ADITYA COLLEGE OF ENGINEERING, MADANAPALLE

(UGC - Autonomous Institution & Accredited with NAAC A+ Grade)

Approved by AICTE, New Delhi & Affiliated to JNTUA, Anantapuramu

Madanapalle - 517325, Annamayya (Dist.), A. P.

www.acem.ac.in

ACEM - R24 REGULATION

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE AND SYLLABUS

for

B. Tech. (Regular – Full Time)

(Effective for the Students Admitted into I Year from the Academic Year 2024 - 25 onwards)

and

B. Tech. (Lateral Entry Scheme)

(Effective for the Students getting Admitted into II Year through Later Entry Scheme from the Academic Year 2025 - 26 onwards)

ADITYA COLLEGE OF ENGINEERING :: MADANAPALLE
Punganur Road, Valasapalle (Post), Madanapalle, Annamayya(Dist.,) – 517325.
(An Autonomous Institution)
Department of Electronics and Communication Engineering

Institute Vision:

To impart quality in engineering education to meet the technological advances and industrial requirements with global standards.

Institute Mission:

- Provide quality technical education through skill-based trainings and promote research and development, and consultancy services.
- Offer state-of-the-art-infrastructure for supporting technological advances.
- Develop disciplined, creative and globally competent engineers.
- Equip and empower the faculty at all levels to promote innovations and technical advancements in various domains of engineering.

Department Vision:

To design centre for excellence in the field of revolutionary electronic developments and the future communication to create quality engineers through innovation and impact professional ethics with a good teamwork to fulfil the social needs.

Department Mission:

- Creating graduates with technical expertise, professional, attitude and ethical values by establishing top notch learning environment.
- Inculcating creative thoughts through innovative and team work-based methods to develop entrepreneurship skills and employability among professionals.
- Strengthening soft skills to rural students through co-curricular and extracurricular activities to face industrial challenges.

Programme Outcomes (POs):

On Successful completion, the graduate 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, 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 modelling 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):

On Successful completion, the graduate (Electronics and Communication Engineering) will be able to,

- Identify, formulate, analyse, and solve problems and apply them to analog and digital electronics, communication, signal processing, VLSI systems, embedded systems, IoT, and other multidisciplinary domains.
- Understand Electronics and Communication Engineering changes and future trends and apply them to electronic system design using hardware, software, and electronic design automation tools.

Programme Educational Objectives (PEOs):

After few years of graduation, the graduates of Electronics and Communication Engineering are expected to

- To be equipped with skills for solving complex real-world problems related to VLSI, Embedded Systems, Signal/Image processing, and Digital and Wireless Communication.
- To communicate effectively, work collaboratively and exhibit high levels of professionalism, moral and ethical responsibility.
- To develop professional skills that will equip them to succeed in their careers and encourage lifelong learning in advanced areas of Electronics and Communications and related fields.
- To develop the ability to understand and analyze engineering issues in a broader perspective with ethical responsibility towards sustainable development.

B.Tech. – Electronics and Communication Engineering
Course Structure & Syllabus – ACEM R24 Regulations
(Applicable from the academic year 2024-25 onwards)

INDUCTION PROGRAMME

S.No.	Course Name	Category	L-T-P-C
1.	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2.	Career Counselling	MC	2-0-2-0
3.	Orientation to all branches -- career options, tools, etc.	MC	3-0-0-0
4.	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5.	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6.	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7.	Remedial Training in Foundation Courses	MC	2-1-2-0
8.	Human Values & Professional Ethics	MC	3-0-0-0
9.	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10.	Concepts of Programming	ES	2-0-2-0

Group - A

B.Tech. – I Year I Semester

S. No.	Category	Course Code	Name of the Course	L/D	T	P	Credits
1.	BS	24BSHB101T	Linear Algebra & Calculus	2	1	0	3
2.	BS	24BSHB103T	Engineering Physics	2	1	0	3
3.	ES	24ES02101T	Basic Electrical & Electronics Engineering	3	0	0	3
4.	ES	24ES03101T	Engineering Graphics	1	0	4	3
5.	ES	24ES05101T	Introduction to Programming	2	1	0	3
6.	BS	24BSHB103P	Engineering Physics Lab	0	0	2	1
7.	ES	24ES02101P	Electrical & Electronics Engineering Workshop	0	0	3	1.5
8.	ES	24ES05101P	Computer Programming Lab	0	0	3	1.5
9.	ES	24ES05102P	IT Workshop	0	0	2	1
10.	HM	24HMHS103L	NSS / NCC / Scouts & Guides/ Community Service	0	0	1	0.5
			Total	**10**	**3**	**15**	**20.5**

B.Tech. – I Year II Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	BS	24BSHB102T	Differential Equations & Vector Calculus	2	1	0	3
2.	BS	24BSHB104T	Chemistry	3	0	0	3
3.	HM	24HMHS101T	Communicative English	2	0	0	2
4.	ES	24ES01101T	Basic Civil & Mechanical Engineering	3	0	0	3
5.	PC	24PC02102T	Network Analysis	2	1	0	3
6.	BS	24BSHB104P	Chemistry Lab	0	0	2	1
7.	HM	24HMHS101P	Communicative English Lab	0	0	2	1
8.	PC	24PC02102P	Network Analysis and Simulation Lab	0	0	3	1.5
9.	ES	24ES03102P	Engineering Workshop	0	0	3	1.5
10.	HM	24HMHS102L	Health and Wellness, Yoga and Sports	0	0	1	0.5
			Total	**12**	**2**	**11**	**19.5**

B. Tech. – II Year I Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	BS	24BSHB208T	Probability and Complex Variables	2	1	0	3
2.	HM	24HMHS204L	Universal Human Values– Understanding Harmony and Ethical Human Conduct	2	1	0	3
3.	PC	24PC04201T	Signals, Systems and Stochastic Processes	2	1	0	3
4.	PC	24PC04202T	Electronic Devices and Circuits	2	1	0	3
5.	PC	24PC04203T	Digital Circuits Design	2	1	0	3
6.	PC	24PC04202P	Electronic Devices and Circuits Lab	0	0	3	1.5
7.	PC	24PC04203P	Digital Circuits & Signal Simulation Lab	0	0	3	1.5
8.	SE	24SE05202S	Python Programming	0	1	2	2
9.	HM	24HMHS205A	Environmental Science	2	0	0	--
			Total	**10+2**	**6**	**8**	**20**

B. Tech. – II Year II Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	HM	**Management Elective – I (HM – I)**		2	0	0	2
		24HMHS206T	Managerial Economics and Financial Analysis				
		24HMHS207T	Organizational Behaviour				
		24HMHS208T	Business Environment				
2.	PC	24PC02209T	Linear Control Systems	2	1	0	3
3.	PC	24PC04205T	EM Waves and Transmission Lines	2	1	0	3
4.	PC	24PC04206T	Electronic Circuits Analysis	2	1	0	3
5.	PC	24PC04207T	Analog and Digital Communications	2	1	0	3
6.	PC	24PC04206P	Electronic Circuits Analysis Lab	0	0	3	1.5
7.	PC	24PC04207P	Analog and Digital Communications Lab	0	0	3	1.5
8.	SE	24SEHS201S	Soft Skills	0	1	2	2
9.	ES	24ES03102T	Design Thinking and Innovation	1	0	2	2
			Total	**11**	**5**	**10**	**21**
Mandatory Community Service Internship (24IPIN301L) of 08 Weeks duration during Summer Vacation							

B.Tech. – III Year I Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	PC	24PC04310T	Analog and Digital IC Applications	3	0	0	3
2.	PC	24PC05307T	Introduction to Quantum Technologies and Applications	3	0	0	3
3.	PC	24PC04311T	Antennas & Wave Propagation	2	1	0	3
4.	PC	24PC04312T	Microprocessors and Microcontrollers	2	1	0	3
5.	PE	**Professional Elective – I (PE – I)**		3	0	0	3
6.	OE	**Open Elective – I (OE – I)**		3	0	0	3
7.	PC	24PC04310P	Analog & Digital IC Applications Lab	0	0	3	1.5
8.	PC	24PC04312P	Microprocessors and Microcontrollers Lab	0	0	3	1.5
9.	SE	24SE04301S	PCB Design and Prototype Development.	0	1	2	2
10.	ES	24ES04301P	Tinkering Lab	0	0	2	1
11.	IP	24IPIN301L	Evaluation of Community Service Internship	0	0	0	2
			Total	**16**	**3**	**10**	**26**

Professional Elective – I (PE - I)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE04302T	Computer Architecture & Organization	3	0	0
2.	24PE04303T	Information theory and coding	2	1	0
3.	24PE04304T	Detection and Estimation Theory	2	1	0

Open Elective – I (OE - I)

S. No.	Course Code	Name of the Course	Offered by the Dept.	L	T	P
1.	24OE01301T	Green Buildings	Civil	2	1	0
2.	24OE01302T	Construction Technology and Management		2	1	0
3.	24OE02301T	Electrical Safety Practices and Standards	EEE	3	0	0
4.	24OE03301T	Sustainable Energy Technologies	ME	3	0	0
5.	24OE05301T	Java Programming	CSE & Alied	2	1	0
6.	24OE31301T	Fundamentals of Artificial Intelligence		2	1	0
7.	24OE05302T	Quantum Technologies and Applications		3	0	0
8.	24OEHB301T	Mathematics for Machine Learning and AI	Mathematics	2	1	0
9.	24OEHB302T	Materials Characterization Techniques	Physics	2	1	0
10.	24OEHB303T	Chemistry of Energy Systems	Chemistry	3	0	0
11.	24OEHS301T	English for Competitive Examinations	Humanities	3	0	0
12.	24OEHS302T	Entrepreneurship and New Venture Creation	Management	3	0	0

Note: 1. A student is permitted to register for Honours or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.
2. A student shall not be permitted to take courses as Open Electives/Minor/Honours with content substantially equivalent to the courses pursued in the student's primary major.
3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline

B.Tech. – III Year II Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	PC	24PC04313T	Digital Signal Processing	2	1	0	3
2.	PC	24PC04314T	Microwave and Optical Communications	2	1	0	3
3.	PC	24PC04315T	VLSI Design	3	0	0	3
4.	PE	**Professional Elective – II (PE – II)**		3	0	0	3
5.	PE	**Professional Elective – III (PE – III)**		3	0	0	3
6.	OE	**Open Elective – II (OE – II)**		3	0	0	3
7.	PC	24PC04314P	Microwave & Optical Communication lab	0	0	3	1.5
8.	PC	24PC04315P	VLSI Design Lab	0	0	3	1.5
9.	SE	24SE04302S	Machine Learning and DSP	0	1	2	2
10.	MC	24MCHS309A	**Mandatory Non-credit Course** Technical Paper Writing &IPR	2	0	0	0
11.	WS	24IPWS302L	Workshop	0	0	0	0
			Total	**16+2**	**3**	**8**	**23**
Mandatory Industry Internship (24IPIN403L) of 08 weeks duration during Summer Vacation							

Professional Elective – II (PE-II)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE04305T	Electronic Measurements and Instrumentation	3	0	0
2.	24PE04306T	Embedded systems & IOT	3	0	0
3.	24PE04307T	Speech Processing	3	0	0

Professional Elective – III (PE - III)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE04310T	Digital Image Processing	2	1	0
2.	24PE31305T	Artificial Intelligence & Machine learning	2	1	0
3.	24PE04311T	Satellite Communications	3	0	0

Open Elective – II (OE - II)

S. No.	Course Code	Name of the Course	Offered by the Dept.	L	T	P
1.	24OE01303T	Disaster Management	Civil	2	1	0
2.	24OE01304T	Sustainability In Engineering Practices		2	1	0
3.	24OE02302T	Renewable Energy Sources	EEE	3	0	0
4.	24OE03302T	Automation and Robotics	ME	3	0	0
5.	24OE05303T	Operating Systems	CSE & Alied	3	0	0
6.	24OE31302T	Introduction to Machine Learning		2	1	0
7.	24OEHB304T	Optimization Techniques	Mathematics	2	1	0
8.	24OEHB305T	Mathematical Foundation of Quantum Technologies		2	1	0
9.	24OEHB306T	Physics of Electronic Materials and Devices	Physics	2	1	0
10.	24OEHB307T	Chemistry of Polymers and Applications	Chemistry	3	0	0
11.	24OEHS303T	Academic Writing and Public Speaking	Humanities	3	0	0

B.Tech. – IV Year I Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	PC	24PC04416T	Data Communications and Networking	3	0	0	3
2.	HM		**Management Elective – (HM – II)**	2	0	0	2
3.	PE		**Professional Elective – IV (PE – IV)**	3	0	0	3
4.	PE		**Professional Elective – V (PE – V)**	3	0	0	3
5.	OE		**Open Elective – III (OE – III)**	3	0	0	3
6.	OE		**Open Elective – IV (OE – IV)**	3	0	0	3
7.	SE	24SE04403S 24SE04404S	RF System Design tools Industrial IoT & Automation	0	1	2	2
8.	MC	24MCHS413A	**Mandatory Non-credit Course** Gender Sensitization	2	0	0	-
9.	IP	24IPIN403L	Evaluation of Industry Internship	-	-	-	2
			Total	**17 +2**	**1**	**2**	**21**

Management Elective – II (HM - II)

S. No.	Course Code	Name of the Course	L	T	P
1.	24HMHS410T	Business Ethics and Corporate Governance	2	0	0
2.	24HMHS411T	E-Business	2	0	0
3.	24HMHS412T	Management Science	2	0	0

Professional Elective – IV (PE - IV)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE04413T	Radar Engineering	3	0	0
2.	24PE04414T	DSP Processors & Architectures	3	0	0
3.	24PE04415T	Cellular & Mobile Communications	3	0	0

Professional Elective – V (PE - V)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE04417T	Low Power VLSI Design	3	0	0
2.	24PE04418T	Wireless Sensor Networks	3	0	0
3.	24PE04419T	5G Communications	3	0	0

Open Elective – III (OE - III)

S. No.	Course Code	Name of the Course	Offered by the Dept.	L	T	P
1.	24OE01405T	Building Materials and Services	Civil	3	0	0
2.	24OE01406T	Environmental Impact Assessment		3	0	0
3.	24OE02403T	Smart Grid Technologies	EEE	3	0	0
4.	24OE03403T	3D Printing Technologies	ME	3	0	0
5.	24PC05204T	Data Base Management Systems	CSE&Alied	2	1	0
6.	24PE05305T	Cyber Security		3	0	0
7.	24OEHB408T	Wavelet transforms and its Applications	Mathematics	2	1	0
8.	24OEHB409T	Smart Materials and Devices	Physics	2	1	0
9.	24OEHB410T	Introduction to Quantum Mechanics		2	1	0
10.	24OEHB411T	Green Chemistry and Catalysis for Sustainable Environment	Chemistry	3	0	0
11.	24OEHS404T	Employability Skills	Humanities	3	0	0

Open Elective – IV (OE-IV)

S. No.	Course Code	Name of the Course	Offered by the Dept.	L	T	P
1.	24OE01407T	Geo-Spatial Technologies	Civil	2	1	0
2.	24OE01408T	Solid Waste Management		2	1	0
3.	24OE02404T	Electric Vehicles	EEE	3	0	0
4.	24OE03404T	Total Quality Management	ME	2	1	0
5.	24OE05404T	Introduction to Computer Networks	CSE & Alied	3	0	0
6.	24PE04416T	Internet of Things		3	0	0
7.	24PE05310T	Introduction to Quantum Computing		3	0	0
8.	24OEHB412T	Financial Mathematics	Mathematics	2	1	0
9.	24OEHB413T	Sensors and Actuators for Engineering Applications	Physics	3	0	0
10.	24OEHB414T	Chemistry of Nanomaterials and Applications	Chemistry	3	0	0
11.	24OEHS405T	Literary Vibes	Humanities	2	1	0

B.Tech. – IV Year II Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	IP	24IPIN404L	Internship	-	-	-	4
2.	IP	24IPPR401L	Project	-	-	-	8
			Total	**-**	**-**	**-**	**12**

HONOURS DEGREEOFFERED IN ECE
VLSI SPECIALIZATION

S.No.	Course Code	Name of the Course	L	T	P	Credits
1.	24HON0401T	Analog IC Design	3	0	0	3
2.	24HON0402T	Digital IC Design	3	0	0	3
3.	24HON0403T	Low power VLSI	3	0	0	3
4.	24HON0404T	Testing and Verification	3	0	0	3
5.	24HON0405T	FPGA architectures	3	0	0	3
6.	24HON0406P	Analog and Digital IC Design Lab	0	0	3	1.5
7.	24HON0407P	Physical Design Automation Lab	0	0	3	1.5
		Total	**15**	**0**	**06**	**18**

MINOR DEGREES OFFERED IN ECE TO OTHERS

EMBEDDED SYSTEMS AND IoT

S.No.	Course Code	Name of the Course	L	T	P	Credits
1.	24MEI0401T	Embedded Systems Technology	3	0	0	3
2.	24MEI0402T	Real Time Embedded systems design and Analysis	3	0	0	3
3.	24MEI0403T	Principles of IoT	3	0	0	3
4.	24PE04418T	Wireless Sensor Networks	3	0	0	3
5.	24MEI0404T	Industrial Internet of things	3	0	0	3
6.	24MEI0405P	Principles of IoT Lab	0	0	3	1.5
7.	24MEI0406P	Industrial Internet of things Lab	0	0	3	1.5
		Total	**15**	**0**	**6**	**18**

ELECTRONIC SYSTEMS

S.No.	Course Code	Name of the Course	L	T	P	Credits
1.	24OE04301T	Electronic Circuits	2	1	0	3
2.	24OE04302T	Digital Electronics	2	1	0	3
3.	24MES0401T	Principles of Communication Engineering	3	0	0	3
4.	24MES0402T	Electronic Instrumentation	3	0	0	3
5.	24PC04312T	Microprocessors and Microcontrollers	2	1	0	3
6.	24MES0403P	Electronic Circuits &Digital Electronics Lab	0	0	3	1.5
7.	24PC04312P	Microprocessors and Microcontrollers Lab	0	0	3	1.5
		Total	**12**	**3**	**6**	**18**

B.Tech. – I Year

I Semester

B. Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB101T	**BS**	**Linear Algebra & Calculus** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites: Basic Knowledge of Mathematics

CourseObjectives:

To equip the students with standard concepts and tools at an intermediate to advancedlevel mathematics to develop the confidence and ability among the students to handlevariousreal-worldproblems andtheirapplications.

Course Outcomes (COs):

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

CO1: Apply matrixalgebratechniques to get optimistic solutions for practical problems. (L3)

CO2: Apply the concepts of Eigenvalues, Eigenvectors, and orthogonal transformation to solve real- lifeproblems. (L3)

CO3: Utilizemeanvaluetheoremstoreal-lifeproblems. (L3)

CO4: Solve real-time problems which are functions of multivariable using partial differentiation. (L3)

CO5: Apply multiple integrals to find the area in two dimensions and volume in three-dimension coordinates systems respectively. (L3)

Unit I: Matrices:

Rank of a matrix by echelon form, normal form. Cauchy–Binet formulae (without proof). Inverse of non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods.

Unit II: Eigen values, Eigenvectors and Orthogonal Transformation:

Eigen values, Eigenvectors and their properties, Diagonalization of a matrix, Cayley Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

Unit III: Calculus:

Mean Value Theorems: Rolle’s Theorem, Lagrange’s mean value theorem with their geometrical interpretation, Cauchy’s mean value theorem, Taylor’s and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

Unit IV: Partial differentiation and Applications (Multi variable calculus):

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Taylor’s and Maclaurin’s series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functions of two variables, method of Lagrange multipliers.

Unit V: Multiple Integrals (Multi variable Calculus):

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley &Sons, 2018, 10th Edition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weirand Joel Hass, Pearson Publishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, R. K. Jainand, S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint).
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, Micheael Greenberg, Pearson publishers, 9th edition
5. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, Third Edition (Reprint 2021).

B. Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB103T	BS	**Engineering Physics** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites: Fundamentals of Physics

Course Objectives:

To bridge the gap between Physics in school at 10+2 level and UG level engineering courses by identifying the importance of optical phenomenon like interference, diffraction, etc, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

Course Outcomes (COs):

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

CO1: Analyze the intensity variation of light due to Interference Diffraction and Polarization. (L4)

CO2: Analyze the properties of crystals and determine the type of structure using the X-ray Diffraction technique. (L4)

CO3: Summarize various types of Polarization of dielectric materials & Classify Magnetic materials. (L4)

CO4: Apply the fundamentals of quantum mechanics &free electron theory to the dimensional motion of particles. (L3)

CO5: Explain the basics concepts in semiconductors and identify the type of semiconductor using Halleffect. (L3)

Unit I: Wave Optics:

Interference: Introduction **-** Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative).

Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

Unit II: Crystallography and X-ray Diffraction :

Space lattice, Basis, Unit Cell and lattice parameters Bravais Lattices – crystal systems (3D) – co ordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer –crystal structure determination by Laue's and powder methods.

Unit III : Dielectric and Magnetic Materials:

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials:

Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

Unit IV: Quantum Mechanics and Free electron Theory:

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy

Unit V: Semiconductors :

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation **--** Direct and Indirect Band gap of semiconductors – Hall effect and its applications.

Text Books:

1. Palanisamy ,"Engineering Physics", Palanisamy, Scitech Publications.
2. K.Thyagarajan,"Engineering Physics", McGraw Hill Publications.
3. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.K.shirsagar& TVS Arun Murthy, S. Chand Publications, 11th Edition 2019
4 Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)
.

Reference Books:

1.Introduction to solid state physics , Charles kittel 7thEdition , John Wiley and Sons.
2. Gaur and Gupta, "Engineering Physics", Dhanpatrai Publications.
3.Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).
4.Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.2010

Reference Website:

1. https://www.youtube.com/watch?v=PEXSH8dB-Uk
2. https://www.youtube.com/watch?v=YvrwVK9ZqQY
3. https://www.digimat.in/nptel/courses/video/115107095/L01.html
4. https://www.youtube.com/watch?v=6QUFuZpCgGw
5.https://nptel.ac.in/courses/115/105/115105122/

B. Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24ES02101T	**ES**	**Basic Electrical and Electronics Engineering** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Part - A: Basic Electrical Engineering

Pre-requisites: Fundamentals of Physics

Course Objectives:

To expose to the field of electrical & electronics engineering, laws and principles of electrical/ electronic engineering and to acquire fundamental knowledge in the relevant field.

Course Outcomes (COs):

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

CO1: Apply KVL& KCL to AC & DC Circuits to determine the various electrical parameters. (L3)

CO2: Explain the construction and working principles of electrical machines and measuring instruments, and compare their functions and applications in practical scenarios. (L4)

CO3: Distinguish between various power generation systems and evaluate domestic energy consumption to calculate electricity bills and implement appropriate electrical safety measures. (L4)

Unit I: DC & AC Circuits:

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

Unit II: Machines and Measuring Instruments:

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

Unit III: Energy Resources, Electricity Bill & Safety Measures:

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various **Power Generation Systems :**Hydel, Nuclear, Solar & Wind power generation. **Electricity bill:** Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "Unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Text Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition
2. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017.
3. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Pearson Publications, 2018, Second Edition.
4. E. Hughes, Electrical and Electronic Technology, PEARSON , 2010
5. 5. G. Rizzoni, Principles and Applications of Electrical Engineering, TMH , 2017

Web Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076
3. https://archive.nptel.ac.in/courses/108/105/108105053

Part-B: Basic Electronics Engineering

Pre-Requisites: Basic fundamentals of Physics and Boolean Algebra

Course Objectives:

This course provides the student with the fundamental skills to understand the principles of digital electronics, basics of semiconductor devices like diodes & transistors, characteristics and its applications.

Course Outcomes (COs):

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

CO1: Apply the concept of science and mathematics to understand the working of diodes, transistors with characteristics. (L3)

CO2: Analyze the applications of the diode and transistors. (L4)

CO3: Interpret number systems and coding schemes, and construct basic combinational and sequential circuits using logic gates and Boolean algebra for digital system design. (L4)

Unit I: Semiconductor Devices:

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode - Zener Effect -Zener Diode and its Characteristics. Bipolar Junction Transistor - CB, CE, CC Configurations and Characteristics- Elementary Treatment of Small Signal CE Amplifier.

Unit II: Basic Electronic Circuits **and Instrumentation:**

Rectifiers and power supplies: Block diagram description of a DC power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator.

Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. **Electronic Instrumentation:** Block diagram of an electronic instrumentation system.

Unit III: Digital Electronics:

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adder, Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

Text Books:

1. R. L. Boylestad& Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009.

Reference Website:

1. https://youtu.be/n9ZytPvXi7w
2. https://youtu.be/ngznoF6z0aw
3. https://youtu.be/S845RG7X70s
4. https://youtu.be/1OM3Bd8GXUo

B. Tech. – I Year I Semester

CourseCode	Category	Nameof the Course	L	T	P	C
24ES03101T	ES	**Engineering Graphics** (Common to all branches of Engineering)	1	0	4	3

Pre-Requisites: Basics of Geometry and Mathematics

Course Objectives:

- To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing
- To impart knowledge on the projection of points, lines and plane surfaces
- To improve the visualization skills for better understanding of projection of solids
- To develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces.
- To make the students understand the viewing perception of a solid object in Isometric and Perspective projections.

CourseOutcomes (COs):

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

CO1: Construct geometrical shapes, regular polygons, and engineering curves using standard drawing instruments and apply appropriate methods to draw plain, diagonal, and vernier scales. (L3)

CO2: Draw the orthographic projections of points, lines, and planes in various positions using reference planes and apply projection principles to solve related engineering problems. (L3)

CO3: Represent the projections of polyhedral and solids of revolution in different positions, including those inclined to reference planes. (L4)

CO4: Determine sectional views and true shapes of solids and develop their surfaces using appropriate geometric methods. (L4)

CO5: Convert isometric views to orthographic views and vice versa, and demonstrate basic 2D and 3D object modelling using CAD tools. (L4)

Unit I: Introduction:

Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabola and hyperbola by general method, Cycloids, Involutes, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernierscales.

Unit II: Orthographic Projections:

Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes.

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one referenceplaneand inclined to theotherreferenceplane; planeinclined to both thereferenceplanes.

Unit III: Projections of Solids:

Types of solids: Polyhedra and Solids of revolution. Projections of solids in simplepositions:

Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel tobooththereferenceplanes, Projection ofSolids withaxis inclined to one reference plane and parallel to anotherplane.

Unit IV: Sections of Solids:

Perpendicular and inclined section planes, Sectional views and True shape of section,Sectionsof solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of acube, prism, cylinder, pyramid andcone.

Unit V: Conversion of Views:

Conversion of isometric views to orthographic views; Conversion of orthographicviewsto isometricviews.

Computer graphics: Creating 2D&3D drawings of objects including PCB and Transformations using AutoCAD (*Not for end examination*).

TextBooks:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House,2016.

ReferenceBooks:

1. Engineering Drawing, K.L. Narayanaand P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M. B. Shah and B. C. Rana, Pearson Education Inc, 2009.
3. Engineering Drawingwith an Introductionto Auto CAD, Dhananjay Jolhe, Tata McGraw Hill,2017.

B. Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24ES05101T	**ES**	**Introduction to Programming** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites: Nil

Course Objectives:

- To introduce students to the fundamentals of computer programming.
- To provide hands-on experience with coding and debugging.
- To foster logical thinking and problem-solving skills using programming.
- To familiarize students with programming concepts such as data types, control structures, functions, and arrays.
- To encourage collaborative learning and teamwork in coding projects.

Course Outcomes (COs):

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

CO1: Demonstrate basics of computers, the concept of algorithm & flow chart and analyse the time & complexities of algorithms. (L4)

CO2: Write the algorithms, draw the flow charts and develop the programs using conditional statements of C-Language. (L3)

CO3: Write the algorithm, draw the flow chart and develop the programs using arrays & strings of C- Language. (L3)

CO4: Apply the Pointers & user defined Data types of C language and Develop solutions to real world problems. (L3)

CO5: Develop the programs using Functions for real world problems in C language. (L3)

Unit I: Introduction to Programming and Problem Solving:

History of Computers, Basic organization of a computer: ALU, input-output Units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program, Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting. Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

Unit II: Control Structures:

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do-while) Break and Continue.

Unit III: Arrays and Strings:

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings.

Unit IV: Pointers & User Defined Data types:

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions.

Unit V: Functions & File Handling:

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling

Note: The syllabus is designed with C Language as the fundamental language of implementation.

Text Books:

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988.
2. “Schaum’s Outline of Programming with C”, Byron S Gottfried, McGraw-Hill Education, 1996.

Reference Books:

1. “Computing fundamentals and C Programming”, Balagurusamy, E., McGraw-Hill Education, 2008.
2. “Programming in C”, Rema Theraja, Oxford, 2016, 2nd Edition.
3. “C Programming, A Problem-Solving Approach”, Forouzan, Gilberg, Prasad, CENGAGE, 3rd Edition.

B. Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB103P	BS	**Engineering Physics Lab** (Common for all branches of Engineering)	0	0	3	1

Pre-Requisites: Fundamentals of Physics

Course Objectives:

- To study the concepts of optical phenomenon like Interference, Diffraction, etc
- To recognize the importance of energy, gap a study of conductivity.
- To study the parameters and applications of di-electric and magnetic materials by conducting
- experiments
- To verify the laws of stretched strings
- To Plot the intensity of the magnetic field of circular coil carrying current with distance.

CourseOutcomes (COs):

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

CO1: Operate optical instruments like travelling microscope and spectrometer to measure the various physical quantities. (L2)

CO2: Examine the wavelengths of different colors using diffraction grating. (L4)

CO3: Plot the intensity of the magnetic field of circular coil carrying current with distance. (L2)

CO4: Determine dielectric constant for dielectric materials. (L2)

CO5: Calculate the band gap of a given semiconductor and to Identify the type of semiconductor using Hall effect. (L3)

CO6: Examine the loss of stretched string using sonometer (L4)

List of Experiments

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using Diffraction grating in normal incidence configuration.
3. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method
11. Determination of Hall voltage, Hall coefficient and type of semiconductor (N-type or P-Type)using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.

17. Determination of young's modulus for the given material of wooden scale by non uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment

Note: Any TEN of the listed experiments are to be conducted and TWO of these TEN experiments may be conducted in virtual mode.

Reference Book:

A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.

Web Resources :

1. www.vlab.co.in
2. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

B. Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24ES02101P	**ES**	**Electrical and Electronics Engineering Workshop** (Common to all branches of Engineering)	**0**	**0**	**3**	**1.5**

Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
    - Provide some exercises so that hardware tools and instruments are learned to be used by the students.
2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
    - Provide some exercises so that measuring instruments are learned to be used by the students.
3. Components:
    - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
    - Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

Part A: Electrical Engineering Lab

Pre-requisites: Fundamentals of Physics

Course Objectives:

To impart knowledge on the fundamental laws & theorems of electrical circuits, functions of electrical machines and energy calculations.

Course Outcomes (COs):

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

CO1: Verify KVL, KCL & various network theorems and Apply to AC & DC Electrical circuits to measure Electric Circuit parameters (R, L & C), Power, Power factor etc. (L3)

CO2: Conduct Experiments on AC & DC Machines, plot characteristics and measure the various electrical parameters or quantities. (L3)

CO3: Design suitable circuits and methodologies for the measurement of various electrical parameters; House hold and commercial wiring. (L3)

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Note: Minimum Six Experiments are to be performed.

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition.

Part-B: Electronics Engineering Lab

Pre-requisites: Fundamentals of Physics

Course Objectives:

To impart knowledge on the principles of digital electronics and fundamentals of electron devices & its applications.

Course Outcomes (COs):

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

CO1: Understand the usage of electronic measuring instruments and Analyze the V-I characteristics of arious electronic devices. (L4)

CO2: Develop various Analog Electronic Circuits such as Rectifier, Regulators and Amplifiers (L3)

CO3: Develop Digital Electronic Circuits such as Combinational and Sequential Circuits. (L3)

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Tables of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Tools / Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

Reference Books:

1. R. L. Boylestad& Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009.

Note: Minimum Six Experiments are to be performed. All the experiments shall be performed using both Hardware and Software

B. Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24ES05101P	ES	**Computer Programming Lab** (Common to all branches of Engineering)	0	0	3	1.5

Pre-Requisites: Nil

Course Objectives:

The course aims at providing students with hands – on experience and train them on the concepts of the C- programming language.

Course Outcomes (COs):

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

CO1: Read, understand, and trace the execution of programs written in C language. (L2)

CO2: Select the right control structure for solving the problem. (L3)

CO3: Develop C programs which utilize memory efficiently using programming constructs like pointers. (L3)

CO4: Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C. (L3)

Unit I: Week 1:

Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.

ii) Exposure to Turbo C, gcc

iii) Writing simple programs using printf (), scanf ()

Week 2:

Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab 1: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

i) Sum and average of 3 numbers

ii) Conversion of Fahrenheit to Celsius and vice versa

iii) Simple interest calculation

Week 3:

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:

Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.

i) Finding the square root of a given number

ii) Finding compound interest

iii) Area of a triangle using heron's formulae

iv) Distance travelled by an object

UNIT – II: Week 4:

Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:

Lab4: Simple computational problems using the operator' precedence and associativity

i) Evaluate the following expressions.

a. A+B*C+(D*E) + F*G

b. A/B*C-B+A*D/3

c. A+++B---A

d. J= (i++) + (++i)

ii) Find the maximum of three numbers using conditional operator

iii) Take marks of 5 subjects in integers, and find the total, average in float

Week 5:

Objective: Explore the full scope of different variants of "if construct" namely if-else, null-else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

Suggested Experiments/Activities:

Tutorial 5: Branching and logical expressions:

Lab 5: Problems involving if-then-else structures.

i) Write a C program to find the max and min of four numbers using if-else.

ii) Write a C program to generate electricity bill.

iii) Find the roots of the quadratic equation.

iv) Write a C program to simulate a calculator using switch case.

v) Write a C program to find the given year is a leap year or not.

Week 6:

Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

Suggested Experiments/Activities:

Tutorial 6: Loops, while and for loops

Lab 6: Iterative problems e.g., the sum of series

i) Find the factorial of given number using any loop.

ii) Find if the given number is a prime or not.

iii) Compute sine and cos series

iv) Checking a number palindrome

v) Construct a pyramid of numbers.

Unit III: Week 7:

Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:

Tutorial 7: 1 D Arrays: searching.

Lab 7:1D Array manipulation, linear search

i) Find the min and max of a 1-D integer array.

ii) Perform linear search on1D array.

iii) The reverse of a 1D integer array

iv) Find 2’s complement of the given binary number.

v) Eliminate duplicate elements in an array.

Week 8:

Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:

Tutorial 8: 2 D arrays, sorting and Strings.

Lab 8: Matrix problems, String operations, Bubble sort

i) Addition of two matrices

ii) Multiplication two matrices

iii) Sort array elements using bubble sort

iv) Concatenate two strings without built-in functions

v) Reverse a string using built-in and without built-in string functions

Unit – IV: Week9:

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C

Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation

Lab 9: Pointers and structures, memory dereference.

i) Write a C program to find the sum of a 1D array using malloc ()

ii) Write a C program to find the total, average of n students using structures

iii) Enter n students data using calloc () and display failed students list

iv) Read student name and marks from the command line and display the student details along with the total.

v) Write a C program to implement realloc ()

Week 10:

Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures

Suggested Experiments/Activities:

Tutorial 10: Bitfields, Self-Referential Structures, Linked lists

Lab10: Bitfields, linked lists

Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit-fields

i) Create and display a singly linked list using self-referential structure.

ii) Demonstrate the differences between structures and unions using a C program.

iii) Write a C program to shift/rotate using bitfields.

iv) Write a C program to copy one structure variable to another structure of the same type.

Unit – V: Week 11:

Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:
Tutorial 11: Functions, call by value, scope and extent,
Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem.

i) Write a C function to calculate NCR value.

ii) Write a C function to find the length of a string.

iii) Write a C function to transpose of a matrix.

iv) Write a C function to demonstrate numerical integration of differential equations using Euler’s method

Week 12:
Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at least five distinct problems that have naturally recursive solutions.
Suggested Experiments/Activities:
Tutorial 12: Recursion, the structure of recursive calls
Lab 12: Recursive functions

i) Write a recursive function to generate Fibonacci series.

ii) Write a recursive function to find the lcm of two numbers.

iii) Write a recursive function to find the factorial of a number.

iv) Write a C Program to implement Ackermann function using recursion.

v) Write a recursive function to find the sum of series.

Week 13:
Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers
Suggested Experiments/Activities:
Tutorial 13: Call by reference, dangling pointers
Lab 13: Simple functions using Call by reference, Dangling pointers.

i) Write a C program to swap two numbers using call by reference.

ii) Demonstrate Dangling pointer problem using a C program.

iii) Write a C program to copy one string into another using pointer.

iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

Week14:
Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.
Suggested Experiments/Activities:
Tutorial 14: File handling
Lab 14: File operations

i) Write a C program to write and read text into a file.

ii) Write a C program to write and read text into a binary file using fread () and fwrite ()

iii) Copy the contents of one file to another file.

iv) Write a C program to merge two files into the third file using command-line arguments.

v) Find no. of lines, words and characters in a file

vi) Write a C program to print the last n characters of a given file.

Text Books:

1. Ajay Mittal, Programming in C: A practical approach, Pearson1st Edition 2010.
2. Byron Gottfried, Schaum's Outline of Programming with C, Mc Graw Hill; 2nd edition 1996.

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India, 1988.
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition, 2011.

B. Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24ES05102P	**ES**	**IT Workshop** (Common to all branches of Engineering)	**0**	**0**	**2**	**1**

Pre-Requisites: Nil

Course Objectives:

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSS
- To teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

Course Outcomes (COs):

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

CO1: Perform Hardware troubleshooting. (L3)
CO2: Demonstrate the Hardware components and inter dependencies. (L2)
CO3: Safeguard computer systems from viruses/worms. (L3)
CO4: Prepare Document/ Presentation by utilizing computer tools. (L3)
CO5: Perform calculations using spreadsheets. (L3)

PC Hardware & Software Installation:

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit it to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also, students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web:

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students should demonstrate to the instructor how to access websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop-up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and Word:

Task 1: Word Orientation: The mentor needs to give an overview of LaTeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of LaTeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using LaTeX and word –Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using LaTeX and Word to create a project certificate. Features to be covered: -Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both LaTeX and Word.

Task 3: Creating project abstract Features to be covered: -Formatting Styles, inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered: -Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

Excel:

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel –Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1: Creating a Scheduler -Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered: -Cell Referencing, Formulae in excel –average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

Lookup/Vlookup

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

Power Point

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations -Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting –Background, textures, Design Templates, Hidden slides.

AI Tools –ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

Ex: Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware -A Handbook, Kate J. Chase, PHI (Microsoft), 1st Edition, 2004.
5. LaTeX Companion, Leslie Lamport, PHI/Pearson, 1st edition, 1994.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition, 2008.
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan–CISCO Press, Pearson Education, 3rd edition, 2008.

B. Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS103L	HM	NSS / NCC / Scouts & Guides / Community Service (Common to all branches of Engineering)	0	0	1	0.5

Pre-Requisites: Nil

Course Objectives:

- To impart discipline, character, and fraternity amongst young citizens
- To train them to work in teams/groups to enhance their team spirit.
- To enable the students to acquire leadership qualities.
- To induce social consciousness among students through various activities.
- To instill self-confidence and the ideals of selfless service
- To engage students in responsible and challenging actions for the common good.

Course Outcomes (COs):

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

CO1: Explain the importance of discipline, character and service motto. (L2)

CO2: Outline the needs and problems of the Community. (L2)

CO3: Solve some societal issues by applying acquired knowledge, facts, and techniques. (L3)

CO4: Explore human relationships by analyzing social problems. (L4)

CO5: Determine to extend their help for the fellow beings and downtrodden people and Develop leadership skills and civic responsibilities. (L3)

Unit I: Orientation:

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

i. Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
ii. Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii. Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv. Conducting talent show in singing patriotic songs-paintings- any other contribution.

Unit II: Nature & Care:

Activities:

i. Best out of waste competition.
ii. Poster and signs making competition to spread environmental awareness.
iii. Recycling and environmental pollution article writing competition.
iv. Organising Zero-waste day.
v. Digital Environmental awareness activity via various social media platforms.
vi. Virtual demonstration of different eco-friendly approaches for sustainable living.
vii. Write a summary on any book related to environmental issues.

Unit III: Community Service:

Activities:

i. Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities experts etc.

a. Conducting awareness programs on Health-related issues such as General Health,

ii. Mental health, Spiritual Health, HIV/AIDS,
    a. Conducting consumer Awareness. Explaining various legal provisions etc.
    b. Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population
iii. Education.
    a. Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

B.Tech. – I Year
II Semester

B. Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB102T	BS	**Differential Equations & Vector Calculus** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites: Basic Knowledge of Mathematics

Course Objectives:

- To enlighten the learners about the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them to advanced level by handling various real-worldapplications.

Course Outcomes (COs):

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

CO1: Solve the differential equations of first order and first degree and apply in Newton's law of Cooling and Electrical Circuits applications. (L3)

CO2: Solve the linear constant coefficient differential equations of higher order and apply in L-C-R Electrical Circuits and Simple Harmonic motion applications. (L3)

CO3: Find the solution to PartialDifferentialEquations and HomogeneousLinearPartialdifferential Equations with constant coefficients and solve real time related problems. (L3)

CO4: Examine the physical meaning of different operators such as gradient, curl and divergence. (L4)

CO5: Determine the Line, Surface and Volume integrals using Vector Calculus and solve related engineering problems. (L4)

Unit I: Differential Equations of First Order and First Degree:

Linear differential equations–Bernoulli'sequations-Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay-Electrical circuits.

Unit II: Linear Differential Equations of Higher Order (Constant Coefficients):

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

Unit III: Partial Differential Equations:

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equation swith constant coefficients.

Unit IV: Vector Differentiation:

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions-Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vectoridentities.

Unit V: Vector Integration:

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (withoutproof), Stoke's theorem (without proof), volume integral, Divergence theorem (withoutproof) and related problems.

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

ReferenceBooks:

1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2018.
2. Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 14/e, Pearson Publishers, 2018.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd., 2021 (9th reprint).
5. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education, 2017.

B. Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB104T	BS	**Chemistry** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	3	0	0	3

Pre-Requisites: Fundamentals of Chemistry

Course Objectives:

- To understand the concepts of Schrodinger wave equation and molecular orbital theory
- To understand and apply the concepts of semiconductors, super conductors and nano materials
- To understand and apply the concepts of electrochemistry effectively.
- To train the students on the fundamentals and applications of polymers.
- To introduce basic principles of spectroscopy and chromatography

Course Outcomes (COs):

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

CO1: Understand the Fundamentals of Quantum mechanics, Apply Schrodinger wave equation to illustrate the molecular orbital energy level diagram for different di- atomic molecules (L3)

CO2: Apply the principle of Band diagrams and classify the Semiconductors, Super conductors, Supercapacitors & Nano materials and demonstrate their applications (L3)

CO3: Analyze electrochemical principles to calculate cell potentials and interpret titration curves, and evaluate the working mechanisms of batteries, fuel cells, and electrochemical sensors.(L4)

CO4: Differentiate between types of polymerization mechanisms and polymer classes, and examine the structure–property relationships and applications of thermoplastics, elastomers, conducting, and biodegradable polymers. (L4)

CO5: Interpret spectroscopic and chromatographic data using principles like Beer-Lambert's law, and analyze the instrumentation and applications of UV-Vis, IR spectroscopy, and HPLC techniques. (L4)

Unit I: Structure and Bonding Models:

Fundamentals of Quantum mechanics- Planck's quantum theory, Dual nature of matter, Schrodinger wave equation, significance of ψ and ψ^2, particle in one-dimensional box, molecular orbital theory- Bonding in homo and heteronuclear di-atomic molecules, Energy level diagrams of N_2, O_2 and CO, NO. π- molecular orbital diagrams for butadiene and benzene, calculation of bond order.

Unit II: Modern Engineering materials:

Semiconductor materials: Introduction, Types of semiconductors, P- type and N- type semiconductors, Band diagrams for conductors, semiconductors and insulators, role of doping on band structures, Applications. **Super conductors -** Introduction, Classification, Properties and Applications. **Supercapacitors:** Introduction, Construction and working, Classification – Applications.**Nano chemistry:** Introduction, classification of nano materials, properties and applications of Fullerenes, carbon nano tubes and Graphene's nanoparticles

Unit III: Electrochemistry and Applications:

Electrochemical cell, Nernst equation, cell potential calculations and numerical problems. **Potentiometry-** potentiometric titrations (redox titration), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations).

Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples. Primary cells – Zinc-air battery, Secondary cells –lithium-ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen, polymer electrolyte membrane fuel cells – working of the cells.

Unit IV: Polymer Chemistry:

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, with specific examples and mechanisms of polymer formation**.** **Plastics -** Thermoplastics and Thermosettings, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6, carbon fibers. Elastomers– Buna-S, Buna-N - preparation, properties and applications. Conducting polymers– polyacetylene, polyaniline, mechanism of conduction and applications. Biodegradable polymers- PGA & PLA.

Unit V: Instrumental Methods and Applications:

Electro magnetic spectrum. Absorption of radiation: Beer-Lambert's law, UV-Visible, Electronic transition, Instrumentation, IR Spectroscopies fundamental modes and selection rules-Instrumentation, Chromatography- Basic principle, classification – HPLC - principle, instrumentation and applications.

Text Books:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. G.V. Subba Reddy, K.N. Jayaveera and C. Ramachandraiah, Engineering Chemistry, Mc Graw Hill, 2020.
2. D. Lee, Concise Inorganic Chemistry, 5/e, Oxford University Press, 2008.
3. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.

Reference Website:

1. https://youtu.be/Oal2zQ84je4?si=d67NlidzOTfrfEon
2. https://youtu.be/qbxRHHnmvJk?si=soLaMMqXYV8xswri
3. https://youtu.be/CKyo2M1mNqQ?si=xLqBkrqtYm3uyN3G
4. https://youtu.be/rG1qDXuRRoE?si=O0z5iQg7AUlZ_2Ik
5. https://youtu.be/Mig9b5hra-k?si=A6Q5vUJ--M4Nv31_

B. Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS101T	HM	**Communicative English** (Common to all branches of Engineering)	2	0	0	2

Pre-Requisites: Basics of LSRW skills

Course Objectives:

The main objective of introducing this course, Communicative English, is to facilitate effective listening, Reading, Speaking and Writing skills among the students. It enhances thesame in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students make them effective in speaking and writing skills and make them industryready.

Course Outcomes (COs):

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

CO1: Understand the context, topic, and pieces of specific information from social or Transactional dialogues. (L2)

CO2: Apply grammatical structures to formulate sentences and correct word forms. (L3)

CO3: Analyze discourse markers to speak clearly on a specific topic in informal discussions. (L4)

CO4: Evaluate reading / listening texts and to write summaries based on global –Comprehensionof these texts. (L5)

CO5: Create a coherent paragraph, essay, and resume. (L6)

Unit I: HumanValues: Gift of Magi (ShortStory)

Listening: Identifying the topic, the context and specific pieces of information by listening toshort audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family , work, studies and interests; introducing one self and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Mechanics of`Writing- Capitalization, Spellings, Punctuation-Parts of sentences.

Grammar: Partsof Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Rootwords.

Unit II: Nature: The Brook by Alfred Tennyson(Poem)

Listening: Answering a seriesof questions aboutmainideas andsupportingideas after listening toaudio texts.

Speaking: Discussion in pairs /small groups on specific topics followed by short structure talks.

Reading: Identifying sequence of ideas; recognizingverbal techniques that help to link the ideas in a paragraph together.

- **Writing:** Structureofaparagraph-Paragraphwriting(specifictopics)
- **Grammar:** Cohesive devices-linkers, use of articles and zero article; prepositions.
- **Vocabulary:** Homonyms, Homophones, Homographs.

Unit III: Biography: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groupsand reporting what is discussed

Reading: Reading a text in detail by making basic inferences-recognizing and interpreting specific contex tclues; strategies to use text cluesfor comprehension.

Writing: Summarizing, Note-making, paraphrasing

Grammar: Verbs-tenses; subject-verb agreement; Compound words, Collocations

Vocabulary: Compound words, Collocations

Unit IV: Inspiration:The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/transactional dialogues without video; listening with video.

Speaking: Roleplays for practice of conversational English in academic contexts (formal and informal) –asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/ patterns/ relationships, communicate processesor display complicated data.

Writing: Letter Writing: Official Letters, Resumes

Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary: Words of ten confused, Jargons

Unit V: Motivation: The Power of Intra personal Communication (AnEssay)

Listening: Identifying keyterms, understanding concepts and answering a seriesof relevant questions that test comprehension.

Speaking: Formaloralpresentationsontopicsfromacademiccontexts

Reading: Readingcomprehension.

Writing: Writing structured essays on specific topics.

Grammar: Editing short texts–identifying and correcting common errors in grammar and usage(articles,prepositions,tenses,subjectverbagreement)

Vocabulary: TechnicalJargons

Text Books:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2&3)
2. Empowering with Language by Cengage Publications, 2023(Units4&5)

Reference Books:

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press.
4. Lewis, Norman. Word Power Made Easy -The Complete Hand book for Building a Superior Vocabulary. Anchor, 2014.

Web Resources:

Grammar:

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

Vocabulary:

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

B. Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24ES01101T	ES	**Basic Civil and Mechanical Engineering** (Common to all branches of Engineering)	3	0	0	3

Part – A: Basic Civil Engineering

Pre-Requisites: Basic Knowledge in Physics & Chemistry

Course Objectives:

- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying
- Acquire preliminary knowledge on Transportation and its importance in nation's economy and
- also learn water resource and water quality.

Course Outcomes (COs):

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

CO1: Identify the roles and disciplines within civil engineering and apply basic knowledge of construction materials and building techniques, including prefabricated construction, in practical civil engineering contexts. (L3)

CO2: Analyse the methods of horizontal and angular measurements used in surveying and interpret levelling and bearing data to generate contour maps and elevation profiles. (L4)

CO3: Differentiate types of transportation systems and pavement structures, and examine the basic components of water resources and environmental engineering systems including hydrology and water conveyance structures. (L4)

Unit I: Basics of Civil Engineering:

Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-Technical Engineering- Transportation Engineering Hydraulics and Water Resources Engineering - Environmental Engineering - Scope of each discipline - Building Construction and Planning- Construction Materials - Cement – Aggregate Bricks- Cement concrete- Steel. Introduction to Prefabricated Construction Techniques.

Unit II: Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

Unit III: Transportation Engineering: Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.**Water Resources and Environmental Engineering:** Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Text Books:

1. Basic Civil Engineering, M.S. Palanisamy, Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016.
3. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.

Part-B : Basic Mechanical Engineering

Pre-Requisites: Basic Knowledge in Physics & Chemistry

Course Objectives:

- Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
- Explain different engineering materials and different manufacturing processes.
- Provide an overview of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

Course Outcomes (COs):

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

CO1: Identify the role of mechanical engineering across various industrial sectors and apply basicknowledge of engineering materials—including metals, ceramics, composites, and smart materials—in mechanical applications. (L3)

CO2: Differentiate between various manufacturing processes including CNC and smart manufacturing, and analyze the working principles of thermal systems such as engines, refrigeration cycles, and hybrid vehicles. (L4)

CO3: Examine the operating principles of different power plants and mechanical transmission systems, and classify types of robotic configurations based on their structure and applications. (L4)

Unit I: Introduction to Mechanical Engineering:

Role of Mechanical Engineering in Industries and Society-Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

Unit II: Manufacturing Processes:

Principles of Casting, Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering – Working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

Unit III : Power Plants :

working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications. **Introduction to Robotics** - Joints & links, configurations, and applications of robotics.

(**Note**: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject)

Text Books:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.
2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

Reference Books:

1. AppuuKuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt. Ltd.
4. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd.

B. Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02102T	PC	Network Analysis	2	1	0	3

Pre-Requisites: Basic Electrical and Electronic Engineering and Mathematics

Course Objectives:

- To introduce basic laws, mesh & nodal analysis techniques for solving electrical circuits
- To impart knowledge on applying appropriate theorem for electrical circuit analysis
- To explain transient behaviour of circuits in time and frequency domains
- To teach concepts of resonance
- To introduce open circuit, short circuit, transmission, hybrid parameters and their inter relationship.

Course Outcomes (COs):

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

CO1: Apply the concepts of KVL & KCL for network reductions, Nodal analysis, Mesh Analysis and various Network theorems with independent & Dependent sources. (L3)

CO2: Analyse the transient response of RLC Circuits by applying Differential equations and Laplace Transforms with DC excitation and AC excitation. (L4)

CO3: Analyse the Study state response of RLC Circuits by applying Differential equations and LaplaceTransforms with AC excitation and solve the Star-Delta conversion related problems. (L4)

CO4: Interpret the various fundamental concepts of magnetic circuits, Analyse the Series and Parallel Resonance circuits and determine the Q-Factor, BW & Selectivity. (L4)

CO5: Compute various parameters of two port networks, determine the relations between two port networks parameters and solve impedance matching related problems. (L3)

Unit I: Introduction to Networks & Network Theorems:

Types of circuit components, Types of Sources and Source Transformations, Mesh analysis and Nodal analysis, problem solving with resistances only including dependent sources also. Principal of Duality with examples. **Network Theorems:** Thevenin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition, Maximum Power Transfer, Tellegens - problem solving using dependent sources also.

Unit II: Transients & Laplace Transform:

Transients: First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem-solving using R-L-C elements with DC excitation and AC excitation, Response as related to s-plane rotation of roots.

Laplace Transform: Introduction, Laplace transformation, basic theorems, problem solving using Laplace transform, partial fraction expansion, Heaviside's expansions, problem solving using Laplace transform.

Unit III: Steady State Analysis of A.C Circuits:

Steady State Analysis of A.C Circuits: Impedance concept, phase angle, series R-L, R-C, R-L-C circuits problem solving. Complex impedance and phasor notation for R-L, R-C, R-L-C problem solving using mesh and nodal analysis, Star-Delta conversion, problem solving using Laplace transforms also.

UNIT IV: Resonance Coupled Circuits:

Resonance: Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, general case-resistance present in both branches, anti-resonance at all frequencies.
Coupled Circuits: Coupled Circuits: Self-inductance, Mutual inductance, Coefficient of coupling, analysis of coupled circuits, Natural current, Dot rule of coupled circuits, conductively coupled equivalent circuits- problem solving.

Unit V: Two-port Networks:
Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h-parameters, Relationships Between parameter Sets, Parallel & series connection of two port networks, cascading of two port networks, problem solving using dependent sources also.
Image and iterative impedances. Image and iterative transfer constants. Insertion loss. Attenuators and pads. Lattice network and its parameters. Impedance matching networks.

Text Books:
1. Network Analysis – ME Van Valkenburg, Prentice Hall of India, revised 3rd Edition, 2019.
2. Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, 9th Edition 2020.
3. Network lines and Fields by John. D. Ryder 2nd Edition, PHI

Reference Books:

1. D. Roy Choudhury, Networks and Systems, New Age International Publications, 2013.
2. Joseph Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Outline Series, 7th Edition, Tata Mc Graw Hill Publishing Company, New Delhi, 2017
3. Fundamentals of Electric Circuits by Charles K. Alexander and Matthew N. O. Sadiku, Mc Graw-Hill Education.

B. Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB104P	**BS**	**Chemistry Lab** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	**0**	**0**	**2**	**1**

Pre-Requisites: Fundamentals of Chemistry

Course Objectives:

- To provide solid foundation in chemistry laboratory to solve engineering problems.
- To Illustrate the applications of conductometry and potentiometry
- To Illustrates the properties of analytical equipment's like UV-VIS and IR.

Course Outcomes (COs):

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

CO1: Prepare advanced polymer Bakelite materials. (L2)

CO2: Measure the strength of an acid present in secondary batteries. (L3)

CO3: Determine the cell constant and conductance of solutions(L3)

CO4: Analyze some simple organic compounds by IR. (L3)

CO5: Prepare advanced Nano materials. (L2)

List of Chemistry Experiments

1. Estimation of Ferrous Iron by Dichrometry
2. Preparation of a Bakelite
3. Conductometric titration of strong acid vs. strong base
4. Conductometric titration of weak acid vs. strong base
5. Determination of Strength of an acid in Pb-Acid battery
6. Potentiometry - determination of redox potentials and emfs
7. Verify Lambert-Beer's law
8. Determination of cell constant and conductance of solutions
9. Identification of simple organic compounds by IR
10. Preparation of nanomaterials by precipitation
11. Measurement of 10Dq by spectrophotometric method
12. Wavelength measurement of sample through UV-Visible Spectroscopy

Note: Minimum Ten experiments are to be performed.

Reference Books:

1. Vogel's Text book of Quantitative Chemical Analysis, Sixth Edition – Mendham J et al, Pearson Education, 2012.
2. Chemistry Practical– Lab Manual, First edition, Chandra Sekhar KB, Subba Reddy GV and Jayaveera KN, SM Enterprises, Hyderabad, 2014.
3. Chemistry Laboratory Manual, Sri Krishna Hitech Publishing Company Pvt.Ltd,2nd Edition, A Ravi Krishanan, B Tirumala Rao, 2020-2021.

B. Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS101P	**HM**	**Communicative English Lab** (Common to all branches of Engineering)	**0**	**0**	**2**	**1**

Pre-Requisites: Basics of LSRW skills

CourseObjectives:

The main objective of introducing this course Communicative English Laboratory is toexpose the students to a variety of self-instructional, learner friendly modes of languagelearning. The students will get trained in basic communication skills and also make themreadytofacejobinterviews.

Course Outcomes (COs):

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

CO1: Understand the different aspects of the English language proficiency with emphasison LSRW skills. (L2)

CO2: Apply communication skills through various language learning activities. (L3)

CO3: Analyze the English speech sounds,stress,rhythm, intonation andsyllabledivision forbetter Listening and speaking comprehension. (L4)

CO4: Evaluate and exhibit professional is min participating in debatesand groupdiscussions. (L5)

CO5: Create effective Course Objectives. (L6)

List of Topics:

1. Vowels & Consonants
2. Neutralization /AccentRules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. Group Discussions-methods&practice
6. Debates-Methods&Practice
7. PPTP resentations/PosterPresentation
8. Interview Skills
9. E-mailWriting
10. Resume Writing, Cover letter, SOP

Suggested Software:

- Walden Infotech
- Young India Films

ReferenceBooks:

1. Raman Meenakshi, Sangeeta- Sharma. Technical Communication. OxfordPress.2018.
2. Taylor Grant: English Conversation Practice,Tata McGraw-Hill Education India,2016
3. Hewing’s, Martin.Cambridge Academic English (B2).CUP,2012.
4. J.Sethi & P.V.Dhamija. A Course in Phonetics and Spoken English , (2nd Ed) Kindly ,2013
5. T. Balasubramanyam, A Textbook of English Phonetics for Indian Students, (3rd Ed) Trinity Press.

B. Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02102P	PC	Network Analysis and Simulation Lab	0	0	3	1.5

Pre-Requisites: Basic Electrical and Electronics Engineering

Course Objectives:

1. To gain hands on experience in verifying Kirchhoff's laws and network theorems
2. To analyse transient behaviour of circuits
3. To study resonance characteristics
4. To determine 2-port network parameters

Course Outcomes:

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

CO1: Verify Kirchhoff's laws and network theorems. (L3)

CO2: Measure time constants of RL & RC circuits (L3)

CO3: Analyse behaviour of RLC circuit for different cases. (L4)

CO4: Design resonant circuit for given specifications (L3)

CO5: Characterize and model the network in terms of all network parameters. (L4)

List of Experiments:

The following experiments need to be performed using both Hardware and simulation Software. The experiments need to be simulated using software and the same need to be verified using the hardware.

1. Study of components of a circuit and Verification of KCL and KVL.
2. Verification of mesh and nodal analysis for AC circuits
3. Verification of Superposition, Thevenin's & Norton theorems for AC circuits
4. Verification of maximum power transfer theorem for AC circuits
5. Verification of Tellegen's theorem for two networks of the same topology.
6. Study of DC transients in RL, RC and RLC circuits
7. To study frequency response of various 1st order RL & RC networks
8. To study the transient and steady state response of a 2nd order circuit by varying its
9. Various parameters and studying their effects on responses
10. Find the Q Factor and Bandwidth of a Series and Parallel Resonance circuit.
11. Determination of open circuit (Z) and short circuit (Y) parameters
12. Determination of hybrid (H) and transmission (ABCD) parameters
13. To measure two port parameters of a twin-T network and study its frequency response.

Hardware Requirements:

Regulated Power supplies, Analog/Digital Function Generators, Digital Multimeters, Decade Resistance Boxes/Rheostats, Decade Capacitance Boxes, Ammeters (Analog or Digital), Voltmeters (Analog or Digital), Active & Passive Electronic Components

Software Requirements:

Multisim/ Pspice / Equivalent simulation software tool, Computer Systems with required specifications

References:

1.Network Analysis – ME Van Valkenburg, Prentice Hall of India, revised 3rd Edition, 2019.

2. Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Jamie Phillips,
Steven M. Durbin, 9th Edition 2020.

B. Tech. – I Year II Semester

CourseCode	Category	Name of the Course	L	T	P	C
24ES03102P	ES	**Engineering Workshop** (Common to all branches of Engineering)	0	0	3	1.5

Pre-Requisites: Nil

Course Objectives:

- To familiarizes students with wood working, sheet metal operations, fitting and electrical house wiring skills

Course Outcomes (COs):

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

CO1: Identify workshop tools and their operational capabilities. (L3)

CO2: Practice on manufacturing of components using workshop trades includingfitting, carpentry, foundry and welding. (L3)

CO3: Apply fitting operations in various applications. (L3)

CO4: Apply basic electrical engineering knowledge for HouseWiring Practice (L3)

1. **Demonstration**: Safety practices and precautions to be observed inworkshop.
2. **WoodWorking:** Familiarity with different typesof woodsand tools used in wood working and make following joints. a) Half Lap joint b) Mortise and Tenon joint c) Corner Dove tail joint or Bridle joint
3. **Sheet Metal Working**: Familiarity with different typesof tools used in sheet metal working Developments of followingsheet metal job from GIsheets. a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with differenttypes oftoolsusedinfittinganddo the following fitting exercises. a)V-fit b)Dovetail fit c) Semi-circular fit d)Bicycle tire puncture and change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different typesof basic electrical circuits and make the following connections. a) Parallel andseriesb) Two-wayswitch c) Godown lighting d) Tube light e) Threephasemotor f) Solderingof wires
6. **FoundryTrade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds forgiven Patterns.
7. **Welding Shop**: Demonstrationand practice onArc Welding andGaswelding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with Coupling for sa mediameterand with reducer for different diameters.

Text Books:

1. Basic Workshop Technology: Manufacturing Process, FelixW.; Independently Published,2019.
2. Workshop Processes, Practices and Materials; BruceJ. Black, Routl edge publishers, 5thEdn. 2015.
3. ACoursein Workshop Technology VolI. & II, B.S. Raghuwanshi, DhanpathRai &Co.,2015 &2017.

Reference Books:

1. Elements of Workshop Technology, Vol.I by S.K. Hajra Choudhury & others, Media Promoters and Publishers, Mumbai.2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. WiringEstimating, Costingand Contracting; Soni P.M. &UpadhyayP.A.; Atul Prakashan,21-22

B. Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS102L	HM	**Health and Wellness, Yoga and Sports** (Common to all branches of Engineering)	0	0	1	0.5

Pre-Requisites: Nil

Course Objectives:

- To maintain their mental and physical wellness upright and develop ability in them to cope up with the stress arising in the life.
- To create space in the curriculum to nurture the potential of the students in sports/games/yoga etc.
- To introduce a practice oriented introductory course on the subject.

Course Outcomes (COs):

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

CO1: Be Physical fit to perform daily routine without undue fatigue. (L2)

CO2: Be Mentally alert and Socially Cohesive. (L2)

CO3: Consider success and failure equally.

CO4: Develop Positive Personality. (L3)

CO5: Improve Leadership qualities. (L3)

Unit I: **Health and Fitness:**

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immUnity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in Community

ii) Preparation of health profile

iii) Preparation of chart for balance diet for all age groups

Unit II: Yoga:

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities: Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

Unit III: Sports and Fitness:

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics

ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.

2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.

3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

B.Tech. – II Year
I Semester

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB208T	BS	Probability and Complex Variables	2	1	0	3

Pre-Requisites: Basic Knowledge of Mathematics

Course Objective:

To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications

Course Outcomes (COs):

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

COl: Interpret probability concepts, including conditional probability, Bayes' theorem, and random variables, and analyse probability distributions to model noise, signal behaviour, and communication system uncertainties.

CO2: Explain operations on random variables analyse multiple random variables through joint, marginal, and conditional distributions to model complex signal and noise processes in communication systems. (L4)

CO3: Describe operations on multiple random variables and analyse properties of jointly Gaussian random variables for modelling signals and noise in communication systems. (L4)

CO4: Apply Cauchy-Riemann equations and the Milne-Thomson method to construct analytic functions and model signal behavior and field distributions in communication systems.

CO5: Apply contour integration and residue calculus, including Cauchy's theorems and series expansions, to evaluate complex integrals relevant to signal analysis and electromagnetic theory. (L4)

Unit I: Probability & Random Variable:

Probability through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, Independent Events. Random variables (discrete and continuous), probability density functions, properties, mathematical expectation. Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh.

Unit II: Operations on Random Variable:

Moments-moments about the origin, Central moments, Variance and Skew, Chebyshev's inequality, moment generating function, characteristic function.

Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Interval conditioning, Statistical Independence.

Unit III: Operations on Multiple Random Variables:

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables, Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties of Gaussian random variables.

Unit IV: Complex Variable –Differentiation:

Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions harmonic functions, finding harmonic conjugate- construction of analytic function by Milne Thomson method.

Unit V: Complex Variable–Integration:

Line integral-Contour integration, Cauchy's integral theorem (Simple Case), Cauchy Integral formula, Power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.

Textbooks:

1. PeytonZ. Peebles, "Probability, Random Variables & Random Signal Principles", 4th Edition, TMH, 2002.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2017, 44th Edition

Reference Books:

1. Athanasios Papoulis and S. Unni krishna Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, PHI, 2002
2. Erwin Kreys zig, Advanced Engineering Mathematics, Wiley India
3. Henry Stark and John W. Woods, "Probability and Random Processes with Application to Signal Processing," 3rd Edition, Pearson Education, 2002.
4. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill publishers.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ma50/preview
2. https://onlinecourses.nptel.ac.in/noc21_ma66/preview#:~:text=This%20course%20provides%20random%20variable,and%20simple%20Markovian%20queueing%20models.

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS204L	**HM**	**Universal Human Values– Understanding Harmony and Ethical Human Conduct** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites: Nil

Course Objectives:

To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes (COs):

CO1: Analyze the interrelationship between right understanding, human relationships, and physical facilities to identify how these contribute to holistic development and fulfillment of basic human aspirations. (L4)

CO2: Analyze the co-existence of the self and the body to distinguish their respective needs and evaluate the conditions necessary to ensure harmony, self-regulation, and health in the human being. (L4)

CO3: Differentiate core human values such as trust and respect, and examine their role in fostering harmonious relationships within the family and society, leading toward a universal human order. (L4)

CO4: Differentiate the four orders of nature and examine their interconnectedness to understand existence as co-existence, leading to a holistic perception of harmony in nature and the universe. (L4)

CO5: Examine how human values shape professional ethics and conduct, supporting competence and transition toward a value-based universal human order. (L4)

Unit I: Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

Lecture 3: self-exploration as the Process for Value Education

Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

Unit II: Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human being as the Co-existence of the self and the body.

Lecture 8: Distinguishing between the Needs of the self and the body

Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

Unit III: **Harmony in the Family and Society** (6 lectures and 3 tutorials for practice Sessions)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

Unit IV: Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence

Unit V: Implications of the Holistic Understanding – a Look at Professional Ethics
(6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order
Practice Sessions for UNIT I –Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance
Practice Sessions for UNIT II –Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III –Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfill Human Goal
Practice Sessions for UNIT IV –Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence
Practice Sessions for UNIT V –Implications of the Holistic Understanding –a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

Readings:

Textbook and Teachers Manual

a. The Textbook

R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher’s Manual

R R Gaur, R Asthana, G P Bagaria,Teachers’ Manual for A Foundation Course in Human Values and Professional Ethics,2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. JeevanVidya: EkParichaya,A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
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
7. Economy of Permanence-J C Kumarappa
8. Bharat Mein Angreji Raj–PanditSunderlal
9. Rediscovering India -by Dharampal
10. Hind Swaraj or Indian Home Rule-by Mohandas K. Gandhi
11. India Wins Freedom-Maulana Abdul Kalam Azad
12. Vivekananda-Romain Rolland (English)
13. Gandhi -Romain Rolland (English)

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor’s role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one’s own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up”ordinary” situations rather than” extra-ordinary” situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included.
The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.
It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content.
Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by anyone department.
Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.
Online Resources

1. *https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf*
2. *https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf*
3. *https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf*
4. *https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf*
5. *https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf*
6. *https://fdp-si.aicte-india.org/download/FDP Teaching Material/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf*
7. *https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf*
8. *https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385*
https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04201T	PC	Signals, Systems and Stochastic Processes	2	1	0	3

Pre-Requisites: Basic Knowledge on Mathematics, Linear Algebra and Probability

CourseObjectives:

- Under standing the basics of signals and systems required for ECE courses.
- To teach concepts of signals and systems and its analysis using different transform techniques.
- To provide basic understanding of random processes which is essential for the random signals and systems encountered in communications and signal processing areas.

Course Outcomes (COs):

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

CO1: Explain the mathematical description & representation of continuous time, discrete time signals and systems, perform the mathematical operations on signals & systems and represent the periodic signals using Fourier Series to analyse the periodic signals. (L4)

CO2: Analyse the spectral characteristics of continuous-time signals using the Fourier and Laplace transforms, and apply these methods to evaluate system response and stability in continuous-time systems, including the application of the sampling theorem. (L4)

CO3: Analyse the characteristics and physical implementation of Linear Time-Invariant (LTI) systems, and explain the concepts of Power Spectral Density (PSD) and Energy Spectral Density (ESD). (L4)

CO4: Analyse random processes and determine the frequency-domain response of LinearTime-Invariant (LTI) systems to random inputs using probability concepts. (L4)

CO5: Analyse random processes and determine the frequency-domain response of Linear Time-Invariant (LTI systems to random inputs using probability concepts. (L4)

Unit I: Signals & Systems:

Basic definitions and classification of Signals and Systems (Continuous time and discrete time), operations on signals, Concepts of Convolution and Correlation of signals, Analogy between vectors and signals-Orthogonality, mean square error,

Fourier Series: Trigonometric & Exponential forms of Fourier series, Properties, Concept of discrete spectrum, Illustrative Problems.

Unit II: Fourier Transform:

Definition, Computation and properties of Fourier transform for different types of signals and systems, Inverse Fourier transform. Sampling: Sampling theorem – Graphical and analytical proof for Band Limited Signals, Reconstruction of signal from its samples, Effect of under sampling – Aliasing. Illustrative Problems.

Laplace Transform: Definition, ROC, Properties, Inverse Laplace transforms, the s-plane and BIBO stability, Transfer functions, System Response to standard signals, Solution of differential equations with initial conditions, Illustrative Problems.

Unit III: Signal Transmission through Linear Systems:

Linear system, impulse response, Response of a linear system for different input signals, linear time-invariant (LTI) system, linear time variant (LTV) system, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between bandwidth and rise time, Energy and Power spectral densities, Illustrative Problems.

Unit IV: Random Processes – Temporal Characteristics:

The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second- Order and Wide-Sense Stationarity, (N-Order) and Strict Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process. Random Signal, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output.

Unit V: Random Processes – Spectral Characteristics:

The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross Correlation Function. Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output.

Text Books:

1. Peyton Z. Peebles, “Probability, Random Variables & Random Signal Principles”, 4th Edition, TMH, 2002.
2. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, “Signals and Systems”, 2nd Edition, PHI, 2009.

Reference Books:

1. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.
2. Athanasios Papoulis and S. Unnikrishna Pillai, “Probability, Random Variables and Stochastic Processes”, 4th Edition, PHI, 2002
3. Simon Haykin and Van Veen, “Signals & Systems”, 2nd Edition, Wiley, 2005.
4. Matthew Sadiku and Warsame H. Ali, “Signals and Systems A primer with MATLAB”, CRC Press, 2016.
5. Hwei Hsu, “Schaum's Outline of Signals and Systems”, 4thEdition, TMH, 2019.

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04202T	PC	Electronic Devices and Circuits	2	1	0	3

Pre-Requisites: Basic Knowledge on Semi conductor physics.

CourseObjectives:

- Students will be able understand the basic principles of all semiconductor devices.
- Able to analyze diode circuits, various biasing and small signal equivalent circuits of amplifiers, compare the performance of BJTs and MOSFETs
- Able to design rectifier circuits and various amplifier circuits using BJTs and MOSFETs.

Course Outcomes (COs):

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

CO1: Understand the operating principles, characteristics, and applications of semiconductor and special diodes, BJTs, JFETs, and MOSFETs, and design related electronic circuits. (L3)

CO2: Analyse the characteristics and operation of BJTs, including biasing techniques, stability factors, and their use in amplification and switching applications. (L4)

CO3: Analyse single-stage BJT amplifiers using small-signal models and determine key performance parameters such as voltage/current gains and input/output resistances. (L4)

CO4: Analyse the construction, operation, and characteristics of FETs and MOSFETs, and apply appropriate biasing techniques to design and evaluate their use in amplifier and switching applications. (L4)

CO5: Understand and utilize small-signal models of MOSFETs to design and evaluate single-stage amplifier circuits, including common source, common gate, and source follower configurations. (L4)

Unit I: PN Junction Diode:

Review, diode current equation, Diode resistance, Transition and Diffusion Capacitance, effect of temperature on PN junction diode, Quantitative analysis of Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Ripple Factor and Regulation Characteristics, Clipping and Clamping circuits, Illustrative problems.

Special Diodes: Construction, operation and VI characteristics of Tunnel Diode, Varactor Diode, LED, LCD, Photo Diode, SCR and UJT.

Unit II: Bipolar Junction Transistors:

Review of Bipolar Junction Transistors, Characteristics, Transistor as an Amplifier and as a Switch, BJT Configurations, Limits of Operation, BJT Specifications.

Biasing and Stabilization**:** Operating Point, DC and AC Load Lines, Importance of Biasing, Fixed Bias, Collector to Base Bias, Self-Bias, Bias Stability, Thermal Runaway, Thermal Stability, Illustrative problems

Unit III: BJT Small Signal Operation and Models:

The transconductance, input resistance at the base, input resistanceattheemitter, Voltage gain, separatingtheSignaland theDCQuantities, The Hybrid π Model, the T Model. Single Stage BJT Amplifiers - Common-Emitter (CE) amplifier without and with emitter resistance, Common-Base (CB) amplifier, Common- Collector (CC) amplifier or Emitter Follower, Problem solving.

Unit IV: Junction Field Effect Transistor (FET):

Construction, Principle of Operation, V–I Characteristics, Comparison of BJT and FET, FET as Voltage Variable Resistor. FET biasing. MOS Field Effect Transistors: Introduction, Device Structure and Physical Operation, CMOS, V - I Characteristics, MOSFET Circuits at DC, MOSFET as an Amplifier and as a Switch. Biasing in MOS Amplifier circuits - biasing by fixing VGS with and without source resistance, biasing using drain to gate feedback resistor, biasing using constant currentsource, body effect, Problem solving.

Unit V: MOSFET Small Signal Operation Models:

The DC bias, separating the DC analysis and the signal analysis, Small signal equivalent circuit models, the transconductance, the T equivalent circuit model, Single stage MOS Amplifiers – common source (CS) amplifier without and with source resistance, common gate (CG) amplifier, source follower, Problem Solving.

Text Books:

1. Adel S. Sedra and Kenneth C. Smith, “MicroelectronicCircuits–Theoryand Applications”, 6th Edition, Oxford Press, 2013.
2. J. Milliman and CHalkias, “Integratedelectronics”,2nd Edition, Tata McGraw Hill, 1991.

Reference Books:

1. Donald A Neamen, “Electronic Circuits – analysis and design”, 3rd Edition, McGraw Hill (India), 2019.
2. Behzad Razavi, “Microelectronics”, Second edition, Wiley, 2013.
3. R.L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuits,” 9th Edition, Pearson, 2006.
4. Jimmie J Cathey, “Electronic Devices and Circuits, ”Schaum’s out lines series, 3rd edition, McGraw-Hill (India), 2010.

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04203T	PC	Digital Circuits Design	2	1	0	3

Pre-Requisites: Basic Knowledge on Electronics and Digital Logic

Course Objectives:

- Understand the properties of Boolean algebra, logic operations, and minimization of Boolean functions.
- Analyze combinational and sequential logic circuits.
- Understand the concepts of FSM and compare various Programmable logic devices.
- Model combinational and sequential circuits using HDLs.

Course Outcomes (COs):

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

CO1: Analyze the properties of Boolean algebra and other logic operations, and evaluate different methods for minimizing Boolean functions using Karnaugh maps. (L4)

CO2: Apply Boolean function minimization techniques to design efficient combinational circuits. (L3)

CO3: Analyze and simulate combinational circuits using Verilog and appropriate CAD tools to verify functionality and performance. (L4)

CO4: Analyze the behavior and structure of sequential logic circuits and implement them using HDLs. (L4)

CO5: Analyze the Finite state machines (FSM) using Flip-Flops. and Compare various Programmable logic devices. (L4)

Unit I: Boolean Algebra, Logic Operations, And Minimization Of Boolean Functions:

Review of Number Systems and Codes, Representation of unsigned and signed integers, Floating Point representation of real numbers, Laws of Boolean Algebra, Theorems of Boolean Algebra, Realization of functions using logic gates, Canonical forms of Boolean Functions, Minimization of Functions using Karnaugh Maps.

Unit II: Combinational Logic Circuits:

Combinational circuits, Design with basic logic gates, design procedure, adders, subtractors, 4-bit binary adder/ subtractor circuit, BCD adder, carry look- a-head adder, binary multiplier, magnitude comparator, data selectors, priority encoders, decoders, multiplexers, demultiplexers.

Unit III: Hardware Description Language:

Introduction to Verilog - structural specification of logic circuits, behavioral specification of logic circuits, hierarchical Verilog Code, Verilog for combinational circuits - conditional operator, if-else statement, case statement, for loop using sequential circuits with CAD tools.

Unit IV: Sequential Logic Circuits:

Basic architectural distinction between combinational and sequential circuits, Design procedure, latches, flip-flops, truth tables and excitation tables, timing and triggering consideration, conversion of flip- flops, design of counters, ripple counters, synchronous counters, ring counter, Johnson counter, registers, shift registers, universal shift register. Verilog constructs for sequential circuits, flip-flop with clear capability, using Verilog constructs for registers and counters.

Unit V: Finite State Machines and Programmable Logic Devices:

Types of FSM, capabilities and limitations of FSM, state assignment, realization of FSM usingflip-flops, Mealy to Moore conversion and vice-versa, reduction of state tables using partition technique, Design of sequence detector. Types of PLD's: PROM, PAL, PLA, basic structure of CPLD and FPGA, advantages of FPGAs.

Text Books:

1. M.MorrisMano, "DigitalDesign", 3rd Edition, PHI. (Unit I to IV)
2. Stephen Brownand Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", 3rd Edition, McGraw-Hill (Unit V)

Reference Books:

1. Charles H. Roth, Jr, "Fundamentals of Logic Design", 4th Edition, Jaico Publishers.
2. Zvi Kohavi and Niraj K. Jha, "Switching and Finite Automata Theory, 3rd Edition, Cambridge University Press, 2010.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2nd Edition, Prentice Hall PTR.
4. D.P. Leach, A.P. Malvino, "Digital Principles and Applications", TMH,7th Edition.

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04202P	PC	Electronic Devices and Circuits Lab	0	0	3	1.5

Pre-Requisites: Basic Knowledge on Semiconductor Physics.

Course Objectives:

- Verify the theoretical concepts practically from all the experiments.
- Analyse the characteristics of Diodes, BJT, MOSFET and UJT.
- Design the amplifier circuits from the given specifications.
- Model the electronic circuits using tools such as PSPICE/Multisim.

Course Outcomes (COs):

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

CO1: Understand the characteristics and applications of basic electronic devices, and apply this knowledge to plot and interpret their behaviour through experimental or simulation-based methods. (L3)

CO2: Analyse different biasing techniques and evaluate electronic circuits functioning as amplifiers. (L4)

CO3: Design MOSFET and BJT-based amplifiers to meet given performance specifications. (L3)

CO4: Analyse and simulate analog and digital circuits using PSPICE or Multisim to evaluate circuit behaviour and performance. (L4).

List of Experiments:(Implement/Execute any10 experiments).

1. Verify various clipping and clamper circuits using PN junction diode and draw the suitable graphs.
2. Study and draw the Volt Ampere characteristics of UJT and determine η, I_p,Iv,V_p, &V_v from the experiment.
3. Verification of the input and output characteristics of BJT in Common Emitter configuration experimentally and find required parameters from the graphs.
4. Study and draw the input and output characteristics of BJT in Common Base configuration experimentally and determine required parameters from the graphs.
5. Verification of the input and output characteristics of BJT in Common Collector configuration experimentally and find required parameters from the graphs Studyand draw the V- I characteristics of JFET experimentally.
6. Study and draw the output and transfer characteristics of MOSFET (Enhancemode) in Common Source Configuration experimentally. Find Threshold voltage (VT), gm, & K from the graphs.
7. Study and draw the output and transfer characteristics of MOSFET (Depletion mode) or JFET in Common Source Configuration experimentally. Find I_{dss}, gm, & V_p from the graphs.
8. Design and analysis of voltage-divider bias/self-bias circuit using BJT.
9. Design and analysis of self-bias circuit using MOSFET.
10. Design a suitable circuit for switchusing MOSFET/BJT.
11. Design a small signal amplifier using MOSFET (commonsource) for the given specifications. Draw the frequency response and find the bandwidth.
12. Design a small signal amplifier using BJT (common emitter) for the given specifications. Draw the frequency response and find the bandwidth.

Tools/EquipmentRequired: SoftwareToollike Multisim/PspiceorEquivalent, DC Power supplies, Multimeters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04203P	PC	Digital Circuits and Signal Simulation Lab	0	0	3	1.5

Pre-Requisites: Basic Knowledge on Electronics and Digital logic

Course Objectives:

- Verify the truth tables of various logic circuits.
- Design sequential/combinational circuit using Hardware DescriptionLanguageand verify their functionality.
- Simulate various Signals and Systems through MATLAB
- Analyze the output of a system when itis excited by different types of deterministic and random signals.

Course Outcomes (COs):

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

CO1: Design combinational and sequential digital circuits for given specifications, simulate them using Hardware Description Language (HDL), and verify their truth tables through hardware implementation. (L4)

CO2: Generate and manipulate various signals and sequences, and perform fundamental signal operations such as convolution, correlation, and signal transformations using MATLAB. (L3)

CO3: Analyse continuous-time signals and systems by computing Fourier series and Fourier transform, evaluating system properties such as linearity, time invariance, and stability, and interpreting the frequency response and pole-zero plots using MATLAB. (L4)

List of Experiments:

PARTA

1. Design a simple combinational circuit with four variables and obtain minimal SOP expression and verify the truth table using Digital Trainer Kit.
2. Verification of functional table of 3to8-line Decoder/De-multiplexer
3. 4 variable logic function verification using 8to1 multiplexer.
4. Design full adder circuit and verify its functional table.
5. Design a four-bit ring counter using DFlip–Flops/JKFlipFlop and verify output.
6. Design a four-bit Johnson’s counter using DFlip-Flops/JKFlipFlops and verify output
7. Verify the operation of 4-bit Universal Shift Register for different Modesof operation.
8. Draw the circuit diagram of MOD-8 ripple counter and construct a circuit using T-Flip-Flops and Test It with a low frequency clock and sketch the output waveforms.
9. Design MOD–8 synchronous counter using T Flip-Flop and verify the result and sketch the output waveforms.
10. (a) Draw the circuit diagram of a single bit comparator and test the output
    (b) Construct 7Segment Display Circuit Using Decoder and 7Segment LED and tes tit.

Note: Design and verify combinational and sequential circuits using Hardware Description Language

Reference Book:

1.M. MorrisMano, “DigitalDesign”, 3rd Edition, PHI

PART B

List of Experiments:

1. Write a programto generate various Signals and Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc function.
2. Perform operations on Signals and Sequences: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3. Write a programto find thetrigonometric &exponentialFourier series coefficientsof a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings- Plot the discrete spectrum of the signal.
4. Write a program to find Fourier transform of a given signal. Plot its amplitude and phase spectrum.
5. Write a program to convolve two discrete time sequences.Plot all thesequences.
6. Writea program to find auto correlation and cross correlation of given sequences.
7. Write a program to verify Linearity and Time Invariance properties of a given Continuous System.
8. Write a program to generate discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
9. Write a program to find magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.
10. Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).
11. Generate a Random data (with bipolar) for a given data rate (say 10kbps). Plot the same for a time period of 0.2 sec.
12. To plot pole-zero diagram in S-plane of given signal/sequence and verify its stability.

Note: Any 10 experiments. All the experiments are to be simulated using MATLAB or equivalent software.

Reference Book:

Stephen J. Chapman, “MAT LAB Programming for Engineers”, Cengage, November 2012.

