVS2016.2: Characterize and analyze human impacts on the environment.

EVS2016.3: Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.

EVS2016.4: Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.

EVS2016.5: Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.

EVS2016.6: Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

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: Air Pollution [6L]

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: Water Pollution [6L]

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: Land Pollution [6L]

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. Gour Krishna 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 Title: Digital Electronics Lab					
Course Code: AEI2251					
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:

AEI2251.1: Analyze and identify different components of digital electronic circuits.

AEI2251.2: Set up testing strategies and select proper instruments to evaluate the performance characteristics of digital electronic circuits.

AEI2251.3: Evaluate the use of computer-based analysis tool to review the performance of digital electronic circuit.

AEI2251.4: Analyze, design and implement combinational logic circuits.

AEI2251.5: Analyze, design and implement sequential logic circuits.

AEI2251.6: Develop necessary digital logic and apply it to solve real life problems keeping in mind technical, economical, safety issues.

List of Experiments:

Do the following experiments using hardware/ software

Design and Implementation of:

1. Basic logic gates using simulation software.
2. Half and Full Adder using logic gates.
3. Binary to Gray /Gray to Binary Code Converters using logic gates.
4. Simple Decoder & Multiplexer circuits using logic gates.
5. 4-bit parity generator & checker circuits using logic gates.
6. RS, JK, D, and T flip-flops using Universal logic gates.
7. Asynchronous Up/Down counter using flip-flops.
8. Synchronous Up/Down counter using flip-flops.
9. Ring counter and Johnson's counter using flip-flops.

References:

1. Malvino & Brown, *Digital Computer Electronics*, TMH
2. M. Mano, *Digital Logic and Design*, PHI
3. Floyed & Jain, *Digital Fundamentals*, Pearson

Course Title: Industrial Instrumentation Lab					
Course Code: AEI2252					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

AEI2252.1: Identify the appropriate sensing element for the measurement of physical parameters like pressure, flow, level, temperature etc.

AEI2252.2: Calibrate the pressure measuring devices using dead weight taster.

AEI2252.3: Measure process parameters like flow, level and temperature using different measuring devices.

AEI2252.4: Understand the transfer characteristics of Flapper-Nozzle system.

AEI2252.5: Calculate load flow rate in conveyor belt using industrial weighing system.

AEI2252.6: Determine moisture percentage of a given sample.

List of Experiments:

1. Familiarization with diaphragm, capsule, bellow, Bourdon tube, orifice plate, pitot tube, venture meter, control valve, control valve positioner, pneumatic relay, etc.
2. Study the characteristics of Flapper Nozzle system used in pneumatic instruments.
3. Calibration of pressure gauge and pressure transmitter using Dead Weight Tester with interfacing facility to LabVIEW software.
4. Case study of a real time industrial weighing system with automation built in LabVIEW software.
5. Study the characteristics of thermocouple and RTD.
6. Measurement of liquid flow through orifice meter/Venturi meter using manometer differential head, and comparison of the same with the reading of flow transmitter interfaced to the software.
7. Measurement of liquid flow rate using Rotameter, and comparison of the same the reading of flow transmitter interfaced to the LabVIEW software.
8. Measurement of liquid level using float type sensor and ultrasonic sensor.
9. Moisture measurement using moisture analyzer.
10. Data logging of different process signals using data acquisition card in LabVIEW software.
11. Calibration of Transmitters used for process parameter (Flow/level/ temperature/ pressure/ displacement) measurement in LabVIEW software.

Course Title: Control Systems Lab					
Course Code: AEI2253					
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:

AEI2253.1: Realise the concept of pole, zero and transfer function.

AEI2253.2: Derive the overall transfer function from block diagram using block reduction.

AEI2253.3: Analyze the time response of first and second order systems using standard inputs.

AEI2253.4: Investigate the stability of a system by root locus method.

AEI2253.5: Assess the stability of a system by frequency response analysis employing Bode plots and Nyquist plot.

AEI2253.6: Examine the effect of different controllers on different systems and understand the state space representation model.

List of Experiments:

1. Generate different forms of transfer function, plot pole- zero map and finding of transfer function from the given poles, zeroes and gain of the system using OCTAVE programming.
2. Overall transfer function evaluation by block reduction techniques using OCTAVE programming.
3. Time response analysis of first order systems with standard test signals and rise time, steady state error evaluation using OCTAVE programming.
4. Time response analysis of second order systems with standard test signals and transient response parameters evaluation using OCTAVE programming.
5. Stability analysis of system by root locus method using OCTAVE programming.
6. Stability analysis of system by getting Bode plot using OCTAVE programming.
7. Stability analysis of system by getting Nyquist plot using OCTAVE programming.
8. Familiarization of state space representation models using OCTAVE programming.
9. Study the effect of P, PI and PID controllers on different processes using OCTAVE programming.
10. Study of speed and position control of dc motors using OCTAVE programming.

Course Title: Power Electronics & Drives Lab					
Course Code: AEI2254					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

AEI2254.1: Determine the V-I characteristics of SCR and TRIAC.

AEI2254.2: Study the operation of Gate firing circuits.

AEI2254.3: Simulate Rectifier, Chopper and AC Voltage Controller.

AEI2254.4: Investigate the performance of PWM bridge inverter using MOSFET/IGBT with R and R-L loads.

AEI2254.5: Conduct the speed control of DC motor using various power electronic circuits.

AEI2254.6: Develop skills to build and troubleshoot power electronic circuits.