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE05202S	SE	**Python Programming** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	0	1	2	2

Pre-Requisites: Logical and Analytical Thinking

Course Objective:

- Introduce core programming concepts of Python programming language.
- Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries.
- Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications using these.

Course Outcomes (COs):

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

CO1: Describe the evolution and thrust areas of Python, and develop basic Python programs using variables, data types, operators, expressions, and input/output constructs in Jupyter Notebook. (L3)

CO2: Develop Python programs using user-defined functions with parameters and returnvalues, apply string and list operations, and utilize built-in functions and command-line arguments. (L4)

CO3: Apply tuple, set, and dictionary operations in Python, including indexing, slicing, built-in methods, and key-value manipulation for data processing tasks. (L4)

CO4: Apply file handling techniques and object-oriented programming concepts such as encapsulation, inheritance, and polymorphism to develop structured and reusable Python programs. (L4)

CO5: Analyse and apply data science libraries such as JSON, NumPy, Pandas, and Matplotlib to perform data processing, manipulation, and visualization using Python. (L4)

List of Experiments:

Unit I:

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.

i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators

5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

Unit II:

Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Sample Experiments:

7. Write a program to define a function with multiple return values.
8. Write a program to define a function using default arguments.
9. Write a program to find the length of the string without using any library functions.
10. Write a program to check if the substring is present in a given string or not.
11. Write a program to perform the given operations on a list: i) Addition ii) Insertion iii) slicing
12. Write a program to perform any 5 built-in functions by taking any list.

Unit III:

Dictionaries: Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Usingzip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:

13. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
14. Write a program to count the number of vowels in a string (No control flow allowed).
15. Write a program to check if a given key exists in a dictionary or not.
16. Write a program to add a new key-value pair to an existing dictionary.
17. Write a program to sum all the items in a given dictionary.

Unit IV:

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

18. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
19. Python program to print each line of a file in reverse order.
20. Python program to compute the number of characters, words and lines in a file.
21. Write a program to create, display, append, insert and reverse the order of the items in the array.
22. Write a program to add, transpose and multiply two matrices.
23. Write a Python program to create a class that represents a shape. Include methods to

calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

Unit V:

Introduction to Data Science: Functional Programming, JSON and XPython, NumPy with Python, Pandas.

Sample Experiments:

24. Python program to check whether a JSON string contains complex object or not25. Python Program to demonstrate NumPy arrays creation using array () function.
26. Python program to demonstrate use of ndim, shape, size, dtype.
27. Python program to demonstrate basic slicing, integer and Boolean indexing.
28. Python program to find min, max, sum, cumulative sum of array
29. Create a dictionary with at least five keys and each key represent value as a list this list contains at least ten values and convert this dictionary as a pandas data and explore the data through the data frame as follows:
    a) Apply head () function to the pandas data frame.
    b) Perform various data selection operations on Data Frame.
30. Select any two columns from the above data frame, and observe the change attribute with respect to other attribute with scatter and plot operations in matplotlib.

Reference Books:

1. Gowrishankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources/Virtual Labs:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS205A	HM	**Environmental Science** (Common for all branches of Engineering)	2	0	0	0

Pre-Requisites: Nil

Course Objectives:

- To make the students to get awareness on environment.
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
- To save earth from the inventions by the engineers.

Course Outcomes (COs):

On Successful completion of the course, Students will be able to

CO1: Apply the concepts of multidisciplinary environmental studies to real-world issues by identifying the interconnections between natural resources and environmental problems. (L3)

CO2: Analyze the structure, function, and energy dynamics of various ecosystems and apply ecological principles and biodiversity conservation strategies to evaluate environmental issues and promote sustainable ecosystem management. (L4)

CO3: Analyze the causes, effects, and control measures of various types of pollution and disasters, and apply appropriate pollution prevention and waste management strategies to mitigate environmental and public health risks. (L4)

CO4: Apply methods like rainwater harvesting, watershed management, and wasteland reclamation to practical scenarios and use of environmental laws (e.g., Air, Water, Wildlife Acts) to explain pollution control strategies to Encourage public awareness and responsible consumer behaviour. (L3)

CO5: Apply concepts of family welfare, value education, and IT in real-world contexts of environmental health and awareness. Use observations from field visits to identify environmental problems and local biodiversity. (L3)

Unit I: Multidisciplinary Nature of Environmental Studies:

Definition, Scope and Importance – Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

Unit II: Ecosystems: Concept of an ecosystem:

Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem. b. Grassland ecosystem c. Desert ecosystem. d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its Conservation: Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit III: Environmental Pollution:

Definition, Cause, effects and control measures of: a. Air Pollution. b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

Unit IV: Social Issues and the Environment:

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

Unit V: Human Population and the Environment:

Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and humanhealth – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain Visit to a local polluted site-Urban /Rural/ Industrial/ Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, "Environmental Studies", Pearson education
3. S. Azeem Unnisa, "Environmental Studies" Academic Publishing Company
4. K. Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", SciTech Publications (India), Pvt. Ltd.

Reference Books:

1. Deeksha Dave and E. Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M. Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice Hall of India Private limited
5. G.R. Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House 6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice Hall of India Private limited.

B.Tech. – II Year
II Semester

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS206T	HM	**Managerial Economics and Financial Analysis** (Common to EEE, ECE, CSE, & AI&DS)	2	0	0	2

Pre-Requisites: Nil

Course Objectives:

- To inculcate the basic knowledge of microeconomics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To Know the Various types of market structure and pricing methods and strategy
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements.

Course Outcomes (COs):

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

CO1: Understand the significance of managerial economics, analyse demand and its elasticity, and apply appropriate forecasting methods for effective business decision-making. (L4)

CO2: Analyse production functions, cost behaviours, and economies of scale, and apply break-even analysis to determine optimal production and cost efficiency in business decisions. (L4)

CO3: Explain forms of business organizations and analyse various market structures and pricing strategies for effective decision-making. (L4)

CO4: Explain the concept and components of working capital, identify sources of capital, and apply capital budgeting techniques for evaluating investment projects. (L4)

CO5: Apply accounting principles and conventions to prepare final accounts, and analyse financial performance using key financial ratios. (L4)

Unit I: Managerial Economics:

Introduction –Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand -Demand Elasticity-Types –Measurement. Demand Forecasting-Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

Unit II: Production and Cost Analysis:

Introduction –Nature, meaning, significance, functions and advantages. Production Function–Least-cost combination–Short run and long run Production Function-Isoquants and Isocosts,

Economies of Scale- Cost & Break-Even Analysis -Cost concepts and Cost behavior-Break-Even Analysis (BEA) -Determination of Break-Even Point (Simple Problems).

Unit III: Business Organizations and Markets:

Introduction –Forms of Business Organizations-Sole Proprietary -Partnership -Joint Stock Companies -Public Sector Enterprises. Types of Markets -Perfect and Imperfect Competition -Features of Perfect Competition Monopoly-Monopolistic Competition–Oligopoly-Price-Output Determination -Pricing Methods and Strategies

Unit IV: Capital Budgeting:

Introduction –Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals, Methods and Evaluation. Projects –Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

Unit V: Financial Accounting and Analysis:

Introduction –Concepts and Conventions-Double-Entry Bookkeeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Introduction to Financial Analysis -Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

Text Books:

1. Varshney & Maheswari: Managerial Economics, Sultan Chand.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH.

Reference Books:

1. Ahuja Hl Managerial economics Schand.
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage.

Online Learning Resources:

https://www.slideshare.net/123ps/managerial-economics-ppt
https://www.slideshare.net/rossanz/production-and-cost-45827016
https://www.slideshare.net/darkyla/business-organizations-19917607
https://www.slideshare.net/balarajbl/market-and-classification-of-market

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS207T	HM	**Organizational Behaviour** ((Common to EEE, ECE, CSE, & AI&DS)	2	0	0	2

Pre-Requisites: Nil

Course Objectives:

- To enable student's comprehension of organizational behavior
- To offer knowledge to students on self-motivation, leadership and management
- To facilitate them to become powerful leaders
- To Impart knowledge about group dynamics
- To make them understand the importance of change and development

Course Outcomes (COs):

CO1: Explain the nature, scope, and functions of organization and examine individual behavior aspects to improve organizational effectiveness. (L4)

CO2: Apply theories of motivation to analyze the performance problems (L4)

CO3: Analyze the different theories of leadership and their application in the organizations. (L4)

CO4: Evaluate group dynamics and demonstrate skills required for working in groups (L4)

CO5: Develop as powerful leader by applying relevant theories to solve problems of change within the organizations. (L4)

Unit I: Introduction to Organizational Behavior:

Meaning, definition, nature, scope and functions -Organizing Process –Making organizing effective -Understanding Individual Behavior –Attitude -Perception -Learning –Personality.

Unit II: Motivation and Leading:

Theories of Motivation-Maslow's Hierarchy of Needs -Hertzberg's Two Factor Theory -Vroom's theory of expectancy –Mc Cleland's theory of needs–Mc Gregor's theory X and theory Y–Adam's equity theory.

Unit III: Organizational Culture:

Introduction –Meaning, scope, definition, Nature -Organizational Climate -Leadership -Traits Theory–Managerial Grid -Transactional Vs Transformational Leadership -Qualities of good Leader -Conflict Management -Evaluating Leader.

Unit IV: Group Dynamics:

Introduction –Meaning, scope, definition, Nature-Types of groups -Determinants of group behavior -Group process –Group Development -Group norms -Group cohesiveness -Small Groups -Group decision making -Team building -Conflict in the organization–Conflict resolution

Unit V: Organizational Change and Development:

Introduction –Nature, Meaning, scope, definition and functions-Organizational Culture -Changing the Culture –Change Management –Work Stress Management -Organizational management –Managerial implications of organization's change and development

Textbooks:

1. Luthans, Fred, OrganisationalBehaviour, McGraw-Hill, 12th edition.
2. P Subba Ran, OrganisationalBehaviour, Himalya Publishing House.

Reference Books:

1. McShane, Organizational Behaviour, TMH
2. Nelson, OrganisationalBehaviour, Thomson.
3. Robbins, P. Stephen, Timothy A. Judge, OrganisationalBehaviour, Pearson.
4. Aswathappa, OrganisationalBehaviour, Himalaya.

Online Learning Resources:

https://www.slideshare.net/Knight1040/organizational- culture9608857

https://www.slideshare.net/AbhayRajpoot3/motivation - 165556714

https://www.slideshare.net/harshrastogi1/group-dynamics-159412405

https://www.slideshare.net/vanyasingla1/organizational

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS208T	HM	**Business Environment** (Common to EEE, ECE, CSE & AI&DS)	2	0	0	2

Pre-Requisites: Nil

Course Objectives:

- To make the student to understand about the business environment
- To enable them in knowing the importance of fiscal and monitory policy
- To facilitate them in understanding the export policy of the country
- To Impart knowledge about the functioning and role of WTO
- To Encourage the student in knowing the structure of stock markets

Course Outcomes (COs):

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

CO1: Apply business environment concepts, classify types and industry structures, and assess environmental analysis pros and cons. (L3)

CO2: Apply concepts of public finance and evaluate recent trends and roles of institutions like RBI and Finance Commission. (L4)

CO3: Analyze India's Trade Policy (L4)

CO4: Analyze trade policies, agreements, EXIM policy, BoP issues, and WTO roles to assess global and Indian trade dynamics. (L4)

CO5: Analyze the Indian financial system, money and capital markets, SEBI regulations, and recent reforms including aspects of international finance. (L4)

Unit I: Overview of Business Environment:

Introduction – meaning Nature, Scope, significance, functions and advantages. Types-Internal &External, Micro and Macro. Competitive structure of industries -Environmental analysis-advantages & limitations of environmental analysis.

Unit II: Fiscal & Monetary Policy:

Introduction – Nature, meaning, significance, functions and advantages. Public Revenues - Public Expenditure - Evaluation of recent fiscal policy of GOI. Highlights of Budget- Monetary Policy - Demand and Supply of Money –RBI -Objectives of monetary and credit policy - Recent trends-Role of Finance Commission.

Unit III: India's Trade Policy:

Introduction – Nature, meaning, significance, functions and advantages. Magnitude and direction of Indian International Trade - Bilateral and Multilateral Trade Agreements - EXIM policy and role of EXIM bank -Balance of Payments– Structure & Major components - Causes for Disequilibrium in Balance of Payments - Correction measures.

Unit IV: World Trade Organization:

Introduction – Nature, significance, functions and advantages. Organization and Structure - Role and functions of WTO in promoting world trade - GATT -Agreements in the Uruguay Round –TRIPS, TRIMS - Disputes Settlement Mechanism - Dumping and Anti-dumping Measures.

Unit V: Money Markets and Capital Markets:

Introduction – Nature, meaning, significance, functions and advantages. Features and components of Indian financial systems - Objectives, features and structure of money markets and capital markets - Reforms and recent development – SEBI – Stock Exchanges - Investor protection and role of SEBI, Introduction to international finance.

Text Books:

1. Francis Cherunilam, International Business: Text and Cases, Prentice Hall of India.

2. K. Aswathappa, Essentials of Business Environment: Texts and Cases & Exercises 13th Revised Edition.HPH

Reference Books:

1. K. V. Sivayya, V. B. M Das, Indian Industrial Economy, Sultan Chand Publishers, New Delhi, India.

2. Sundaram, Black, International Business Environment Text and Cases, Prentice Hall of India, New Delhi, India.

3. Chari. S. N, International Business, Wiley India.

4. E. Bhattacharya, International Business, Excel Publications, New Delhi.

Online Learning Resources:

https://www.slideshare.net/ShompaDhali/business-environment-53111245

https://www.slideshare.net/rbalsells/fiscal-policy-ppt

https://www.slideshare.net/aguness/monetary-policy-presentationppt

https://www.slideshare.net/DaudRizwan/monetary-policy-of-india-69561982

https://www.slideshare.net/ShikhaGupta31/indias-trade-policyppt

https://www.slideshare.net/viking2690/wto-ppt-60260883

https://www.slideshare.net/prateeknepal3/ppt-mo

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02209T	PC	Linear Control System	2	1	0	3

Pre-Requisites: Basic Knowledge of Mathematics

Course Objectives:

- Introduce the basic principles and applications of control systems.
- Learn the time response and steady state response of the systems.
- Know the time domain analysis and solutions to time invariant systems.
- Understand different aspects of stability analysis of systems in frequency domain.
- Understand the concept of state space, controllability and observability.

Course Outcomes (COs):

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

CO1: Analyse control systems by modelling with differential equations and simplifying using block diagrams and signal flow graphs. (L4)

CO2: Examine the time response of first and second order systems, including transient and steady-state behaviour, and evaluate the effects of P, PI, PD, and PID controllers on system performance. (L4)

CO3: Analyse the stability of control systems using Routh's stability criterion and root locus methods, and determine the effects of adding poles and zeros on system performance. (L4)

CO4: Determine system stability and frequency domain performance using Bode, Polar, and Nyquist plots, and evaluate the impact of compensators on second-order system behaviour. (L4)

CO5: Apply state space methods to model continuous systems, solve state equations, and determine system controllability and observability to assess system behaviour. (L4)

Unit I: Control Systems Concepts:

Open loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feedback characteristics, Effects of positive and negative feedback, Mathematical models – Differential equations of translational and rotational mechanical systems and electrical systems, Analogous Systems, Block diagram reduction methods – Signal flow graphs - Reduction using Mason's gain formula. Controller components, DC Servomotor and AC Servomotor- their transfer functions, Synchros.

Unit II: Time Response Analysis:

Step Response - Impulse Response - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants, Study of effects and Design of P, PI, PD and PID Controllers on second order system.

Unit III: Stability Analysis in Time Domain:

The concept of stability – Routh's stability criterion – Stability and conditional stability - limitations of Routh's stability. The Root locus concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.

Unit IV: Frequency Response Analysis:

Introduction, Frequency domain specifications-Bode Diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram - Stability Analysis from Bode Plots. Polar Plots- Nyquist Plots- Phase margin and Gain Margin-Stability Analysis. Compensation techniques – Study of Effects and Design of Lag, Lead, Lag-Lead Compensator design in frequency Domain on a second order system.

Unit V: State Space Analysis of Continuous Systems:

Concepts of state, state variables and state model - differential equations & Transfer function models - Block diagrams. Diagonalization, Transfer function from state model, solving the Time invariant state Equations- State Transition Matrix and its Properties. System response through State Space models. The concepts of controllability and observability,

Text Books:

1. Modern Control Engineering by Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 5thedition, 2010.
2. Control Systems Engineering by I. J. Nagrath and M. Gopal, New Age International (P) Limited Publishers, 5th edition, 2007.

Reference Books:

1. Control Systems Principles & Design by M.Gopal, 4th Edition, McGraw Hill Education,2012.
2. Automatic Control Systems by B. C. Kuo and Farid Golnaraghi, John wiley and sons, 8th edition,2003. 3. Feedback and Control Systems, Joseph J Distefano III, Allen R Stubberud & Ivan J Williams, 2nd Edition, Schaum's outlines, McGraw Hill Education,2013.
4. Control System Design by Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, Pearson, 2000.
5. Feedback Control of Dynamic Systems by Gene F. Franklin, J.D. Powell and Abbas Emami- Naeini, 6th Edition, Pearson,2010.

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04205T	PC	EM Waves and Transmission Lines	2	1	0	3

Pre-Requisites: Basic Knowledge on Mathematics, Electromagnetics and Basic circuit theory

Course Objectives:

- To understand and analyze different laws and theorems of electrostatic fields.
- To study and analyze different laws and theorems of magnetostatic fields.
- Analyzing Maxwell's equations in different forms.
- To learn the concepts of wave theory and its propagation through various mediums.
- To get exposure to the properties of transmission lines.

Course Outcomes (COs):

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

CO1: Apply electrostatic laws and Maxwell's equations to evaluate electric fields, potentials, and capacitance in various coordinate systems. (L4)

CO2: Apply Maxwell's equations, Biot–Savart and Ampere's laws to solve static and time-varying field problems, and evaluate magnetic forces, inductance, and boundary conditions. (L4)

CO3: Analyse EM wave propagation, reflection, refraction, polarization, and apply Poynting theorem in different media. (L4)

CO4: Determine transmission line parameters using T and π models, derive expressions for Characteristic impedance and propagation constants, and evaluate performance of infinite, lossless, and distortion less lines. (L4)

CO5: Apply impedance matching techniques and use Smith Chart to solve high-frequency transmission line problems. (L4)

Unit I: Review of Co-ordinate Systems:

Electrostatics: Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss Law and Applications, Electric Potential, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Illustrative Problems. Convection and Conduction Currents, Dielectric Constant, Poisson's and Laplace's Equations; Capacitance – Parallel Plate, Coaxial Capacitors, Illustrative Problems.

Unit II: Magnetostatics:

Biot-Savart Law, Ampere's CircuitalLaw and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductances and Magnetic Energy, Illustrative Problems**.**

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements, Conditions at a Boundary Surface, Illustrative Problems.

Unit III: EM Wave Characteristics:

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations Between E & H, Sinusoidal Variations, Wave Propagation in Lossy dielectrics, lossless dielectrics, free space, wave propagation in good conductors, skin depth, Polarization & Types, Illustrative Problems.

Reflectionand RefractionofPlane Waves – Normaland Oblique Incidences, for bothPerfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem, Illustrative Problems.

Unit IV: Transmission Lines-I:

Types, Parameters, T&π Equivalent Circuits, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line, Lossless lines, distortion less lines, Illustrative Problems.

Unit V: Transmission Lines – II:

Input Impedance Relations, Reflection Coefficient, VSWR, Average Power, Shorted Lines, Open Circuited Lines, and Matched Lines, Low loss radio frequency and UHF Transmission lines, UHF Lines as Circuit Elements, Smith Chart – Construction and Applications, Quarter wave transformer, Single Stub Matching, Illustrative Problems.

Text Books:

1. Elementsof Electromagnetics, Matthew N.O. Sadiku, 4th Edition, Oxford University Press, 2008.
2. Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, 2nd Edition, PHI, 2000.

Reference Books:

1. Electromagnetic Field Theory and Transmission Lines, G.S.N. Raju, 2nd Edition, Pearson Education, 2013.
2. Engineering Electromagnetics, WilliamH. Hayt Jr. and John A. Buck, 7thEdition, Tata McGraw Hill, 2006.
3. Electromagnetics, John D. Krauss, 3rd Edition, McGraw Hill, 1988.
4. Networks, Lines, and Fields, JohnD.Ryder, 2nd Edition, PHI publications, 2012.

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04206T	PC	Electronic Circuits Analysis	2	1	0	3

Pre-Requisites: Basic Knowledge on Network analysis and Electronic Devices and Circuits

Course Objectives:

- Understand the characteristics of Differential amplifiers, feedback and power amplifiers.
- Analyze the response of tuned amplifiers
- Categorize different oscillator circuits based on the application
- Design the electronic circuits for the given specifications and for a given application.

Course Outcomes (COs):

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

CO1: Evaluate multistage and differential amplifier performance using BJT and MOS configurations. (L4)

CO2: Analyse frequency response of BJT and MOSFET amplifiers and determine key frequency parameters. (L4)

CO3: Evaluate negative feedback amplifier topologies and assess the design and operation of different oscillator circuits. (L4)

CO4: Analyse the working principles, characteristics, and applications of various classes of power amplifiers. (L4)

CO5: Examine tuned amplifiers' frequency response and Q-factor, and design transistor-based multivibrators and Schmitt triggers. (L4)

Unit I: Multistage & Differential Amplifiers:

Introduction, Classification of Amplifiers, Distortion in amplifiers, Coupling Schemes, RC Coupled Amplifier using BJT, Cascaded RC Coupled BJT Amplifiers, Cascode amplifier, Darlington pair, the MOS Differential Pair, Small-Signal Operation of the MOS Differential Pair, The BJT Differential Pair, and other Nonideal Characteristics of the Differential Amplifier.

Unit II: Frequency Response:

Low-Frequency Response of the CS and CE Amplifiers, Internal Capacitive Effects and the High-Frequency Model of the MOSFET and the BJT, High- Frequency Response of the CE, Emitter follower, CS, CD, f_β, f_T and gain bandwidth product.

Unit III: Feedback Amplifiers:

Introduction, The General Feedback Structure, Some Properties of Negative Feedback, The Four Basic Feedback Topologies, Series—Shunt, Series—Series, Shunt—Shunt, Shunt—Series.

Oscillators: General Considerations, Phase Shift Oscillator, Wien-Bridge Oscillator, LC Oscillators, Relaxation Oscillator, Crystal Oscillators, Illustrative Problems

Unit IV: Power Amplifiers:

Introduction, Class A amplifiers (Series fed, Transformer coupled, Push pull), Second Harmonic distortion, Class B amplifiers (Push pull, Complementary symmetry), Crossover distortion and Class AB operation, Class C amplifiers, Power BJTs, MOS power transistors.

Unit V: Tuned Amplifiers:

Introduction, single Tuned Amplifiers – Q-factor, frequency response, Double Tuned Amplifiers – Q-factor, frequencyresponse, Concept of stagger tuningandsynchronous tuning.

Multivibrators: Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using Transistors.

Text Books:

1. Adel. S. Sedra and Kenneth C. Smith, "MicroElectronicCircuits,"6th Edition, Oxford University Press, 2011.
2. J. Millman, H. Taub and Mothiki S.Prakash Rao - Pulse, Digital and Switching Waveforms – 2nd Ed., TMH, 2008.
3. Millman, C Chalkias, "Integrated Electronics", 4th Edition, McGraw Hill Education (India) Private Ltd., 2015.

Reference Books:

1. Behzad Razavi,"FundamentalsofMicroElectronics",Wiley, 2010.
2. Donald A Neamen, "ElectronicCircuits –Analysis and Design,"3rd Edition, McGraw Hill (India), 2019.
3. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", 9th Edition, Pearson/Prentice Hall, 2006.

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04207T	PC	Analog and Digital Communications	2	1	0	3

Pre-Requisites: Basic Knowledge on Mathematics, Electronics and Signals and Systems

Course Objectives:

- Introduce various modulation and demodulation techniquesof analog and digital communication systems.
- Analyze different parameters of analog and digital communication echniques.
- Understand function of various stagesofAM, FM transmitters and Know characteristics of AM &FM receivers.
- Analyze the performance of various digital modulation techniques in the presence of AWGN.

Course Outcomes (COs):

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

CO1: Explain the concepts of various amplitude modulation and demodulation techniques, and analyse their performance in both time and frequency domains. (L4)

CO2: Understand concepts of angle modulation and demodulation techniques and analyse their performance in both time and frequency domains. (L4)

CO3: Explain the operation principles and design aspects of transmitters and receivers. L3)

CO4: Describe concepts of analog, pulse, and digital modulation and demodulation techniques, and evaluate their performance under noisy conditions. (L4)

CO5: Compute the various parameters of baseband and bandpass transmissions schemes by applying basic engineering knowledge and evaluate their performance in terms of bandwidth & power efficiency. (L4)

Unit I: Amplitude Modulation:

Need for modulation, Amplitude Modulation - Time and frequency domaindescription, singletone modulation, powerrelations inAMwaves, GenerationofAM waves - Switching modulator, Detection of AM Waves - Envelope detector, DSBSC modulation - time and frequency domain description, Generation of DSBSC Waves - Balanced Modulators, Coherent detection of DSB-SC Modulated waves, COSTAS Loop,SSB modulation - time and frequency domain description, frequency discrimination and Phase discrimination methods for generating SSB, DemodulationofSSB Waves, principle of Vestigial side band modulation.

Unit II: Angle Modulation:

Basic concepts ofPhase Modulation, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave using Bessel functions, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth ofFM Wave - Generation of FM Signal- Armstrong Method, Detection of FM Signal: Balanced slopedetector,Phase locked loop,ComparisonofFMand AM., ConceptofPre-emphasis and de-emphasis

Unit III: Transmitters & Receivers:

Classificationof Transmitters, AM Transmitters, FM Transmitters

Receivers: Radio Receiver - Receiver Types - Tuned radio frequency receiver, Super heterodyne receiver, RF section and Characteristics - Frequency changing and tracking, Intermediate frequency, Image frequency, AGC, Amplitude limiting, FM Receiver, Comparison of AM and FM Receivers.

Unit IV: Introduction to Noise:
Types of Noise, Receiver Model, Noise in AM, DSB, SSB, and FM Receivers.
Pulse Modulation: Types of Pulse modulation- PAM, PWM and PPM. Comparison of FDM and TDM. **Pulse Code Modulation:** PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, Delta Modulation, DPCM, Noise in PCM and DM.

Unit V: Digital Modulation Techniques:
Coherent Digital Modulation Schemes – ASK, BPSK, BFSK, QPSK, Non-coherent BFSK, DPSK. M-ary Modulation Techniques, Power Spectra, Bandwidth Efficiency.

BasebandTransmission and Optimal Reception of Digital Signal: A Base band Signal Receiver, Probability of Error, Optimum Receiver, Coherent Reception, ISI, Eye Diagrams.

Text Books:
1. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th Edition, 2004.
2. WayneTomasi -ElectronicsCommunicationSystems-Fundamentalsthrough Advanced, 5th Ed., PHI, 2009 B.P.Lathi, Zhi Ding "Modern Digital and Analog Communication Systems",Oxford press, 2011.

Reference Books:
1. Sam Shanmugam, "Digital and Analog Communication Systems", John Wiley & Sons, 1999.
2. Bernard Sklar, F.J. harris "Digial Communications: Fundamentals and Applications", Pearson Publications, 2020.
3. Taub and Schilling, "Principles of Communication Systems", Tata McGraw Hill, 2007.

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04206P	PC	Electronic Circuits Analysis Lab	0	0	3	1.5

Pre-Requisites: Basic Knowledge on Network analysis and Electronic Devices and Circuits

Course Objectives:

- Plot the characteristics of Differential amplifiers, feed back and power amplifiers.
- Analyze the response of tuned amplifiers and multivibrators.
- Categorize different oscillator circuits based on the application.
- Design the electronic circuits for the given specifications and for a given application.

Course Outcomes (COs):

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

CO1: Design the Darlington, CE, CC, Cascode, Feedback, Power, Tuned and Differential amplifiers for given specifications and analyse their performance (L4)

CO2: Design and construct oscillators to generate stable sinusoidal oscillations.

CO3: Design and implement various multivibrators and Schmitt triggers to meet given specifications. (L4)

CO4: Compare and interpret theoretical and experimental results to draw meaningful conclusions. (L4)

List of Experiments:

1. Design and Analysisof Darlington pair.
2. Frequency response of CE– CC multistageAmplifier
3. Design and Analysis of CascodeAmplifier.
4. FrequencyResponse of DifferentialAmplifier
5. Design and Analysis of any two topologies of feedback amplifies and find the frequency response of it.
6. DesignandAnalysisof ClassApoweramplifier.
7. DesignandAnalysisof ClassABamplifier.
8. DesignandAnalysisof RC phaseshiftoscillator.
9. DesignandAnalysisof LC Oscillator
10. Frequency Response of SingleTuned amplifier
11. Design a Bistable Multivibrator and analyze the effect of commutating capacitors and draw the wave forms at base and collector of transistors.
12. Design an Astable Multivibrator and draw the waveforms at base and collector of transistors.
13. Design a Monostable Multivibrator and draw the input andoutput waveforms.
14. Draw the responseof Schmit ttrigger for gainof greater than and less than one.

Note:Atleast 12 experiments shall be performed.

Faculty members who are handling the laboratory shall see that students are given design specifications for a given circuit appropriately and monitor the designand analysis aspects of the circuit.

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04207P	PC	Analog and Digital Communications Lab	0	0	3	1.5

Pre-Requisites: Basic Knowledge on Mathematics, Electronics and Signals and Systems

Course Objectives:

- Underst and the basics of analog and digital modulation techniques.
- Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course.
- Design and implement different modulation and demodulation techniques and their applications.
- Develop cognitive and behavioral skills for performance analysis of various modulation techniques.

Course Outcomes (COs):

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

CO1: Design and implement Analog &Pulse Modulation/Demodulation schemes using suitable electronic components/Integrated Circuits, and evaluate their performance based on key communication metrics. (L4)

CO2: Design and implement Baseband and Bandpass Modulation/Demodulation schemes using suitable electronic components/Integrated Circuits, and assess their performance using key communication metrics. (L4)

CO3: Implement FDM and TDM techniques using suitable electronic components /Integrated Circuits and evaluate their effectiveness in multiplexed signal transmission and conduct experiments on Radioreceivermeasurements. (L4)

CO4: Demonstrate the Sampling Theorem using suitable tools and evaluate the effect of sampling rate on signal reconstruction. (L4)

List of Experiments:

Design the circuits andverify thefollowing experiments takingminimum of six from each section shown below.

Section – A:

1. AM Modulation and Demodulation
2. DSB-SC Modulation and Demodulation
3. FrequencyDivision Multiplexing
4. FM Modulation and Demodulation
5. Radioreceiver measurements
6. PAM Modulation and Demodulation
7. PWM Modulationand Demodulation
8. PPM Modulation and Demodulation

Section-B:

1. SamplingTheorem.
2. Time Division Multiplexing
3. Delta Modulation and Demodulation
4. PCM Modulationand Demodulation
5. BPSK Modulation and Demodulation
6. BFSK Modulation and Demodulation
7. QPSK Modulationand Demodulation
8. DPSK Modulation and Demodulation

Note: Faculty members (who are handling the laboratory) are requested to instruct the students not to use ready made kits for conducting the experiments.They are advised to make the students work in the laboratory by constructing the circuits

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24SEHS201S	SE	**Soft Skills** (Common to all branches of Engineering)	0	1	2	2

Pre-Requisites: Nil

Course Objectives:

- To encourage all round development of the students by focusing on soft skills
- To make the students aware of critical thinking and problem-solving skills
- To enhance healthy relationship and understanding within and outside an organization
- To function effectively with heterogeneous teams Course Outcomes

Course Outcomes (COs):

On Successful completion of the course, Students will be able to

CO1: Apply effective communication techniques by understanding its significance, process, types, and overcoming barriers to enhance professional and interpersonal interactions. (L3)

CO2: Apply active listening, observation, curiosity, introspection, and critical thinking skills to enhance problem-solving, decision-making, and reflective practices. (L3)

CO3: Apply problem-solving techniques, conflict management strategies, and team decision-making methods to resolve issues and enhance collaboration in professional environments. (L3)

CO4: Analyse emotional and stress responses to identify triggers, evaluate coping strategies, and develop effective methods for emotional control and resilience in personal and professional contexts. (L4)

CO5: Analyse the importance of etiquette and grooming in professional settings to enhance personal branding and overcome workplace challenges. (L4)

Unit I: Soft Skills:

Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills -Significance, process, types - Barriers of communication - Improving techniques

Activities:

Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self expression – articulating with felicity

(The facilitator can guide the participants before the activity citing examples from the lives of `the great, anecdotes and literary sources)

Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.

Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing , negotiating- agreeing and disagreeing with professional grace.

Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation

Unit II Critical Thinking:

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking - Positive thinking – Reflection

Activities:

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues –placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

Unit III : Problem Solving & Decision Making:

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution –Team building - Effective decision making in teams – Methods & Styles

Activities:

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.

Case Study & Group Discussion

Unit IV: Emotional Intelligence & Stress Management:

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.

Providing opportUnities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

Unit V: Corporate Etiquette:

Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction- Cell phone etiquette - Dining etiquette - Netiquette - Job interview etiquette -Corporate grooming tips - Overcoming challenges

Activities

Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette - Group Activities to showcase gender sensitivity, dining etiquette etc. Conducting mock job interviews - Case Study - Business Etiquette Games

Prescribed books:

1. Mitra Barun K, *Personality Development and Soft Skills*, Oxford University Press, Pap/Cdr edition 2012
2. DrShikhaKapoor, *Personality Development and Soft Skills: Preparing for Tomorrow,* I K International Publishing House, 2018

Online Learning Resources:

1. **https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q**
2. **https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ**
3. **https://youtu.be/-Y-R9hDl7lU**
4. **https://youtu.be/gkLsn4ddmTs**
5. **https://youtu.be/2bf9K2rRWwo**
6. **https://youtu.be/FchfE3c2jzc**
7. **https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/**
8. **https://onlinecourses.nptel.ac.in/noc24_hs15/preview**

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24ES03102T	**ES**	**Design Thinking & Innovation** (Common for all branches of Engineering)	**1**	**0**	**2**	**2**

Pre-Requisites: Nil

Course Objectives:

- Familiarize students with design thinking process as a tool for breakthrough innovation.
- Equip students with design thinking skills and ignite the minds to create innovative ideas.
- Develop solutions for real-time problems.

Course Outcomes (COs):

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

CO1: Explain fundamental elements and principles of design, and analyze the role of design thinking and material innovations in shaping modern industrial practices. (L4)

CO2: Apply the design thinking process—empathize, analyze, ideate, prototype—and use tools like journey maps and brainstorming to develop innovative solutions for product and social innovation. (L4)

CO3: Distinguish between creativity and innovation, and apply creative thinking in teams to develop and evaluate innovative ideas in organizational contexts. (L4)

CO4: Formulate problems and define product specifications by applying product design strategies and planning for value-driven innovation. (L4)

CO5: Apply design thinking principles to address business challenges and develop innovative business models, prototypes, and startup strategies. (L4)

Unit I: Introduction to Design Thinking:

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

Unit II: Design Thinking Process:

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development.

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

Unit III: Innovation:

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

Unit IV: Product Design:

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

Unit V: Design Thinking in Business:

Processes Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Text books:

1. Tim Brown, Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough.H, The Era of Open Innovation – 2013

Online Learning Resources:

1. https://nptel.ac.in/courses/110/106/110106124/
2. https://nptel.ac.in/courses/109/104/109104109/
3. https://swayam.gov.in/nd1_noc19_mg60/preview

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPIN301L	IP	**Community Service Internship** (Common to all branches of Engineering)	0	0	0	0

Pre-Requisites: Problem-Solving & Critical Thinking, Communication & Presentation Skills, Teamwork& Collaboration Skills, Foundations in Ethics and Social Responsibility.

Course Objectives:

- To develop social awareness and responsibility among engineering students by engaging with real-world Community needs.
- To apply basic engineering knowledge and problem-solving skills in designing practical solutions for local societal challenges.
- To foster teamwork, leadership, and communication skills through collaborative, interdisciplinary project work.
- To cultivate ethical reasoning, empathy, and intercultural understanding by working with diverse commUnities and stakeholders.
- To enhance students' ability to plan, execute, and document projects through structured project management and reporting.
- To bridge academic learning with practical experience, strengthening the relevance of engineering education to societal development.

Course Outcomes (COs):

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

CO1: Apply engineering knowledge to identify and address Community needs through structured service-based projects. (L3)

CO2: Work collaboratively in diverse teams to plan, execute, and evaluate Community service initiatives. (L3)

CO3: Communicate project goals, processes, and outcomes effectively through written reports and oral presentations. (L3)

CO4: Assess the social, ethical, and environmental implications of engineering solutions implemented in Community settings. (L4)

CO5: Evaluate personal and professional development achieved through Community engagement, with emphasis on leadership, empathy, and social responsibility. (L4)

Community Service Internship……Experiential learning through Community engagement

Introduction

- Community Service Internship is an experiential learning strategy that integrates meaningfulCommunity service with instruction, participation, learning and Community development.
- Community Service Internship involves students in Community development and service activities and applies the experience to personal and academic development.
- Community Service Internship is meant to link the Community with the college for mutual benefit. The Community will benefit with the focused contribution of the college students for the village/ local development. The college finds an opportUnity to develop social sensibility and responsibility among students and emerge as a socially responsible institution.

Objective

Community Service Internship should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships.

The Specific Objectives are

- To sensitize the students to the living conditions of the people who are around them,
- To help students to realize the stark realities of society.
- To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
- To make students aware of their inner strength and help them to find new /out of box solutions to social problems.
- To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
- To help students to initiate developmental activities in the Community in coordination with public and government authorities.
- To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Internship

- Every student should put in 6 weeks for the Community Service Internshipduring the summer vacation.
- Each class/section should be assigned with a mentor.
- Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, housewives, etc
- A logbook must be maintained by each of the students, where the activities undertaken/ involved to be recorded.
- The logbook has to be countersigned by the concerned mentor/faculty in charge.
- An evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
- The final evaluation to be reflected in the grade memo of the student.
- The Community Service Internshipshould be different from the regular programs of NSS/NCC/Green Corps/Red Ribbon Club, etc.
- Minor project reports should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the jobtraining.

Procedure

- A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, to enable them to commute from their residence and return back by evening or so.

The Community Service Internship is a two fold one –

- First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.
- Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –
    - Agriculture
    - Health
    - Marketing and Cooperation
    - Animal Husbandry
    - Horticulture
    - Fisheries
    - Sericulture
    - Revenue and Survey
    - Natural Disaster Management
    - Irrigation
    - Law & Order
    - Excise and Prohibition
    - Mines and Geology
    - Energy
    - Internet
    - Free Electricity
    - Drinking Water

Expected Outcomes:

Benefits of Community Service Internship to Students

Learning Outcomes

- Positive impact on students' academic learning
- Improves students' ability to apply what they have learned in "the real world"
- Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development.
- Improved ability to understand complexity and ambiguity

Personal Outcomes

- Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
- Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills.

Social Outcomes

- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in Community service after graduation

Career Development

- Connections with professionals and Community members for learning and career opportUnities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportUnity. Relationship with the Institution
- Stronger relationships with faculty
- Greater satisfaction with college

- Improved graduation rates

Benefits of Community Service Internshipto Faculty Members

- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and Community
- Providing networking opportUnities with engaged faculty in other disciplines or institutions
- A stronger commitment to one's research.

Benefits of Community Service Internshipto Colleges And Universities

- Improved institutional commitment.
- Improved student retention
- Enhanced Community relations

Benefits of Community Service Internshipto Community

- Satisfaction with student participation
- Valuable human resources needed to achieve Community goals.
- New energy, enthusiasm and perspectives applied to Community work.
- Enhanced Community-university relations.

Suggestive List of Programmes Under Community Service Internship

The following the recommended list of projects for Engineering students. The lists are not exhaustive and open for additions, deletions, and modifications. Colleges are expected to focus on specific local issues for this kind of project. The students are expected to carry out these projects with involvement, commitment, responsibility, and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of project. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting should be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases

22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation
27. Floury culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species 3
3. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilisation of free electricity to farmers and related issues
40. Gender ration in schooling level- observation.

Complimenting the Community Service Internship, the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programs

Programs for School Children

1. Reading Skill Program (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Program on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Program on Socially relevant themes.

Programs for Women Empowerment

1. Government Guidelines and Policy Guidelines
2. Women's Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharath
7. AIDS awareness camp
8. Anti Plastic Awareness
9. Programs on Environment
10. Health and Hygiene
11. Hand wash programmes

12. Commemoration and Celebration of important days

Programs for Youth Empowerment

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programs

1. Awareness on RTI
2. Health intervention programmes
3. Yoga
4. Tree plantation
5. Programs in consonance with the Govt. Departments like –
   i. Agriculture
   ii. Health
   iii. Marketing and Cooperation
   iv. Animal Husbandry
   v. Horticulture
   vi. Fisheries
   vii. Sericulture
   viii. Revenue and Survey
   ix. Natural Disaster Management
   x. Irrigation
   xi. Law & Order
   xii. Excise and Prohibition
   xiii. Mines and Geology
   xiv. Energy

Role of Students:

- Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
- As and when required the College faculty themselves act as Resource Persons.
- Students can work in close association with Non-Governmental Organizations like Lions lub, Rotary Club, etc or with any NGO actively working in that habitation.
- And also, with the Governmental Departments. If the program is rolled out, the district Administration could be roped in for the successful deployment of the program.
- An in-house training and induction program could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service InternshipActivity

Duration: 8 weeks

1. Preliminary Survey (One Week)

- A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.

- A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.
- The Governmental agencies, like revenue administration, corporation and municipal authorities and village secreteriats could be aligned for the survey.

2. **Community Awareness Campaigns (One Week)**
   - Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.
3. **Community Immersion Programme (Three Weeks)**
   - **Along with the Community Awareness Programmes,** the student batch can also work with any one of the below-listed governmental agencies and work in tandem with them. This Community involvement programme will involve the students in exposing themselves to experiential learning about the Community and its dynamics. Programs could be in consonance with the Govt. Departments.
4. **Community Exit Report (One Week)**
   - During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks' works to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University. Throughout the Community Service Project, a daily logbook needs to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.

B.Tech. – III Year
I Semester

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04310T	PC	Analog and Digital IC Applications	3	0	0	3

Pre-Requisites: Basics of Digital Electronics and Electronic Circuits

Course Objectives:

- To introduce the classification of Integrated Circuits, internal blocks and characteristics of Op-Amp.
- To analyse linear and non-linear applications of Op-Amp.
- To gain knowledge on active filters, timers and phased locked loops.
- To understand the working of Voltage Regulators and Converters.
- To study about different types of Digital ICs and their applications.