List of Experiments:

1. Study of V-I Characteristics of SCR.
2. Study of V-I Characteristics of a TRIAC.
3. UJT Triggering circuits for SCR.
4. Study of the operation of a single-phase fully controlled bridge converter supplying
   a) Resistive load
   b) R-L loads with freewheeling diode including generation of triggering pulses for the devices for both continuous and discontinuous modes of conduction.
5. Simulation of DC to DC step up chopper.
6. Simulation of PWM bridge inverter using MOSFET/IGBT with R and R-L loads.
7. Simulation of Single-phase AC regulator
8. DC motor speed control.

Course Title: Data Structures and Basic Algorithms Lab					
Course Code: CSE2054					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

CSE2054.1: Identify the appropriate data structure for given problem.

CSE2054.2: Understand the concept of Dynamic memory management, data types, algorithms etc.

CSE2054.3: Understand and implement basic data structures such as arrays, linked lists, stacks and queues,

CSE2054.4: Implement various applications involving array, stack, queue and linked lists.

CSE2054.5: Solve problem involving graphs and trees.

CSE2054.6: Apply algorithm for solving problems like sorting and searching.

List of Experiments:

1. Implementation of array operations
2. Stack and Queues: adding, deleting elements, Circular Queue: adding, deleting elements
3. Evaluation of expressions operations using stacks
4. Implementation of linked lists: inserting, deleting, inverting a linked list
5. Implementation of stacks & queues using linked lists
6. Polynomial addition
7. Addition of Sparse Matrices
8. Traversal of Trees
9. DFS and BFS implementation
10. Sorting and searching algorithms

TEXT BOOKS

1. “Data Structures and Program Design In C”,2/E byRobertL.Kruse,BruceP.Leung.
2. “Fundamentals of Data Structures of C” by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. “Classic Data Structures” by D.Samanta.
4. “Data Structures in C ” by Aaron M. Tanenbaum.
5. “Data Structures” by S. Lipschutz

DETAILED SYLLABUS

3rd Year

Course Title: Process Control					
Course Code: AEI3101					
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:

AEI3101.1: Determine the process model, outline the process control loops and describe the elements of the control loop.

AEI3101.2: Analyze controller modes, controller responses and apply as per requirement.

AEI3101.3: Distinguish control valves, valve characteristics and apply them accordingly.
AEI3101.4: Describe the schemes of complex control strategies.

AEI3101.5: Understand the concept of PLC, DCS, SCADA and implement PLC programming and applications.

AEI3101.6: Illustrate the components of pneumatic, electronic and software controllers design.

Module I – [8L]

Process Modeling and Characteristics:

Introduction to process control system, process control loop block diagram, process variables, control configurations (SISO & MIMO), control strategies, mathematical modelling of first and second order system, dynamics and analysis of first, second and higher order systems, self-regulating processes, process lag, process dead time, degrees of freedom, process model for liquid label tank and stirred tank heater, interacting and non- interacting processes, piping and instrumentation diagram.

Module II - [10L]

Theory of Controller and Controller Design:

Discontinuous control modes: two position, three position, multi-position; continuous control modes: proportional, integral, derivative; composite controller modes: P-I, P-D, P-I-D, integral windup and prevention, auto/manual transfer, bumpless transfer, digital control loop components, position and velocity algorithm, closed loop response of 1st & 2nd order systems, selection of control modes for processes like: level, pressure, temperature and flow; design of electronic/pneumatic controllers; controller tuning methods: evaluation criteria - IAE, ISE, ITAE, process reaction curve method, continuous oscillation method, auto tuning.

Module III-[8L]

Final Control Elements and Accessories:

Final control elements: actuators (pneumatic actuators, electrical actuators) and control valves (globe, ball, butterfly, gate, pinch), different parts, single & double seated valves, failsafe operation, valve sequencing, inherent and installed valve characteristics, valve sizing, valve selection, flashing, cavitation, noise, instrument air; control valve accessories: air filter regulator, booster relay, I/P converter, pneumatic positioner, electro-pneumatic positioner, limit switches.

Module IV- [10L]

Advanced Control Systems and Process Automation:

Complex control system: feed forward control, cascade control, ratio control, override control, split range control, multivariable process control; case studies: boiler drum level control, combustion control.

Introduction to programmable logic controllers (PLC): basic architecture and functions, input output modules and interfacing, relays, timers, counters and their uses, PLC ladder programming and applications.

Introduction to DCS and SCADA, automation hierarchy/system architecture.

References:

1. Stephanopoulos. G, “Chemical Process Control”, Prentice Hall of India, New Delhi, 1984.
2. B. Wayne Bequette, “Process control, modeling, Design and simulation”, Prentice Hall of India (P) Ltd., 2003
3. Curtis D. Johnson, Process Control: Instrumentation Technology, Prentice Hall College Div; Custom edition, 2008.
4. Béla G. Lipták, Process Control: Instrument Engineers' Handbook, Butterworth, Heinemann
5. Surekha Bhanot, Process Control: Principles and Applications, Oxford University Press, 1st Edition, 2008.

Course Title: Microprocessor & Microcontroller					
Course Code: AEI3102					
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:

AEI3102.1: Describe the architecture and fundamentals of 8085 Microprocessor and 8051 Microcontroller.

AEI3102.2: Understand and classify the instruction set of 8085 Microprocessor and 8051 Microcontroller.

AEI3102.3: Select the appropriate instructions and apply them to write the assembly level programming of 8085 Microprocessor and 8051 Microcontroller.

AEI3102.4: Interface different types of memory devices with 8085 Microprocessor.

AEI3102.5: Familiarize the architecture and operation of various Programmable Peripheral Devices, and interface with 8085 Microprocessor.

AEI3102.6: Design the interface of various I/O devices with 8085 Microprocessor and 8051 Microcontroller.

Module I – [10L]

Introduction to 8 bit Microprocessor:

History of Microprocessors, 8085 Microprocessor architecture, bus organization, pin description, machine cycle & bus timing, interrupts.
8085 Microprocessor instruction set, addressing modes, assembly language programming, stack and subroutine, counter and time delay generation.

Module II - [6L]

Memory and I/O Interface:

Absolute and partial address decoding, interfacing of different size of memory (RAM and ROM) chips with 8085 Microprocessor.
Memory mapped I/O and I/O mapped I/O techniques, interfacing of input/output devices (like LEDs, switches, 7-segment display) with 8085 Microprocessor.

Module III-[10L]

Programmable Peripherals and Applications:

Block diagram, pin description and interfacing of 8255 PPI with 8085 Microprocessor. Interfacing of LEDs, switches, 7-segment display, stepper motor, ADC and DAC using 8255. Block diagram and interfacing of 8254 and 8251 USART with 8085 Microprocessor.

Introduction to DMA controller, Priority Interrupt Controller.

Module IV- [10L]

Microcontroller Architecture, Programming and Applications:

8051 Microcontroller architecture, pin description, I/O ports, special function registers (SFRs) and memory organization.

8051 Microcontroller instruction set, assembly language programming, I/O port programming.

8051 Microcontroller applications: Interfacing of LEDs, switches, 7- segment display, stepper motor, temperature sensor, etc.

References:

1. Ramesh S. Gaonkar, *Microprocessor architecture, programming and applications with 8085/8085A*; Wiley eastern Ltd.
2. B. Ram, *Fundamental of Microprocessor and Microcontrollers*; Dhanpat Rai Publications.
3. Muhammed Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems*, Pearson Education Inc.
4. M. Saravanan, N. Senthil Kumar, and S. Jeevananthan, *Microprocessors and Microcontrollers*, Oxford University Press, 2010.
5. A. Nagoor Kani, *8085 Microprocessor and its Applications*; Third Edition, TMH Education Pvt. Ltd.

Course Title: Digital Signal Processing & Applications					
Course Code: AEI3103					
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:

AEI3103.1: Characterize and analyze the properties of discrete time signals.

AEI3103.2: Perform convolution, correlation, time and transform domain analysis of discrete linear time invariant systems.

AEI3103.3: Apply the Z-transform to compute magnitude and phase responses and determine the stability of a system.

AEI3103.4: Perform DFT, IDFT and FFT, and learn the properties of DFT.

AEI3103.5: Design digital FIR and IIR filters according to the given specification.

AEI3103.6: Realize a digital filter structure from its transfer function.

Module I [9L]:

Discrete Time Signals and Systems:

Introduction, Discrete Time signals, Sampling of Continuous Time (Analog) Signals, Classification of Discrete Time Signals, Mathematical Operations on Discrete Time Signals, Discrete Time System, Response of LTI Discrete Time System in Time Domain, Classification of Discrete Time Systems, Discrete or Linear Convolution, Correlation, Cross correlation and Autocorrelation.

Module II [8L]:

Z – Transform:

Introduction, Region of Convergence, Properties of ROC, Properties of Z-Transform, Representation of Poles and Zeros in z-plane, Stability criteria, Inverse Z-Transform- long division method, partial fraction, Residue method, convolution method; Analysis of LTI Discrete Time System Using Z-Transform, Relationship with S-plane.

Module III [9L]:

Discrete Fourier Transform (DFT):

Introduction to DTFT, Discrete Fourier Transform (DFT) of Discrete Time Signal, Inverse DFT, Properties of DFT, Relation between DFT and Z-Transform, Analysis of LTI Discrete Time Systems using DFT, concepts of circular convolution, relationship between linear convolution and circular convolution, computation of linear convolution from circular convolution.

Fast Fourier Transform (FFT): Decimation in Time (DIT) Radix-2 FFT, Decimation in Frequency (DIF) Radix-2 FFT, Computation of inverse DFT using FFT.

Introduction to STFT and power spectral density measurement.

Module IV [10L]:

IIR Filter design:

Design an analog Butterworth low pass filter, design of IIR filters from analog filters using approximation of derivatives, the impulse invariance technique and bilinear transformation; Realization of Digital IIR filters - direct form-I, direct form-II, cascade and parallel form.

FIR Filter design:

Linear phase FIR filters, Frequency response of linear phase FIR filters, Characteristics of different windows- Rectangular, Bartlett, Blackman, Hamming and Hanning, FIR filter design using rectangular window technique, Realization of Digital IIR filters - direct form, cascade form and linear phase structure.

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Edition, Pearson Education Inc., New Delhi, India.
2. Li Tan, Jean Jiang, Digital Signal Processing: Fundamentals and Applications, 2nd Edition, Academic Press.
3. A.V. Oppenheim, R.W. Schaffer and John R. Buck, Discrete Time Signal Processing, 3rd Edition, Prentice-Hall Signal Processing Series

Reference Books:

1. Sanjit K. Mitra, Digital Signal Processing- A computer based Approach, 4th Edition McGraw-HillS.
2. A. Nagoor Kani, Digital Signal Processing, 2nd Edition, Tata McGraw-Hill, India
3. P. Ramesh Babu, Digital Signal Processing, 4th Edition, Scitech Publications, India
4. S. Salivahanan, Digital Signal Processing, 3rd Edition, McGraw-Hill, India

Course Title: Basics of RDBMS					
Course Code: CSE3106					
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:

CSE3106.1: Identify the basic concepts and various data model used in database design. Be able to model an application's data requirements using conceptual modelling tools like ER diagrams and design database schemas based on the conceptual model.