Course Outcomes (COs):

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

CO1: Understand and analyse the internal structure and characteristics (DC and AC) of Op-Amp IC 741 to evaluate its performance in practical applications. (L4)

CO2: Analyse linear and non-linear Op-Amp circuits such as amplifiers, converters, waveform generators, and comparators in analog signal processing (L4)

CO3: Analyse the working of active filters, timer circuits using IC 555, and PLL circuits for signal generation, conditioning, and control applications (L4)

CO4: Evaluate DAC and ADC architectures and voltage regulation techniques based on accuracy, speed, and suitability for specific applications. (L5)

CO5: Evaluate the performance and reliability of CMOS logic gates, combinational, and sequential circuits in digital system design. (L5)

Unit I: ICs and Op-Amps:

Integrated Circuits and Operational Amplifier: Introduction, Classification of ICs, IC chip size and circuit complexity, basic information of Op-Amp IC741 and its features, the ideal Operational amplifier, Op-Amp internal circuit, Op-Amp characteristics – DC and AC, Features of 741 Op-Amp.

Unit II: Applications of Op-Amp:

Linear Applications: Inverting, non-inverting, Differential amplifiers, adder, subtractor, Instrumentation amplifier, AC amplifier, V to I and I to V converters, Integrator and differentiator. Non-Linear Applications: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multi vibrators, Triangular and Square waveform generators, Oscillators.

Unit III: Active Filters and other ICs:

Active Filters: Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters. Timer and Phase Locked Loops: IC 555 timer – monostable and astable operations, applications, Schmitt trigger. PLL – introduction, basic principle, phase detector, voltage-controlled oscillator (IC 566), low pass filter, monolithic PLL and applications.

Unit IV: Voltage Regulators and Converters:

Voltage Regulator: Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator. D to A and A to D Converters: Basic DAC techniques – weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters – parallel comparator type

ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

Unit V: Digital ICs:

CMOS Logic: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic.

Combinational Logic ICs: Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs Code Converters, Decoders, Encoders, Priority Encoders, Multiplexers, Demultiplexers, Parallel Binary Adder/Subtractor, Magnitude Comparators.

Sequential Logic ICs: All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers.

Text Books:

1. D. Roy Choudhury, Shail B. Jain, "Linear Integrated Circuit", 4th edition, New Age International Pvt. Ltd., 2012.
2. Floyd, Jain, "Digital Fundamentals", 8th edition, Pearson Education, 2009.

Reference Books:

1. Ramakant A. Gayakwad, "OP-AMP and Linear Integrated Circuits", 4th edition, Prentice Hall/Pearson Education, 2012.
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", McGraw Hill, 1997.
3. Gray, Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05307T	PC	**Introduction to Quantum Technologies and Applications** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites: Fundamentals of Physics and Mathematics

Course Objectives:

- Introduce fundamental quantum concepts like superposition and entanglement.
- Understand theoretical structure of qubits and quantum information.
- Explore conceptual challenges in building quantum computers.
- Explain principles of quantum communication and computing.
- Examine real-world applications and the future of quantum technologies.

Course Outcomes (COs):

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

CO1: Apply fundamental quantum principles such as superposition, entanglement, uncertainty, and wave-particle duality to explain the behaviour of basic quantum systems like electrons, photons, and atoms. (L3)

CO2: Demonstrate conceptual understanding of qubits using spin and polarization to differentiate classical and quantum information systems, and illustrate key phenomena such as coherence,entanglement, and decoherence in basic quantum systems. (L3)

CO3: Illustrate the conceptual requirements for building a quantum computer by explaining system fragility, error correction, scalability, and comparing quantum hardware platforms like superconducting circuits, trapped ions, and photonics. (L3)

CO4 : Examine the principles of quantum communication and computing by comparing classical and quantum gates, evaluating the impact of entanglement on secure communication, and analyzing the feasibility of the quantum internet and its future applications.(L4)

CO5: Analyze the societal, ethical, and industrial implications of quantum technology adoption by evaluating real-world use cases, challenges related to cost and standardization, and India's strategic position in the global quantum research and career landscape. (L4)

Unit I: Introduction to Quantum Theory and Technologies:

The transition from classical to quantum physics. Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality. Classical vs Quantum mechanics – theoretical comparison. Quantum states and measurement: nature of observation. Overview of quantum systems: electrons, photons, atoms. The concept of quantization: discrete energy levels. Why quantum? Strategic, scientific, and technological significance. A snapshot of quantum technologies: Computing, Communication, and Sensing. National and global quantum missions: India's Quantum Mission, EU, USA, China.

Unit II: Theoretical Structure of Quantum Information Systems:

What is a qubit? Conceptual understanding using spin and polarization. Comparison: classical bits vs quantum bits. Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view). Quantum coherence and decoherence – intuitive explanation. Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract. The role of entanglement and non-locality in systems. Quantum information vs classical information: principles and differences. Philosophical implications: randomness, determinism, and observer role.

Unit III: Building a Quantum Computer – Theoretical Challenges:

What is required to build a quantum computer? Fragility of quantum systems: decoherence, noise, and control. Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability. Theoretical barriers: Why maintaining entanglement is difficult. Error correction as a theoretical necessity. Quantum hardware platforms: Superconducting circuits, Trapped ions, Photonics. Vision vs reality: what's working and what remains elusive. The role of quantum software in managing theoretical complexities.

Unit IV: Quantum Communication and Computing – Theoretical Perspective:

Quantum vs Classical Information. Basics of Quantum Communication. Quantum Key Distribution (QKD). Role of Entanglement in Communication. The Idea of the Quantum Internet – Secure Global Networking. Introduction to Quantum Computing. Quantum Parallelism (Many States at Once). Classical vs Quantum Gates. Challenges: Decoherence and Error Correction. Real-World Importance and Future Potential.

Unit V: Applications, Use Cases, and the Quantum Future:

Real-world application domains: Healthcare (drug discovery), Material science, Logistics and optimization, Quantum sensing and precision timing. Industrial case studies: IBM, Google, Microsoft, PsiQuantum. Ethical, societal, and policy considerations. Challenges to adoption: cost, skills, standardization. Emerging careers in quantum: roles, skillsets, and preparation pathways. Educational and research landscape – India's opportUnity in the global quantum race.

Text Books:

1. Michael A. Nielsen, Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, "Quantum Computing: A Gentle Introduction", MIT Press, 2011.
3. Chris Bernhardt, "Quantum Computing for Everyone", MIT Press, 2019.

Reference Books:

1. David McMahon, "Quantum Computing Explained", Wiley, 2008.
2. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
3. Leonard Susskind, Art Friedman, "Quantum Mechanics: The Theoretical Minimum", Basic Books, 2014.

Online Learning Resources:

1. IBM Quantum Experience and Qiskit Tutorials
2. Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
3. edX – The Quantum Internet and Quantum Computers

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04311T	PC	Antennas & Wave Propagation	2	1	0	3

Pre-Requisites: Basics of Electro Magnetic Transmission lines

Course Objectives:

- To learn the antennas basic terminology, radiation mechanism of antennas and dipole antennas.
- To gain knowledge on HF, VHF & UHF antennas, their operation and applications.
- To analyze the working and applications of Microwave antennas.
- To understand different techniques involved in the design of antenna arrays and antenna parameter measurements.
- To study the various types of radio wave propagation methods.

Course Outcomes (COs):

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

CO1: Explain basic antenna concepts and apply electromagnetic theory to determine radiation parameters of dipole and monopole antennas. (L3)

CO2: Apply antenna theory to analyse and design HF, VHF, and UHF antennas such as loop, Yagi-Uda, log-periodic, helical, and horn antennas. (L4)

CO3: Evaluate microwave antennas like microstrip, reflector, and lens types based on design, characteristics, and performance. (L5)

CO4: Examine antenna arrays and measurement setups using pattern multiplication, directivity, and gain estimation. (L4)

CO5: Evaluate wave propagation mechanisms to determine path loss and coverage using ray and mode concepts in wireless communication systems. (L5)

Unit I: Antenna Basics & Dipole Antennas:

Definition of antenna, Radiation Mechanism – single wire, two wire, dipoles. Antenna Parameters: Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Aperture Efficiency, Effective Height and length, Antenna Theorems. Radiation: Basic Maxwell's equations, Retarded potential, Helmholtz Theorem, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Field Components, Radiated power, Radiation Resistance, Beam width, Natural current distributions, far fields and patterns of Thin Linear Center-fed Antennas.

Unit II: HF, VHF and UHF Antennas:

Loop Antennas – Small Loop, Comparison of far fields of small loop and short dipole, Radiation Resistances and Directives of small and large loops (Qualitative). Arrays with Parasitic Elements – Yagi-Uda Arrays, Folded Dipoles & their characteristics. Log Periodic Antenna, Helical Antennas – Helical Geometry, Helix modes, Practical Design considerations for Monofilar Helical Antenna in Axial and Normal Modes. Horn Antennas – Types, Fermat's Principle, Optimum Horns, Design considerations of Pyramidal Horns.

Unit III: Microwave Antennas:

Microstrip Antennas – Introduction, features, advantages and limitations, Rectangular patch antennas – Geometry and parameters, characteristics of Microstrip antennas. Reflector antennas – Flat sheet and corner reflectors, parabola reflectors – geometry, pattern characteristics, Feed Methods, Reflector

Types. Lens Antennas – Geometry of Non-metallic Dielectric Lenses, Zoning, Tolerances, Applications.

Unit IV: Antenna Arrays:

Point sources – Definition, Patterns, arrays of 2 Isotropic sources. Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, Endfire Arrays, EFA with Increased Directivity. BSA with Non-uniform Amplitude Distributions – General considerations and Binomial Arrays. Antenna Measurements: Sources of errors, Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by comparison, Absolute and 3-Antenna Methods).

Unit V: Wave Propagation:

Introduction, Definitions, Characterizations and general classifications, different modes of wave propagation. Ground wave propagation – Plane earth reflections, Space and surface waves, wave tilt, curved earth reflections. Space wave propagation – field strength variation with distance and height, effect of earth's curvature, absorption, Super refraction, M-curves and duct propagation, tropospheric propagation, fading and path loss calculations. Sky wave propagation – structure of Ionosphere, refraction and reflection of sky waves, Ray path, Critical frequency, MUF, LUF, OF, Virtual height and Skip distance, Multi-HOP propagation.

Text Books:

1. John D. Kraus, Ronald J. Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", TMH, New Delhi, 4th Ed., 2010.
2. C.A. Balanis, "Antenna Theory – Analysis and Design", John Wiley & Sons, 2nd Edn., 2001.
3. K.D. Prasad, "Antennas and Wave Propagation", Tech. India Publications, New Delhi, 2001.

Reference Books:

1. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 2000.
2. G.S.N. Raju, "Antenna and Wave Propagation", Pearson Education India, 3rd Edition 2009.
3. R.K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw-Hill, 2006.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04312T	**PC**	**Microprocessors and Microcontrollers** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites: Basics of Digital Electronics and Programming

Course Objectives:

- To learn the fundamental architectural concepts of microprocessors.
- To gain knowledge about assembly language programming concepts.
- To get familiar about 8086 interfacing.
- To understand the fundamentals of the 8051 Microcontroller.
- To learn interfacing with the 8051 Microcontroller.

Course Outcomes (COs):

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

CO1: Learn the fundamental architectural concepts of microprocessors. Apply knowledge of 8086 architecture to identify the roles of Bus Interface Unit (BIU) and Execution Unit (EU) in instruction execution. (L3)

CO2: Analyse the 8086-instruction set and addressing modes to develop assembly language programs for arithmetic and logical operations (L4)

CO3: Examine and Interfacing of Peripheral devices with the 8086 microprocessors. (L4)

CO4: Analyse the fundamentals of 8051 and the function of SFRs and I/O ports in executing control operations. (L4)

CO5: Evaluate the interfacing of peripheral devices with the 8086 microprocessors for efficient system performance(L5)

Unit I: 8086 Architecture:

Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing Unit, execution Unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

Unit II: 8086 Programming:

Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

Unit III: 8086 Interfacing:

Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDs, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

Unit IV: Microcontroller – Architecture of 8051:

Special Function Registers (SFRs) – I/O Pins, Ports and Circuits – Instruction set – Addressing modes – Assembly language programming.

Unit V: Interfacing Microcontroller:

Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface – Stepper Motor and Waveform generation – Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

Text Books:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, Tata McGraw Hill Education Private Limited, 3rd Edition, 1994.
2. K.M. Bhurchandi, A.K. Ray, "Advanced Microprocessors and Peripherals", 3rd edition, McGraw Hill Education, 2017.
3. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", 2nd edition, Pearson, 2012.

Reference Books:

1. Ramesh S. Gaonkar, "Microprocessor Architecture Programming and Applications with the 8085", 6th edition, Penram International Publishing, 2013.
2. Kenneth J. Ayala, "The 8051 Microcontroller", 3rd edition, Cengage Learning, 2004.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04310P	PC	Analog & Digital IC Applications Lab	0	0	3	1.5

Pre-Requisites: Basics of Analog & Digital Electronic Circuits

Course Objectives:

- To design an Inverting and Non-inverting Amplifier using an Op Amp.
- To demonstrate the Linear and Non-Linear Applications using IC 741.
- To design Astable and Monostable Multivibrator using timer ICs.
- To analyse the DAC and ADC converter.
- To design Counters and Registers using digital ICs.

Course Outcomes (COs):

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

CO1: Apply principles of current sources, sinks, mirrors, and construct single-stage and multi-stage amplifiers with feedback techniques. (L3)

CO2: Analyse and implement CMOS differential amplifiers and two-stage operational amplifiers using post-layout simulations (L4)

CO3: Analyse and construct CMOS inverters and logic gates under various design constraints and logic styles. (L4)

CO4: Design and evaluate digital circuits such as adders, shift registers, and multipliers for performance optimization. (L5)

CO5: Evaluate and verify digital systems using functional simulation, static timing analysis, and post-synthesis verification techniques. (L5)

List of Experiments (At least 8 Linear and 4 Digital IC experiments to be performed):

1. Design an Inverting and Non-inverting Amplifier using Op Amp and calculate gain.
2. Design Adder and Subtractor using Op Amp and verify addition and subtraction process.
3. Design a Comparator using Op Amp and draw the comparison results (A=B, A>B, A<B).
4. Design an Integrator and Differentiator Circuit using IC741.
5. Design an Active LPF, HPF with cutoff frequency of 2 KHz and find the roll off.
6. Design a Circuit using IC741 to generate sine/square/triangular wave with period of 1KHz.
7. Construct Mono-stable Multivibrator using IC555 and draw its output waveform.
8. Construct Astable Multivibrator using IC555 and find its duty cycle.
9. Design a Schmitt Trigger Circuit and find its LTP and UTP.
10. Design Voltage Regulator using IC723, IC 7805/7809/7912 and find its load regulation factor.
11. Design R-2R ladder DAC and find its resolution and write a truth table with respective voltages.
12. Design Parallel comparator type/counter type/successive approximation ADC and find its efficiency.
13. Design a 8x1 multiplexer using digital ICs.
14. Design a 4-bit Adder/Subtractor using digital ICs.
15. Design a Decade counter and verify its truth table and draw respective waveforms.
16. Design an Up/down counter using IC74163 and draw read/write waveforms.
17. Design a Universal shift register using IC 74194/195 and verify its shifting operation.
18. Design a 8x3 encoder/3x8 decoder and verify its truth table.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04312P	PC	**Microprocessors and Microcontrollers Lab** (Common to ECE & EEE)	0	0	3	1.5

Pre-Requisites: Basics of Digital Electronics and Programming

Course Objectives:

- To become skilled in 8086 Assembly Language programming.
- To understand the detailed software and hardware structure of the microprocessor.
- To train practical knowledge through laboratory experiments.
- To understand and learn 8051 Microcontroller.
- To acquire knowledge on microprocessors and microcontrollers, interfacing various peripherals.

Course Outcomes (COs):

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

CO1: Apply 8086 assembly language programming to perform arithmetic, bit manipulation, and array operations using various addressing modes. (L3)

CO2: Develop and execute assembly language programs for string manipulation and real-time applications such as digital clock design using interrupts. (L3)

CO3: Analyse and implement interfacing techniques of peripherals such as stepper motors, ADC/DAC, and communication modules with 8086 microprocessors. (L4)

CO4: Apply 8051 microcontroller programming to perform arithmetic, logical operations, timer/counter-based tasks, and serial communication using UART(L3)

CO5: Design and implement embedded system applications by interfacing external devices like LCD and evaluating system performance. (L5)

List of Experiments (Any Ten to be conducted):

1. Programs for 16-Bit Arithmetic Operations: Addition and Subtraction of Multi precision numbers; Multiplication and division of signed/unsigned Hexadecimal numbers; Square, cube and factorial of a given number.
2. Programs Involving Bit Manipulation Instructions: Find if given data is positive or negative; odd or even; find Logical ones and zeros in given data.
3. Programs on Arrays for 8086: Addition/subtraction of N numbers; Finding largest/smallest number; Sorting in Ascending/Descending order.
4. Programs on String Manipulations for 8086: String length, Displaying a string, Comparing two strings, Reverse string and Palindrome check.
5. Programs for Digital Clock Design Using 8086.
6. Interfacing Stepper Motor with 8086: Clockwise and Anti-clockwise operation with variable step-size.
7. Interfacing ADC/DAC with 8086: Interface ADC; Interface DAC and generate Square Wave/Triangular Wave.
8. Communication between Two Microprocessors: Parallel communication using 8255; Serial communication using 8251.
9. Programs using Arithmetic and Logical Instructions for 8051: Addition, subtraction, multiplication, division; AND, OR, XOR operations; Register Banks.
10. Programs to Verify Timers/Counters of 8051: Delays using Timer0, Timer1, Counter0, Counter1.

11. UART Operation in 8051: Serial transfer with baud rates 9600, 4800, 2400.
12. Interfacing LCD with 8051: 16x2 LCD interface in 4-bit and 8-bit mode.

Reference Books:

1. Kenneth J. Ayala, "The 8051 Microcontroller", 3rd edition, Cengage Learning, 2010.
2. Advanced Microprocessors and Peripherals – A.K. Ray and K.M. Bhurchandani, TMH, 2nd edition, 2006.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE04301S	**SE**	**PCB Design and Prototype Development**	**0**	**1**	**2**	**2**

Pre-Requisites: Nil

Course Objectives:

- Identifying Electronic Components Symbols & Footprints.
- To analyse the capability to produce PCBs of their circuit.
- To effectively use the design rules & interfacing between schematic & PCB.

Course Outcomes (COs):

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

CO1: Analyse circuit requirements to interpret and break down designs for schematic representation. (L4)

CO2: Evaluate PCB layout options based on component placement, routing, and design constraints. (L4)

CO3: Examine the PCB design process using tools and techniques through practical analysis. (L4)

Unit I: Fundamentals of Basic Electronics:

Component identification, Component symbols & their footprints, understand schematic, Creating new PCB, Browsing footprints libraries, Setting up the PCB layers, Design rule checking, Track width selection, Component selection, Routing and completion of the design.

Unit II: Introduction to PCB:

Definition and Need/Relevance of PCB, Background and History of PCB, Types of PCB, Classes of PCB Design, Terminology in PCB Design, Different Electronic Design Automation (EDA) tools and comparison.

Unit III: PCB Design Process and Practice Exercises:

PCB Design Flow, Placement and routing, Steps involved in layout design, Artwork generation Methods – manual and CAD, General design factors for digital and analogue circuits, Layout and Artwork making for Single-side, double-side and Multilayer Boards, Design for manufacturability, Design-specification standards.

Practice Exercises (Any 12 to be done):

1. PCB Design steps: Schematic Design (Schematic creation, Annotation, Netlist generation); Layout Design (Mapping of components, PCB layout Schematic); Create new schematic components; Create new component footprints.
2. Regulator circuit using 7805.
3. Inverting Amplifier or Summing Amplifier using op-amp.
4. Full-wave Rectifier.
5. Astable multivibrator using IC555.
6. Monostable multivibrator using IC555.
7. RC Phase-shifter oscillator using transistor.
8. Wein-bridge Oscillator using op-amp.
9. Full-Adder using half-adders.
10. 4-bit binary/MOD N counter using D-Flip flops.
11. Design an 8051 Development board – Power section (IC7805, capacitor, resistor, headers, LED).
12. Design an 8051 Development board – Serial communication section (MAX 232, DB9 connector).

13. Design an 8051 Development board – Reset & I/O sections (89C51, Crystal Oscillator, Capacitors).
14. Fabricate a single-sided PCB, mount components and assemble in cabinet for any one above circuit.

References:

1. Jon Varteresian, "Fabricating Printed Circuit Boards", 2002.
2. R. Tummala, "Fundamentals of Microsystems Packaging", McGraw-Hill, 2001.
3. C. Robertson, "PCB Designer's Reference", Prentice Hall, 2003.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24ES04301P	**ES**	**Tinkering Lab** (Common to all branches of Engineering)	**0**	**0**	**2**	**1**

Pre-Requisites: The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

Course Objectives:

- Encourage Innovation and Creativity.
- Provide Hands-on Learning and Impart Skill Development.
- Foster Collaboration and Teamwork.
- Enable Interdisciplinary Learning and Prepare for Industry.

Course Outcomes (COs):

CO1: Apply fundamental engineering concepts to design and build working prototypes. (L3)

CO2: Analyse the properties and functions of various materials, tools, and technologies to determine them suitability for specific tasks or projects. (L4)

CO3: Collaborate effectively in teams to solve interdisciplinary engineering problems (L4)

CO4: Evaluate tools and techniques to develop solutions with potential for real-world applications and entrepreneurship. (L5)

CO5: Evaluate and improve prototype performance based on testing and feedback (L5)

These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

List of experiments:

1) Make your own parallel and series circuits using breadboard for any application of your choice.
2) Design and 3D print a Walking Robot
3) Design and 3D Print a Rocket.
4) Temperature & Humidity Monitoring System (DHT11 + LCD)
5) Water Level Detection and Alert System
6) Automatic Plant Watering System
7) Bluetooth-Based Door Lock System
8) Smart Dustbin Using Ultrasonic Sensor
9) Fire Detection and Alarm System
10) RFID-Based Attendance System
11) Voice-Controlled Devices via Google Assistant
12) Heart Rate Monitoring Using Pulse Sensor
13) Soil Moisture-Based Irrigation
14) Smart Helmet for Accident Detection
15) Milk Adulteration Detection System
16) Water Purification via Activated Carbon
17) Solar Dehydrator for Food Drying

18) Temperature-Controlled Chemical Reactor
19) Ethanol Mini-Plant Using Biomass
20) Smart Fluid Flow Control (Solenoid + pH Sensor)
21) Portable Water Quality Tester
22) AI Crop Disease Detection
23) AI-based Smart Irrigation
24) ECG Signal Acquisition and Plotting
25) AI-Powered Traffic Flow Prediction
26) Smart Grid Simulation with Load Monitoring
27) Smart Campus Indoor Navigator
28) Weather Station Prototype
29) Firefighting Robot with Sensor Guidance
30) Facial Recognition Dustbin
31) Barcode-Based Lab Inventory System
32) Growth Chamber for Plants
33) Biomedical Waste Alert System
34) Soil Classification with AI
35) Smart Railway Gate
36) Smart Bin Locator via GPS and Load Sensors
37) Algae-Based Water Purifier
38) Contactless Attendance via Face Recognition

- Note: The students can also design and implement their own ideas, apart from the list of experiments mentioned above.
- Note: A minimum of 8 to 10 experiments must be completed by the students.

Professional Elective – I (PE - I)

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04302T	**PE**	**Computer Architecture & Organization**	**3**	**0**	**0**	**3**

Pre-Requisites: Basics of Digital Logic Design and Basic Programming

Course Objectives:

- To learn the design of various functional Units of digital computers and performance issues.
- To understand the basic processing Unit and their connections.
- To get familiar with different types of Data representation and Computer Arithmetic operations.
- To know about different types of memory and their interconnections.
- To learn the basics of parallel computing and pipelining.

Course Outcomes (COs):

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

CO1: Learn and Implement register transfer language and micro-operations to perform basic data processing and control in a digital computer system. (L3)

CO2: Understand the basic processing unit and their connections. analyse the Micro programmed control techniques and general register-based CPU operations using instruction formats and addressing modes. (L4)

CO3: Differentiate data representation formats and arithmetic algorithms by examining their structure and operation to understand their influence on computational accuracy and performance. (L4)

CO4: Evaluate different types of memory and their interconnections in digital systems for efficient performance and optimal system design(L5)

CO5: Evaluate parallel computing and pipelining techniques, and assess multiprocessor architectures, interconnection structures, and communication mechanisms based on their impact on performance and cache coherence. (L5)

Unit I: Digital Computers and Register Transfer:

Introduction, Block diagram of Digital Computer, Computer Organization, Computer Design and Architecture. Register Transfer Language and Micro operations: Register Transfer language, Bus and memory transfers, Arithmetic, logic and shift micro-operations, Arithmetic logic shift Unit. Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input–Output and Interrupt.

Unit II: Microprogrammed Control and CPU:

Control memory, Address sequencing, micro program example, design of control Unit. Central Processing Unit: General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.

Unit III: Data Representation and Computer Arithmetic:

Data types, Complements, Fixed Point Representation, Floating Point Representation. Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating-point Arithmetic operations, Decimal Arithmetic Unit, Decimal Arithmetic operations.

Unit IV: Input-Output Organization and Memory:

Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access. Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

Unit V: RISC, Pipeline and Multiprocessors:

CISC Characteristics, RISC Characteristics. Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor. Multiprocessors: Characteristics, Interconnection Structures, Inter-processor arbitration, Inter-processor communication and synchronization, Cache Coherence.

Text Books:

1. Computer System Architecture – M. Morris Mano, Third Edition, Pearson/PHI.

Reference Books:

1. Computer Organization – Carl Hamacher, ZvonksVranesic, Safea Zaky, 5th Edition, McGraw Hill.
2. Computer Organization and Architecture – William Stallings, Sixth Edition, Pearson/PHI.
3. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04303T	PE	Information Theory and Coding	2	1	0	3

Pre-Requisites: Basics of Probability Theory and Basic Mathematics

Course Objectives:

- To provide an insight into the concept of information in the context of communication theory.
- To implement various source coding algorithms and analyze their performance.
- To gain knowledge about techniques for error detection and error correction.
- To design linear block codes and cyclic codes.
- To get familiar with various convolutional codes.

Course Outcomes (COs):

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

CO1: Apply the concepts of entropy, coding techniques (Shannon-Fano, Huffman, Tunstall) and solve problems related to information sources and coding methods. (L3)

CO2: Analyse asymptotic properties, source coding techniques (LZ, LZW), channel capacity, and rate distortion concepts for efficient communication systems. (L4)

CO3: Analyse error control coding techniques and evaluate error detection and correction methods using different decoding strategies. (L4)

CO4: Evaluate the performance of linear block codes and compare different coding techniques such as Hamming, cyclic, BCH, and Reed-Solomon codes. (L5)

CO5: Evaluate convolutional coding techniques and advanced coding methods (Turbo, LDPC) for reliable data transmission in noisy channels. (L5)

Unit I: Information Theory and Source Coding:

Introduction, Definition of Entropy, Conditional Entropy, Relative Entropy, Basic Properties of Entropy, Mutual Information, Information Inequalities. Block to Variable length Coding: Prefix-free Code, Kraft Inequality, Bounds on optimal Code length, Shannon-Fano Coding, Huffman Coding. Variable to Block Length Coding: Proper message set, Tunstall message set, Tunstall coding.

Unit II: Asymptotic Equi-partition and Universal Source Coding:

Chebyshev inequality, Weak law of large numbers, Typical Sequences, Block to Block Coding of DMS: Consequences of Asymptotic Equipartition Property. Universal Source Coding: Lempel-Ziv Algorithm, LZ-77 Encoding and Decoding, Lempel-Ziv Welch (LZW) Algorithm. Coding of Sources with memory, Channel Capacity, Noisy Channel Coding Theorem, Differential Entropy, Gaussian Channel, Rate Distortion Theory, Blahut-Arimoto Algorithm.

Unit III: Error Control Coding:

Introduction to Error Control Codes, Error Probability with Repetition in the Binary Symmetric Channel, Parity Check Bit Coding for Error Detection, Block Coding for Error Detection and Correction, The Hamming Distance, Soft Decision Decoding, Hard Decision Decoding.

Unit IV: Linear Block Codes:

Introduction to Linear Block Codes, Syndrome and Error Detection, Encoding Block Codes, Decoding of Block Codes, Single Parity Check bit Code, Repeated Codes, Hadamard Code, Hamming Code, Cyclic Codes, Generator and Parity-Check Matrices of Cyclic Codes, Encoding and Decoding of Cyclic Codes, BCH codes, Reed-Solomon Code.

Unit V: Convolutional Codes:

Convolutional Coding, Code Generation, Decoding Convolutional Code, the Code Tree, Decoding in the presence of Noise, State and Trellis Diagrams, The Viterbi Algorithm, Comparison of Error Rates in Coded and Uncoded Transmission, Turbo Codes, LDPC codes, Hard and Soft Decision Decoding.

Text Books:

1. Thomas M. Cover, Joy A. Thomas, "Elements of Information Theory", John Wiley & Sons, 2nd Edition, 2006.
2. Herbert Taub, Donald L. Shilling, Goutam Saha, "Principles of Communication Systems", 4th Edition, McGraw Hill, 2017.

Reference Books:

1. Shu Lin, Daniel J. Costello Jr., "Error Control Coding", Pearson, Second Edition, 2013.
2. Simon Haykin, "Communication Systems", John Wiley, 4th Edition, 2010.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04304T	**PE**	**Detection and Estimation Theory**	**2**	**1**	**0**	**3**

Pre-Requisites: Basics of Probability and Random Processes and Calculus

Course Objectives:

- To understand the impact of white Gaussian noise on the detection of signals.
- To analyze the detection of deterministic signals and random signals.
- To learn about the nonparametric detections.
- To analyze estimation signal parameter and apply suitable estimation techniques.
- To understand the signal estimation in Discrete-Time techniques.

Course Outcomes (COs):

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

CO1: Apply statistical decision theory concepts, hypothesis testing, and decision rules for signal detection problems. (L3)

CO2: Analyse detection techniques for deterministic and random signals using matched filters and linear models. (L4)

CO3: Analyse nonparametric detection methods and evaluate robustness of detectors under incomplete information. (L4)

CO4: Evaluate parameter estimation techniques including ML, MMSE, MAP, and CRLB. (L4)

CO5: Evaluate signal estimation techniques such as Wiener filtering and Kalman filtering for discrete-time systems. (L5)

Unit I: Statistical Decision Theory:

Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain. Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency.

Unit II: Detection of Signals:

Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model. Detection of Random Signals: Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.

Unit III: Nonparametric Detection:

Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors.

Unit IV: Estimation of Signal Parameters:

Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency. Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.

Unit V: Signal Estimation in Discrete-Time:

Linear Bayesian estimation, Wiener filtering, dynamical signal model, discrete Kalman filtering.

Text Books:

1. H.L. Van Trees, "Detection, Estimation and Modulation Theory: Part I, II, and III", John Wiley, NY, 1968.
2. H.V. Poor, "An Introduction to Signal Detection and Estimation", Springer, 2nd edition, 1998.

Reference Books:

1. S.M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall PTR, 1993.
2. S.M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.

Open Elective – I
(OE - I)

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01301T	OE	**Green Buildings** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Building Construction and Environmental Concepts.
- Familiarity with Sustainable Development and Energy Efficiency Basics.

Course Objectives:

- To understand the fundamental concepts of green buildings, their necessity, and sustainable features.
- To analyze green building concepts, rating systems, and their benefits in India.
- To apply green building design principles, energy efficiency measures, and renewable energy sources.
- To evaluate air conditioning systems, HVAC designs, and energy modeling for sustainable buildings.
- To assess material conservation strategies, waste management, and indoor environmental quality in green buildings.

Course Outcomes (COs):

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

CO1: Apply concepts of sustainable building design to explain the significance of energy efficiency and green building rating systems. (L3)

CO2: Analyze indoor environmental quality requirements including thermal comfort, ventilation, lighting, and acoustic conditions for green buildings. (L4)

CO3: Evaluate the impact of climatic factors such as solar radiation, temperature, and wind on building energy performance. (L5)

CO4: Apply passive and active design strategies to optimize building energy performance and reduce environmental footprint. (L3)

CO5: Assess green building certification criteria and recommend appropriate design modifications for sustainable building construction. (L5)

Unit I: Introduction to Green Building:

Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing A Green Building, Important Sustainable Features for Green Buildings.

Unit II: Green Building Concepts and Practices:

Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation. Green Building OpportUnities and Benefits: OpportUnities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, Energy Efficiency.

Unit III: Green Building Design:

Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-Friendly Captive Power Generation for Factories, Building Requirements.

Unit IV: Air Conditioning and HVAC Design:

Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling towers, Selection of Air Handling Units, Pre-Cooling of Fresh Air, Interior Lighting Systems, Key Features of The Building, Eco-Friendly Captive Power Generation for Factories.

Unit V: Material Conservation and Indoor Environment Quality:

Handling of Non-Process Waste, Waste Reduction During Construction, Materials With Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture. Indoor Environment Quality and Occupational Health: Air Conditioning, Indoor Air Quality, Sick Building Syndrome, Tobacco Smoke.

Text Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.
2. Green Building Hand Book by Tom Woolley and Sam Kimmins, 2009.

Reference Books:

1. Complete Guide to Green Buildings by Trish Riley.
2. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009.
3. Energy Conservation Building Code – ECBC-2020, published by BEE.

Online Learning Resources:

- https://archive.nptel.ac.in/courses/105/102/105102195/

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01302T	OE	**Construction Technology and Management** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Construction Materials and Building Methods.
- Familiarity with Planning, Estimation, and Project Management Basics.

Course Objectives:

- To understand project management fundamentals, organizational structures, and leadership principles in construction.
- To analyze manpower planning, equipment management, and cost estimation in civil engineering projects.
- To apply planning, scheduling, and project management techniques such as CPM and PERT.
- To evaluate various contract types, contract formation, and legal aspects in construction management.
- To assess safety management practices, accident prevention strategies, and quality management systems.

Course Outcomes (COs):

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

CO1: Apply estimation techniques to prepare detailed cost estimates for various construction projects using standard methodologies. (L3)

CO2: Analyze abstract estimates and rate analysis for different civil engineering construction works and project components. (L4)

CO3: Apply project management tools including CPM, PERT, and resource planning for effective construction project control. (L3)

CO4: Develop specifications and tender documents for construction projects as per standard practices and government procedures. (L5)

CO5: Assess construction project performance using quality management, safety standards, and value engineering techniques. (L5)

Unit I: Introduction to Project Management:

Project forms, Management Objectives and Functions; Organizational Chart of A Construction Company; Manager's Duties and Responsibilities; Public Relations; Leadership and Team-Work; Ethics, Morale, Delegation and Accountability.

Unit II: Man and Machine:

Man-Power Planning, Training, Recruitment, Motivation, Welfare Measures and Safety Laws; Machinery for Civil Engineering – Earth Movers and Hauling Costs, Factors Affecting Purchase, Rent, and Lease of Equipment, Cost Benefit Estimation.

Unit III: Planning, Scheduling and Project Management:

Planning Stages, Construction Schedules and Project Specification, Monitoring and Evaluation; Bar-Chart, CPM, PERT, Network-formulation and Time Computation.

Unit IV: Contracts and Computer Applications:

Types of Contracts, formation of Contract – Contract Conditions – Contract for Labour, Material, Design, Construction – Drafting of Contract Documents Based On IBRD/MORTH Standard Bidding Documents – Construction Contracts – Contract Problems – Arbitration and Legal Requirements. Computer Applications in Construction Management: Software for Project Planning, Scheduling and Control.

Unit V: Safety Management:

Implementation and Application of QMS in Safety Programs, ISO 9000 Series, Accident Theories, Cost of Accidents, Problem Areas in Construction Safety, Fall Protection, Incentives, Zero Accident Concepts, Planning for Safety, Occupational Health and Ergonomics.

Text Books:

1. Construction Project Management, SK. Sears, GA. Sears, RH. Clough, John Wiley and Sons, 6th Edition, 2016.
2. Construction Project Scheduling and Control by Saleh Mubarak, 4th Edition, 2019.

Reference Books:

1. Brien, J.O. and Plotnick, F.L., CPM in Construction Management, McGraw Hill, 2010.
2. Punmia, B.C., and Khandelwal, K.K., Project Planning and Control with PERT and CPM, Laxmi Publications, 2002.
3. Construction Methods and Management, Stephens Nunnally, Pearson, 8th Edition.

Online Learning Resources:

- https://archive.nptel.ac.in/courses/105/104/105104161/
- https://archive.nptel.ac.in/courses/105/103/105103093/

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE02301T	OE	**Electrical Safety Practices and Standards** (Common to CE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Electrical Fundamentals such as Current, Voltage, Resistance, and Power.
- Familiarity with Basic Electrical Components and Safe Handling Practices.

Course Objectives:

- To understand the fundamental concepts of electrical safety, including electric shock, hazards, and physiological effects of electric current.
- To familiarize students with safety components such as conductors, insulators, protective devices, and fire safety equipment used in electrical systems.
- To develop knowledge on grounding and earthing practices, including system and equipment grounding for safe electrical installations.
- To impart practical awareness of electrical safety practices in real-life environments and the application of first aid during electrical accidents.

Course Outcomes (COs):

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

CO1: Describe the fundamentals of electrical safety, including electric shock effects, hazards, arc blast, and causes of electrical failures. (L3)

CO2: Analyze safety components such as conductors, insulators, overvoltage protection, static electricity control, and electrical safety equipment. (L4)

CO3: Analyze grounding and bonding concepts, including system and equipment grounding, earthing practices, and safety distance determination. (L4)

CO4: Analyze safety practices in electrical installations and usage environments including first aid procedures and case studies of electrical accidents. (L4)

CO5: Evaluate electrical safety standards, codes, and regulations including NFPA, OSHA, IEEE, NESC, and statutory requirements. (L5)

Unit I: Introduction to Electrical Safety:

Fundamentals of Electrical safety – Electric Shock – Physiological effects of electric current – Safety requirements – Hazards of electricity – Arc-Blast – Causes for electrical failure.

Unit II: Safety Components:

Introduction to conductors and insulators – voltage classification – safety against over voltages – safety against static electricity – Electrical safety equipments – Fire extinguishers for electrical safety.

Unit III: Grounding:

General requirements for grounding and bonding – Definitions – System grounding – Equipment grounding – The Earth – Earthing practices – Determining safe approach distance – Determining arc hazard category.

Unit IV: Safety Practices:

General first aid – Safety in handling handheld electrical appliance tools – Electrical safety in train stations – swimming pools, external lighting installations, medical locations – Case studies.

Unit V: Standards for Electrical Safety:

Electricity Acts – Rules & regulations – Electrical standards – NFPA 70E – OSHA standards – IEEE standards – National Electrical Code 2005 – National Electric Safety Code (NESC) – Statutory requirements from electrical inspectorate.

Text Books:

1. Massimo A.G. Mitolo, "Electrical Safety of Low-Voltage Systems", McGraw Hill, USA, 2009.
2. Mohamed El-Sharkawi, "Electric Safety – Practice and Standards", CRC Press, USA, 2014.

Reference Books:

1. Kenneth G. Mastrullo, Ray A. Jones, "The Electrical Safety Program Book", Jones and Bartlett Publishers, London, 2nd Edition, 2011.
2. Palmer Hickman, "Electrical Safety-Related Work Practices", Jones & Bartlett Publishers, London, 2009.
3. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, "Electrical Safety Handbook", McGraw-Hill, New York, 4th edition, 2012.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03301T	**OE**	**Sustainable Energy Technologies** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Energy Sources and Electrical Fundamentals.
- Familiarity with Environmental Science and Sustainability Concepts.

Course Objectives:

- To demonstrate the importance the impact of solar radiation, solar PV modules.
- To understand the principles of storage in PV systems.
- To discuss solar energy storage systems and their applications.
- To get knowledge in wind energy and bio-mass.
- To gain insights in geothermal energy, ocean energy and fuel cells.

Course Outcomes (COs):

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

CO1: Analyze solar radiation parameters, solar geometry, and photovoltaic module characteristics to estimate solar energy availability and design basic off-grid solar PV systems. (L4)

CO2: Apply the principles of battery operation, selection, installation, and maintenance for effective energy storage in solar photovoltaic systems. (L3)

CO3: Analyze the performance of solar energy collection and storage methods for suitable thermal energy applications such as heating, cooling, drying, and power generation. (L4)

CO4: Evaluate the operational characteristics and energy conversion potential of wind and biomass energy systems for practical renewable energy applications. (L5)

CO5: Analyze the working principles, performance, and applications of geothermal, ocean, and fuel cell technologies in sustainable energy generation. (L4)

Unit I: Solar Radiation and PV Modules:

Solar Radiation: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. **Solar PV Modules and PV Systems:** PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems – Design of Off Grid Solar Power Plant. Installation and Maintenance.

Unit II: Storage in PV Systems:

Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.

Unit III: Solar Energy Collection and Applications:

Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation. Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications – solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

Unit IV: Wind Energy and Bio-Mass:

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement. BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

Unit V: Geothermal, Ocean Energy and Fuel Cells:

GEOTHERMAL ENERGY: Origin, Applications, Types of Geothermal Resources, Relative Merits. OCEAN ENERGY: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges. FUEL CELLS: Introduction, Applications, Classification, Different Types of Fuel Cells – Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell.

Text Books:

1. Solar Energy – Principles of Thermal Collection and Storage, Sukhatme S.P. and J.K. Nayak, TMH.
2. Non-Conventional Energy Resources, Khan B.H., Tata McGraw Hill, New Delhi, 2006.

Reference Books:

1. Principles of Solar Engineering, D. Yogi Goswami, Frank Kreith& John F. Kreider, Taylor & Francis.
2. Non-Conventional Energy, Ashok V. Desai, New Age International (P) Ltd.
3. Renewable Energy Technologies, Ramesh & Kumar, Narosa.

Online Learning Resources:

- https://nptel.ac.in/courses/112106318

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE05301T	OE	**Java Programming** (Common to CE, EEE & ECE)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Programming Concepts and Problem-Solving.
- Familiarity with Algorithms, Flowcharts, and Basic Computer Operations.

Course Objectives:

- Identify Java language components and how they work together in applications.
- Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- Learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications.
- Understand how to design applications with threads in Java.
- Understand how to use Java APIs for program development.