CSE3106.2: Formulate relational algebra expression for queries and evaluate it using the concept of query processing and optimization

CSE3106.3: Create RDBMS schema mapping various business validations and formulate queries based on that schema using SQL to satisfy business requirements.

CSE3106.4: Apply normalization and various types of dependencies for evaluating a relational database design

CSE3106.5: Apply and relate the concept of transaction, concurrency control and recovery in database.

CSE3106.6: Understand with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

Module I: [8L]

Introduction ***[4L]***

Concepts relating to Overview of DBMS, Comparison among file-based data management and DBMS, Types of DBMS and RDBMS, Data Models, Database Languages, Role of database administrator and database Users, Three Tier architecture of DBMS.

Entity-Relationship Model ***[5L]***

Basic concepts, Design Issues, Mapping Constraint Types, Various types of Keys, Entity and Attributes, Cardinality Ratio, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

Module II: [10L]

Relational Model ***[4L]***

Structure of relational Databases, Relational Algebra, Union compatibility and Different types of Joins, Extended Relational Algebra Operations, Views, Modifications of the Database.

Relational Database Design ***[7L]***

Functional Dependency, Different anomalies in designing a Database, Normal Forms, 1NF, 2NF, 3NF, BCNF, Normalization using functional dependencies, Decomposition, Normalization using multi-valued dependencies.

Module III: [8L]

SQL and Integrity Constraints ***[8L]***

Concept of DDL, DML, DCL, Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, Views, Nested Subqueries, Stored procedures and triggers.

Module IV: [10L]

Internals of RDBMS ***[6L]***

Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols, two phase locking.

File Organization & Index Structures ***[6L]***

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree.

Textbooks:

1. Henry F. Korth and Silberschatz Abraham, Database System Concept, McGraw Hill.
2. Elmasri Ramez and Navathe Shamkant, Fundamentals of Database Systems, Pearson Education.
3. Ramakrishnan, Database Management System, McGraw-Hill.
4. Gray Jim and Reuter Address, Transaction Processing: Concepts and Techniques, Morgan Kauffman Publishers.
5. Jain, Advanced Database Management System Cyber Tech.
6. Date C. J., Introduction to Database Management, Addison Wesley.
7. Ullman JD., Principles of Database Systems, Galgotia Publication.

References:

1. James Martin, Principles of Database Management Systems, Prentice Hall of India, New Delhi
2. Arun K.Majumdar, Pritimay Bhattacharya, Database Management Systems, Tata McGraw Hill.

Course Title: Opto Electronics & Fiber Optics					
Course Code: AEI3131					
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:

AEI3131.1: Understand the basic concepts of opto-electronic devices and their properties with industrial applications.

AEI3131.2: Learn principles of optical fibers, properties and performances.

AEI3131.3: Understand working principle of LED and photodiode.

AEI3131.4: Calculate various type of losses in fiber optic system.

AEI3131.5: Acquire the knowledge of different types of optical fiber sensors and their applications.

AEI3131.6: Gain the fundamentals of LASERS, properties and industrial applications.

Module I – [8L]

Optoelectronics:

Characteristics of optical emission, electro-luminescence, photo electric effect, photo conducting effect, photo voltaic effect: organic and inorganic, solar cell, Dye Synthesize Solar Cell, LDR, phototransistor.

Module II - [10L]

Optical fibers and their performances:

Principle of light propagation through fiber, different types of fibers and their properties, fiber characteristics, absorption losses, scattering losses, dispersions, connectors; Industrial applications of optical fiber.

Fiber optic sensors:

Fiber optic instrumentation system; Different types of modulators, infer-metric method of measurement of length, Moire fringes, Bi-refringence fringes, measurement of pressure, temperature, current, voltage, liquid level and strain.

Module III-[9L]

LED:

Structure of LED and its characteristics, heterojunction LED, power and efficiency calculation.

Photo diode:

PIN photodiode, hetero junction diode, avalanche photo diode.

Module IV- [8L]

LASER fundamentals:

Fundamental characteristics of lasers, three level and four level lasers, properties of lasers, laser modes, resonator configuration-Q switching and mode locking, cavity damping, types of lasers-gas lasers, liquid laser, solid lasers, semi-conductor lasers: double heterojunction broad area laser, stripe geometry DH laser.

Industrial applications of LASER:

Laser for measurement of distance, length, velocity, acceleration and atmospheric effect; Material processing: Laser heating, welding, melting and trimming of material- removal and vaporization.

References:

1. J. M. Senior, *Optical Fibre Communication, Principles and Practice;* Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, *Introduction to Opto Electronics*; Prentice Hall of India, 2001.
3. Donald J. Sterling Jr, *Technicians Guide to Fibre Optics ;* 3rd Edition, Vikas Publishing House, 2000.
4. M. Arumugam, *Optical Fibre Communication and Sensor;* Anuradha Agencies, 2002.
5. John F. Read, *Industrial Applications of Lasers;* Academic Press, 1978.
6. Monte Ross, *Laser Applications*; McGraw Hill, 1968.
7. G. Keiser, *Optical Fibre Communication*; McGraw Hill, 1995.
8. S. M. Zse*, Physics of Semiconductor Devices;* Wiley; Third edition , 2008
9. Ajay Ghatak, *Optics*; TMH,2012

Course Title: Analytical Instrumentation					
Course Code: AEI3132					
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:

AEI3132.1: Explain the functions of different gas analyzers.

AEI3132.2: Apply liquid analysis techniques for analyzing liquids.

AEI3132.3: Acquire knowledge of UV-V, IR, X- Ray and atomic mass spectroscopy.

AEI3132.4: Analyze different chromatographic methods used in industries and research purposes.

AEI3132.5: Select instrument for a particular analysis with advantages and limitations
AEI3132.6: Learn applications of analytical methods used in clinical analysis, drugs and pharmaceutical laboratories and monitoring environmental pollution.

Module I – [10L]

Gas Analyzers:

Introduction to analytical instruments: classification, qualitative and quantitative analysis; Gas analyzers: gas analysis of component in binary gas mixture by thermal conductivity method, heat of reaction method; oxygen analysis- magneto dynamic instrument (Pauling cell), thermo magnetic type or hot wire type instrument, zirconia oxygen analyzer, NOx, COx, SO_X analyzers.

Module II - [6L]

Spectrometry:

Electromagnetic radiation, Beer-Lambert law, colorimeters, UV-Visible spectrophotometers: single and double beam instruments, sources and detectors. IR spectrophotometers: types, FTIR spectrophotometers, flame photometer. Atomic spectrophotometers: absorption/emission type, sources, detectors applications; fluorescence spectrophotometer; X-ray diffractometer: working principle and applications; Mass spectrometer: working principle,

Module III-[10L]

Chromatography:

Principle of chromatography, basic definitions – distribution or partition coefficient, retention time and volume, dead time, capacity factor, retention ratio, chromatographic band broadening, column efficiency, column resolution ; gas chromatography – gas – solid and gas – liquid chromatography, different stages of it; liquid chromatography – classifications, adsorption type, partition type, gel permeation type, ion- exchange type chromatography; high-pressure liquid chromatography (HPLC): principle, sample injection system, column, detectors, applications.

Module IV- [10L]

Liquid Analysis:

Galvanic cell, electrolytic cell, electrode potential, reference and measuring or indicator electrodes, Nernst equation, standard hydrogen electrode, types of indicator electrodes – metallic electrode and membrane electrode – types, ion-selective and molecular selective electrode, dissolved oxygen analysis; pH analysis: pH electrodes, circuit for pH measurement and applications; conductivity cells, TDS analyzer: standards, circuits and applications; voltametry and polarography: apparatus, circuits and techniques, applications.

References:

1. Skoog, Holler and Nieman, *principles of Instrumental Analysis,* Thomson Brooks/ Cole.
2. R.S. Khandpur, *Handbook of Analytical Instruments*, Tata McGraw-Hill.
3. G. W. Ewing, *Instrumental Methods of Analysis*, Tata McGraw-Hill.
4. Robert D. Braun, *Introduction to Instrumental Analysis*, pharma book syndicate.
5. D. Patranabis, *Principles of Industrial Instrumentation, McGraw Hill Education (India) Pvt. Ltd, Noida, 2013.*

Course Title: Industrial Networking					
Course Code: AEI3133					
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:

AEI3133.1: Describe various communication techniques used in industrial networks.

AEI3133.2: Interpret industrial communication standards and protocols.

AEI3133.3: Explain automation components and systems application.

AEI3133.4: Apply HART to calibrate smart instruments.

AEI3133.5: Differentiate the network architecture of HART, Fieldbus, PROFIBUS, MODBUS.

AEI3133.6: Distinguish features of HART, Fieldbus, PROFIBUS, MODBUS.

Module I – [8L]

Introduction to Industrial networking:

Introduction, digital and analog communication, transmission modes, use of modems, data rate and bandwidth relationship, multiplexing types, Manchester encoding and synchronous communications, analog signalling, sharing the communication channel, data communication standards and organizations, network topology, network components, classification of networks, OSI model, TCP/IP protocol suite, communication hierarchy in factory, network and protocol standards.

Module II - [10L]

Industrial Communication Standards and Protocols:

Standards organizations, serial data communication interface standards, balanced and unbalanced transmission lines, synchronous and asynchronous communication, industry open standards: RS 232, 422, 485 standards, IEEE 488, Ethernet networks, MODBUS, proprietary protocols: MODBUS Plus, data highway plus, Industrial protocols - XON/OFF signalling, binary synchronous protocol (BSC), HDLC/SDLC protocol, CSMA/CD, CA protocol, sensor-level protocols: AS-i, CAN, DeviceNet, Interbus, and LON.

Module III-[8L]

Highway Addressable Remote Transducer (HART):

HART Communication - networks, Mechanism: HART system - system devices, system installation, system configuration, system calibration, HART multi-drop mode, HART multi-variable transmitters and burst mode; HART Protocol - protocol model, protocol commands, protocol data; HART integration - basic industrial field networks, choosing the right field networks, choosing the right field networks, wireless HART, benefits.

Module IV- [10L]

Fieldbus, PROFIBUS, MODBUS and HMI system:

Foundation fieldbus - definition and features, architecture, standards, communication process, technology of foundation fieldbus, linking and scheduling of blocks, device information, redundancy, system configuration; PROFIBUS - architecture, bus access model, characteristics, network configuration; MODBUS - network architecture, communication transactions, protocol description, transmission modes, message framing, MODBUS TCP/IP; HMI – overview, models, systems, designs, interfaces.

Introduction to wireless sensor networks.

References:

1. Sunit Kumar Sen, "Fieldbus and Networking in Process Automation", CRC Press, 2020.
2. Béla G. Lipták, "Instrument Engineers' Handbook, Process Software and Digital Networks" CRC Press, 2002.
3. Tan Kok Kiong, Andi Sudjana Putra, "Drives and Control for Industrial Automation," Springer-Verlag London Limited, 2011.
4. Peng Zhang,"Industrial Control Technology," William Andrew Inc., Norwich , NY, USA 2008.
5. Tony R. Kuphaldt, "Lessons In Industrial Instrumentation," 2014

Course Title: Introduction to MEMS					
Course Code: AEI3121					
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:

AEI3121.1: Familiarise with working principles of MEMS devices.