Course Outcomes (COs):

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

CO1: Apply fundamental object-oriented programming concepts in Java to develop simple programs using data types, variables, operators, and control statements. (L3)

CO2: Apply object-oriented concepts by designing and implementing classes and methods in Java, including constructors, method overloading, method overriding, accesscontrol, and parameter passing techniques. (L3)

CO3: Analyze and implement array operations and advanced object-oriented concepts in Java, including inheritance, interfaces, and dynamic method dispatch, to develop structured and reusable programs. (L4)

CO4: Apply Java packages, standard libraries, exception handling mechanisms, and I/O streams to develop robust programs with proper error handling and file processing. (L3)

CO5: Develop Java applications using strings, multithreading, JDBC, and JavaFX GUI. (L5)

Unit I: Object Oriented Programming and Control Structures:

Basic concepts, Principles, Program Structure in Java. Data Types, Variables, and Operators: Data Types in Java, Declaration of Variables, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf () Method, Static Variables and Methods, Attribute Final, Operators – Arithmetic, Increment/Decrement, Ternary, Relational, Boolean Logical, Bitwise Logical. Control Statements: if, if-else, switch, while, do-while, for, Nested for Loop, For-Each for Loop, Break, Continue.

Unit II: Classes, Objects and Methods:

Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Constructor Methods, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this. Methods: Defining Methods, Overloaded Methods, Class Objects as Parameters, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

Unit III: Arrays, Inheritance and Interfaces:

Arrays: Declaration and Initialization, Storage in Memory, Accessing Elements, Operations, Dynamic Change of Array Size, Sorting, Search, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors. Inheritance: Types of Inheritances, Universal Super Class Object Class, Inhibiting Inheritance using Final, Access Control and Inheritance, Multilevel Inheritance, Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes. Interfaces: Declaration, Implementation, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods, Static Methods, Functional Interfaces, Annotations.

Unit IV: Packages, Exception Handling and File I/O:

Packages: Defining Package, Importing Packages and Classes, Path and Class Path, Access Control, Java.lang Package and its Classes, Class Object, Enumeration, Class Math, Wrapper Classes, Auto-boxing and Unboxing, Java util Classes. Exception Handling: Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked and Checked Exceptions. Java I/O and File: Java I/O API, Standard I/O streams, Byte streams, Character streams, Scanner class, Files in Java.

Unit V: String Handling, Multithreading, JDBC and JavaFX:

String Handling: Interface Char Sequence, Class String, Methods for Extracting Characters, Comparison, Modifying, Searching; Class String Buffer. Multithreaded Programming: Need for Multiple Threads, Thread Class, Main Thread, Creation of New Threads, Thread States, Thread Priority, Synchronization, Deadlock and Race Situations, Inter thread Communication. Java Database Connectivity: JDBC Architecture, Installing MySQL, JDBC Environment Setup, Establishing Connections, ResultSet Interface. Java FX GUI: Java FX Scene Builder, App Window Structure, displaying text and image, event handling, laying out nodes, mouse events.

Text Books:

1. JAVA one step ahead, Anitha Seth, B.L. Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object-Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Reference Books:

1. The Complete Reference Java, 11th edition, Herbert Schildt, TMH.
2. Introduction to Java Programming, 7th Edition, Y. Daniel Liang, Pearson.

Online Learning Resources:

- https://nptel.ac.in/courses/106/105/106105191/

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE31301T	**OE**	**Fundamentals of Artificial Intelligence** (Common to CE, EEE & ECE)	**2**	**1**	**0**	**3**

Pre-Requisites: Basics of Programming and Mathematics

Course Objectives:

- To learn the distinction between optimal reasoning vs. human-like reasoning.
- To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
- To learn different knowledge representation techniques.
- To understand the applications of AI, namely game playing, theorem proving, and machine learning.

Course Outcomes (COs):

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

CO1: Apply intelligent agent concepts, problem-solving techniques, and search algorithms for solving AI-based problems. (L3)

CO2: Illustrate game-playing strategies, alpha-beta pruning, and constraint satisfaction techniques for decision-making problems. (L3)

CO3: Examine first-order logic, inference mechanisms, and knowledge representation techniques for AI reasoning systems. (L4)

CO4: Analyze planning algorithms, planning graphs, and hierarchical planning approaches for automated decision systems. (L4)

CO5: Examine probabilistic reasoning methods and Bayesian Networks for decision-making under uncertainty. (L4)

Unit I: Introduction to AI and Search:

Introduction to AI – Intelligent Agents, Problem-Solving Agents, Searching for Solutions – Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.

Unit II: Games, Constraints and Logic:

Games – Optimal Decisions in Games, Alpha-Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, Logic – Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

Unit III: First-order Logic and Knowledge Representation:

First-order Logic – Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution. Knowledge Representation: Ontological Engineering, Categories and Objects, Events.

Unit IV: Planning:

Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Hierarchical Planning.

Unit V: Probabilistic Reasoning:

Acting under Uncertainty, Basic Probability Notation, Bayes' Rule and Its Use, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First-order Probability.

Text Books:

1. Artificial Intelligence: A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

Reference Books:

1. Artificial Intelligence, 3rd Edn., E. Rich and K. Knight (TMH).
2. Artificial Intelligence, 3rd Edn., Patrick Henry Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems, Patterson, Pearson Education.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE05302T	**OE**	**Quantum Technologies and Applications** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Physics and Mathematical Fundamentals.
- Familiarity with Waves, Energy, and Fundamental Computing Concepts.

Course Objectives:

- To introduce the fundamentals of quantum mechanics relevant to quantum technologies.
- To explain key quantum phenomena and their role in enabling novel technologies.
- To explore applications in quantum computing, communication, and sensing.
- To encourage understanding of emerging quantum-based technologies and innovations.

Course Outcomes (COs):

CO1: Apply the fundamental principles of quantum theory such as superposition, entanglement, uncertainty principle, and wave-particle duality to explain thebehavior of quantum systems conceptually. (L3)

CO2: Analyze the structure and working of quantum information systems by comparing classical bits and qubits, coherence and decoherence, and the role of entanglement in information processing. (L4)

CO3: Analyze the theoretical challenges and requirements involved in building a quantum computer, including decoherence, noise, scalability, stability, and error correction. (L4)

CO4: Evaluate the principles and significance of quantum communication and quantum computing, including QKD, quantum gates, quantum parallelism, and the conceptof the quantum internet. (L5)

CO5: Evaluate the applications, industrial relevance, future scope, and career opportunities in quantum technologies with reference to healthcare, materials, sensing, logistics, and global quantum initiatives. (L5)

Unit I: Fundamentals of Quantum Mechanics:

Classical vs Quantum Paradigm. Postulates of Quantum Mechanics. Wavefunction and Schrödinger Equation (Time-independent). Quantum states, Superposition, Qubits. Measurement, Operators, and Observables. Entanglement and Non-locality.

Unit II: Quantum Computing:

Qubits and Bloch Sphere. Quantum Logic Gates: Pauli, Hadamard, CNOT, and Universal Gates. Quantum Circuits. Basic Algorithms: Deutsch-Jozsa, Grover's, Shor's (conceptual). Error Correction and Decoherence.

Unit III: Quantum Communication and Cryptography:

Teleportation & No-Cloning. BB84 Protocol. Quantum Networks & Repeaters. Classical vs Quantum Cryptography. Challenges in Implementation.

Unit IV: Quantum Sensors and Metrology:

Quantum Sensing: Principles and Technologies. Quantum-enhanced Measurements. Atomic Clocks, Gravimeters. Magnetometers, NV Centers. Industrial Applications.

Unit V: Quantum Materials and Emerging Technologies:
Quantum Materials: Superconductors, Topological Insulators. Quantum Devices: Qubits, Josephson Junctions. National Quantum Missions (India, EU, USA, China). Quantum Careers and Industry Initiatives.

Text Books:

1. "Quantum Computation and Quantum Information" by Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press.
2. "Quantum Mechanics: The Theoretical Minimum" by Leonard Susskind and Art Friedman, Basic Books.

Reference Books:

1. "Quantum Computing for Everyone" by Chris Bernhardt, MIT Press.
2. "Quantum Physics: A Beginner's Guide" by Alastair I.M. Rae.
3. "An Introduction to Quantum Computing" by Phillip Kaye, Raymond Laflamme, and Michele Mosca.
    - IBM Quantum Experience and Qiskit Documentation: https://qiskit.org/

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB301T	**OE**	**Mathematics for Machine Learning and AI** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Matrices, Vectors, and Calculus.
- Familiarity with Probability, Statistics, and Algebra Fundamentals.

Course Objectives:

- To provide a strong mathematical foundation for understanding and developing AI/ML algorithms.
- To enhance the ability to apply linear algebra, probability, and calculus in AI/ML models.
- To equip students with optimization techniques and graph-based methods used in AI applications.
- To develop critical problem-solving skills for analysing mathematical formulations in AI/ML.

Course Outcomes (COs):

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

CO1: Apply linear algebra concepts to ML techniques like PCA and regression. (L3)

CO2: Analyze probabilistic models and statistical methods for AI applications. (L4)

CO3: Implement optimization techniques for machine learning algorithms. (L3)

CO4: Utilize vector calculus and transformations in AI-based models. (L3)

CO5: Develop graph-based AI models using mathematical representations. (L5)

Unit I: Linear Algebra for Machine Learning:

Review of Vector spaces, basis, linear independence, Vector and matrix norms, Matrix factorization techniques, Eigenvalues, eigenvectors, diagonalization, Singular Value Decomposition (SVD) and Principal Component Analysis (PCA).

Unit II: Probability and Statistics for AI:

Probability distributions: Gaussian, Binomial, Poisson. Bayes' Theorem, Maximum Likelihood Estimation (MLE), and Maximum a Posteriori (MAP). Entropy and Kullback-Leibler (KL) Divergence in AI, Cross entropy loss, Markov chains.

Unit III: Optimization Techniques for ML:

Multivariable calculus: Gradients, Hessians, Jacobians. Constrained optimization: Lagrange multipliers and KKT conditions. Gradient Descent and its variants (Momentum, Adam). Newton's method, BFGS method.

Unit IV: Vector Calculus and Transformations:

Vector calculus: Gradient, divergence, curl. Fourier Transform & Laplace Transform in ML applications.

Unit V: Graph Theory for AI:

Graph representations: Adjacency matrices, Laplacian matrices. Bayesian Networks & Probabilistic Graphical Models. Introduction to Graph Neural Networks (GNNs).

Text Books:

1. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 2020.
2. Pattern Recognition and Machine Learning by Christopher Bishop, Springer.

Reference Books:

1. Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning, 2016.
2. Jonathan Gross, Jay Yellen, Graph Theory and Its Applications, CRC Press, 2018.

Web Resources:

- MIT – Mathematics for Machine Learning: https://ocw.mit.edu
- Stanford CS229 – Machine Learning Course: https://cs229.stanford.edu/

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB302T	**OE**	**Materials Characterization Techniques** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Materials Science and Solid-State Physics.
- Familiarity with Waves, Optics, and Fundamental Spectroscopy Concepts.

Course Objectives:

- To provide exposure to different characterization techniques.
- To explain the basic principles and analysis of different spectroscopic techniques.
- To elucidate the working of Scanning Electron Microscope – Principle, limitations and applications.
- To illustrate the working of Transmission Electron Microscope (TEM) – SAED patterns and its applications.
- To educate the uses of advanced electric and magnetic instruments for characterization.

Course Outcomes (COs):

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

CO1: Analyze crystal structures and microstructural parameters of polycrystalline materials using powder X-ray diffraction techniques, including Bragg's law, intensity analysis, crystallite size estimation, and SAXS. (L4)

CO2: Apply Scanning Electron Microscopy (SEM) techniques to examine specimen preparation, imaging modes, and surface morphology of materials. (L3)

CO3: Analyze the principles and applications of Transmission Electron Microscopy (TEM) for image formation, diffraction studies, and microstructural characterization of materials. (L4)

CO4: Apply spectroscopic techniques such as UV-Visible, Raman, FTIR, and X-ray photoelectron spectroscopy to interpret the composition and structural characteristics of materials. (L3)

CO5: Analyze the electrical and magnetic properties of materials using conductivity measurements, Hall effect, and magnetization characterization techniques such as VSM and SQUID. (L4)

Unit I: Structure Analysis by Powder X-Ray Diffraction:

Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherrer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).

Unit II: Scanning Electron Microscopy (SEM):

Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.

Unit III: Transmission Electron Microscopy (TEM):

Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of TEM, Difference between SEM and TEM, Advantage and Limitations of TEM.

Unit IV: Spectroscopy Techniques:

Principle, Experimental arrangement, Analysis and advantages of: (i) UV-Visible spectroscopy, (ii) Raman Spectroscopy, (iii) Fourier Transform Infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

Unit V: Electrical and Magnetic Characterization Techniques:

Electrical Properties analysis techniques (DC conductivity, AC conductivity), Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating Sample Magnetometer (VSM) and SQUID.

Text Books:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods, Yang Leng, John Wiley & Sons (Asia) Pvt. Ltd., 2013.
2. Microstructural Characterization of Materials, David Brandon, Wayne D. Kalpan, John Wiley & Sons Ltd., 2008.

Reference Books:

1. Fundamentals of Molecular Spectroscopy, IV Ed., Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction, Bernard Dennis Cullity & Stuart R. Stocks, Prentice Hall, 2001.
3. Materials Characterization Techniques, Sam Zhang, Lin Li, Ashok Kumar, CRC Press, 2008.

NPTEL Course Links:

- https://nptel.ac.in/courses/115/103/115103030/
- https://nptel.ac.in/courses/113106034

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB303T	OE	**Chemistry of Energy Systems** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Chemistry, Chemical Reactions, and Electrochemical Concepts.
- Familiarity with Energy Sources and Fundamental Thermodynamic Principles.

Course Objectives:

- To make the student understand basic electrochemical principles such as standard electrode potentials, EMF and applications in the design of batteries.
- To understand the basic concepts of processing and limitations of Fuel cells & their applications.
- To impart knowledge about fundamental concepts of photochemical cells, reactions and applications.
- Necessity of harnessing alternate energy resources such as solar energy and its basic concepts.
- To impart knowledge about fundamental concepts of hydrogen storage in different materials and liquefaction method.

Course Outcomes (COs):

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

CO1: Solve the problems based on electrode potential, Describe the Galvanic Cell Differentiate between Lead acid and Lithium-ion batteries, Illustrate the electrical double layer. (L4)

CO2: Describe the working Principle of Fuel cell, Explain the efficiency of the fuel cell Discuss about the Basic design of fuel cells, Classify the fuel cell. (L4)

CO3: Differentiate between Photo and Photo electrochemical Conversions, Illustrate the photochemical cells, Identify the applications of photochemical reactions, Interpret advantages of photoelectron catalytic conversion. (L3)

CO4: Apply the photo voltaic technology, demonstrate about solar energy and prospects Illustrate the Solar cells, discuss about concentrated solar power. (L3)

CO5: Differentiate Chemical and Physical methods of hydrogen storage, Discuss the metal organic frame work, Illustrate the carbon and metal oxide porous structures Describe the liquification methods. (L3)

Unit I: Electrochemical Systems:

Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization. Batteries – Introduction, Lead-acid, Nickel-cadmium, Lithium ion batteries and their applications.

Unit II: Fuel Cells:

Fuel cell – Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency and applications.

Unit III: Photo and Photoelectrochemical Conversions:

Photochemical cells – Introduction and applications of photochemical reactions, specificity of photoelectrochemical cell, advantage of photoelectron catalytic conversions and their applications.

Unit IV: Solar Energy:

Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications.

Unit V: Hydrogen Storage:

Hydrogen storage and delivery: State-of-the-art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage, Liquid hydrogen storage, Other storage methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel, and Organic hydrogen carriers.

Text Books:

1. Physical Chemistry by Ira N. Levine.
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins.

Reference Books:

1. Fuel Cell Handbook 7th Edition, by US Department of Energy (EG&G Technical Services).
2. Handbook of Solar Energy and Applications by Arvind Tiwari and Shyam.
3. Solar Energy Fundamental, Technology and Systems by Klaus Jäger et al.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHS301T	**OE**	**English for Competitive Examinations** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of English Grammar and Sentence Construction.
- Familiarity with Vocabulary, Comprehension, and Writing Skills.

Course Objectives:

- To enable the students to learn about the structure of competitive English.
- To understand the grammatical aspects and identify the errors.
- To enhance verbal ability and identify the errors.
- To improve word power to answer competitive challenges.
- To make them ready to crack competitive exams.

Course Outcomes (COs):

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

CO1: Apply grammatical concepts such as nouns, pronouns, adjectives, articles, degrees of comparison, adverbs, conjunctions, prepositions, and tag questions to identify and correct errors in sentences. (L3)

CO2: Apply knowledge of tenses, voice, reported speech, subject–verb agreement, modals, and conditional clauses to analyze and rectify grammatical errors in competitive examination contexts. (L4)

CO3: Analyze verbal ability questions involving sentence completion, analogies, word groups, critical reasoning, verbal deduction, para-jumbles, and reading comprehension to select appropriate responses. (L4)

CO4: Apply vocabulary-building strategies and reading techniques to interpret passages, infer meanings, and solve questions related to vocabulary, comprehension, and contextual usage effectively. (L3)

CO5: Evaluate and employ appropriate writing skills such as paragraph development, note-making, summarizing, précis writing, paraphrasing, essay writing, and punctuation for competitive examination requirements. (L5)

Unit I: Grammar-1:

Nouns – classification – errors; Pronouns – types – errors; Adjectives – types – errors; Articles – definite-indefinite; Degrees of Comparison; Adverbs – types – errors; Conjunctions – usage; Prepositions – usage; Tag Questions, types – identifying errors – Practice.

Unit II: Grammar-2:

Verbs – tenses – structure – usages – negatives – positives – time adverbs; Sequence of tenses; If Clause; Voice – active voice and passive voice; Reported Speech; Agreement – subject and verb; Modals; Spotting Errors – Practices.

Unit III: Verbal Ability:

Sentence completion; Verbal analogies; Word groups; Instructions; Critical reasoning; Verbal deduction; Select appropriate pair; Reading Comprehension – Paragraph; Jumbles; Selecting the proper statement by reading a given paragraph.

Unit IV: Reading Comprehension and Vocabulary:

Competitive Vocabulary: Word Building – Memory techniques; Synonyms, Antonyms, Affixes – Prefix & Suffix; One-word substitutes; Compound words; Phrasal Verbs; Idioms and Phrases; Homophones; Linking Words; Modifiers; Intensifiers; Mastering Competitive Vocabulary; Cracking the unknowing passage; Speed reading techniques – Skimming & Scanning; Types of answering – Elimination methods.

Unit V: Writing for Competitive Examinations:

Punctuation; Spelling rules; Word order; Sub Skills of Writing; Paragraph meaning – salient features – types; Note-making, Note-taking, summarizing; Précis writing; Paraphrasing; Expansion of proverbs; Essay writing – types.

Text Books:

1. Wren & Martin, English for Competitive Examinations, S. Chand & Co, 2021.
2. Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.

Reference Books:

1. Hari Mohan Prasad, Objective English for Competitive Examination, Tata McGraw Hill, 2014.
2. Philip Sunil Solomon, English for Success in Competitive Exams, Oxford, 2016.
3. Shalini Verma, Word Power Made Handy, S. Chand Publications.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHS302T	OE	**Entrepreneurship and New Venture Creation** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Understanding of Business, Markets, and Economic Concepts.
- Familiarity with Communication, Problem-solving, and Creative thinking skills.

Course Objectives:

- To foster an entrepreneurial mind-set for venture creation and intrapreneurial leadership.
- To encourage creativity and innovation.
- To enable them to learn pitching and presentation skills.
- To make the students understand MVP development and validation techniques to determine Product-Market fit.
- To enhance the ability of analyzing Customer and Market segmentation and estimate Market size.

Course Outcomes (COs):

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

CO1: Analyze entrepreneurial mindset, attributes, leadership, and role models to understand their impact on economic development. (L4)

CO2: Evaluate problems and customer needs using design thinking principles, customer segmentation, and persona validation. (L5)

CO3: Analyze customer needs to design solutions, develop MVP/prototypes, assess market potential, and size opportUnities. (L4)

CO4: Evaluate business models, financial planning, and go-to-market strategies; develop lean canvas, sales plans, and funding approaches. (L5)

CO5: Evaluate venture scaling potential, develop persuasive storytelling, and prepare an investor-ready pitch deck. (L5)

Unit I: Entrepreneurship Fundamentals and Context:

Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset, skill sets, attributes and networks while on campus.

Core Teaching Tool: Simulation, Game, Industry Case Studies, Venture Activity.

Unit II: Problem and Customer Identification:

Understanding and analysing the macro-Problem and Industry perspective – technological, socioeconomic and urbanization trends and their implication on new opportUnities. Identifying passion – identifying and defining problem using Design thinking principles – Analysing problem and validating with the potential customer – Understanding customer segmentation, creating and validating customer personas.

Core Teaching Tool: Several types of activities including Class, game, Gen AI, Get out of the Building and Venture Activity.

Unit III: Solution Design, Prototyping and OpportUnity Assessment:

Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition – Understanding prototyping and Minimum Viable

Product (MVP) – Developing a feasibility prototype with differentiating value, features and benefits – Assess relative market position via competition analysis – Sizing the market and assess scope and potential scale of the opportunity.

Core Teaching Tool: Venture Activity, no-code Innovation tools, Class activity

Unit IV: Business and Financial Model, Go-to-Market Plan:

Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build-Measure-Lean approach. Business planning: components of Business plan – Sales plan, People plan and financial plan. Financial Planning: Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics. Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy. Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity, Map the Start-up Life-cycle to Funding Options.

Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

Unit V: Scale Outlook and Venture Pitch Readiness:

Understand and identify potential and aspiration for scale vis-à-vis your venture idea. Persuasive Storytelling and its key components. Build an Investor ready pitch deck.

Core Teaching Tool: Expert talks; Cases; Class activity and discussions; Venture Activities, Ideation Techniques (Brainstorming, SCAMPER, Mind Mapping, Role-Playing etc).

Text Books:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha, "Entrepreneurship", McGraw Hill, 11th Edition, 2020.
2. Ries, E., "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Crown Business, 2011.
3. Osterwalder, A., & Pigneur, Y., "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers", John Wiley & Sons, 2010.

Reference Books:

1. Simon Sinek, "Start with Why", Penguin Books Limited, 2011.
2. Brown Tim, "Change by Design Revised & Updated", Harper Business, 2019.
3. Namita Thapar, "The Dolphin and the Shark: Stories on Entrepreneurship", Penguin Books Limited, 2022.

B.Tech. – III Year
II Semester

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04313T	PC	Digital Signal Processing	2	1	0	3

Pre-Requisites: Basics of Signals & Systems and Mathematics

Course Objectives:

- To get familiar with the properties of discrete time signals, systems and z-transform.
- To learn the importance of FFT algorithm for computation of DFT with decimations.
- To understand the implementations of digital filter structures.
- To analyse the FIR filter design using Fourier series and windowing methods.
- To gain the knowledge on Programmable DSP Devices.

Course Outcomes (COs):

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

CO1: Apply discrete-time signal processing techniques including Z-transform and difference equations to analyse and determine system response and stability. (L3)

CO2: Apply DFT and FFT algorithms to compute frequency domain representations and performconvolution operations for discrete-time signals. (L3)

CO3: Analyse discrete-time LTI systems in time and frequency domains using pole-zero plots, transfer functions, and stability criteria. (L4)

CO4: Analyse and design IIR and FIR digital filters using various approximation and transformation techniques, and compare their performance characteristics. (L4)

CO5: Evaluate DSP system performance by selecting appropriate filter structures and programmable DSP architectures such as TMS320C5X for efficient implementation. (L5)

Unit I: Discrete Time Signals, Systems and Z-Transform:

Introduction to digital signal processing, Review of discrete-time signals and systems, Analysis of discrete-time linear time invariant systems, frequency domain representation of discrete time signals and systems. Z-Transform: Definition, ROC, Properties, Poles and Zeros in Z-plane, the inverse Z-Transform, System analysis, Transfer function, BIBO stability, System Response to standard signals, Solution of difference equations with initial conditions, analysis of LTI systems in the z-domain, pole-zero stability.

Unit II: DFT and FFT:

Discrete Fourier Transform: Introduction, Discrete Fourier Series, properties of DFS, Discrete Fourier Transform, Inverse DFT, properties of DFT, Linear and Circular convolution, convolution using DFT, sampling, Quantization effects. Fast Fourier Transform: Radix-2 Decimation in time and Decimation in frequency FFT, Inverse FFT (Radix-2).

Unit III: IIR Filters:

Introduction to digital filters, Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from analog filters by Impulse invariant and bilinear transformation methods, Frequency transformations. Basic structures of IIR Filters – Direct form-I, Direct form-II, Cascade form and Parallel form realizations.

Unit IV: FIR Filters:

Introduction, Characteristics of FIR filters with linear phase, Frequency response of linear phase FIR filters, Design of FIR filters using Fourier series and windowing methods (Rectangular, Triangular, Raised Cosine, Hanning, Hamming, Blackman). Comparison of IIR & FIR filters. Basic structures of FIR Filters – Direct form, Cascade form, Linear phase realizations.

Unit V: Architectures for Programmable DSP Devices:

Architecture of TMS320C5X: Introduction, Bus Structure, Central Arithmetic Logic Unit, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped registers, program controller, some flags in the status registers, On-chip memory, On-chip peripherals.

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithms, and Applications", Pearson Education, 2007.
2. A.V. Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", PHI.

Reference Books:

1. S.K. Mitra, "Digital Signal Processing – A Practical Approach", 2nd Edition, Pearson Education, 2004.
2. M.H. Hayes, "Digital Signal Processing", Schaum's Outline series, TATA Mc-Graw Hill, 2007.
3. Robert J. Schilling, Sandra L. Harris, "Fundamentals of Digital Signal Processing using Matlab", Thomson, 2007.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04314T	PC	Microwave and Optical Communication	2	1	0	3

Pre-Requisites: Basics of Communication Systems and Electro Magnetic and Transmission lines

Course Objectives:

- To analyse different modes of operation in rectangular wave guides, circular wave guides and resonators.
- To study and analyse various microwave components and microwave sources.
- To gain knowledge on different microwave semiconductor devices and microwave measurements procedures.
- To analyse different optical fiber modes and to study different types of distortions and losses in optical communication.
- To study various optical sources, optical detectors and to analyze various optical links.

Course Outcomes (COs):

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

CO1: Analyse different modes of operation in rectangular waveguides, circular waveguides and resonators. (L4)

CO2: Understand and analyse various microwave components and microwave sources. (L4)

CO3: Apply the concepts of different microwave semiconductor devices and demonstrate microwave measurement procedures in practical scenarios. (L3)

CO4: Analyse different optical Fiber modes and to study different types of distortions and losses in optical communication. (L4)

CO5: Evaluate the performance of various optical sources and optical detectors, and assess different optical links based on their efficiency, reliability, and application requirements. (L5)

Unit I: Waveguides:

Introduction, Rectangular waveguides, Field expressions for TE and TM modes, Wave propagation in the guide, Phase and group velocities, Power transmission and attenuation, Waveguide current and mode excitation. Circular waveguide – TE and TM modes (Qualitative), Wave propagation. Cavity resonators (Qualitative).

Unit II: Passive Microwave Devices and Tubes:

Passive Microwave Devices: Introduction to scattering parameters and their properties, Terminations, Variable short circuit, Attenuators, Phase shifters, Hybrid Tees (H-plane, E-plane, Magic Tees), Directional Couplers – Bethe hole and Two-hole Couplers, Scattering matrix for Microwave passive devices. Microwave propagation in Ferrites, Gyrator, Isolator, Circulator. Microwave Tubes: Linear Beam Tubes – Two cavity Klystron amplifier, Reflex Klystron oscillator, Travelling Wave Tube (TWT) (Qualitative). Crossed Field Tubes – Magnetron oscillator.

Unit III: Microwave Semiconductor Devices and Measurements:

Gunn Oscillator – Principle of operation, Characteristics, Two valley model, IMPATT, TRAPATT diodes. Microwave Measurements: Description of Microwave bench, errors and precautions, Microwave power measurements, Measurement of attenuation, frequency, VSWR (low, medium, high), Measurement of Q of a cavity, Impedance measurements.

Unit IV: Optical Fibers and Transmission Characteristics:

The propagation of light in optical waveguides – Classification of optical fibers – Numerical aperture, Step index and Graded index fiber – Modes in cylindrical fiber – Linearly polarized modes. Attenuation: Absorption, Scattering, Bending losses. Modal dispersion and chromatic dispersion – Single mode fiber – waveguide dispersion – MFD – PMD.

Unit V: Optical Transmitters, Receivers and Link Design:

Optical Sources: Light source materials – LED homo and hetero structures – surface and edge emitters – Quantum efficiency – Injection Laser Diode – Modes and threshold condition – Structures and Radiation Pattern. Optical detectors: Physical principles – PIN and APD diodes – Photo detector noise. Optical Link Design: Point-to-point links – System considerations – Link Power budget – Rise time budget.

Text Books:

1. David M. Pozar, "Microwave Engineering", John Wiley & Sons, Inc., 4th edition, 2012.
2. Samuel Y. Liao, "Microwave Devices and Circuits", PHI publications, Third Edition, 1997.
3. Gerd Keiser, "Optical Fiber Communications", McGraw Hill, Third Edition, 2000.

Reference Books:

1. R.E. Collin, "Foundations for Microwave Engineering", Wiley Student Edition, 2nd Edition, 2009.
2. F.E. Terman, "Electronic and Radio Engineering", McGraw Hill, 4th Edition, 1984.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04315T	PC	VLSI Design	3	0	0	3

Pre-Requisites: Basics of Digital Electronics and Semiconductor Physics

Course Objectives:

- To understand the steps involved in fabrication of ICs using MOS transistor technology.
- To learn about the VLSI design processes, Stick diagrams and Layouts.
- To gain knowledge on the Gate Level Design concepts.
- To learn the design of various subsystems with different VLSI Design styles.
- To get familiar with CMOS testing techniques.

Course Outcomes (COs):

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

CO1: Apply the concepts of IC technologies (MOS, CMOS, BiCMOS) and use electrical properties to design basic MOS circuits and inverters. (L3)

CO2: Analyse VLSI design flow, stick diagrams, layout techniques, and examine the impact of scaling and design rules. (L4)

CO3: Analyse gate-level design and evaluate circuit parameters like resistance, capacitance, delays, and fan-in/fan-out. (L4)

CO4: Evaluate VLSI subsystems and compare different design styles based on performance metrics (power, area, speed). (L5)

CO5: Evaluate CMOS testing techniques and justify design-for-testability methods for reliable systems. (L5)

Unit I: Introduction and Basic Electrical Properties:

Brief Introduction to IC technology: MOS, PMOS, NMOS, CMOS &BiCMOS Technologies. Basic Electrical Properties of MOS and BiCMOS Circuits: IDS-VDS relationships, MOS transistor Threshold Voltage, figure of merit, Transconductance, Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

Unit II: VLSI Circuit Design Processes:

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Lambda (λ)-based design rules for wires, contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

Unit III: Gate Level Design:

Logic gates and other complex gates, Switch logic, Alternate gate circuits. Basic Circuit Concepts: Sheet Resistance Rs and its concepts to MOS, Area Capacitances calculations, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out.

Unit IV: Subsystem Design and VLSI Design Styles:

Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters. VLSI Design styles: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices, parameters influencing low power design.

Unit V: CMOS Testing:

Need for testing, Design for testability – built in self-test (BIST) – testing combinational logic – testing sequential logic – practical design for test guidelines – scan design techniques.

Text Books:

1. Kamran Eshraghian, Douglas A. Pucknell, "Essentials of VLSI Circuits and Systems", PHI, 2005.
2. Wayne Wolf, "Modern VLSI Design", 3rd Ed., Pearson Education, 1997.

Reference Books:

1. Neil H.E. Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design – A Circuits and Systems Perspective", 3rd Edn, Pearson, 2009.
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2003.
3. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits", 2nd edition, Prentice Hall, 2009.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04314P	PC	Microwave and Optical Communications Lab	0	0	3	1.5

Pre-Requisites: Basics of Communication Systems and Electro Magnetic and Transmission lines

Course Objectives:

- To understand the working of microwave bench set up and characteristics of microwave sources.
- To verify the characteristics of various microwave components and to draw the radiation pattern of antennas.
- To verify the characteristics of optical sources & detectors and to study losses in optical fiber.

Course Outcomes (COs):

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

CO1: Understand the operation of the microwave bench setup and evaluate the characteristics of microwave sources. (L5)

CO2: Verify the performance characteristics of key microwave components and plot the radiation patterns of antennas. (L3)

CO3: Examine the characteristics of optical sources and detectors, and analyze the various losses encountered in optical fibres. (L4)

Part-A: Microwave Lab (Any Seven experiments):

1. Reflex Klystron Characteristics
2. Gunn Diode Characteristics
3. Attenuation Measurement
4. Directional Coupler Characteristics
5. VSWR Measurement
6. Impedance Measurements
7. Frequency and Wavelength measurement
8. Scattering Parameters of Directional coupler
9. Scattering Parameters of Magic TEE
10. Radiation pattern measurement of an Antenna
11. Antenna gain measurement

Part B: Optical Fiber Lab (Any Five experiments):

1. Characterization of LED
2. Characterization of Laser Diode
3. Intensity Modulation of Laser output through Optical fiber
4. Measurement of data rate for digital Optical link
5. Measurement of Numerical Aperture
6. Measurement of Losses for Analog optical link

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04315P	PC	VLSI Design Lab	0	0	3	1.5

Pre-Requisites: Basics of Digital Electronics and Semiconductor Physics

Course Objectives:

- To design a logic circuit using CMOS transistor using 180 nm technology in terms of schematic, symbol, test bench, DC and AC analysis.
- To evaluate different schematics & output responses for AOI logic by using different software tools.
- To design CMOS circuits using Full & Semi custom IC designs for analysis.
- To design different layouts using different software tools for analog circuits.

Course Outcomes (COs):

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

CO1: Design a logic circuit using CMOS transistors using 180 nm technology in terms of schematic, symbol, test bench, DC and AC analysis. (L3)

CO2: Evaluate different schematics & output responses for AOI logic by using different software tools. (L4)

CO3: Evaluate CMOS circuits designed using full-custom and semi-custom IC design approaches, and justify their performance based on analysis parameters. (L5)

CO4: Evaluate different analog circuit layouts developed using various software tools and justify the selection based on performance, accuracy, and design constraints. (L5)

List of Experiments (Any TEN to be conducted):

1. Design and analysis of CMOS Inverter: Implement schematic, symbol, test bench; DC and AC analysis; parametric sweep.
2. Design and analysis of NAND and NOR Logic gates: Implement schematic, test bench; DC, AC analysis; parametric sweep.
3. Design and analysis of XOR and XNOR Logic gates.
4. Design of AOI logic: Schematic for AB+C'D, AB'+C'D, (A+B')(C+D), (A+B')(C'+D).
5. Design and analysis of Full adder: Full custom and Semi custom IC design.
6. Analysis of NMOS and PMOS characteristics: DC, AC analysis; parametric sweep.
7. Design and analysis of Common source amplifier: Schematic, test bench; DC, AC analysis.
8. Design and analysis of Common drain amplifier: Schematic, test bench; DC, AC analysis.
9. Design of MOS differential amplifier: Schematic, test bench; DC, AC analysis.
10. Design of differential amplifier using FET/BJT: Two stage differential amplifier; DC, AC analysis.
11. Design of Inverter Layout: Implement schematic and layout; LVS, DRC, extract parasitic R and C.
12. Design of NAND/NOR Layout: Implement schematic and layout; LVS, DRC, extract parasitic R and C.

Software Required: Mentor Graphics / Synopsis / Cadence or equivalent Industry Standard EDA Tools.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE04302S	SE	Machine Learning and DSP	0	1	2	2

Pre-Requisites: - Basics of Signals & Systems and Mathematics

Course Objectives:

- To understand modules and dependencies for machine learning for different applications.
- To understand a range of machine learning regression techniques & clustering along with their datasets.
- To write programs and implement k-Nearest Neighbor algorithm to classify iris datasets, images & CNN.
- To simulate basic signal processing operations like convolution and correlation.
- To simulate DSP operations like DFT, FFT & implement IIR and FIR filters.

Course Outcomes (COs):

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

CO1: Analyse machine learning modules and dependencies corresponding to various real-world applications. (L4)

CO2: Apply regression and clustering techniques on datasets to solve machine learning problems. (L3)

CO3: Implement k-Nearest Neighbour algorithm and convolutional neural networks for classification of datasets and images. (L3)

CO4: Apply basic signal processing operations such as convolution and correlation through simulation. (L3)

CO5: Analyse and implement DSP operations such as DFT, FFT, and design of IIR and FIR filters using simulation tools. (L4)

Machine Learning – Implement any Six concepts using Python:

1. Familiarizing with Anaconda and Jupyter; importing modules and dependencies for ML; NumPy, Panda and Matplotlib – Loading Dataset in Python.
2. Linear regression: Predict profit of a company/House price from a dataset; Implement speech recognition model (NLP) from a speech/audio dataset.
3. Logistic regression: Identify whether patient has diabetes or not from diabetes dataset; Implement speech-to-text model.
4. Polynomial regression: Determine quality of wine using wine dataset; Implement speech recognition model from a speech/audio dataset.
5. K-means clustering: Apply concept of K-means clustering for image segmentation (Brain tumor and Lung images)/Color quantization.
6. k-Nearest Neighbor algorithm to classify the iris data set; demonstrate working of decision tree based ID3 algorithm.
7. k-Nearest Neighbor algorithm for image classification and distance metric learning.
8. PCA/LDA: Reduce the dimensionality of a dataset for Face recognition system.
9. Design an Artificial neural network for Digit classification using Back Propagation Algorithm for MNIST Dataset; train MLP using Gradient descent algorithm.
10. Digit recognition using CNN: Identify digits 0-9 from MNIST data and CIFAR-10 set.
11. Image Classification using CNN: Classify cats and dogs from given dataset.
12. LSTM/ARIMA: Implementation of biomedical signal (EEG, ECG, EMG) classification and disease prediction.

Digital Signal Processing – Implement any Six concepts:

1. Generate standard discrete time signals: Unit Impulse, Unit step, Ramp, Exponential, Sawtooth.
2. Generate sum of two sinusoidal signals and find the frequency response (magnitude and phase).
3. Implement and verify linear and circular convolution between two given signals.
4. Implement and verify autocorrelation and cross correlation between two given signals.
5. Compute and implement the N-point DFT of a given sequence and power density spectrum.
6. Implement and verify N-point DIT-FFT of a given sequence and find frequency response.
7. Implement and verify N-point IFFT of a given sequence.
8. Design IIR Butterworth filter (LPF/HPF) with different orders.
9. Design IIR Chebyshev filter (LPF/HPF) with different orders.
10. Design FIR filter (LPF/HPF) using rectangular, hamming and Kaiser windows.
11. Design and verify Filter (IIR and FIR) frequency response using Filter design and Analysis Tool.
12. Compute the Decimation and Interpolation for a given signal.
13. Real time implementation of an audio signal using a digital signal processor.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24MCHS309A	MC	**Technical Paper Writing and Intellectual Property Rights** (Common to all branches of Engineering)	2	0	0	0

Pre-Requisites:

- Basic Knowledge of Academic Writing and Research Fundamentals.
- Familiarity with Technical Communication and Ethical Practices.

Course Objectives:

- To enable students to practice the basic skills of research paper writing.
- To make the students understand the importance of IP and educate them on basic concepts of Intellectual Property Rights.
- To practice the basic skills of performing quality literature review.
- To help them know the significance of real-life practice and procedure of Patents.
- To enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks.

Course Outcomes (COs):

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

CO1: Apply clarity, precision, and coherence to produce effective and plagiarism-free technical writing. (L4)

CO2: Analyze key components of a research paper to develop a well-structured synopsis. (L4)

CO3: Evaluate publication processes and citation practices to prepare accurate and ethical manuscripts. (L4)

CO4: Analyze intellectual property types, treaties, and trademark processes to assess protection mechanisms. (L4)

CO5: Examine copyright and patent laws to determine ownership and registration procedures. (L4)

Unit I: Principles of Technical Writing:

Styles in technical writing; clarity, precision, coherence and logical sequence in writing – avoiding ambiguity, repetition, and vague language – highlighting your findings – discussing limitations – hedging and criticizing – plagiarism and paraphrasing.

Unit II: Technical Research Paper Writing:

Abstract – Objectives – Limitations – Review of Literature – Problems and Framing Research Questions – Synopsis.

Unit III: Process of Research and Publication:

Publication mechanism: types of journals – indexing – seminars – conferences – proof reading – plagiarism style; seminar & conference paper writing; Methodology – discussion – results – citation rules.

Unit IV: Introduction to Intellectual Property:

Introduction, types of intellectual property, International organizations, agencies and treaties, importance of intellectual property rights. Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Unit V: Law of Copyrights and Patents:

Fundamentals of copyright law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, copyright registration, notice of copyright, international copyright law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer, patent law, intellectual property audits.

Text Books:

1. Deborah. E. Bouchoux, "Intellectual Property Rights", Cengage Learning India, 2013.
2. Meenakshi Raman, Sangeeta Sharma, "Technical Communication: Principles and Practices", Oxford.

Reference Books:

1. R. Myneni, "Law of Intellectual Property", 9th Ed, Asia Law House, 2019.
2. Prabuddha Ganguli, "Intellectual Property Rights", Tata McGraw Hill, 2001.
3. Adrian Wallwork, "English for Writing Research Papers", Second Edition, Springer, 2016.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPWS302L	**WS**	**Workshop** (Common to all branches of Engineering)	**0**	**0**	**0**	**0**

Pre-Requisites: Basic knowledge of programming concepts using any programming language, fundamental understanding of mathematics, familiarity with core technical subjects, and basic problem-solving and logical thinking skills.

Course Objectives

- To provide domain-specific knowledge and practical exposure in emerging areas relevant to various engineering disciplines.
- To enhance analytical thinking and problem-solving skills through hands-on sessions and real-world applications.
- To develop the ability to apply theoretical concepts learned in earlier semesters to practical engineering scenarios.
- To promote active learning and technical competency through participation in quizzes, assignments, and interactive activities.
- To prepare students for industry and research challenges by strengthening their technical skills and fostering a habit of continuous learning.

Course Outcomes (COs):

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

CO1: Explain the fundamental concepts and techniques covered in the workshop. (L2)
CO2: Apply domain-specific tools and techniques to solve basic problems (L3)
CO3: Analyze real-world problems and identify appropriate methodologies for solution development. (L4)
CO4: Develop practical solutions using learned concepts and hands-on experience. (L6)
CO5: Evaluate the effectiveness of implemented solutions and interpret the results. (L5)

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Professional Elective – II (PE - II)

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04305T	PE	Electronic Measurements and Instrumentation	3	0	0	3

Pre-Requisites: Basics of Electronic Circuits

Course Objectives:

- To know about the performance characteristics of instruments and measurement of electrical quantities.
- To understand the construction, working and applications of different types of CROs.
- To analyze the working of different types of bridges.
- To study the working of signal & function generators and analyzers.
- To analyze the working of sensors and transducers in measuring physical parameters.