AEI3121.2: Identify the fabrication procedure like deposition, lithography and etching.

AEI3121.3: Understand the issues related to deposition and etching.

AEI3121.4: Select the materials related to different types of micro sensors and actuators.
AEI3121.5: Learn different types of micro-manufacturing techniques.

AEI3121.6: Acquire knowledge regarding wafer bonding and FEM.

Module I – 12L

Introduction and Historical Background of MEMS, Scaling Laws – Scaling in geometry.
Concepts of sensing and actuation: Electrostatic sensing and actuation-parallel plate capacitor – Application-Inertial, pressure and tactile sensor; parallel plate actuator- comb drive.
Thermal sensing and Actuations-thermal sensors – Actuators – Applications - Inertial, Flow and Infrared sensors. Piezoresistive sensors- piezoresistive sensor material- stress in flexural cantilever and membrane Application-Inertial, pressure, flow and tactile sensor.

Module II- 8L

Basic MEMS fabrication modules: Different types of Deposition Techniques, Oxidation, Ion implantation, CVD, PVD, Photo Lithography and Dry and wet Etching. Reactive Ion Etching. Isotropic Etching and Anisotropic Etching.

Module III- 9L

Materials for MEMS and Microsystems: Overview of Semiconductors, Silicon as a MEMS material – mechanical properties of silicon; Mechanical components in MEMS; Introduction to MEMS and MOEMS materials: Detailed overview of Poly Silicon, Quratz, SiO2, SiC, GaAs etc. Piezoelectric sensing and actuation- piezoelectric material properties-quartz.

Module IV - 8L

Micromachining: Bulk Micromachining and Surface Micromachining, Issues related to Bulk and surface micro-manufacturing. Introduction to LIGA process. Concept of Wafer Bonding.
Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.

2. S. E. L. Yshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M. H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Course Title: Fundamentals of Operating Systems					
Course Code: CSE3121					
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:

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.

Text Book:

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

Reference Books:

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 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 completion of the course, students 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:

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

Course Title: Industrial Engineering					
Course Code: MEC3124					
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:

MEC3124.1: Identify different concepts of IE functions.

MEC3124.2: Execute product development and design-manufacturing decisions with IE tools.

MEC3124.3: Classify and implement plant layout/location decisions.

MEC3124.4: Explain different types of production systems and their characteristics.

MEC3124.5: Judge the production planning and inventory management with a mechanism of proper control.

MEC3124.6: Recognize and select appropriate tools of work-study for improvement in productivity.

Module I: [7L] Introduction to Industrial Engineering

Evolution of modern concepts in IE-Functions of IE, Field of application of IE, Product Development and Research-Design Functions-Objectives of Design-Manufacturing vs. Purchase-Economic aspects-CVP Analysis-Simple Problems, Development of designs- prototype, production and testing-Human factors in design-Value Engineering,

Module II: [10L] Location Selection and Plant Layout

Nature of Location Decision, Importance of Plant Location, Dynamic Nature of Plant Location, Choice of site for selection, Comparison of Location, Principles of Plant Layout and Types, Factors affecting Layout, methods, Factors governing flow pattern, travel chart, analytical tool of plant layout, layout of manufacturing shop floor, repair shop, service sectors and process plant, Quantitative methods of Plant Layout: CRAFT and CORELAP, Relationship Diagrams.

Module III: [10L] Production Planning & Control

Importance of Planning, Types of Production Systems and their Characteristics, Functions & Objectives of Production Planning & Control-Routing, Scheduling, Dispatching and Expediting-Gantt Charts, Inventory Control, Inventory models-determination of EOQ and reorder levels-simple problems- selective Inventory control techniques, introduction to line of balance, assembly line balancing ,and progress control.

Module IV: [12L] Productivity and Work Study

Definition of Productivity, application and advantages of Productivity improvement tools, reasons for increase and decreases in Productivity, Areas of application of work study in Industry, Method Study: objectives and procedure for methods analysis, recording techniques,

operations process chart, man- machine chart, multiple activity chart, travel chart, and two handed process chart, string diagram, Therbligs, micro-motion study: principles of motion economy, Work measurement : objectives, work measurement techniques-time study, work sampling, pre-determined motion time standards(PMTS)Determination of time standards ,observed time, basic time, normal rating, rating factors, allowances, and standard time. Ergonomics-wages and incentives, primary wage system, wage incentive plans.

Text Books

1. Modern Production/Operations Management (Wiley Series in Production)/Operations Management by Elwood S. Buffa and Rakesh K. Sarin | 2 September 1987.
2. Production System, Planning, Analysis and Control by J L Riggs, 3rd Edition Wiley.

Reference Books

1. Production and Operation Management by R Panneerselvam , PHI publishers
2. Industrial Engineering and Production Management by Martland Telsang, S. Chand and Company.

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 completion of the course, students will be able to:

INC3016.1: Analyse the historical, political and philosophical context behind the Indian Constitution-making process
INC3016.2: Appreciate the important principles characterizing the Indian Constitution and institute comparisons with other constitutions
INC3016.3: Understand the contemporaneity and application of the Indian Constitution in present times
INC3016.4: Critique the contexts for constitutional amendments in consonance with changing times and society.
INC3016.5: Establish the relationship between the Indian Constitution and civil society at the collective as well as the individual levels
INC3016.6: 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, 2001.
2. David Held et al. (ed), The Idea of the Modern State, Open Univ. Press, Bristol, 1993
3. Neera Chandoke, State and Civil Society, Sage, Delhi, 1995

Course Title: Process Control Lab					
Course Code: AEI3151					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

AEI3151.1: Draw and explain P&I diagram of flow, pressure, level and temperature control loop from their engineering knowledge.

AEI3151.2: Analyze the process responses with respect to various tuning parameters.

AEI3151.3: Use software tool to study the close loop process responses.

AEI3151.4: Create ladder logic diagram for various sequential operations commonly used in industrial environment.

AEI3151.5: Conduct experiments either in group or by individual means.

AEI3151.6: Familiarise with BMS and boiler drum level control system.

List of Experiments:

1. Familiarization with transmitters (pressure, flow, level, temperature), air pressure regulators, I/P converters, control valves, electromechanical relays, SIEMENS PLC hardware etc.
2. Study of flow, level and pressure processes and building of P&I diagram as per ISA guidelines /Standards.
3. Study of controller responses for different values of *KP, TI* and *TD* in flow control loops (air duct and water flow system).
4. Study of controller responses for different values of *KP, TI* and *TD* in pressure control loop.
5. Study of controller responses for different values of *KP, TI* and *TD* in Level control loop.
6. Study of a furnace temperature control loop.
7. Realization of ladder logic programs in SIEMENS PLC.
8. Study of single element & three element boiler drum level control and burner management system using boiler simulation software (WinCC).

Course Title: Microprocessor & Microcontroller Lab					
Course Code: AEI3152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

AEI3152.1: Identify and select the appropriate instructions, and develop different assembly language programs for the 8085 microprocessor.

AEI3152.2: Develop the interfacing of various input/output devices with 8085 microprocessor.

AEI3152.3: Execute assembly language program to control LEDs, switches and 7 segment displays for various applications.

AEI3152.4: Write assembly language program to control the speed and rotation of stepper motor.

AEI3152.5: Analyze the processing of analog signal using A/D converter.

AEI3152.6: Generate various analog signals (like square wave, triangular wave) using D/A converter.

List of Experiments:

1. Familiarization with the 8085 training kit/simulator components and the procedure of saving and examining the contents of memory and registers.
2. Analyzing pre-written programs on 8085 trainer kit/simulator using the basic instruction set (data transfer, load/store, arithmetic and logical). Assignments based on these.
3. Programming using 8085 trainer kit/simulator for:
   a) Addition of two 8 bit BCD numbers
   b) Addition of two 16 bit unsigned numbers
   c) Multiplication of two 8 bit unsigned numbers
   d) Division of two 8 bit unsigned numbers
   e) Copy/Shift a block of data from one memory location to another memory location
   f) Packing and unpacking of 8 bit BCD number
   g) Binary to ASCII conversion
   h) Sorting (Bubble) of numbers
4. Interfacing of switches and LEDs to 8085A trainer kit via 8255A PPI/8051 Microcontroller to perform the following tasks:
   a) Display operation
   b) Blinking operation
   c) Scrolling operation
5. Interfacing of seven segment displays to 8085A trainer kit via 8255A PPI/8051 Microcontroller via 8-bit latch (e.g., 74LS373).

6. Interfacing of Analog to Digital Converter (ADC) and Digital to Analog Converter (DAC) to 8085A trainer kit via 8255A PPI/8051 Microcontroller via 8-bit latch (e.g., 74LS373).
7. Interfacing of stepper motor to 8085A trainer kit via 8255A PPI/8051 Microcontroller.

Course Title: Basics of RDBMS Lab					
Course Code: CSE3156					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:

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

CSE3156.1: Understand the formal foundation on the relational model of data

CSE3156.2: Define SQL and procedural interfaces to SQL comprehensively

CSE3156.3: Analyze systematic database design approaches covering conceptual design, logical design and an overview of physical design

CSE3156.4: Demonstrate techniques relating to query processing by SQL engines

CSE3156.5: Apply the DDL and DML components of Structured query language (SQL) in Oracle RDBMS system

CSE3156.6: Understand and create database programs with PL/SQL programming

Experiments on Database on RDBMS Platform (Oracle):

DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding and modifying column data types, etc.

DML: Inserting rows, Updating rows, Deleting rows.

SQL Query: Cartesian product, All types of Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause.

Nested Sub-Queries, Views, Programming using Stored Procedures, Triggers.

Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc.

Textbooks:

1. Ivan Bayross, SQL PL/SQL: The Programming Language of Oracle, BPB Publications.

Open Elective I to be offered by Dept. of AEIE:							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	AEI3122	Fundamentals of Sensors & Transducers	3	0	0	3	3
2	AEI3123	Optical Instrumentation	3	0	0	3	3

Course Title: Fundamentals of Sensors & Transducers					
Course Code: AEI3122					
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:

AEI3122.1: Memorize the knowledge on mechanical, electromechanical, thermal and acoustic, and optical sensors.

AEI3122.2: Identify and classify the sensors based on type of measurand such as strain, force, pressure, displacement, temperature, flow, etc.

AEI3122.3: Choose the application specific Sensors and Transducers.

AEI3122.4: Relate the sensors in various industrial applications.

AEI3122.5: Design and set up the sensing systems

AEI3122.6: Create the applications of smart sensors

Module I – [10L]

Fundamentals: Definition, principle of sensing and transduction, classification of transducers, static and dynamic characteristics of Transducers.
Resistive Transducers: Potentiometric transducer- Theory, type, symbol, materials, error calculations due to loading effects, sensitivity, and specifications.
Strain gauge- Theory, type, symbol, materials, gauge factor, temperature compensation and dummy gauge, Strain measurement circuit- quarter, half and full bridge configuration, and specifications.
Inductive Transducers: Principle, common types, Reluctance change type, Mutual inductance change type, transformer action type. LVDT- Construction, working principle, characteristics (modulated and demodulated).