Course Outcomes (COs):

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

CO1: Apply performance characteristics of instruments and analyse measurement errors and calibration techniques. (L3)

CO2: Analyse the working and applications of oscilloscopes and perform measurements of amplitude, frequency, and phase. (L4)

CO3: Analyse bridge circuits for measurement of resistance, inductance, and capacitance and evaluate associated errors. (L4)

CO4: Evaluate the operation of signal generators, analysers, and digital instruments using block diagram approach. (L5)

CO5: Evaluate sensors and transducers for measuring physical parameters and design suitable signal conditioning circuits. (L5)

Unit I: Performance Characteristics and Electrical Measurements:

Static characteristics: Accuracy, Precision, Resolution, Sensitivity, static and dynamic calibration, Errors in Measurement, statistical analysis, dynamic characteristics – speed of Response, fidelity, Lag and dynamic error. DC ammeters, DC voltmeters – multirange, range extension, solid state and differential voltmeters. AC voltmeters – multirange, range extension. Thermocouple type RF ammeter, ohm meters, series type, shunt type, multimeter for voltage, current and resistance measurements.

Unit II: Oscilloscopes:

Basic Principle, Standard specifications of CRO, CRT features, vertical and horizontal amplifiers, deflection systems, sweep trigger pulse, delay line, sync selector circuits, probes for CRO – active, passive, and attenuator type, triggered sweep CRO and Delayed sweep, dual trace/beam CRO. Measurement of amplitude, frequency and phase (Lissajous method). Sampling oscilloscope, storage oscilloscope, digital storage oscilloscope, Digital frequency counters, time & Period measurements.

Unit III: Bridges:

DC Bridges: Wheat stone bridge, Kelvin's Bridge. AC Bridges for Measurement of inductance: Maxwell's bridge, Hay's Bridge, Anderson bridge. Measurement of capacitance: Schearing Bridge, Wien Bridge. Errors and precautions in using bridges.

Unit IV: Signal Generators and Analyzers:

Signal generator – fixed and variable, AF oscillators, function generators, pulse, random noise, sweep, and arbitrary waveform generators, their standards, specifications and principles of working (Block diagram approach). Wave analyzers, Harmonic distortion analyzers, Spectrum analyzers, Logic analyzers.

Unit V: Sensors and Transducers:

Active and passive transducers: Measurement of displacement (Resistance, capacitance, inductance; LVDT), Force (strain gauges), Pressure (piezoelectric transducers), Temperature (resistance thermometers, thermocouples and thermistors), Velocity, Acceleration, Vibration, pH measurement. Signal Conditioning Circuits.

Text Books:

1. A.D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 5th Edition, PHI, 2002.
2. H.S. Kalsi, "Electronic Instrumentation", 2nd edition, Tata McGraw Hill, 2004.

Reference Books:

1.David A. Bell, "Electronic Instrumentation & Measurements", 2nd Edition, PHI, 2003.
2.K. Lal Kishore, "Electronic Measurements & Instrumentations", Pearson Education, 2009.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04306T	PE	Embedded Systems & IoT	3	0	0	3

Pre-Requisites: Basics of Electronics, Microcontrollers, Programming, and Basic networking

Course Objectives:

- To understand the Architecture, Development & Design of Embedded Systems and IoT.
- To learn the architecture and programming of ARM Microcontroller.
- To be able to work with Raspberry Pi using Python Programming.
- To know about the IoT standards, communication technologies and protocols for IoT devices.
- To implement case studies and applications using the tools and techniques of IoT Platform.

Course Outcomes (COs):

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

CO1: Applyembedded systems and IoT architectures, design methodologies, and enabling technologies for real-world applications(L3)

CO2: Analyse ARM microcontroller architecture and develop programs for interfacing, communication, and control applications(L4)

CO3: Analyse Python programming concepts and implement IoT applications using Raspberry Pi and interfacing techniques(L4)

CO4: Evaluate IoT communication technologies, protocols, and M2M networks for efficient data transmission(L4)

CO5: Evaluate IoT platforms, cloud services, and data analytics tools for developing and deploying IoT applications(L5)

Unit I: Introduction to Embedded Systems and IoT:

Introduction, Hardware & Software Architecture of Embedded Systems, Embedded Systems Development process, Architecture of Internet of Things, Physical Design & Logical Design of IoT, IoT Enabling Technologies, IoT Levels & Deployment Tools, Applications of Embedded Systems and IoT, Design Methodology for IoT Products.

Unit II: ARM Microcontrollers Architecture and Programming:

Architecture, Pin Diagram, Register Set & Modes, Memory Organization, Instruction set, Programming ports, Timer/Counter, Serial communication, I/O System, Development Tools, interrupts in C, Introduction to ARM mBed platform.

Unit III: Python Programming & Raspberry Pi:

Introduction to Python programming, Data Types & Data Structures, working with functions, Modules & Packages, File Handling, classes, RESTful Web Services, Client Libraries, Introduction & programming Raspberry Pi 3, Interfaces, Integrating Input Output devices with Raspberry Pi 3.

Unit IV: IoT Technologies, Standards, Tools & M2M Network:

Fundamental characteristics and high-level requirements of IoT, IoT Reference models; Introduction to Communication Technologies & Protocols of IoT: BLE, Wi-Fi, LoRA, 3G/4G Technologies and HTTP, MQTT, CoAP protocols; M2M Network, SDN (Software Defined Networking) & NFV (Network Function Virtualization) for IoT.

Unit V: IoT Platform, Cloud Computing and Data Analytics:

IoT Platform Architecture (IBM IoT & Watson Platforms); API Endpoints for Platform Services; Devices Creation and Data Transmission; Introduction to NODE-RED and Application deployment, Introduction to Data Analytics, Apache Hadoop, Apache Oozie, Spark & Storm.

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach", 1st Edition, VPT, 2014.
2. K.V.K.K. Prasad, "Embedded Real Time Systems: Concepts, Design and Programming", 1st Edition, Dreamtech Publication, 2014.
3. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley Publications, 2013.

Reference Books:

1. Jonathan W. Valvano, "Embedded Microcomputer Systems: Real-Time Interfacing", 3rd Edition, Thomson Engineering, 2012.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key applications and Protocols", 2nd Edition, Wiley Publications, 2012.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04307T	**PE**	**Speech Processing**	**3**	**0**	**0**	**3**

Pre Requisites: Basics of Signals & Systems, Signal Processing, and Probability

Course Objectives:

- To impart knowledge on anatomy and physiology of speech organs and the process of Speech Production.
- To understand the methods for extracting speech using Time domain parameters.
- To learn the Frequency Domain Methods for Speech Processing.
- To interpret and analyze LPC Parameters for Speech Processing.
- To introduce the concepts of Homomorphic Speech Processing.

Course Outcomes (COs):

CO1: Apply fundamentals of speech production, acoustic models, and digital models for speech signal analysis. (L3)

CO2: Analyse time-domain methods to extract speech parameters such as zero crossings, autocorrelation, and pitch. (L4)

CO3: Investigate the structure and functionality of STFT, filter banks, and spectrographic analysis methods used in speech processing. (L4)

CO4: Analyse linear predictive coding (LPC) techniques for pitch detection and formant estimation. (L4)

CO5: Evaluate homomorphic speech processing techniques and applications such as speech enhancement, recognition, and synthesis. (L5)

Unit I: Fundamentals of Digital Speech Processing:

Anatomy & Physiology of Speech Organs, The process of Speech Production, The Acoustic Theory of Speech Production – Uniform lossless tube model, effect of losses in vocal tract and radiation at lips, Digital models for speech signals.

Unit II: Time Domain Methods for Speech Processing:

Time domain parameters of speech, methods for extracting the parameters: Zero crossings, Auto-correlation function, pitch estimation.

Unit III: Frequency Domain Methods for Speech Processing:

Short time Fourier analysis, Filter bank analysis, Spectrographic analysis, Formant extraction, Pitch extraction.

Unit IV: Linear Predictive Coding (LPC) for Speech:

Formulation of linear prediction problem in time domain, solution of normal equations, Interpretation of linear prediction in auto correlation and spectral domains. Method of Solution of the LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

Unit V: Homomorphic Speech Processing:

Introduction to Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, pitch Detection and Formant

Estimation. Applications of speech processing – Speech Enhancement, Speech recognition, Speech synthesis and Speaker Verification.

Text Books:

1. L.R. Rabiner and S.W. Schafer, "Digital Processing of Speech Signals", Pearson Education.
2. Douglas O'Shaughnessy, "Speech Communications: Human & Machine", 2nd Ed., Wiley-IEEE Press.

Reference Books:

1. Thomas F. Quatieri, "Discrete Time Speech Signal Processing: Principles and Practice", 1st Ed., Pearson Education.
2. Ben Gold & Nelson Morgan, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", 1st Ed., Wiley.

Professional Elective – III (PE - III)

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04310T	**PE**	**Digital Image Processing**	**2**	**1**	**0**	**3**

Pre-Requisites: Basics of Signal Processing and Mathematics

Course Objectives:

- To learn the fundamentals of Image Processing with different Transforms.
- To understand functions of Intensity Transformations and working fundamentals of Spatial Filters.
- To implement various models of Restoring and Reconstruction of Images from filtering projections.
- To study the concepts of image compression using different coding & Wavelets and Multiresolution Processes.
- To design image processing systems using Segmentation techniques for Morphological & Color Images.

Course Outcomes (COs):

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

CO1: Apply fundamental concepts of digital image processing and various image transforms for image analysis(L3)

CO2: Analyse intensity transformations and spatial/frequency domain filtering techniques for image enhancement(L4)

CO3: Analyse image restoration and reconstruction techniques under different noise and degradation models. (L4)

CO4: Evaluate image compression techniques and wavelet-based multiresolution processing methods(L5)

CO5: Evaluate image segmentation, morphological operations, and colour image processing techniques for real-world applications(L5)

Unit I: Introduction and Image Transforms:

Introduction to Image Processing, Fundamental steps, components of an image processing system, image sensing and acquisition, image sampling and quantization, basic relationships between pixels. Image Transforms: DFT of one variable, Extension to functions of two variables, properties of 2-D DFT, Importance of Phase, Walsh Transform, Hadamard transform, Haar Transform, Slant transform, Discrete Cosine transform, KL Transform, SVD and Radon Transform.

Unit II: Intensity Transformations and Spatial/Frequency Filtering:

Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters, Combining spatial enhancement methods. Filtering in the Frequency Domain: The Basics of filtering in the frequency domain, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering.

Unit III: Image Restoration and Reconstruction:

A model of the image degradation/Restoration process, Noise models, restoration in the presence of noise only – Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear Position-Invariant Degradations, Estimating the degradation function, Inverse filtering, Wiener filtering, constrained least squares filtering, geometric mean filter, image reconstruction from projections.

Unit IV: Image Compression and Multiresolution Processing:

Fundamentals, Basic compression methods: Huffman coding, Golomb coding, Arithmetic coding, LZW coding, Run-Length coding, Symbol-Based coding, Bit-Plane coding, Block Transform coding, Predictive coding. Wavelets and Multiresolution Processing: Image pyramids, subband coding, Multiresolution expansions, wavelet transforms in one and two dimensions, Wavelet coding.

Unit V: Image Segmentation, Morphology and Color Processing:

Image segmentation: Fundamentals, point, line, edge detection, thresholding, region-based segmentation. Morphological Image Processing: Erosion and dilation, opening and closing, boundary extraction, thinning, gray-scale morphology, Segmentation using morphological watersheds. Color image processing: color fundamentals, color models, pseudo color image processing, color transformations, smoothing and sharpening, image segmentation based on color, color image compression.

Text Books:

1.R.C. Gonzalez and R.E. Woods, "Digital Image Processing", 3rd edition, Prentice Hall, 2008.
2.Jayaraman, S. Esakkirajan, and T. Veerakumar, "Digital Image Processing", Tata McGraw-Hill Education, 2011.

Reference Books:

1.Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, 2002.
2.B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009.

Web Resources:

1.https://nptel.ac.in/courses/117105079
2.https://nptel.ac.in/courses/117105135

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31305T	PE	Artificial Intelligence & Machine Learning	2	1	0	3

Pre-Requisites: Basics of Mathematics

Course Objectives:

- To learn the basics and problems of Artificial Intelligence with rationality and structure of agents.
- To describe the search for solutions using various search strategies & algorithms for optimization.
- To evaluate the representation of Agents with Propositional Logic.
- To understand the concepts of Machine Learning with different Perspectives.
- To analyze Decision Tree Representation with different problems & issues.

Course Outcomes (COs):

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

CO1: Analyze the structure of intelligent agents and environments to determine the level of rationality and behavior required for AI systems. (L4)

CO2: Apply uninformed and heuristic search strategies to solve complex problem-solving tasks and local optimization problems. (L3)

CO3: Construct knowledge-based agents using propositional logic and ontological engineering for reasoning in structured domains. (L3)

CO4: Analyze machine learning perspectives and concept learning algorithms (FIND-S, Candidate-Elimination) to evaluate inductive bias and version spaces. (L4)

CO5: Implement decision tree learning algorithms to solve classification problems while addressing issues like overfitting and hypothesis space search. (L3)

Unit I: Introduction to AI:

What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art. Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit II: Problem Solving:

Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions.

Unit III: Knowledge Representation:

Knowledge-Based Agents, Logic, Propositional Logic: A Very Simple Logic, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, The Internet Shopping World.

Unit IV: Introduction to Machine Learning:

Well-Posed Learning Problem, Designing a Learning system, Perspectives and Issues in Machine Learning. Concept Learning and The General-to-Specific Ordering: A Concept Learning Task, Concept Learning as Search, FIND-S algorithm, Version Spaces and the Candidate Elimination Algorithm, Inductive Bias.

Unit V: Decision Tree Learning:

Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning, The Basic Decision Tree Learning Algorithm, Hypothesis Space Search in Decision Tree Learning, Inductive Bias in Decision Tree Learning, Issues in Decision Tree Learning.

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Pearson.
2. Tom M. Mitchell, "Machine Learning", McGraw Hill Edition, 2013.

Reference Books:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill.
3. Christopher Bishop, "Pattern Recognition and Machine Learning (PRML)", Springer, 2007.
4. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04311T	**PE**	**Satellite Communications**	**3**	**0**	**0**	**3**

Pre-Requisites: Basics of Communication Systems

Course Objectives:

- To learn the principles of orbital mechanics & satellite launch system with performance parameters.
- To describe the elements of communication satellite design for matching reliability.
- To know the working concepts of various multiple access techniques and Onboard processing.
- To analyze the satellite links design with communication links.
- To evaluate the working of earth station design with satellite broadcasting.

Course Outcomes (COs):

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

CO1: Apply principles of orbital mechanics, satellite motion, and launch systems for satellite communication analysis (L3)

CO2: Analyse communication satellite design, spacecraft subsystems, and reliability considerations (L4)

CO3: Analyse multiple access techniques such as FDMA, TDMA, CDMA and satellite onboard processing (L4)

CO4: Analyse satellite link design for various systems like DOMSAT, INSAT, INTELSAT, and INMARSAT (L4)

CO5: Evaluate earth station design, antenna systems, and satellite broadcasting techniques (L5)

Unit I: Orbital Mechanics and Satellite Launch:

Elements of orbital mechanics. Equations of motion. Tracking and orbit determination. Orbital correction/control. Satellite launch systems. Multistage rocket launchers and their performance.

Unit II: Communication Satellite Design:

Elements of communication satellite design. Spacecraft subsystems. Reliability considerations. Spacecraft integration.

Unit III: Multiple Access Techniques:

FDMA, TDMA, CDMA. Random access techniques. Satellite onboard processing.

Unit IV: Satellite Link Design:

Performance requirements and standards. Design of satellite links – DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite-based personal communication links.

Unit V: Earth Station Design and Satellite Broadcasting:

Earth station design. Configurations. Antenna and tracking systems. Satellite broadcasting.

Text Books:

1. D. Roddy, "Satellite Communication", 4th edition, McGraw-Hill, 2009.
2. T. Pratt & C.W. Bostain, "Satellite Communication", Wiley, 2000.

Reference Books:

1. B.N. Agrawal, "Design of Geosynchronous Spacecraft", Prentice-Hall, 1986.

Open Elective – II
(OE - II)

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01303T	**OE**	**Disaster Management** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Understanding of Environmental and Societal Issues.
- Familiarity with Risk, Safety, and Emergency Response Concepts.

Course Objectives:

- To understand the fundamental concepts of natural disasters, their occurrence, and disaster risk reduction strategies.
- To analyze the impact of cyclones on structures and explore retrofitting techniques for adaptive reconstruction.
- To apply wind engineering principles and computational techniques in designing wind-resistant structures.
- To evaluate earthquake effects on buildings and develop strategies for seismic retrofitting.
- To assess seismic safety planning, design considerations, and innovative construction materials for disaster-resistant structures.

Course Outcomes (COs):

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

CO1: Apply knowledge of natural and man-made hazards to explain disaster types, risk assessment frameworks, and vulnerability analysis. (L3)

CO2: Analyze disaster preparedness, mitigation, and early warning systems for effective Community- level risk reduction. (L4)

CO3: Evaluate disaster response and recovery strategies including emergency relief operations and post-disaster rehabilitation. (L5)

CO4: Apply disaster risk reduction policies, legal frameworks, and international guidelines for disaster management planning. (L3)

CO5: Assess the role of technology, remote sensing, and GIS in disaster monitoring, mapping, and management decision-making. (L5)

Unit I: Introduction to Natural Disasters:

Brief Introduction to Different Types of Natural Disasters, Occurrence of Disasters in Different Climatic and Geographical Regions, Hazard Maps (Earthquake and Cyclone) of The World and India, Regulations for Disaster Risk Reduction, Post-Disaster Recovery and Rehabilitation (Socioeconomic Consequences).

Unit II: Cyclones and Their Impact:

Climate Change and Its Impact On Tropical Cyclones, Nature of Cyclonic Wind, Velocities and Pressure, Cyclone Effects, Storm Surges, Floods, and Landslides. Behavior of Structures in Past Cyclones and Windstorms, Case Studies. Cyclonic Retrofitting, Strengthening of Structures, and Adaptive Sustainable Reconstruction. Life-Line Structures Such as Temporary Cyclone Shelters.

Unit III: Wind Engineering and Structural Response:

Basic Wind Engineering, Aerodynamics of Bluff Bodies, Vortex Shedding, and Associated Unsteadiness Along and Across Wind forces. Wind Tunnel Testing and Its Salient Features.

Introduction to Computational Fluid Dynamics (CFD). General Planning and Design Considerations Under Windstorms and Cyclones. Wind Effects On Buildings, Towers, Glass Panels. Codal Provisions, Design Wind Speed, Pressure Coefficients. Coastal Zoning Regulations for Construction. Innovative Construction Materials and Techniques.

Unit IV: Seismology and Earthquake Effects:

Causes of Earthquakes, Plate Tectonics, Faults, Seismic Waves; Magnitude, Intensity, Epicenter, Energy Release, and Ground Motions. Earthquake Effects: On Ground, Soil Rupture, Liquefaction, Landslides. Performance of Ground and Buildings in Past Earthquakes – Behavior of Various Types of Buildings, Collapse Patterns; Behavior of Non-Structural Elements – Case Studies. Seismic Retrofitting: Weakness in Existing Buildings, Aging, Concepts in Repair, Restoration, and Seismic Strengthening.

Unit V: Planning and Design for Seismic Safety:

General Planning and Design Considerations; Building forms, Horizontal and Vertical Eccentricities, Mass and Stiffness Distribution, Soft Storey Effects; Seismic Effects Related to Building Configuration. Plan and Vertical Irregularities, Redundancy, and Setbacks. Construction Details: Various Types of Foundations, Soil Stabilization, Retaining Walls, Walls, Openings, Roofs, Parapets, Underground and Overhead Tanks, Staircases, and Isolation of Structures. Innovative Construction Materials and Techniques. Local Practices – Traditional Regional Responses. Computational Investigation Techniques.

Text Books:

1. David Alexander, "Natural Disasters", 1st Edition, CRC Press, 2017.
2. Edward A. Keller and Duane E. DeVecchio, "Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes", 5th Edition, Routledge, 2019.

Reference Books:

1. Ben Wisner, J.C. Gaillard, and Ilan Kelman (Editors), "Handbook of Hazards and Disaster Risk Reduction and Management", 2nd Edition, Routledge, 2012.
2. Damon P. Coppola, "Introduction to International Disaster Management", 4th Edition, Butterworth-Heinemann, 2020.

Online Learning Resources:

- https://nptel.ac.in/courses/124107010
- https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01304T	OE	**Sustainability in Engineering Practices** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Engineering Principles and Environmental Concepts.
- Familiarity with Sustainable Development and Resource Conservation Basics.

Course Objectives:

- To understand the fundamentals of sustainability, the carbon cycle, and the environmental impact of construction materials.
- To analyze sustainable construction materials, their durability, and life cycle assessment.
- To apply energy calculations in construction materials and assess their embodied energy.
- To evaluate green building standards, energy codes, and performance ratings.
- To assess the environmental effects of energy use, climate change, and global warming.

Course Outcomes (COs):

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

CO1: Apply sustainability principles to explain their integration in engineering design, construction, and project lifecycle management. (L3)

CO2: Analyze sustainable material selection, energy efficiency strategies, and life cycle assessment methods in engineering practice. (L4)

CO3: Evaluate environmental, social, and economic impacts of engineering projects using sustainability assessment tools and metrics. (L5)

CO4: Apply green engineering principles and clean technology approaches to develop sustainable infrastructure solutions. (L3)

CO5: Assess sustainable development goals and their alignment with engineering decision-making and professional responsibilities. (L5)

Unit I: Introduction to Sustainability:

Introduction and Definition of Sustainability – Carbon Cycle – Role of Construction Material: Concrete and Steel, etc. – CO2 Contribution from Cement and Other Construction Materials.

Unit II: Materials Used in Sustainable Construction:

Construction Materials and Indoor Air Quality – No/Low Cement Concrete – Recycled and Manufactured Aggregate – Role of QC and Durability – Life Cycle and Sustainability.

Unit III: Energy Calculations:

Components of Embodied Energy – Calculation of Embodied Energy for Construction Materials – Energy Concept and Primary Energy – Embodied Energy Vis-à-Vis Operational Energy in Conditioned Building – Life Cycle Energy Use.

Unit IV: Green Buildings:

Control of Energy Use in Building – ECBC Code, Codes in Neighboring Tropical Countries – OTTV Concepts and Calculations – Features of LEED and TERI – GRIHA Ratings – Role of Insulation and Thermal Properties of Construction Materials – Influence of Moisture Content and Modeling – Performance Ratings of Green Buildings – Zero Energy Building.

Unit V: Environmental Effects:

Non-Renewable Sources of Energy and Environmental Impact – Energy Norm, Coal, Oil, Natural Gas – Nuclear Energy – Global Temperature, Green House Effects, Global Warming – Acid Rain: Causes, Effects and Control Methods – Regional Impacts of Temperature Change.

Text Books:

1. Charles J. Kibert, "Sustainable Construction: Green Building Design & Delivery", 4th Edition, Wiley Publishers, 2016.
2. Steve Goodhew, "Sustainable Construction Process", Wiley Blackwell, UK, 2016.

Reference Books:

1. Craig A. Langston & Grace K.C. Ding, "Sustainable Practices in the Built Environment", Butterworth Heinemann Publishers, 2011.
2. William P. Spence, "Construction Materials, Methods & Techniques", 3rd Edition, Yesdee Publication Pvt. Ltd., 2012.

Online Learning Resources:

- https://archive.nptel.ac.in/courses/105/105/105105157/

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE02302T	OE	**Renewable Energy Sources** (Common to CE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Energy Concepts and Electrical Fundamentals.
- Familiarity with Conventional and Non-Conventional Energy Sources.

Course Objectives:

- To understand the fundamental principles of various renewable energy sources such as solar, wind, geothermal, ocean, and biomass energy.
- To analyze solar radiation parameters, solar thermal systems, and photovoltaic technologies for effective energy conversion.
- To study the working principles, design considerations, and performance analysis of wind energy conversion systems.
- To explore geothermal and ocean energy resources, their extraction methods, applications, and feasibility, particularly in the Indian context.

Course Outcomes (COs):

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

CO1: Describe solar energy fundamentals including solar radiation geometry, solar collectors, and thermal energy storage systems. (L3)

CO2: Analyze photovoltaic energy systems including PV cell characteristics, module design, and standalone and grid-connected configurations. (L4)

CO3: Examine wind energy systems including wind turbine components, aerodynamic forces, energy estimation, and site selection criteria. (L4)

CO4: Evaluate geothermal energy resources, characteristics, applications, and prospects for sustainable energy generation. (L5)

CO5: Assess miscellaneous renewable energy technologies including tidal, wave, biomass, and fuel cell systems for energy production. (L5)

Unit I: Solar Energy:

Solar radiation – beam and diffuse radiation, solar constant, Sun at Zenith, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. Flat plate collectors, concentrating collectors, storage of solar energy – thermal storage.

Unit II: PV Energy Systems:

Introduction, The PV effect in crystalline silicon – basic principles, the film PV, Other PV technologies, Solar PV modules from solar cells, mismatch in series and parallel connections, design and structure of PV modules, Electrical characteristics of silicon PV cells and modules, Stand-alone PV system configuration, Grid connected PV systems.

Unit III: Wind Energy:

Principle of wind energy conversion; Basic components of wind energy conversion systems; windmill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines; analysis of aerodynamic forces acting on windmill blades; wind data and energy estimation and site selection considerations.

Unit IV: Geothermal Energy:

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

Unit V: Miscellaneous Energy Technologies:

Ocean Energy: Tidal Energy – Principle of working, Operation methods, advantages and limitations. Wave Energy – Principle of working, energy and power from waves, wave energy conversion devices. Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration. Fuel Cell: Principle of working of various types of fuel cells, performance and limitations.

Text Books:

1. G.D. Rai, "Non-Conventional Energy Sources", 4th Edition, Khanna Publishers, 2000.
2. Chetan Singh Solanki, "Solar Photovoltaics Fundamentals, Technologies and Applications", 2nd Edition, PHI Learning Pvt. Ltd., 2012.

Reference Books:

1. Stephen Peake, "Renewable Energy Power for a Sustainable Future", Oxford International Edition, 2018.
2. S.P. Sukhatme, "Solar Energy", 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., 2008.
3. B.H. Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw Hill, 2011.

Online Learning Resources:

- https://nptel.ac.in/courses/103103206
- https://nptel.ac.in/courses/108108078

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03302T	**OE**	**Automation and Robotics** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Electrical, Electronic, and Mechanical Fundamentals.
- Familiarity with Control Systems and Basic Programming Concepts.

Course Objectives:

- Fundamentals of industrial automation, production types, automation strategies, and hardware elements used in modern manufacturing processes.
- Understanding of automated manufacturing systems, and strategies for improving productivity and flexibility in industrial automation.
- Knowledge of industrial automation and robotics, sensors, and end-effector design for modern manufacturing environments.
- Explain industrial automation and robotics, and trajectory planning for intelligent and efficient manufacturing applications.
- Familiarity of industrial automation and robotics, and practical applications in manufacturing processes.

Course Outcomes (COs):

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

CO1: Apply the concepts of automation, manufacturing systems, production types, automation strategies, and hardware components to identify and implement suitable automation solutions in manufacturing environments. (L3)

CO2: Analyze automated flow lines and assembly line balancing techniques to improve production efficiency in manufacturing systems. (L4)

CO3: Analyze the configuration, components, actuators, and sensor systems of industrial robots for effective selection and application in automation tasks. (L4)

CO4: Apply manipulator kinematics, dynamics, and trajectory planning techniques for robot motion control and path optimization. (L3)

CO5: Apply robot programming methods and evaluate robotic applications in manufacturing processes such as material handling, welding, painting, assembly, and inspection. (L3)

Unit I: Introduction to Automation:

Introduction to Automation, Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation, Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

Unit II: Automated Flow Lines:

Automated flow lines, Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines. Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Unit III: Introduction to Industrial Robotics:

Introduction to Industrial Robotics, Classification of Robot Configurations, functional line diagram, degrees of freedom. Components – common types of arms, joints, grippers, factors to be considered in the design of grippers. Robot actuators and Feedback components: Actuators – Pneumatic, Hydraulic actuators, Electric & Stepper motors. Position sensors – potentiometers, resolvers, encoders – velocity sensors, Tactile sensors, Proximity sensors.

Unit IV: Manipulator Kinematics and Dynamics:

Manipulator Kinematics: Homogenous transformations as applicable to rotation and transition – D-H notation, Forward and inverse kinematics. Manipulator Dynamics: Differential transformations, Jacobians, Lagrange-Euler and Newton-Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles, path planning, skew motion, joint integrated motion, straight line motion.

Unit V: Robot Programming and Applications:

Robot Programming: Methods of programming – requirements and features of programming languages, software packages. Problems with programming languages. Robot Application in Manufacturing: Material Transfer – Material handling, loading and unloading – Process – spot and continuous arc welding & spray painting – Assembly and Inspection.

Text Books:

1. Automation, Production Systems and CIM, M.P. Groover, Pearson Edu.
2. Industrial Robotics, M.P. Groover, TMH.

Reference Books:

1. Robotics, Fu K.S., McGraw Hill, 4th edition, 2010.
2. An Introduction to Robot Technology, P. Coiffet and M. Chirouze, Kogan Page Ltd., 1983.
3. Robotics Engineering, Richard D. Klafter, Prentice Hall.
4. Robotics, Fundamental Concepts and Analysis, Ashitave Ghosal, Oxford Press, 1/e, 2006.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE05303T	OE	**Operating Systems** (Common to CE, ECE & EEE)	3	0	0	3

Prerequisites: Computer Fundamentals, Programming in C, Data Structures, and Computer Organization & Architecture.

Course Objectives:

- Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
- Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
- Illustrate different conditions for deadlock and their possible solutions.

Course Outcomes (COs):

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

CO1: Analyze the architecture, functions, services, system structures, and interfaces of operating systems to explain their role in managing computing environments. (L4)

CO2: Apply process management, multithreading, scheduling algorithms, synchronization, and inter-process communication mechanisms to solve process coordination and resource-sharing problems. (L3)

CO3: Analyze memory management and virtual memory techniques, including paging, segmentation, and page replacement strategies, to optimize memory utilization and system performance. (L4)

CO4: Evaluate deadlock handling methods, file system organization, and secondary storage management techniques to improve system efficiency, reliability, and resource utilization. (L5)

CO5: Evaluate operating system protection and security mechanisms, including access control, authentication, cryptography, and threat mitigation techniques, to enhance system and network security. (L5)

UNIT I: Operating Systems Overview, System Structures:

Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Open-Source Operating Systems System Structures: Operating System Services, User and Operating-System Interface, systems call, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Operating system debugging, System Boot.

UNIT II: Process Concept, Multithreaded Programming, Process Scheduling, Inter-process Communication:

Process Concept: Process scheduling, Operations on processes, Inter-process communication, Communication in client server systems. Multithreaded Programming: Multithreading models, Thread libraries, Threading issues, Examples. Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling, Examples. Inter-process Communication: Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Barriers, Classical IPC Problems - Dining philosophers problem, Readers and writers problem.

UNIT III: Memory-Management Strategies, Virtual Memory Management:

Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation, Examples. Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation, Examples.

UNIT IV: Deadlocks, File Systems:
Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection and recovery, Deadlock avoidance, Deadlock prevention. File Systems: Files, Directories, File system implementation, management and optimization. Secondary-Storage Structure: Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.

UNIT V: System Protection, System Security:
System Protection: Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights. System Security: Introduction, Program threats, System and network threats, Cryptography as a security, User authentication, implementing security defenses, firewalling to protect systems and networks, Computer security classification. Case Studies: Linux, Microsoft Windows.

Text Books:
1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2016.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008.

Reference Books:
1. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.
2. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw Hill, 2012.
3. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009
4. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

Online Learning Resources:
https://nptel.ac.in/courses/106/106/106106144/
http://peterindia.net/OperatingSystems.html

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE31302T	OE	**Introduction to Machine Learning** (Common to CE, EEE & ECE)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Programming and Problem-Solving Techniques.
- Familiarity with Probability, Statistics, and Linear Algebra Fundamentals.

Course Objectives:

- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbors (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.

Course Outcomes (COs):

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

CO1: Interpret machine learning fundamentals, linear regression models, and evaluation metrics for predictive analytics. (L3)

CO2: Apply classification algorithms such as Logistic Regression, KNN, Naïve Bayes, Decision Trees, and Random Forests for supervised learning tasks. (L3)

CO3: Analyze support vector machines, ensemble learning methods, and hyperparameter optimization strategies. (L4)

CO4: Inspect clustering and dimensionality reduction techniques for unsupervised learning applications. (L4)

CO5: Examine advanced machine learning applications including reinforcement learning, neural networks, feature engineering, and model deployment. (L4)

Unit I: Introduction to Machine Learning:

Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

Unit II: Nearest Neighbor-Based Models:

Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures, K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

Unit III: Decision Trees and Bayes Classifier:

Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias-Variance Trade-off, Random Forests for Classification and Regression. The Bayes Classifier: Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification, Class Conditional Independence and Naive Bayes Classifier (NBC).

Unit IV: Linear Discriminants for Machine Learning:

Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

Unit V: Clustering:

Introduction to Clustering, Partitioning of Data, Matrix Factorization, Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

1. "Machine Learning Theory and Practice", M.N. Murthy, V.S. Ananthanarayana, Universities Press (India), 2024.

Reference Books:

1. "Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017.
2. "Machine Learning in Action", Peter Harrington, DreamTech.
3. "Introduction to Data Mining", Pang-Ning Tan, Michel Steinbach, Vipin Kumar, 7th Edition, 2019.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB304T	**OE**	**Optimization Techniques** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Algebra, Matrices, and Calculus.
- Familiarity with Mathematical Modelingand Problem-Solving Techniques.

Course Objectives:

- To understand the formulation and solution of linear programming problems, including graphical and simplex-based approaches.
- To analyze advanced linear programming concepts such as duality, transportation, and assignment problems for efficient resource allocation.
- To develop knowledge of unconstrained optimization techniques, including direct search and gradient-based methods for solving real-world problems.
- To apply constrained optimization methods such as feasible direction methods and sequential linear programming to engineering problems.

Course Outcomes (COs):

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

CO1: Understand the meaning, purpose, tools of Operations Research and linear programming in solving practical problems in industry. (L3)

CO2: Analyse andInterpret solutions are transportationmodelsto address real -world problems. (L3)

CO3: Develop mathematical skills to analyse and solve nonlinear programming models arising from a wide range of applications. (L3)

CO4: Apply the concept of non-linear programming for solving problems involving non-linear constraints and objectives. (L3)

CO5: Apply the concept of unconstrained geometric programming for solving problems involving non-linear constraints and objectives. (L5)

Unit I: Linear Programming I:

Introduction, Applications of Linear Programming, Standard form of a Linear Programming Problem, Geometry of Linear Programming Problems, Basic Definitions in Linear Programming. Simplex Method, Simplex Algorithm and Two-phase Simplex Method, Big-M method.

Unit II: Linear Programming II – Duality:

Symmetric Primal-Dual Relations, General Primal-Dual Relations, Duality Theorem, Dual Simplex Method, Transportation Problem and assignment problem, Complementary slackness Theorem.

Unit III: Non-linear Programming – Unconstrained Optimization:

Introduction: Classification of Unconstrained minimization methods. Direct Search Methods: Random Search Methods, Descent Method and Fletcher-Powell Method, Grid Search Method.

Unit IV: Non-linear Programming – Constrained Optimization:

Introduction, Characteristics of a constrained problem, Random Search Methods, complex method, Sequential linear programming, Basic approach in methods of Feasible directions, Zoutendijk's method of feasible directions: direction finding problem, determination of step length, Termination criteria.

Unit V: Geometric Programming:

Unconstrained Minimization Problems: solution of unconstrained geometric programming using differential calculus and arithmetic-geometric inequality. Constrained Minimization Problems: Solution of a constrained geometric programming problem, primal-dual programming in case of less-than inequalities, geometric programming with mixed inequality constraints.

Text Books:

1. Singiresu S. Rao., "Engineering Optimization: Theory and Practices", New Age Int. (P) Ltd. Publishers, New Delhi.
2. J.C. Pant, "Introduction to Optimization Techniques", 7th edition, Jain Brothers, New Delhi.

Reference Books:

1. Harvey M. Wagner, "Principles of Operation Research", Prentice-Hall of India Pvt. Ltd., New Delhi.
2. Peressimi A.L., Sullivan F.E., Uhl, J.J., "Mathematics of Non-linear Programming", Springer-Verlag.

Web References:

- https://onlinecourses.nptel.ac.in/noc24_ee122/preview
- https://archive.nptel.ac.in/courses/111/105/111105039/

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB305T	OE	**Mathematical Foundation of Quantum Technologies** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Matrices, Vectors, and Complex Numbers.
- Familiarity with Calculus, Probability, and Elementary Physics Concepts.

Course Objectives:

- To provide students with essential linear algebra foundations including vector spaces, inner products, and operators for quantum mechanical applications.
- To develop understanding of the transition from finite-dimensional systems to infinite-dimensional function spaces and Hilbert space concepts.
- To establish quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution principles.
- To enable students to apply quantum mechanical principles to solve problems in simple quantum systems.
- To introduce advanced concepts in composite systems, measurement processes, and modern perspectives in quantum mechanics.

Course Outcomes (COs):

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

CO1: Apply the principles of Vector spaces to solve mathematical problems. (L3)

CO2: Apply linear algebra concepts to function spaces and analyse the transition from finite to infinite dimensional systems. (L4)

CO3: Analyse quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution. (L4)

CO4: Apply quantum mechanical principles to solve problems in simple quantum systems and evaluate statistical interpretations. (L5)

CO5: Evaluate advanced concepts in composite systems and synthesize understanding of measurement processes and modern quantum theory. (L6)

Unit I: Linear Algebra Foundation for Quantum Mechanics:

Vector spaces definition and examples (R^2, R^3, function spaces), Inner products (dot product, orthogonality, normalization), Linear operators (matrices, eigenvalues, eigenvectors), Finite-dimensional examples (2×2 matrices, spin-1/2 systems), Dirac notation introduction ($|\psi\rangle$, $\langle\varphi|$, $\langle\varphi|\psi\rangle$), Change of basis (transformations, Unitary matrices).

Unit II: From Finite to Infinite Dimensions:

Function spaces (L^2 space, square-integrable functions), Inner products for functions ($\int\psi^*\varphi\, dx$), Orthogonal function sets (Fourier series, basis functions), Introduction to Hilbert space concept (complete inner product spaces), Position and momentum representations (wave functions), Operators on functions (d/dx, multiplication by x).

Unit III: Quantum Mechanical Formalism:

Mathematical formulation (states as vectors, observables as operators), Measurement theory (Born rule, expectation values, probabilities), Uncertainty relations (mathematical derivation from commutators), Time evolution (Schrödinger equation, Unitary evolution).

Unit IV: Applications and Statistical Interpretation:

Simple applications (infinite square well, harmonic oscillator), Statistical interpretation (ensembles, pure vs mixed states), Measurement process (von Neumann measurement scheme).

Unit V: Advanced Topics:

Composite systems (tensor products basic introduction), Reversibility and irreversibility (Unitary evolution vs measurement), Thermodynamic connections (equilibrium states, entropy), Modern perspectives (decoherence, measurement problem conceptual).

Text Books:

1. David J. Griffiths, Darrell F. Schroeter, "Introduction to Quantum Mechanics", 3rd Edition, Cambridge University Press, 2018.
2. R. Shankar, "Principles of Quantum Mechanics", 2nd Edition, Kluwer Academy/Plenum Publishers, 1994.

Reference Books:

1. George F. Simmons, "Introduction to Topology and Modern Analysis", MedTech Science Press.
2. Gilbert Strang, "Linear Algebra and Its Applications", 4th Edition, Cengage Learning, 2006.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB306T	OE	**Physics of Electronic Materials and Devices** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Semiconductor Physics and Electronic Fundamentals.
- Familiarity with Crystal Structures, Materials Properties, and Basic Device Concepts.

Course Objectives:

- To make the students understand the concept of crystal growth, defects in crystals and thin films.
- To provide insight into various semiconducting materials and their properties.
- To develop a strong foundation in semiconductor physics and device engineering.
- To elucidate excitonic and luminescent processes in solid-state materials.
- To understand the principles, technologies, and applications of modern display systems.

Course Outcomes (COs):

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

CO1: Analyze phase diagrams, crystal growth mechanisms, crystal defects, and thin film deposition techniques for the characterization of engineering materials. (L4)

CO2: Apply the principles of semiconductors to analyze charge carrier transport, carrier concentration, conductivity, mobility, and temperature-dependent semiconductor behavior(L3)

CO3: Analyze the operating principles and characteristics of semiconductor devices such as PN junctions, heterojunctions, transistors, and MOSFETs. (L4)

CO4: Apply the principles of excitonic and luminescent processes to interpret light emission phenomena in solid-state materials and optoelectronic devices. (L3)

CO5: Analyze the working principles and applications of modern display technologies, including LCD, holographic displays, light-field displays, head-mounted displays, MOEMS, and MEMS displays. (L4)

Unit I: Fundamentals of Materials Science:

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. The basic idea of point, line, and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RF and glow discharge).

Unit II: Semiconductors:

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, change of electron-hole concentration (Qualitative analysis), Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

Unit III: Physics of Semiconductor Devices:

Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Heterojunctions, Transistors, MOSFETs.

Unit IV: Excitons and Luminescence:

Luminescence: Different types of luminescence, basic definitions, Light emission in solids, Inter-band luminescence, Direct and indirect gap materials. Photoluminescence: General Principles, Excitation and relaxation, OLED, Quantum-dot. Electroluminescence: General Principles, light emitting diode, diode laser.

Unit V: Display Devices:

LCD, three-dimensional display: Holographic display, light-field displays: Head-mounted display, MOEMS (Micro-Opto-Electro-Mechanical Systems) and MEMS displays.

Text Books:

1. Principles of Electronic Materials and Devices, S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd., 4th edition, 2021.
2. Semiconductor Physics & Devices: Basic Principles, 4th Edition, McGraw-Hill, 2012.

Reference Books:

1. Solid State Electronic Devices, B.G. Streetman and S. Banerjee, PHI Learning, 6th edition.
2. Electronic Materials Science, Eugene A. Irene, Wiley, 2005.
3. Electronic Components and Materials, Grover and Jamwal, Dhanpat Rai and Co., New Delhi, 2012.

NPTEL Course Links:

- https://nptel.ac.in/courses/113/106/113106062/
- https://onlinecourses.nptel.ac.in/noc20_ph24/preview

III B.Tech. – II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB307T	**OE**	**Chemistry of Polymers and Applications** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Chemistry, Chemical Bonding, and Organic Compounds.
- Familiarity with Basic Material Properties and Chemical Reactions.

Course Objectives:

- To understand the basic principles of polymers.
- To understand natural polymers and their applications.
- To impart knowledge about synthetic polymers, their preparation and importance.
- To enumerate the applications of hydrogel polymers.
- To enumerate applications of conducting and degradable polymers in engineering.

Course Outcomes (COs):

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

CO1: Classify the polymers, explain polymerization mechanism, differentiate addition, condensation polymerizations, Describe measurement of molecular weight of polymer (L4)

CO2: Describe the physical and chemical properties of natural polymers and modified cellulosic. (L4)

CO3: Differentiate Bulk, solution, Suspension and emulsion polymerization, describe fibers and elastomers, Identify the thermosetting and thermo polymers. (L4)

CO4: Identify types of polymer networks, describe methods involve in hydrogel preparation, Explain applications of hydrogels in drug delivery. (L3)

CO5: Explain classification and mechanism of conducting and degradable polymers. (L3)

Unit I: Polymers – Basics and Characterization:

Basic concepts: monomers, repeating Units, degree of polymerization, linear, branched and network polymers, classification of polymers. Polymerization: addition, condensation, copolymerization and coordination polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

Unit II: Natural Polymers and Modified Cellulosics:

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins. Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics – PES, PAES, PEEK, PEA.

Unit III: Synthetic Polymers:

Addition and condensation polymerization processes – Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers: Olefin polymers (PE, PVC), Butadiene polymers (BUNA-S, BUNA-N), nylons, Urea-formaldehyde, phenol-formaldehyde, Melamine, Epoxy and Ion exchange resins.

Unit IV: Hydrogels of Polymer Networks:

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

Unit V: Conducting and Degradable Polymers:

Conducting polymers: Introduction, Classification, Mechanism of conduction in Poly Acetylene, Poly Aniline, Poly Thiophene, Doping, Applications. Degradable polymers: Introduction, Classifications, Examples, Mechanism of degradation, poly lactic acid, Nylon-6, Polyesters, applications.

Text Books:

1. A Text book of Polymer Science, Billmayer.
2. Polymer Chemistry, G.S. Mishra.
3. Polymer Chemistry, Gowarikar.

Reference Books:

1. Organic Polymer Chemistry, K.J. Saunders, Chapman and Hall.
2. Advanced Organic Chemistry, B. Miller, Prentice Hall.
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHS303T	OE	**Academic Writing and Public Speaking** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of English Grammar, Vocabulary, and Writing Skills.
- Familiarity with Oral Communication and Presentation Basics.

Course Objectives:

- To encourage all round development of the students by focusing on writing skills.
- To make the students aware of non-verbal skills.
- To develop analytical skills.
- To deliver effective public speeches.

Course Outcomes (COs):

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

CO1: Apply the principles and features of academic writing to compose clear, coherent, concise, and well-structured descriptive, analytical, persuasive, and critical texts. (L3)

CO2: Develop academic and professional documents such as abstracts, project proposals, internship applications, technical papers, and journal articles by applying appropriate writing, editing, proofreading, and ethical citation practices. (L3)

CO3: Analyze and construct different forms of academic writing such as argumentative essays, exploratory essays, book reviews, film reviews, summaries, and statements of purpose. (L4)

CO4: Demonstrate effective public speaking skills by applying presentation strategies, stage dynamics, audience engagement techniques, and response strategies in academic contexts. (L3)

CO5: Evaluate and employ verbal and non-verbal communication elements such as body language, facial expressions, kinesics, oculesics, proxemics, haptics, chronemics, and paralanguage to enhance the effectiveness of public speaking. (L5)

Unit I: Introduction to Academic Writing:

Introduction to Academic Writing – Essential Features of Academic Writing – Courtesy – Clarity – Conciseness – Correctness – Coherence – Completeness – Types: Descriptive, Analytical, Persuasive, Critical writing.

Unit II: Academic Journal Article:

Art of condensation – summarizing and paraphrasing – Abstract Writing, writing Project Proposal, writing application for internship, Technical/Research/Journal Paper Writing – Conference Paper writing – Editing, Proof Reading – Plagiarism.

Unit III: Essay and Writing Reviews:

Compare and Contrast – Argumentative Essay – Exploratory Essay – Features and Analysis of Sample Essays – Writing Book Report, Summarizing, Book/film Review – Statement of Purpose (SoP).

Unit IV: Public Speaking:

Introduction, Nature, characteristics, significance of Public Speaking – Presentation – 4 Ps of Presentation – Stage Dynamics – Answering Strategies – Analysis of Impactful Speeches – Speeches for Academic events.

Unit V: Public Speaking and Non-Verbal Delivery:

Body Language – Facial Expressions – Kinesics – Oculesics – Proxemics – Haptics – Chronomics – Paralanguage – Signs.

Text Books:

1. Critical Thinking, Academic Writing and Presentation Skills: MG University Edition, Pearson Education, 2010.
2. Pease, Allan & Barbara, "The Definitive Book of Body Language", RHUS Publishers, 2016.

Reference Books:

1. Alice Savage, Masoud Shafiei, "Effective Academic Writing", 2nd Ed., 2014, Oxford University Press.
2. Shalini Verma, "Body Language", S. Chand Publications, 2011.
3. Sanjay Kumar and Pushpalata, "Communication Skills", 2nd Ed., 2015, Oxford.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc21_hs76/preview
- https://archive.nptel.ac.in/courses/109/107/109107172/

B.Tech. – IV Year
I Semester

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04416T	PC	Data Communications and Networking	3	0	0	3

PreRequisites: Basics of Communication basics and Computer Networks

Course Objectives:

- To understand the fundamentals of data communication and networking concepts.
- To study various data link protocols, error detection and correction techniques.
- To analyze network layer protocols including IP addressing and routing algorithms.
- To explore transport layer protocols and their role in end-to-end communication.
- To understand application layer protocols and network security fundamentals.

Course Outcomes (COs):

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

CO1: Apply fundamentals of data communication, network models (OSI, TCP/IP), and networking concepts. (L3)

CO2: Analyse physical layer concepts such as encoding techniques, transmission media, switching, and queuing theory. (L4)

CO3: Analyse data link layer protocols, error control methods, and multiple access techniques. (L4)

CO4: Evaluate network and transport layer mechanisms including routing, congestion control, and QoS techniques. (L5)

CO5: Evaluate application layer protocols and network security mechanisms such as cryptography and firewalls. (L5)

Unit I: Data Communications and Transmission Media:

Data Communications – Components, Data Representation, Data Flow. Networks – Distributed Processing, Network Criteria, Physical Structures. Network Models – Layered Tasks, OSI Model, Layers in OSI Model, TCP/IP Protocol Suite. Line Configuration, Topology, Transmission Mode. Analog and Digital Signals, Periodic Analog Signals, Digital Signals, Transmission Impairment, Data Rate Limits, Performance. Bandwidth Utilization: Multiplexing – FDM, WDM, TDM. Spread Spectrum.

Unit II: Data Link Layer:

Error Detection and Correction – Types of Errors, Detection, Error Correction, Forward Error Correction Versus Retransmission. Data Link Control – Framing, Flow and Error Control, Protocols, Noiseless Channels, Noisy Channels, HDLC, Point-to-Point Protocol. Multiple Access – Random Access, Controlled Access, Channelization.

Unit III: Network Layer:

Logical Addressing – IPv4 Addresses, IPv6 Addresses. Internet Protocol – IPv4, IPv6. Address Mapping – ARP, RARP, BOOTP, DHCP. ICMP, IGMP. Delivery, Forwarding and Routing – Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing.

Unit IV: Transport Layer:

Process-to-Process Delivery: UDP, TCP – TCP Services, TCP Features, Segment, A TCP Connection, Flow Control, Error Control, Congestion Control, TCP Timers. SCTP – SCTP Services, SCTP Features, Packet Format, An SCTP Association, Flow Control, Error Control.

Unit V: Application Layer and Network Security:

Domain Name System – Name Space, Domain Name Space, Distribution of Name Space, DNS in Internet, Resolution, DNS Messages, Types of Records. Remote Logging – TELNET, SSH. Electronic Mail – Architecture, Web-Based Mail, MIME, SMTP, POP3. File Transfer – FTP. WWW and HTTP. Network Security – Cryptography, Firewalls, VPNs.

Text Books:

1. Data Communications and Networking, Behrouz A. Forouzan, Tata McGraw-Hill, 5th Edition, 2013.
2. Computer Networks, A. S. Tanenbaum, Prentice Hall, 5th Edition, 2011.

Reference Books:

1. Data and Computer Communications, William Stallings, Prentice Hall, 10th Edition, 2013.
2. Computer Networks and Internet Protocol, D. E. Comer, Prentice Hall, 2001.
3. Data Communications and Computer Networks, Prakash C. Gupta, PHI, 2006.

Web Resources:

- https://nptel.ac.in/courses/106105081
- https://nptel.ac.in/courses/106104032

IV B.Tech. – I Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE04403S	SE	RF System Design Tools	0	1	2	2

Pre-Requisites: Basics of Electromagnetics, and Communication systems

Course Objectives:

- To introduce RF design software and tools for designing and simulating RF systems.
- To understand impedance matching techniques and the role of scattering parameters in RF circuit design.
- To explore the design of RF power amplifiers, filters, oscillators, mixers, and voltage-controlled oscillators (VCOs).
- To analyze microstrip transmission lines, their discontinuities, and their applications in RF systems.
- To study the design, simulation, and measurement of antennas and microwave integrated circuits.

Course Outcomes (COs):

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

CO1: Apply RF design software and tools to simulate and analyse RF circuits and components(L3).

CO2: Design and implement impedance matching networks such as L-match, Pi-match, and T-match circuits. (L6)

CO3: Develop and evaluate RF amplifiers, filters, oscillators, and mixers for high-frequency applications. (L6)

CO4: Analyse microstrip transmission lines and evaluate their characteristics using S-parameters and Smith charts(L4)

CO5: Design and simulate various antennas including microstrip patch, Yagi-Uda, and horn antennas for communication systems. (L6)

Module I: Basic Concepts in RF Design:

Introduce RF design software and orient students with the tools of the laboratory. Introduction to RF Design, Time Variance and Nonlinearity, Effects of nonlinearity, Passive impedance transformation, Scattering parameters, impedance matching, L match, Pi match, T match, Passive IC Components - Resistors, capacitors, Inductors, Schottky Diode, RF Switch.

Module II: RF Power Amplifiers and Filters:

RF Power amplifier design examples, Gain equalizers, Voltage controlled oscillators, Phase locked loops, Linearized PLL models, PLL design examples, High frequency oscillators, Loop filters, lumped filter. LPF, HPF and BPF.

Module III: LNA, VCO and Mixers:

General considerations, Problem of input matching, Low Noise Amplifiers design in various topologies, Gain Switching, Band Switching, Voltage Controlled Oscillators, Mixers - General considerations, Passive down conversion mixers, Active down conversion mixers, Up conversion mixers.

Module IV: Microstrip Transmission Lines and Discontinuities:

S parameters of a Microstrip Transmission Line, Smith Chart, Analysis of Microstrip Transmission Line standing wave patterns at various frequencies, Different types of Transmission lines like CPW, Microstrip and Co-axial cable. Different types of Microstrip discontinuities like Bend, T, Via, Gap etc., Microstrip Ring Resonator.

Module V: Antennas and Microwave Integrated Circuits:

Radiation Pattern, Gain, S Parameters, Return loss and VSWR. Design considerations of Microstrip Patch Antenna and Microstrip Array, Yagi Uda Antenna and Horn Antenna. Hybrid Microwave Integrated Circuits, Monolithic Microwave Integrated Circuits (MMIC), MMIC Amplifier.

List of Experiments (Any 12 to be performed):

1. Design and simulate Impedance matching circuits like L-Matching, Pi Matching and T-Matching.
2. Design and Simulate a Schottky Diode and RF Switch.
3. Design and simulate a RF BJT Amplifier and LNA.
4. Design and simulate a Power Amplifier and Gain Equalizer.
5. Analyse and measure the gain of a Power Amplifier and equalise its gain using an Equalizer.
6. Design and simulate a High Frequency Oscillator and Lumped Filter.
7. Measurement of insertion loss, -3dB Cut off frequency of LPF, HPF and BPF.
8. Design and Simulate a VCO and RF Mixer.
9. Measure the S parameters of a Micro strip Transmission Line and plot the normalised impedance on a smith chart.
10. Analysis of Microstrip Transmission Line standing wave pattern at various frequencies.
11. Study of different types of Transmission lines like CPW, Microstrip and Co-axial and find/measure its Insertion Loss (S21 and S12).
12. Study of different types of Microstrip discontinuities like Bend, T, Via, Gap etc. and find/measure its Insertion loss.
13. Determine the Bandwidth and Quality Factor of a Microstrip Ring Resonator.
14. Design and simulate the Radiation Pattern, gain, S11 and VSWR of a Microstrip Patch Antenna and Microstrip Array.
15. Design and simulate the Radiation Pattern, gain, S11 and VSWR of a Yagi Uda Antenna and Horn Antenna.
16. Design and Simulate a MMIC Amplifier.

Equipment Required:

- RF Circuit Design and Simulation Software
- RF Training System
- Antenna Measurement System with Antenna Design Software

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE04404S	SE	Industrial IoT and Automation	0	1	2	2

Pre-Requisites: Basics of electronics, Embedded systems and Basic Networking

Course Objectives:

- To introduce the fundamentals of Industrial IoT (IIoT), its architecture, and its differences from traditional IoT.
- To understand the components of IIoT, including sensors, actuators, and control systems, and their integration with embedded platforms.
- To explore communication technologies such as ZigBee, Bluetooth, NFC, RFID, and MQTT for IIoT applications.
- To study data visualization techniques, dashboard creation, and web-based connectivity for IIoT systems.
- To learn data retrieval techniques, machine-to-machine (M2M) communication, and cloud integration for IIoT applications.
- To implement automation using PLCs, SCADA, and real-time control systems for industrial applications.

Course Outcomes (COs):

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

CO1: Analyse the fundamental concepts of IIoT, its architecture, and challenges in industrial automation systems. (L4)

CO2: Apply integration of sensors and actuators with Raspberry Pi/NodeMCU for real-time monitoring and control. (L3)

CO3: Implement communication protocols such as MQTT, ZigBee, and Bluetooth for seamless IIoT connectivity. (L3)

CO4: Develop web-based dashboards for real-time visualization and remote monitoring of IIoT devices. (L6)

CO5: Analyse industrial data using web-based interactions and M2M communication techniques. (L4)

Module I: Introduction & Architecture:

What is IIoT and connected world? The difference between IoT and IIoT, Architecture of IIoT, IoT node, Challenges of IIoT. Practice: Introduction to Arduino, Introduction to Raspberry Pi.

Module II: IIoT Components:

Fundamentals of Control System: introductions, components, closed loop & open loop system. Introduction to Sensors (Description and Working principle): What is sensor? Types of sensors, working principle of basic Sensors - Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11), Digital switch, Electro Mechanical switches. Practice: Measurement of temperature & pressure values of the process using Raspberry Pi/Node MCU. Modules and Sensors Interfacing using Raspberry Pi/Node MCU. Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry Pi/Node MCU.

Module III: Communication Technologies of IIoT:

Communication Protocols: IEEE 802.15.4, ZigBee, Bluetooth, BLE, NFC, RFID, Industry standards communication technology (MQTT), wireless network communication. Practice: Demonstration of MQTT communication.

Module IV: Visualization and Data Types of IIoT:

Connecting an Arduino/Raspberry Pi to the Web: Introduction, setting up the Arduino/Raspberry Pi development environment, Options for Internet connectivity with Arduino/Raspberry Pi, Configuring your board for the IoT. Practice: Visualization of diverse sensor data using dashboard. Sending alert message to the user.

Module V: Retrieving Data:

Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M). Practice: Device control using mobile Apps or through Web pages. Machine to Machine communication.

Module VI: Control & Supervisory Level of Automation:

Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). Practice: Digital logic gates programming using ladder diagram. Implementation of Boolean expression using ladder diagram. Simulation of PLC to understand the process control concept.

Suggested Mini Projects:

- IIoT based smart energy meter
- Smart Agriculture system
- Automation using controller via Bluetooth
- Temperature controlled Fan/cooler using controller
- Automatic streetlight
- Smart Baggage Tracker

Text Books:

1. Zaigham Mahmood (Ed.), The Internet of Things in the Industrial Sector, Springer Publication.
2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Industrial Internet of Things: Cybermanufacturing System, Springer Publication.
3. Ismail Butun (editor), Industrial IoT Challenges, Design Principles, Applications, and Security, Springer.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24MCHS413A	**MC**	**Gender Sensitization** (Common to all branches of Engineering)	**0**	**1**	**2**	**0**

Pre-Requisites:

- Basic Understanding of Society, Culture, and Human Relationships.
- Familiarity with Social Issues and Communication Skills

Course Objectives:

- To enable students to understand the gender related issues, vulnerability of women and men.
- To familiarize them about constitutional safeguard for gender equality.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To make them understand that gender identities and gender relations are part of culture as they shape the way daily life is lived in the family as well as wider Community and the workplace.

Course Outcomes (COs):

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

CO1: Apply fundamental concepts and terminology related to gender to examine attitudes, socialization processes, and the construction of gender roles in society. (L3)

CO2: Analyze gender roles, relationships, discrimination, and demographic issues to interpret their impact on individuals and society. (L4)

CO3: Analyze issues related to gender and labour, including unpaid work, unrecognized labour, work distribution, and gender mainstreaming in the context of sustainable development and human rights. (L4)

CO4: Evaluate the causes, forms, and consequences of gender-based violence from human rights and social perspectives. (L5)

CO5: Analyze the representation of gender in films, electronic media, advertisements, popular literature, and cultural practices to promote gender-sensitive perspectives and just relationships. (L4)

Unit I: Understanding Gender:

Introduction: Definition of Gender - Basic Gender Concepts and Terminology - Exploring Attitudes towards Gender - Construction of Gender - Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male. First lessons in Caste.

Unit II: Gender Roles and Relations:

Two or Many? - Struggles with Discrimination - Gender Roles and Relations - Types of Gender Roles - Gender Roles and Relationships Matrix - Missing Women - Sex Selection and its Consequences - Declining Sex Ratio - Demographic Consequences - Gender Spectrum.

Unit III: Gender and Labour:

Division and Valuation of Labour - Housework: The Invisible Labor - Work: Its Politics and Economics - Fact and Fiction - Unrecognized and Unaccounted work - Gender Development Issues –

Gender, Governance and Sustainable Development - Gender and Human Rights - Gender and Mainstreaming.

Unit IV: Gender-Based Violence:

The Concept of Violence - Types of Gender-based Violence - Gender-based Violence from a Human Rights Perspective - Sexual Harassment - Domestic Violence - Different forms of violence against women - Causes of violence, impact of violence against women - Consequences of gender-based violence.

Unit V: Gender and Culture:

Gender and Film - Gender and Electronic Media - Gender and Advertisement - Gender and Popular Literature - Gender Development Issues - Gender Issues - Gender Sensitive Language - Just Relationships.

Text Books:

1. Suneetha, Uma Bhrugubanda, et al. Towards a World of Equals: A Bilingual Textbook on Gender, Telugu Akademi, Telangana, 2015.
2. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity. UK Paperback Edn., March 1990.

Reference Books:

1. Datt, R. and Kornberg, J.(eds), Women in Developing Countries, Assessing Strategies for Empowerment, London: Lynne Rienner Publishers, 2002.
2. Brush, Lisa D., Gender and Governance, New Delhi, Rawat Publication, 2007.
3. Raj Pal Singh, Anupama Sihag, Gender Sensitization: Issues and Challenges, Raj Publications, 2019.

Online Resources:

- https://onlinecourses.swayam2.ac.in/nou24_hs53/preview
- https://onlinecourses.swayam2.ac.in/cec23_hs29/preview
- https://onlinecourses.nptel.ac.in/noc23_mg67/preview

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPIN403L	**IP**	**Industrial Internship** (Common to all branches of Engineering)	**0**	**0**	**0**	**2**

Pre-Requisites:

- Fundamental knowledge of core engineering concepts, laboratory practices, tools, and relevant software for applying technical skills in real-world environments.
- Ability to work collaboratively in teams with basic proficiency in technical communication, including report writing and presentations.
- Awareness of professional ethics, safety practices, organizational processes, and readiness to learn and adapt in industrial settings.

Course Objectives

- To provide practical exposure to industrial environments for applying engineering knowledge and technical skills to real-world problems.
- To develop the ability to work effectively in multidisciplinary teams and understand organizational structure and processes.
- To enhance communication skills for preparing technical reports, delivering presentations, and engaging in professional interactions.
- To build analytical skills for studying industrial practices, workflows, and technologies to identify inefficiencies and suggest improvements.
- To cultivate critical thinking and professional ethics for evaluating engineering solutions, project outcomes, and personal growth in a societal and environmental context.

Course Outcomes (COs):

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

CO1: Apply engineering knowledge and technical skills to perform assigned tasks and solve real-world industrial problems. (L3)

CO2: Collaborate with multidisciplinary teams to understand organizational processes and effectively contribute to project execution. (L3)

CO3: Communicate technical information effectively through reports, presentations, and professional interactions with supervisors and team members. (L3)

CO4: Analyze industrial practices, workflows, and technologies to identify inefficiencies and propose appropriate improvements. (L4)

CO5: Evaluate industrial processes, project outcomes, and personal professional development based on technical, economic, environmental, ethical, and societal considerations. (L5)

Management Elective – II (HM - II)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS410T	**HM**	**Business Ethics and Corporate Governance** (Common to all branches of Engineering)	**2**	**0**	**0**	**2**

Pre-Requisites:

- Basic Understanding of Business, Management, and Organizational Concepts.
- Familiarity with Social Responsibility, Ethics, and Legal Awareness.

Course Objectives:

- To make the student understand the principles of business ethics.
- To enable them in knowing about the ethics in management.
- To facilitate the student's role in corporate culture.
- To impart knowledge about the fair-trade practices.
- To encourage the student in knowing about the corporate governance.

Course Outcomes (COs):

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

CO1: Analyze ethical principles, value systems, business ethics, and CSR in organizational contexts. (L4)

CO2: Evaluate ethical theories (e.g., Utilitarianism, Distributive Justice) and apply them across functional areas. (L5)

CO3: Analyze corporate culture, leadership styles, and their impact on organizational effectiveness. (L4)

CO4: Evaluate legal and ethical compliance requirements related to corporate governance, environmental protection, and fair trade practices. (L5)

CO5: Evaluate corporate governance practices, roles of boards, auditors, and committees (e.g., Cadbury Committee) in ensuring transparency and accountability. (L5)

Unit I: Ethics:

Introduction – Meaning – Nature, Scope, significance, Loyalty, and ethical behavior. Value systems - Business Ethics - Types, Characteristics, Factors, Contradictions and Ethical Practices in Management - Corporate Social Responsibility – Issues of Management – Crisis Management.

Unit II: Ethics in Management:

Introduction – Ethics in production, finance, Human resource management and Marketing Management - The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures - Culture and Individual Ethics – professional ethics and technical ethics.

Unit III: Corporate Culture:

Introduction - Meaning, definition, Nature, and significance – Key elements of corporate culture, shared values, beliefs and norms, rituals, symbols and language - Types of corporate culture, hierarchical culture, market driven culture – Organization leadership and corporate culture, leadership styles and their impact on culture, transformational leadership and culture change.

Unit IV: Legal Frame Work:

Law and Ethics - Agencies enforcing Ethical Business Behavior - Legal Impact – Environmental Protection, Fair Trade Practices, Legal Compliances, Safeguarding Health and wellbeing of Customers – Corporate law, Securities and financial regulations, corporate governance codes and principles.

Unit V: Corporate Governance:

Introduction - Meaning – Corporate governance code, transparency & disclosure - Role of auditors, board of directors and shareholders. Global issues, accounting and regulatory framework - Corporate scams - Committees in India and abroad, corporate social responsibility. BoDs composition, Cadbury Committee - Various committees - Reports - Benefits and Limitations.

Text Books:

1. Murthy CSV: Business Ethics and Corporate Governance, HPH, July 2017.
2. Bholananth Dutta, S.K. Podder – Corporation Governance, VBH, June 2010.

Reference Books:

1. Dr. K. Nirmala, Karunakara Reddy. Business Ethics and Corporate Governance, HPH.
2. H.R. Machiraju: Corporate Governance, HPH, 2013.
3. K. Venkataramana, Corporate Governance, SHBP.
4. N.M. Khandelwal. Indian Ethos and Values for Managers.

Online Resources:

- https://onlinecourses.nptel.ac.in/noc21_mg46/
- https://archive.nptel.ac.in/courses/110/105/110105138/

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS411T	**HM**	**E-Business** (Common to all branches of Engineering)	**2**	**0**	**0**	**2**

Pre-Requisites:

- Basic Knowledge of Business and Internet Fundamentals.
- Familiarity with Computer Applications and Online Communication.

Course Objectives:

- To provide knowledge on emerging concept on E-Business related aspects.
- To understand various electronic markets & business models.
- To impart the information about electronic payment systems & banking.
- To create awareness on security risks and challenges in E-commerce.
- To make the students aware of different e-marketing channels & strategies.

Course Outcomes (COs):

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

CO1: Apply concepts of e-business, e-commerce functions, internet services, and online shopping to identify business opportUnities and advantages. (L3)

CO2: Analyze and evaluate electronic market types, business models (B2B, B2C, B2G), portals, and auction systems for strategic business decisions. (L5)

CO3: Apply various electronic payment methods (cards, UPI, wallets, crypto) and evaluate infrastructure and regulatory requirements for business transactions. (L4)

CO4: Analyze and evaluate e-commerce security risks, cyber threats, and protection mechanisms including firewalls, SSL/TLS, and digital signatures. (L4)

CO5: Evaluate online marketing strategies, digital advertising, social media, eCRM, and e-supply chain management to improve business performance. (L5)

Unit I: Electronic Business:

Introduction – Nature, meaning, significance, functions and advantages - Definition of Electronic Business - Functions of Electronic Commerce (EC) - Advantages & Disadvantages of E-Commerce – E-Commerce and E-Business, Internet Services, Online Shopping - E-Commerce OpportUnities for Industries.

Unit II: Electronic Markets and Business Models:

Introduction – E-Shops, E-Malls, E-Groceries - Portals - Vertical Portals, Horizontal Portals - Advantages of Portals - Business Models - Business to Business (B2B), Business to Customers (B2C), Business to Government (B2G) - Auctions, B2B Portals in India.

Unit III: Electronic Payment Systems:

Introduction to electronic payment systems (EPS) - Types of electronic payments - Credit/debit cards, e-wallets, UPI, and crypto currencies - Smart cards and digital wallets: Features and usage - Electronic Fund Transfer (EFT): Role in business transactions - Infrastructure requirements and regulatory aspects of e-payments.

Unit IV: E-Security:

Security risks and challenges in electronic commerce - Cyber threats - Phishing, hacking, identity theft, and malware - Digital Signatures & Certificates - Security protocols over public networks (HTTP, SSL, TLS) - Firewalls in securing e-business platforms.

Unit V: E-Marketing:

Introduction – Online Marketing – Advantages of Online Marketing – Internet Advertisement – Advertisement Methods – Conducting Online Market Research – E-marketing planning: Online branding, social media marketing, Role of AI&ML in E-Marketing and email marketing - E-business strategies: Digital advertising, content marketing, and analytics – E-Customer Relationship Management (eCRM), E-supply chain management (e-SCM).

Text Books:

1. Arati Oturkar & Sunil Khilari. E-Business. Everest Publishing House, 2022.
2. P.T.S Joseph. E-Commerce, Fourth Edition, Prentice Hall of India, 2011.

Reference Books:

1. Debjani, Kamalesh K Bajaj. E-Commerce, Second Edition, Tata McGraw-Hill, 2005.
2. Dave Chaffey. E-Commerce E-Management, Second Edition, Pearson, 2012.
3. Henry Chan. E-Commerce Fundamentals and Application, Wiley India, 2007.
4. S. Jaiswal. E-Commerce, Galgotia Publication Pvt Ltd., 2003.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS412T	**HM**	**Management Science** (Common to all branches of Engineering)	**2**	**0**	**0**	**2**

Pre-Requisites:

- Basic Understanding of Business, Management, and Organizational Concepts.
- Familiarity with Quantitative Reasoning and Problem-solving skills.

Course Objectives:

- To provide fundamental knowledge on Management, Administration, Organization & its concepts.
- To make the students understand the role of management in Production.
- To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts.
- To create awareness on strategic management areas & the PERT/CPM for better Project Management.
- To make the students aware of the contemporary issues in modern management.

Course Outcomes (COs):

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

CO1: Analyze management principles, classical theories, and organizational structures to interpret their role in organizational effectiveness. (L4)

CO2: Apply production methods, inventory techniques (EOQ, ABC), and marketing strategies in solving operational and business problems. (L3)

CO3: Analyze HRM functions such as recruitment, training, and performance appraisal to improve workforce effectiveness. (L4)

CO4: Evaluate strategic alternatives and project management techniques (PERT, CPM) for effective decision-making and project execution. (L5)

CO5: Evaluate modern management tools like MIS, ERP, CRM, and SCM in enhancing organizational performance and competitiveness. (L5)

Unit I: Introduction to Management:

Management - Concept and meaning - Nature - Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory - Henry Fayol's principles - Elton Mayo's Human relations - Organizational Designs - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

Unit II: Operations Management:

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control - Material Management - Objectives - Inventory - Functions - Types, Inventory Techniques - EOQ, ABC Analysis - Marketing Management - Concept - Meaning - Nature - Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

Unit III: Human Resources Management (HRM):

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Job Analysis - Job description and Job specification - Recruitment and Selection procedure - Training and Development - Performance Appraisal - Job Evaluation and Merit Rating - Wages and Incentives.

Unit IV: Strategic Management:

Strategic Management - Definition - Vision, Mission and Objectives - SWOT Analysis - Strategy Formulation, Implementation and Evaluation - Corporate strategies: Growth, Stability, Retrenchment - Business level strategies - Functional level strategies.

Unit V: Project Management (PERT/CPM):

Network diagram representation – Network scheduling by CPM - Critical path calculations – Network scheduling by PERT - probability of completing a project – Cost analysis – Time-Cost optimization – Resource planning and smoothing. Contemporary Issues: Industry 4.0, AI in Management, Startup ecosystem, Digital transformation in organizations.

Text Books:

1. Management Science, A.R. Aryasri, TMH, 2019.
2. Principles of Management, P.C. Tripathi & P.N. Reddy, TMH, 6th Edition, 2012.

Reference Books:

1. Industrial Engineering and Management, O.P. Khanna, Dhanpat Rai, 2015.
2. Principles and Practice of Management, L.M. Prasad, S. Chand Publications, 2012.

Professional Elective – IV (PE - IV)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04413T	PE	Radar Engineering	3	0	0	3

Pre-Requisites: Basics of Electromagnetics, Signals and Communication Systems

Course Objectives:

- To understand the fundamentals of radar systems and their applications.
- To study different types of radar waveforms and their characteristics.
- To analyze radar signal processing techniques and target detection methods.
- To explore MTI, pulse Doppler and tracking radars.
- To study advanced radar systems including phased array and synthetic aperture radar.

Course Outcomes (COs):

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

CO1: Apply radar fundamentals and radar equation to analyse system performance and range parameters. (L3)

CO2: Analyse CW and FM-CW radar principles for range and Doppler measurement applications. (L4)

CO3: Analyse MTI and pulse Doppler radar techniques and evaluate their performance limitations. (L4)

CO4: Evaluate tracking radar techniques and compare different tracking methods. (L5)

CO5: Evaluate radar signal detection methods, receiver performance, and advanced radar technologies. (L5)

Unit I: Introduction to Radar:

Basic principle of Radar – Simple form of the Radar Equation – Radar Block Diagram and Operation – Radar Frequencies – Applications of Radar. Radar Range Equation – Minimum Detectable Signal – Receiver Noise and the Signal-to-Noise Ratio – Integration of Radar Pulses – Radar Cross Section of Targets – Radar Cross Section Fluctuations – Transmitter Power – Pulse Repetition Frequency and Range Ambiguities – Antenna Parameters.

Unit II: CW and Frequency Modulated Radar:

Doppler Effect – CW Radar – Frequency Modulated CW Radar – Multiple-Frequency CW Radar. Pulse Compression – Linear Frequency Modulation – Phase Modulation.

Unit III: MTI and Pulse Doppler Radar:

Introduction – Single Delay-Line Canceler – Double Delay-Line Canceler – MTI Recursive (Feedback) Filter – Staggered Pulse Repetition Frequencies – Doppler Filter Banks – Moving Clutter – Limitations to MTI Performance – MTI from a Moving Platform. Pulse Doppler Radar.

Unit IV: Tracking Radar:

Tracking with Radar – Sequential Lobing – Conical Scan – Simultaneous Lobing or Monopulse – Tracking in Range – Acquisition. Comparison of Trackers – Tracking in Doppler Frequency.

Unit V: Advanced Radar Systems:

Electronically Steered Phased Array Antennas in Radar – Phase Shifters – Frequency Scan Arrays – Applications of the Phased Array. Synthetic Aperture Radar – Principle of operation, applications. Detection of Signals in Noise – Matched Filters – Receiver Operating Characteristics.

Text Books:

1. Introduction to Radar Systems, Merrill I. Skolnik, Tata McGraw Hill, 3rd Edition, 2001.
2. Radar Engineering, N. Balakrishnan, C. Chandrasekhar, Tata McGraw Hill, 2010.

Reference Books:

1. Principles of Radar, J. L. Eaves, E. K. Reedy, Academic Press, 2012.
2. Radar Principles, Nadav Levanon, Wiley Interscience, 1988.

Course Code	Category	Name of the Course	L	T	P	C
24PE04414T	PE	DSP Processors & Architectures	3	0	0	3

Pre-Requisites: Basics of Digital Signal Processing and Microprocessor

Course Objectives:

- To describe the unique features and significance of Digital Signal Processing (DSP).
- To demonstrate various computational parameters and accuracy considerations in DSP systems.
- To introduce architectural improvements in programmable DSP devices and their execution models.
- To expose students to basic DSP algorithms, including filtering, FFT, and adaptive processing.
- To outline DSP processor applications and their interfacing with memory and I/O peripherals.

Course Outcomes (COs):

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

CO1: Analyse digital signal processing fundamentals including sampling, DFT/FFT, LTI systems, and computational accuracy issues. (L4)

CO2: Analyse DSP processor architectures, memory organization, addressing modes, and execution control mechanisms. (L4)

CO3: Examine addressing modes, pipeline operations, and interrupt handling mechanisms in DSP processors (TMS320C54XX). (L4)

CO4: Evaluate the implementation of DSP algorithms such as FIR, IIR, FFT, and adaptive filters for performance and efficiency (L5)

CO5: Evaluate interfacing techniques between DSP processors and memory/I/O peripherals for system integration. (L5)

Unit I: Introduction to Digital Signal Processing:

Introduction, a Digital signal-processing system, the sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems – MATLAB, DSP using MATLAB. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

Unit II: Architectures for Programmable DSP Devices:

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing. Execution Control and Pipelining: Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models.

Unit III: Programmable Digital Signal Processors:

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

Unit IV: Implementations of Basic DSP Algorithms:

The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing. Implementation of FFT Algorithms: An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum.

Unit V: Interfacing Memory and I/O Peripherals to Programmable DSP Devices:

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

Text Books:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing Implementation, 1st Edition, Cengage Learning, 2004.
2. Lapsley et al. S. Chand and Co., DSP Processor Fundamentals, Architectures & Features, 2000.

Reference Books:

1. B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, TMH, 2004.
2. Jonatham Stein, Digital Signal Processing: A Computer Science Perspective, John Wiley, 2000.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04415T	**PE**	**Cellular & Mobile Communications**	**3**	**0**	**0**	**3**

Pre-Requisites: Basics of Communication Systems

Course Objectives:

- To explain the basic cellular system and its working.
- To understand the impact of multipath fading channels and techniques to mitigate fading effects in cellular communication.
- To explore frequency management, channel assignment strategies, and different types of handoffs in cellular networks.
- To analyze the performance of mobile antennas, interference issues, and cellular system design principles.
- To evaluate system performance metrics such as dropped call rates, handoff strategies, and spectrum efficiency.

Course Outcomes (COs):

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

CO1: Analyse concepts of cellular mobile communication systems and analyse their operation and performance characteristics. (L3)

CO2: Analyse cellular system design aspects including interference, frequency reuse, and antenna parameters. (L4)

CO3: Analyse signal propagation and cell coverage models for different terrains and environments. (L4)

CO4: Evaluate antenna systems, frequency management, and channel assignment techniques in cellular networks. (L5)

CO5: Evaluate handoff techniques and system performance metrics for efficient cellular communication. (L5)

Unit I: Cellular Mobile Radio Systems:

Introduction to Cellular Mobile system, basic cellular system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, Hexagonal shaped cells, Analog and Digital Cellular systems.

Unit II: Elements of Cellular Radio System Design:

General description of the problem, concept of frequency channels, Co-channel Interference Reduction Factor, desired C/I from a normal case in an Omni directional Antenna system, Cell splitting, consideration of the components of cellular system. Interference: Introduction to Co-channel interference, real time co-channel interference, Co-channel measurement, design of Antenna system, Antenna parameters and their effects, diversity receiver, non-co-channel interference - different types.

Unit III: Cell Coverage for Signal and Traffic:

Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long-distance propagation antenna height gain, form of a point-to-point model.

Unit IV: Cell Site and Mobile Antennas:

Sum and difference patterns and their synthesis, Omni directional antennas, directional antennas for interference reduction, space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, high gain antennas. Frequency Management and Channel Assignment: Numbering and grouping, setup access and paging channels, channel assignments to cell sites and mobile Units, channel sharing and borrowing, sectorization, overlaid cells, non-fixed channel assignment.

Unit V: Handoff and System Evaluations:

Handoff: Handoff, dropped calls and cell splitting, types of handoffs, handoff invitation, delaying handoff, forced handoff, mobile assigned handoff. Intersystem handoff, cell splitting, micro cells, vehicle locating methods, dropped call rates and their evaluation. System Evaluations: Performance evaluation, Signal evaluation, Measurement of average received level and level crossings, Spectrum efficiency evaluation.

Text Books:

1. W.C.Y. Lee, Mobile Cellular Telecommunications, Tata Mc-Graw Hill, 2nd Edition, 2006.
2. Theodore S. Rapport, Wireless Communications, Pearson Education, 2nd Edition, 2002.

Reference Books:

1. Gordon L. Stuber, Principles of Mobile Communications, Springer International, 2nd Edition, 2007.
2. Lee, Wireless and Mobile Communications, Mc Graw Hills, 3rd Edition, 2006.
3. Jon W. Mark and Weihua Zhqung, Wireless Communications and Networking, PHI, 2005.

Professional Elective – V (PE - V)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04417T	PE	Low Power VLSI Design	3	0	0	3

Pre-Requisites: Basics of VLSI Design

Course Objectives:

- To understand the need for low-power circuit design and analyze different power dissipation mechanisms in VLSI circuits.
- To explore various low-power design approaches at the system, circuit, and mask levels.
- To study low-power adder architectures and their role in power-efficient computing.
- To examine different low-power multiplier architectures and their impact on digital design.
- To gain knowledge of low-power memory technologies and their future developments.

Course Outcomes (COs):

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

CO1: Apply fundamentals of low power design and analyse sources of power dissipation and short channel effects in VLSI circuits. (L3)

CO2: Analyse low-power design techniques including voltage scaling, architectural approaches, and capacitance minimization methods. (L4)

CO3: Analyse low-voltage low-power adder architectures and evaluate different design techniques for power optimization. (L4)

CO4: Evaluate low-power multiplier architectures and compare their performance for efficient computation. (L5)

CO5: Evaluate low-power memory design techniques for ROM, SRAM, and DRAM and assess their performance. (L5)

Unit I: Fundamentals:

Need for Low Power Circuit Design, Sources of Power Dissipation – Static and Dynamic Power Dissipation, Short Circuit Power Dissipation, Glitching Power Dissipation, Short Channel Effects – Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

Unit II: Low-Power Design Approaches:

Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

Unit III: Low-Voltage Low-Power Adders:

Introduction, Standard Adder Cells, CMOS Adder Architectures – Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques – Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

Unit IV: Low-Voltage Low-Power Multipliers:

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

Unit V: Low-Voltage Low-Power Memories:

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Text Books:

1. CMOS Digital Integrated Circuits – Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
2. Low-Voltage, Low-Power VLSI Subsystems, Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective, Ming-BO Lin, CRC Press, 2011.
2. Low Power CMOS Design, Anantha Chandrakasan, IEEE Press/Wiley International, 1998.
3. Low Power CMOS VLSI Circuit Design, Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04418T	PE	Wireless Sensor Networks	3	0	0	3

Pre-Requisites: Basics of Communication Systems, Networking, Embedded systems, and Sensors

Course Objectives:

- To introduce the fundamental concepts and architecture of wireless sensor networks.
- To explore various network architectures, optimization techniques, and design principles for wireless sensor networks.
- To study MAC protocols, routing techniques, and addressing mechanisms for efficient sensor network communication.
- To understand the infrastructure establishment of sensor networks, including topology control and synchronization.
- To provide knowledge on sensor network platforms, programming challenges, and simulation tools.

Course Outcomes (COs):

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

CO1: Analyse the fundamental concepts and architecture of Wireless Sensor Networks (WSNs) to understand their operation and applications. (L4)

CO2: Evaluate various network architectures, optimization techniques, and design principles for efficient WSN deployment. (L5)

CO3: Apply MAC protocols, routing techniques, and addressing mechanisms for efficient communication in sensor networks. (L3)

CO4: Analyse the infrastructure establishment of sensor networks, including topology control and synchronization mechanisms. (L4)

CO5: Evaluate sensor network platforms, programming challenges, and simulation tools for effective WSN design and implementation. (L5)

Unit I: Overview of Wireless Sensor Networks:

Single-Node Architecture - Hardware Components - Network Characteristics - Unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks - Types of wireless sensor networks.

Unit II: Architectures:

Network Architecture - Sensor Networks - Scenarios - Design Principles, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts.

Unit III: Networking Sensors:

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - SMAC - B-MAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols, Energy-Efficient Routing, Geographic Routing.

Unit IV: Infrastructure Establishment:

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Unit V: Sensor Network Platforms and Tools:

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

Text Books:

1. Holger Karl & Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks - An Information Processing Approach, Elsevier, 2007.