Module II - [8L]

Capacitive sensors: Parallel plate type- Variable distance, variable area, variable dielectric constant type, calculation of sensitivity, response characteristics, specifications, and applications.

Piezoelectric transducers: Piezoelectric effect, type, charge and voltage co-efficient and relationships, crystal model, materials, charge amplifier; Ultrasonic sensors- Liquid velocity and level measurements.

Module III-[10L]

Contact type Thermal Sensors:

Resistance change type:

Resistance Temperature Detector (RTD) - materials, temperature range, R-T characteristics, configurations, specifications, and applications. Thermistors- materials, temperature range, R-T characteristics, applications and specification.

Thermo-emf sensor:

Thermocouple- Thermo electric laws, types, temperature ranges, series and parallel configurations, cold junction compensation, compensating cables.

Introduction to semiconductor type temperature sensors.

Non-Contact type Thermal Sensors:

Thermal Radiation sensors- types, constructions, working, temperature ranges and comparison.

Module IV- [8L]

Radiation Sensors:

LED, LDR, photodiodes, Photovoltaic cells, photo emissive cell types, materials, construction, response, applications. Geiger counters, Scintillation detectors.

Introduction to smart sensors.

References:

1. K. Ghosh, Introduction to transducers, PHI, 2015
2. E. A. Doebelin, Measurement Systems: Application and Design, Mc Graw Hill, New York
3. H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta.
4. S. Renganathan, Transducer engineering, Allied Publishers Limited, 2003.
5. D. V. S. Murty, Transducer and instrumentation, PHI, second edition, 2008.
6. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs and applications, Third edition, Springer International, 2010.
7. D Patranabis, Sensors and Transducers, PHI, 2nd ed.

Course Title: Optical Instrumentation					
Course Code: AEI3123					
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:

AEI3123.1: Study Optical Fibers and their performances.

AEI3123.2: Understand the basic concepts of LED and photo detector, properties and industrial applications.

AEI3123.3: Understand the LASER and application.

AEI3123.4: Study Fiber-optic sensor and application

AEI3123.5: Acquire the knowledge optical fibers.

AEI3123.6: Gain the fundamentals of opto-electronics

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.

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 :

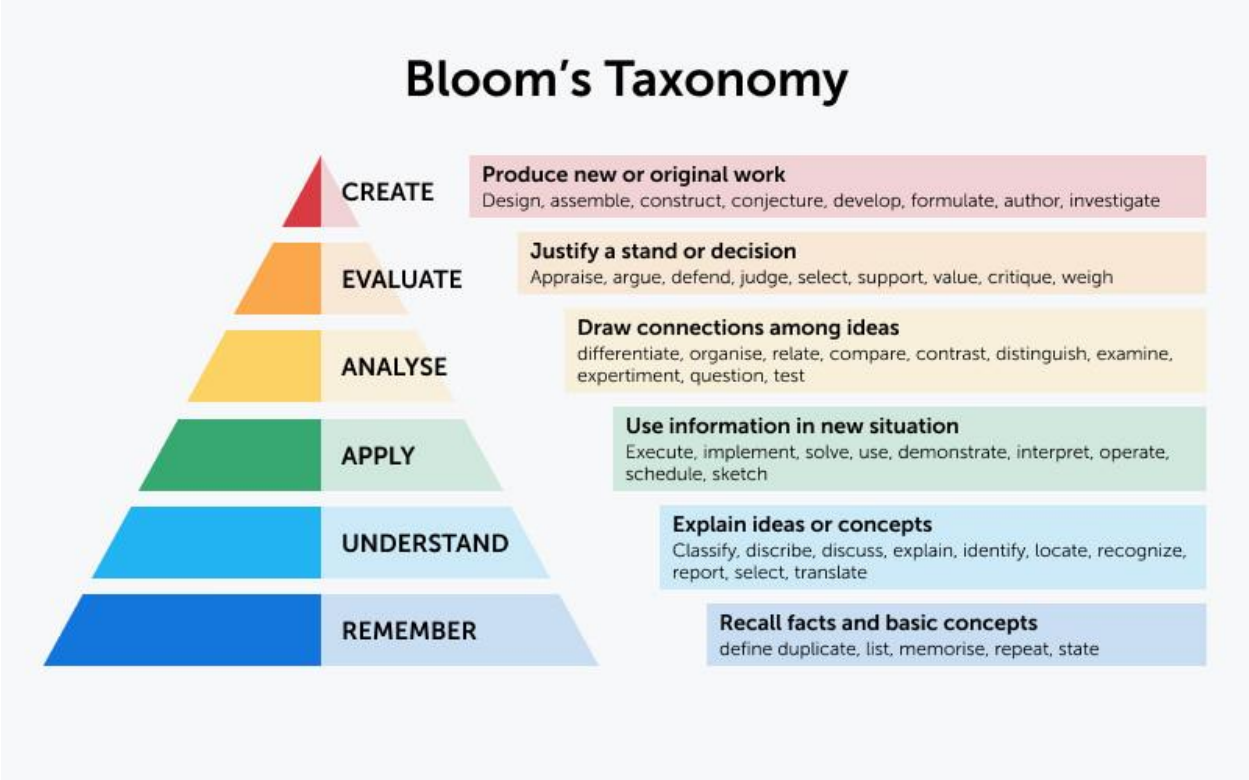
Report :

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