Reference Books:

1. Walteneur Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks Theory and Practice, John Wiley & Sons, 2011.
2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, Wireless Sensor Networks - Technology, Protocols, and Applications, John Wiley, 2007.
3. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04419T	PE	5G Communications	3	0	0	3

Pre-Requisites: Basics of Communication Systems

Course Objectives:

- To introduce the fundamental concepts of 5G spectrum, radio access technologies, and system requirements.
- To understand the architecture and physical layer aspects of 5G networks, including MIMO and beamforming.
- To explore advanced 5G radio-access technologies and their role in multi-user communication.
- To study network slicing, SDN, NFV, and their applications in vehicular communications.
- To analyze mobility management, interference control, and dynamic network reconfiguration in 5G.

Course Outcomes (COs):

CO1: Analyse the 5G radio spectrum and channel models, including spectrum sharing and propagation challenges for efficient communication. (L4)

CO2: Analyse the 5G network architecture, including core network, RAN, and physical layer procedures. (L4)

CO3: Evaluate different 5G radio-access technologies, including new waveforms and non-orthogonal multiple access schemes. (L5)

CO4: Apply network slicing concepts and vehicular communication techniques for efficient 5G network deployment. (L3)

CO5: Develop strategies for mobility and handoff management to optimize network performance and minimize interference. (L6)

Unit I: 5G Radio Spectrum and Channel Models:

5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies. 5G Channel Model: The 5G wireless Propagation Channels - Channel modeling requirements, propagation scenarios and challenges in the 5G modeling. 5G Use Cases and System Concept: Use cases and requirements, 5G system concept.

Unit II: Radio Interface Architecture:

5G architecture options, core network architecture, RAN architecture. 5G Physical Layer: Physical channels and signals, 5G frame structure, physical layer procedures (MIMO, Power control, link adaptation, beam forming).

Unit III: 5G Radio-Access Technologies:

Access design principles for multi-user communications, multi-carrier with filtering: a new waveform, non-orthogonal schemes for efficient multiple access.

Unit IV: 5G Network Slicing and Vehicular Communications:

Introduction to 5G Network Slicing: Network Slicing, E2E Slicing, SDN and NFV Slicing. Vehicular Communications: From V2V to AV2X, key standards, VC architectures, V2X Use cases.

Unit V: Mobility and Handoff Management in 5G:

Network deployment types, Interference management in 5G, Mobility management in 5G, Dynamic network reconfiguration in 5G.

Text Books:

1. Afif Osseiran, Jose F. Monserrat, Patrick Marsch, 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016.
2. Saad Z. Asif, 5G Mobile Communications Concepts and Technologies, CRC Press, Taylor & Francis Group, First Edition, 2018.
3. Harri Holma, Antti Toskala, Takehiro Nakamura, 5G Technology 3GPP NEW RADIO, John Wiley & Sons, First Edition, 2020.

Reference Books:

1. Gordon L. Stuber, Principles of Mobile Communication, KLUWER ACADEMIC PUBLISHERS, 2nd Edition, 2002.
2. Joseph C. Liberti, Theodore S. Rappaport, Smart Antennas for Wireless Communications, Prentice Hall PTR, 1999.
3. Ying Zhang, Network Function Virtualization Concepts and Applicability in 5G Networks, John Wiley & Sons, 2018.

Open Elective – III (OE - III)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01405T	OE	**Building Materials and Services** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Construction Materials and Building Components.
- Familiarity with Building Systems and Service Requirements.

Course Objectives:

- Understand properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
- Analyze the composition, manufacturing process, and properties of cement and admixtures.
- Apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
- Evaluate masonry, mortars, finishing techniques, and formwork systems.
- Assess various building services including plumbing, ventilation, air conditioning, acoustics, and fire protection.

Course Outcomes (COs):

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

CO1: Apply knowledge of conventional and modern building materials to explain their properties, specifications, and construction applications. (L3)

CO2: Analyze the performance characteristics of building materials under various environmental and structural loading conditions. (L4)

CO3: Evaluate building services systems including water supply, drainage, electrical, fire protection, and HVAC for efficient building operation. (L5)

CO4: Apply appropriate material selection criteria and service system design principles for safe and sustainable building construction. (L3)

CO5: Assess the integration of smart building technologies and energy management systems for optimized building performance. (L5)

UNIT – I: Stones, Bricks, Tiles, Timber, Aluminum, Glass, Paints and Plastics

Stones and Bricks, Tiles: Building Stones – Classifications and Quarrying – Properties – Structural Requirements – Dressing. Bricks – Composition of Brick Earth – Manufacture and Structural Requirements, Fly Ash, Ceramics. Timber, Aluminum, Glass, Paints and Plastics: Wood – Structure – Types and Properties – Seasoning – Defects; Alternate Materials for Timber – GI/Fibre – Reinforced Glass Bricks, Steel & Aluminum, Plastics.

UNIT – II: Cement & Admixtures

Types of Cement – Ingredients of Cement – Manufacture – Chemical Composition – Hydration – Field & Lab Tests – Fineness – Consistency – Initial & Final Setting – Soundness. Admixtures – Mineral & Chemical Admixtures – Uses.

UNIT – III: Building Components

Lintels, Arches, Walls, Vaults – Stair Cases – Types of Floors – Types of Roofs: Flat, Curved, Trussed; Foundations – Types; Damp Proof Course; Joinery – Doors – Windows – Materials – Types.

UNIT – IV: Mortars, Masonry and Finishings

Lime and Cement Mortars. Brick Masonry – Types – Bonds; Stone Masonry – Types; Composite Masonry – Brick-Stone Composite; Concrete, Reinforced Brick. Finishes: Plastering, Pointing, Painting, Claddings – Types – Tiles – ACP. Formwork: Types – Requirements – Standards – Scaffolding – Design; Shoring, Underpinning.

UNIT – V: Building Services

Plumbing Services: Water Distribution, Sanitary Lines & Fittings; Ventilation: Functional Requirements, Systems of Ventilation. Air-Conditioning – Essentials and Types; Acoustics – Characteristics – Absorption – Acoustic Design; Fire Protection – Fire Hazards – Classification of Fire Resistant Materials and Constructions.

Text Books:

1. Building Materials and Construction – Arora & Bindra, Dhanpat Roy Publications.
2. Building Materials and Construction by G C Sahu, Joygopal Jena, McGraw Hill Pvt Ltd, 2015.

Reference Books:

1. Building Construction by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications (P) Ltd., New Delhi.
2. P. C. Varghese, Building Materials, Prentice Hall of India, 2015.
3. N. Subramanian, Building Materials Testing and Sustainability, Oxford Higher Education, 2019.
4. R. Chudley, Construction Technology, Longman Publishing Group, 1973.
5. S. K. Duggal, Building Materials, Oxford & IBH Publishing Co. Ltd., New Delhi, 2019.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01406T	OE	**Environmental Impact Assessment** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Environmental Science and Ecology.
- Familiarity with Pollution, Resource Management, and Sustainability Concepts.

Course Objectives:

- Understand the principles, methodologies, and significance of Environmental Impact Assessment (EIA).
- Analyze the impact of developmental activities on land use, soil, and water resources.
- Evaluate the impact of development on vegetation, wildlife, and assess environmental risks.
- Develop environmental audit procedures and assess compliance with environmental regulations.
- Understand and apply environmental acts, notifications, and legal frameworks in EIA studies.

Course Outcomes (COs):

CO1: Apply EIA methodologies to explain the significance and legal framework governing Environmental Impact Assessment. (L3)

CO2: Analyze the environmental impacts of developmental projects on air, water, land, and ecological systems. (L4)

CO3: Evaluate environmental clearance procedures, mitigation measures, and monitoring plans for infrastructure development. (L5)

CO4: Apply risk assessment and environmental audit techniques to ensure regulatory compliance in developmental projects. (L3)

CO5: Assess the effectiveness of EIA processes and recommend improvements for sustainable project development. (L5)

Unit I: Concepts and Methodologies of EIA:

Initial Environmental Examination, Elements of EIA, Factors Affecting EIA Impact Evaluation and Analysis, Preparation of Environmental Base Map, Classification of Environmental Parameters, Criteria for the Selection of EIA Methodology, EIA Methods: Ad-Hoc Methods, Matrix Methods, Network Method, Environmental Media Quality Index Method, Overlay Methods and Cost/Benefit Analysis.

Unit II: Impact of Developmental Activities and Land Use:

Introduction and Methodology for the Assessment of Soil and Ground Water, Delineation of Study Area, Identification of Activities. Procurement of Relevant Soil Quality, Impact Prediction, Assessment of Impact Significance, Identification and Incorporation of Mitigation Measures. EIA in Surface Water, Air and Biological Environment: Methodology for the Assessment of Impacts on Surface Water Environment, Air Pollution Sources, Generalized Approach for Assessment of Air Pollution Impact.

Unit III: Assessment of Impact on Vegetation, Wild life and Risk Assessment:

Introduction – Assessment of Impact of Development Activities on Vegetation and Wildlife; Environmental Impact of Deforestation – Causes and Effects; Risk Assessment and Treatment of Uncertainty – Key Stages in Performing an Environmental Risk Assessment – Advantages of Environmental Risk Assessment.

Unit IV: Environmental Audit:

Introduction – Environmental Audit & Environmental Legislation – Objectives of Environmental Audit, Types of Environmental Audit, Audit Protocol, Stages of Environmental Audit, Onsite Activities, Evaluation of Audit Data and Preparation of Audit Report.

UNIT V: Environmental Acts and Notifications:

The Environmental Protection Act, The Water Preservation Act, The Air (Prevention & Control of Pollution) Act, Wild Life Act – Provisions in the EIA Notification, Procedure for Environmental Clearance, Procedure for Conducting Environmental Impact Assessment Report – Evaluation of EIA Report. Concept of ISO and ISO 14000.

Text Books:

1. Environmental Impact Assessment Methodologies by Y. Anjaneyulu, B.S. Publication, Hyderabad, 2nd Edition, 2011.
2. Environmental Impact Assessment by Canter Larry W., McGraw-Hill Education Edi, 1996.

Reference Books:

1. Environmental Engineering by Peavy H.S., Rowe D.R., Tchobanoglous G., McGraw-Hill International Editions, New York, 1985.
2. Environmental Science and Engineering by Suresh K. Dhaneja, S.K. Katania & Sons Publication, New Delhi.
3. Environmental Science and Engineering by J. Glynn and Gary W. Hein Ke, Prentice Hall Publishers.
4. Environmental Pollution and Control by H.S. Bhatia, Galgotia Publication (P) Ltd, Delhi.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE02403T	OE	**Smart Grid Technologies** (Common to CE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Electrical Power Systems and Power System Components.
- Familiarity with Fundamental Communication Concepts and Electrical Measurements.

Course Objectives:

- To provide an understanding of the evolution of the electric power system and the need for Smart Grid technologies.
- To familiarize students with the architecture, components, and enabling technologies of Smart Grids.
- To develop knowledge of Wide Area Monitoring Systems (WAMS), including synchrophasor technology, PMUs, and PDCs.
- To introduce the concepts and applications of smart metering, AMR, and Advanced Metering Infrastructure (AMI).
- To impart understanding of communication technologies and protocols used in Smart Grid systems.

Course Outcomes (COs):

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

CO1: Describe the evolution, architecture, and enabling technologies of Smart Grid systems along with national and international deployment initiatives. (L3)

CO2: Analyze Wide Area Monitoring Systems using synchrophasor technology, PMU, and PDC for grid monitoring and blackout analysis. (L4)

CO3: Examine smart metering systems including AMR, AMI, smart meter functionalities, and demand-side management applications. (L4)

CO4: Analyze communication technologies and protocols used in Smart Grid systems including RF, PLC, optical fiber, and mobile communication. (L4)

CO5: Evaluate Smart Grid applications and cybersecurity aspects including renewable integration, energy storage systems, EVs, and security risk assessment. (L5)

Unit I: Introduction to Smart Grid:

Evolution of Electric Grid – Need for Smart Grid – Difference between Conventional & Smart Grid – Overview of Enabling Technologies – International Experience in Smart Grid Deployment – Smart Grid Road Map for India – Smart Grid Architecture.

Unit II: Wide Area Monitoring System:

Fundamentals of Synchrophasor Technology – Concept and Benefits of Wide Area Monitoring System – Structure and Functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC) – Road Map for Synchrophasor Applications (NAPSI) – Operational Experience and Blackout Analysis using PMU.

Unit III: Smart Meters:

Features and Functions of Smart Meters – Functional Specification – Category of Smart Meters – Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) Drivers and Benefits – AMI Protocol – Demand Side Integration: Peak Load, Outage and Power Quality Management.

Unit IV: Information and Communication Technology:

Overview of Smart Grid Communication System – Modulation and Demodulation Techniques: Radio Communication – Mobile Communication – Power Line Communication – Optical Fibre Communication – Communication Protocol for Smart Grid.

Unit V: Smart Grid Applications and Cyber Security:

Applications: Overview and Concept of Renewable Integration – Introduction to Distributed Generation – Role of Protective Relaying in Smart Grid – House Area Network – Advanced Energy Storage Technology: Flow Battery, Fuel Cell, SMES, Super Capacitors, Plug-in Hybrid Electric Vehicles. Cyber Security: Security Issues in DG, Distribution Automation, AMI, Electric Vehicle Management Systems – Approach to Assessment of Smart Grid Cyber Security Risks – Methodologies, Cyber Security Requirements – Smart Grid Information Model.

Text Books:

1. James Momoh, Smart Grid: Fundamentals of Design and Analysis, John Wiley and Sons, New York, 2012.
2. Janaka Ekanayake et al., Smart Grid: Technology and Applications, John Wiley & Sons, New Jersey, 2012.

Reference Books:

1. Power Grid Corporation of India Limited, Smart Grid Primer, 1st Edition, Bangalore, India, 2013.
2. Fereidoon P. Sioshansi, Smart Grid – Integrating Renewable, Distributed and Efficient Energy, Academic Press, USA, 2011.
3. Stuart Borlase, Smart Grids: Infrastructure, Technology and Solutions, CRC Press, England, 2013.
4. Phadke A G, Thorp J S, Synchronized Phasor Measurements and Their Applications, Springer, New York, 2012.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03403T	OE	**3D Printing Technologies** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Engineering Materials and Manufacturing Processes.
- Familiarity with Technical Drawing and Design Fundamentals.

Course Objectives:

- Understand the fundamental concepts of prototyping and distinguish between traditional and rapid prototyping methods.
- Demonstrate the working principles, materials, and applications of solid-, liquid-, and powder-based RP systems.
- Define the processes and classifications of rapid tooling and reverse engineering techniques.
- Identify common errors in 3D printing and evaluate pre-processing, processing, and post-processing issues.
- Familiarize RP-related software and its role in applications such as design, manufacturing, and medical fields.

Course Outcomes (COs):

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

CO1: Apply the fundamentals of rapid prototyping technologies, including classification, processes, comparison with traditional manufacturing methods, and their role in product development. (L3)

CO2: Analyze working principles, materials, advantages, limitations, and applications of solid and liquid based rapid prototyping systems such as FDM, LOM, SLA, DLP, and SGC. (L4)

CO3: Analyze powder-based and other rapid prototyping systems including SLS, DMLS, LENS, EBM, 3DP, BPM, and SDM for suitable engineering and manufacturing applications. (L4)

CO4: Apply reverse engineering and rapid tooling concepts including scanning methods, data processing, and tool development for product design and manufacturing. (L3)

CO5: Evaluate errors in 3D printing processes, related software tools, data formats, and applications of rapid prototyping in engineering, medical, and industrial domains. (L5)

Unit I: Introduction to 3D Printing:

Introduction to Prototyping, Traditional Prototyping vs. Rapid Prototyping (RP), Need for Time Compression in Product Development, Usage of RP Parts, Generic RP Process, Distinction between RP and CNC, Classification of RP.

Unit II: Solid and Liquid Based RP Systems:

Working Principle, Materials, Advantages, Limitations and Applications of: Fusion Deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Stereolithography (SLA), Direct Light Projection System (DLP) and Solid Ground Curing (SGC).

Unit III: Powder Based & Other RP Systems:

Powder Based RP Systems: Working Principle, Materials, Advantages, Limitations and Applications of Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS) and Electron Beam Melting (EBM). Other RP Systems: Three Dimensional Printing (3DP), Ballistic Particle Manufacturing (BPM), Shape Deposition Manufacturing (SDM).

Unit IV: Rapid Tooling & Reverse Engineering:

Rapid Tooling: Conventional Tooling vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling Methods. Reverse Engineering (RE): Meaning, Use, RE Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model Development.

Unit V: Errors in 3D Printing and Applications:

Pre-processing, processing and post-processing errors. Part building errors in SLA, SLS, etc. Software: MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, SolidView, 3DView, etc. Preparation of CAD models, Problems with STL files, STL file manipulation. RP Data Formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP. Applications: Design, Engineering Analysis and Planning, Rapid Tooling, Reverse Engineering, Medical Applications.

Text Books:

1. Chee Kai Chua and Kah Fai Leong, 3D Printing and Additive Manufacturing Principles and Applications, 5/e, World Scientific Publications, 2017.
2. Ian Gibson, David W Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Springer, 2/e, 2010.

Reference Books:

1. Frank W. Liou, Rapid Prototyping & Engineering Applications, CRC Press, Taylor & Francis Group, 2011.
2. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05204T	OE	**Data Base Management System** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites: Basics of Programming

Course Objectives:

- Introduce database management systems and provide a good formal foundation on the relational model and Relational Algebra.
- Introduce the concepts of basic SQL as a universal Database language.
- Demonstrate the principles behind systematic database design approaches: conceptual design, logical design through normalization.
- Provide an overview of physical design of a database system, discussing Database indexing techniques and storage techniques.

Course Outcomes (COs):

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

CO1: Apply the foundational concepts and characteristics of database systems to distinguish them from traditional file systems and identify various types of database users and applications. (L3)

CO2: Analyze relational model concepts and integrity constraints to evaluate data consistency, and apply relational algebra, relational calculus, and basic SQL commands for data definition and manipulation in structured schemas. (L4)

CO3: Apply SQL constructs to retrieve and manipulate relational data, and analyze the use of constraints, views, and relational set operations for building consistent and relationally complete database applications. (L4)

CO4: Analyze database schemas to identify functional dependencies and apply normalization techniques to achieve lossless join and dependency preservation, ensuring minimal redundancy and data consistency. (L4)

CO5: Analyze the concepts of transaction management, including ACID properties, serializability, and concurrency control protocols, and apply recovery techniques and indexing methods to ensure data consistency, isolation, and efficient retrieval. (L4)

Unit I: Introduction & Entity Relationship Model:

Database system characteristics (Database vs File System), Database Users, Advantages, Applications. Brief introduction of different Data Models; Concepts of Schema, Instance and Data Independence; Three-tier Schema Architecture; Database System Structure. Entity Relationship Model: Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub-classes, super-class, inheritance, specialization, generalization using ER Diagrams.

Unit II: Relational Model & Basic SQL:

Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, Integrity constraints). Relational Algebra, Relational Calculus. Basic SQL: Simple database schema, data types, table definitions (CREATE, ALTER), different DML operations (INSERT, DELETE, UPDATE).

Unit III: SQL:

Basic SQL querying (SELECT and PROJECT) using WHERE clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion). Creating tables with relationships, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of JOINS, views (updatable and non-updatable), relational set operations.

Unit IV: Schema Refinement (Normalization):

Purpose of Normalization, concept of functional dependency, normal forms based on functional dependency. Lossless join and dependency preserving decomposition (1NF, 2NF and 3NF), concept of surrogate key, Boyce-Codd Normal Form (BCNF), MVD, 4NF, 5NF.

Unit V: Transaction Concept & Indexing:

Transaction State, ACID Properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability. Lock-based, Timestamp-based, Optimistic Concurrency Protocols. Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm. Introduction to Indexing Techniques: B+ Trees, operations on B+ Trees, Hash-Based Indexing.

Text Books:

1. Database Management Systems, 3rd edition, Ramakrishnan & Gehrke, TMH.
2. Database System Concepts, 5th edition, Silberschatz, Korth, Sudarsan, TMH.

Reference Books:

1. Introduction to Database Systems, 8th edition, C.J. Date, Pearson.
2. Database Management System, 6th edition, Ramez Elmasri, Shamkant B. Navathe, Pearson.
3. Database Principles: Fundamentals of Design, Implementation and Management, Coronel, Morris, Robb, Cengage Learning.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE05305T	OE	**Cyber Security** (Common to CE, EEE & ECE)	3	0	0	3

Pre-Requisites: Basic knowledge of Computer Fundamentals, Programming, Data Structures, and Computer Networks.

Course Objectives:

- Introduce the concept of cybercrime and its impact on information security, and provide an overview of cybercriminal behavior and classifications.
- Explore methodologies used by cybercriminals to plan and execute attacks, including social engineering, botnets, and cloud-related threats.
- Understand security risks associated with mobile and wireless devices and examine countermeasures for securing mobile computing.
- Familiarize students with tools and techniques used in cybercrimes: phishing, malware, DoS/DDoS attacks, and code-based exploits.
- Analyze implications of cybercrime for organizations, including cost of cyber attacks, intellectual property issues, and challenges of social computing.

Course Outcomes (COs):

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

CO1: Apply knowledge of cybercrime concepts, classifications, and legal frameworks including Indian ITA 2000 to identify cyber offenses. (L3)

CO2: Analyze cyber attack strategies, social engineering techniques, and attack vectors used by cybercriminals to assess system vulnerabilities. (L4)

CO3: Examine security challenges and threats in mobile and wireless environments to recommend appropriate protection mechanisms. (L4)

CO4: Evaluate various cybercrime tools and techniques such as phishing, malware, and network attacks to detect and mitigate security breaches. (L5)

CO5: Design organizational cybersecurity strategies considering privacy, legal, and social implications to ensure secure computing environments. (L5)

Unit I: Introduction to Cybercrime:

Introduction, Cybercrime and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, Legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Unit II: Cyber Offenses – How Criminals Plan Them:

How Criminals Plan the Attacks, Social Engineering, Cyber Stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Unit III: Cybercrime – Mobile and Wireless Devices:

Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Unit IV: Tools and Methods Used in Cybercrime:

Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow.

Unit V: Cyber Security – Organizational Implications:

Cost of Cybercrimes and IPR Issues, Web Threats for Organizations, Security and Privacy Implications, Social Media Marketing: Security Risks and Perils for Organizations, Social Computing and the Associated Challenges for Organizations.

Text Books:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives – Nina Godbole and Sunil Belapure, Wiley India.

Reference Books:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa (John) Wu, J. David Irwin, CRC Press T&F Group.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB408T	**OE**	**Wavelet Transforms and its Applications** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Calculus, Linear Algebra, and Transforms.
- Familiarity With Signals and Mathematical Analysis.

Course Objectives:

- To introduce the fundamental concepts of wavelets, wavelet expansion, and wavelet transform.
- To develop understanding of multiresolution analysis (MRA) and its role in signal representation.
- To explain the implementation of the Discrete Wavelet Transform (DWT) using filter banks and related structures.
- To provide knowledge of time-frequency analysis and compare wavelet transform with Fourier-based methods.

Course Outcomes (COs):

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

CO1: Understand wavelets and wavelet basis and characterize continuous and discrete wavelet transforms. (L3)

CO2: Illustrate multiresolution analysis and scaling functions. (L5)

CO3: Implement discrete wavelet transforms with multirate digital filters. (L3)

CO4: Understand multiresolution analysis and identify various wavelets and evaluate their time-frequency resolution properties. (L3)

CO5: Design certain classes of wavelets to specification and justify the basis of the application of wavelet transforms to different fields. (L5)

Unit I: Wavelets:

Wavelets and Wavelet Expansion Systems – Wavelet Expansion – Wavelet Transform – Wavelet System – More Specific Characteristics of Wavelet Systems – Haar Scaling Functions and Wavelets – Effectiveness of Wavelet Analysis – The Discrete Wavelet Transform – The Discrete-Time and Continuous Wavelet Transforms.

Unit II: A Multiresolution Formulation of Wavelet Systems:

Signal Spaces – The Scaling Function – Multiresolution Analysis – The Wavelet Functions – The Discrete Wavelet Transform – A Parseval's Theorem – Display of the Discrete Wavelet Transform and the Wavelet Expansion.

Unit III: Filter Banks and the Discrete Wavelet Transform:

Analysis – From Fine Scale to Coarse Scale – Filtering and Down-Sampling or Decimating – Synthesis – From Coarse Scale to Fine Scale – Filtering and Up-Sampling or Stretching – Input Coefficients – Lattices and Lifting – Different Points of View.

Unit IV: Time-Frequency and Complexity:

Multiresolution versus Time-Frequency Analysis – Periodic versus Nonperiodic Discrete Wavelet Transforms – The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform – Numerical Complexity of the Discrete Wavelet Transform.

Unit V: Bases and Matrix Examples:

Bases, Orthogonal Bases, and Biorthogonal Bases – Matrix Examples – Fourier Series Example – Sine Expansion Example – Frames and Tight Frames – Matrix Examples – Sine Expansion as a Tight Frame Example.

Text Books:

1. C. Sidney Burrus, Ramesh A. Gopinath, Introduction to Wavelets and Wavelet Transforms, Prentice Hall, 1997.
2. James S. Walker, A Primer on Wavelets and their Scientific Applications, CRC Press, 1999.

Reference Books:

1. Raghuveer Rao, Wavelet Transforms, Pearson Education, Asia.
2. C.S. Burrus, Ramosh and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB409T	**OE**	**Smart Materials and Devices** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Materials Science and Solid-State Physics.
- Familiarity with Material Properties and Basic Characterization Techniques.

Course Objectives:

- Provide exposure to smart materials and their engineering applications.
- Impart knowledge on the basics and phenomenon behind the working of smart materials.
- Explain the properties exhibited by smart materials.
- Educate various techniques used to synthesize and characterize smart materials.
- Identify the required smart material for distinct applications/devices.

Course Outcomes (COs):

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

CO1: Describe the classification, characteristics, and applications of smart materials, including shape memory, chromoactive, magnetorheological, photoactive materials, and polymer composites. (L3)

CO2: Apply the optical, electrical, dielectric, piezoelectric, ferroelectric, pyroelectric, and magnetic properties of smart materials to explain their functional behavior. (L3)

CO3: Discuss the synthesis methods of smart materials using chemical routes, mechanical alloying, and thin film deposition techniques. (L3)

CO4: Analyze the role of characterization techniques such as X-ray diffraction, Raman spectroscopy, UV-Visible spectroscopy, SEM, TEM, and AFM in determining the structural and morphological properties of smart materials. (L4)

CO5: Evaluate the working principles and applications of smart material-based devices such as robotic hands, piezoelectric devices, MEMS, and intelligent systems. (L5)

Unit I: Introduction to Smart Materials:

Historical account of the discovery and development of smart materials, Shape memory materials, chromoactive materials, magnetorheological materials, photoactive materials, Polymers and polymer composites (Basics).

Unit II: Properties of Smart Materials:

Optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials.

Unit III: Synthesis of Smart Materials:

Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Mechanical alloying. Thin film deposition techniques: Chemical etching, Spray pyrolysis.

Unit IV: Characterization Techniques:

Powder X-ray diffraction, Raman spectroscopy (RS), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM).

Unit V: Smart Materials Based Devices:

Devices based on smart materials: Shape memory alloys in robotic hands, piezoelectric based devices, MEMS and intelligent devices.

Text Books:

1. Yaser Dahman, Nanotechnology and Functional Materials for Engineers, Elsevier, 2017.
2. E. Zschech, C. Whelan, T. Mikolajick, Materials for Information Technology: Devices, Interconnects and Packaging, Springer-Verlag London Limited, 2005.

Reference Books:

1. Gauenzi P., Smart Structures, Wiley, 2009.
2. Mahmood Aliofkhazraei, Handbook of Functional Nanomaterials, Vol (1 & 2), Nova Publishers, 2014.
3. Handbook of Smart Materials, Technologies, and Devices, Chaudhery Mustansar Hussain, Paolo Di Sia, Springer, 2022.
4. Fundamentals of Smart Materials, Mohsen Shahinpoor, Royal Society of Chemistry, 2020.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB410T	**OE**	**Introduction to Quantum Mechanics** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Calculus, Linear Algebra, and Differential Equations.
- Familiarity with Classical Mechanics, Waves, and Elementary Physics Concepts

Course Objectives:

- Understand the fundamental differences between classical and quantum mechanics.
- Study wave-particle duality, uncertainty principle, and their implications.
- Learn and apply Schrödinger equations to basic quantum systems.
- Use operator formalism and mathematical tools in quantum mechanics.
- Explore angular momentum, spin and their quantum mechanical representations.

Course Outcomes (COs):

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

CO1: Describe the fundamental principles of quantum mechanics, including wave-particle duality, uncertainty principle, and Schrödinger wave equations for describing microscopic systems. (L3)

CO2: Apply quantum mechanical principles to analyze one-dimensional systems such as potential step, potential well, potential barrier, periodic potential, and harmonic oscillator. (L4)

CO3: Discuss the operator formalism of quantum mechanics, including operator algebra, eigenvalues, eigenvectors, and matrix representation of wave functions and operators. (L3)

CO4: Analyze the mathematical tools of quantum mechanics, including matrix algebra, Hermitian operators, Dirac notation, expectation values, and ladder operators. (L4)

CO5: Evaluate angular momentum and spin systems using angular momentum operators, Pauli spin matrices, Clebsch–Gordon coefficients, and rigid rotator models. (L5)

Unit I: Principles of Quantum Mechanics:

Limitations of Classical Mechanics, Difficulties with Classical Theories of Black Body Radiation and Origin of Quantum Theory of Radiation. Wave-Particle Duality: de Broglie wavelength, Heisenberg Uncertainty Principle. Schrödinger time independent and time dependent wave equations, Solution of the time dependent Schrödinger equation, Concept of stationary states, Physical significance of wave function (ψ), Orthogonal, Normalized and Orthonormal functions.

Unit II: One Dimensional Problems and Solutions:

Potential Step – Reflection and Transmission at the interface. Potential Well: Square well potential with rigid walls, Square well potential with finite walls. Potential Barrier: Penetration of a potential barrier (tunneling effect). Periodic Potential and Harmonic Oscillator, Energy Eigen functions and Eigen values.

Unit III: Operator Formalism:

Operators, Operator Algebra, Eigen values and Eigen vectors, Postulates of Quantum Mechanics, Matrix representation of wave functions and linear operators.

Unit IV: Mathematical Tools for Quantum Mechanics:

The concept of row and column matrices, Matrix algebra, Hermitian operators. Dirac's bra and ket notation, Expectation values, Heisenberg (operator) representation of harmonic oscillator, Ladder operators and their significance.

Unit V: Angular Momentum and Spin:

Angular Momentum Operators: Definition. Eigen functions and Eigen values of angular momentum operators. Matrix representation of angular momentum operators, System with spin half (1/2), Spin Angular Momentum, Pauli's Spin Matrices. Clebsch-Gordon Coefficients. Rigid Rotator: Eigen functions and Eigen values.

Text Books:

1. Quantum Mechanics, Vol 1, A. Messaia, North-Holland Pub. Co., Amsterdam, 1961.
2. A Text Book of Quantum Mechanics, P.M. Mathews and K. Venkatesan, Tata McGraw Hill, New Delhi, 1976.
3. Introduction to Quantum Mechanics, R.H. Dicke and J.P. Witke, Addison-Wesley Pub. Co. Inc., London, 1960.

Reference Books:

1. Quantum Mechanics, L.I. Schiff, McGraw Hill Book Co., Tokyo, 1968.
2. Introduction to Quantum Mechanics, Richard L. Liboff, Pearson Education Ltd., 4th Edition, 2003.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB411T	**OE**	**Green Chemistry and Catalysis for Sustainable Environment** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Chemistry, Chemical Reactions, and Catalysis.
- Familiarity with Environmental Science and Sustainable Development Concepts.

Course Objectives:

- Understand Principles and Concepts of Green Chemistry.
- Understand the Types of Catalysis and Industrial Applications.
- Apply Green Solvents in Chemical Synthesis.
- Enumerate different sources of Green Energy.
- Apply Alternative Greener Methods for Chemical Reactions.

Course Outcomes (COs):

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

CO1: Apply the Green chemistry Principles for day-to-day life as well as synthesis, describe the sustainable development and green chemistry, explain economic and un-economic reactions, Demonstrate Polymer recycling. (L3)

CO2: Explain Heterogeneous catalyst and its applications in Chemical and Pharmaceutical Industries, Differentiate Homogeneous and Heterogeneous catalysis, Identify the importance of Bio and Photo Catalysis, Discuss Transition metal and Phase transfer Catalysis(L3)

CO3: Demonstrate Green solvents and importance, Discuss Supercritical carbon dioxide, Explain Supercritical water, recycling of green solvents. (L3)

CO4: Describe importance of Biomass and Solar Power, Illustrate Sonochemistry, Apply Green Chemistry for Sustainable Development; discuss the importance of Renewable resources, mechanochemical synthesis. (L4)

CO5: Discuss Alternative green methods like Photo redox catalysis, single electron transfer reactions (SET), Photochemical Reactions, Microwave-assisted Reactions and Sono chemical reactions, examples and applications. (L3)

Unit I: Principles and Concepts of Green Chemistry:

Introduction, Green Chemistry Principles, Sustainable Development and Green Chemistry, E Factor, Atom Economy. Atom Economic Reactions: Rearrangement and Addition Reactions. Atom Un-economic Reactions: Substitution, Elimination and Wittig Reactions. Reducing Toxicity. Waste – Problems and Prevention: Design for Degradation, Polymer Recycling.

Unit II: Catalysis and Green Chemistry:

Introduction, Types of Catalysis, Heterogeneous Catalysis: Basics, Zeolite and the Bulk Chemical Industry, Heterogeneous Catalysis in Fine Chemical and Pharmaceutical Industries, Catalytic Converters. Homogeneous Catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, and Phase Transfer Catalysis. Bio-catalysis and Photo-catalysis with examples.

Unit III: Green Solvents in Chemical Synthesis:

Green Solvents: Concept, Tools and Techniques for Solvent Selection. Supercritical Fluids: Supercritical CO2, Supercritical Water. Polyethylene Glycol (PEG), Ionic Liquids, Recycling of Green Solvents.

Unit IV: Emerging Greener Technologies:

Biomass as Renewable Resource, Energy from Biomass, Solar Power, Chemicals from Renewable Feedstocks, Chemicals from Fatty Acids, Polymers from Renewable Resources. Alternative Economies: The Syngas Economy, The Biorefinery, Design for Energy Efficiency, Mechanochemical Synthesis.

Unit V: Alternative Greener Methods:

Photochemical Reactions – Examples, Advantages and Challenges. Photoredox Catalysis, Single Electron Transfer Reactions (SET). Microwave-assisted Reactions and Sonochemical Reactions – Examples and Applications.

Text Books:

1. M. Lancaster, Green Chemistry: An Introductory Text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry: Theory and Practice, 4th Edition, Oxford University Press, USA.

Reference Books:

1. Green Chemistry for Environmental Sustainability, 1st Edition, Sanjay K. Sharma and Ackmez Mudhoo, CRC Press, 2010.
2. Edited by Alvise Perosa and Maurizio Selva, Handbook of Green Chemistry Volume 8: Green Nanoscience, Wiley-VCH, 2013.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHS404T	**OE**	**Employability Skills** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Communication and Writing Skills.
- Familiarity with Presentation, Teamwork, and Interpersonal Skills.

Course Objectives:

- Encourage all round development of the students by focusing on productive skills.
- Make the students aware of Goal Setting and Writing Skills.
- Enable them to know the importance of Presentation Skills in achieving desired goals.
- Help them develop Organizational Skills through group activities.
- Function effectively with heterogeneous teams.

Course Outcomes (COs):

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

CO1: Apply goal-setting and self-management techniques, including SMART goals, motivation strategies, and SWOT analysis, for personal and professional development. (L3)

CO2: Develop professional written communication such as resumes, CVs, cover letters, emails, and statements of purpose by applying appropriate writing conventions and etiquette. (L3)

CO3: Demonstrate effective technical presentation skills through planning, preparation, stage management, and delivery of PPT and poster presentations in academic and professional contexts. (L3)

CO4: Analyze group behaviour, team dynamics, leadership qualities, and corporate etiquette to participate effectively in group discussions, debates, and collaborative tasks. (L4)

CO5: Evaluate interview situations and employ appropriate job-cracking strategies, including interview preparation, answering techniques, and mock interview performance, to enhance employability. (L5)

Unit I: Goal Setting and Self-Management:

Definition, importance, types of Goal Setting – SMART Goal Setting – Advantages – Motivation – Intrinsic and Extrinsic Motivation – Self-Management – Knowing about Self – SWOC Analysis.

Unit II: Writing Skills:

Definition, significance, types of Writing Skills – Resume Writing vs CV Writing – E-Mail Writing, Cover Letters – E-Mail Etiquette – SoP (Statement of Purpose).

Unit III: Technical Presentation Skills:

Nature, meaning & significance of Presentation Skills – Planning, Preparation, Presentation, Stage Dynamics – Anxiety in Public Speaking (Glossophobia) – PPT & Poster Presentation.

Unit IV: Group Presentation Skills:

Body Language – Group Behaviour – Team Dynamics – Leadership Skills – Personality Manifestation – Group Discussion – Debate – Corporate Etiquette.

Unit V: Job Cracking Skills:

Nature, characteristics, importance & types of Interviews – Job Interviews – Skills for Success – Job Searching Skills – STAR Method – FAQs – Answering Strategies – Mock Interviews.

Text Books:

1. Sabina Pillai, Agna Fernandez, Soft Skills & Employability Skills, Cambridge Publisher, 2014.
2. Alka Wadkar, Life Skills for Success, Sage Publications, 2016.

Reference Books:

1. Gangadhar Joshi, Campus to Corporate, Sage Publications, 2015.
2. Sherfield Montogomery Moody, Cornerstone: Developing Soft Skills, Pearson Publications, 4th Ed., 2008.
3. Shikha Kapoor, Personality Development and Soft Skills, Wiley, 2017.
4. M. Sen Gupta, Skills for Employability, Innovative Publication, 2019.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01407T	OE	**Geo-Spatial Technologies** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Maps, Measurements, and Geometry.
- Familiarity with Computer Applications and Spatial Data Basics.

Course Objectives:

- Understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
- Analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
- Apply network analysis techniques for geo coding, shortest path analysis, and location-allocation problems.
- Evaluate surface and geo statistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
- Assess GIS customization, Web GIS, and mobile mapping techniques for real-world applications.

Course Outcomes (COs):

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

CO1: Apply concepts of remote sensing, GIS, and GPS to explain their principles, components, and applications in civil engineering. (L3)

CO2: Analyze satellite imagery and geospatial data for mapping, land use classification, and change detection applications. (L4)

CO3: Evaluate GIS-based spatial analysis techniques for infrastructure planning, transportation, and environmental management. (L5)

CO4: Apply digital terrain modeling and photogrammetry principles for topographic mapping and engineering survey applications. (L3)

CO5: Assess geospatial technology applications in disaster management, urban planning, and resource mapping decision-making. (L5).

Unit I: Raster Analysis:

Raster Data Exploration: Query Analysis – Local Operations: Map Algebra, Reclassification, Logical and Arithmetic Overlay Operations – Neighborhood Operations: Aggregation, Filtering – Extended Neighborhood Operations – Zonal Operations – Statistical Analysis – Cost-Distance Analysis – Least Cost Path.

Unit II: Vector Analysis:

Non-Topological Analysis: Attribute Database Query, Structured Query Language, Co-Ordinate Transformation, Summary Statistics, Calculation of Area, Perimeter and Distance. Topological Analysis: Reclassification, Aggregation, Overlay Analysis: Point-In-Polygon, Line-In-Polygon, Polygon-On-Polygon: Clip, Erase, Identity, Union, Intersection – Proximity Analysis: Buffering.

Unit III: Network Analysis:

Network – Introduction – Network Data Model – Elements of Network – Building a Network Database – Geocoding – Address Matching – Shortest Path in a Network – Time and Distance Based

Shortest Path Analysis – Driving Directions – Closest Facility Analysis – Catchment/Service Area Analysis – Location-Allocation Analysis.

Unit IV: Surface and Geostatistical Analysis:

Surface Data – Sources of X, Y, Z Data – DEM, TIN – Terrain Analysis – Slope, Aspect, Viewshed. Watershed Analysis: Watershed Boundary, Flow Direction, Flow Accumulation, Drainage Network. Spatial Interpolation: IDW, Spline, Kriging, Variogram.

Unit V: Customization, Web GIS, Mobile Mapping:

Customization of GIS: Need, Uses, Scripting Languages – Embedded Scripts – Use of Python Script. Web GIS: Web GIS Architecture, Advantages of Web GIS, Web Applications. Location Based Services: Emergency and Business Solutions – Big Data Analytics.

Text Books:

1. Kang-Tsung Chang, Introduction to Geographical Information System, 4th Ed., Tata McGraw Hill Edition, 2008.
2. Lo C.P. and Yeung Albert K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall, 2002.

Reference Books:

1. Michael N. Demers, Fundamentals of Geographic Information Systems, Wiley, 2009.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasaraju, An Introduction to Geographical Information Systems, Pearson Education, 2nd Edition, 2007.
3. John Peter Wilson, The Handbook of Geographic Information Science, Blackwell Pub., 2008.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01408T	**OE**	**Solid Waste Management** (Common to EEE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Understanding of Environmental Science and Pollution Control.
- Familiarity with Waste Generation and Resource Management Concepts.

Course Objectives:

- Understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
- Analyze engineering systems for solid waste collection, storage, and transportation.
- Apply resource and energy recovery techniques for sustainable solid waste management.
- Evaluate landfill design, construction, and environmental impact mitigation strategies.
- Assess hazardous waste management techniques, including biomedical and e-waste disposal.

Course Outcomes (COs):

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

CO1: Apply knowledge of solid waste characterization to explain sources, classification, and health impacts of municipal solid waste. (L3)

CO2: Analyze collection, transportation, and storage systems for solid waste management in urban and rural settings. (L4)

CO3: Evaluate thermo-chemical and bio-chemical waste treatment methods for energy recovery and waste minimization. (L5)

CO4: Apply design principles for engineered sanitary landfills including site selection, leachate management, and closure plans. (L3)

CO5: Assess integrated solid waste management strategies, recycling policies, and regulatory frameworks for sustainable waste handling. (L5)

Unit I: Solid Waste Fundamentals:

Definitions, Types of Solid Wastes, Sources of Solid Wastes, Characteristics, and Perspectives; Properties of Solid Wastes, Sampling of Solid Wastes, Elements of Solid Waste Management – Integrated Solid Waste Management, Solid Waste Management Rules 2016.

Unit II: Engineering Systems for Solid Waste Management:

Solid Waste Generation; On-Site Handling, Storage and Processing; Collection of Solid Wastes; Stationary Container System and Hauled Container Systems – Route Planning – Transfer and Transport; Processing Techniques.

Unit III: Engineering Systems for Resource and Energy Recovery:

Processing Techniques; Materials Recovery Systems; Recovery of Biological Conversion Products – Composting, Pre and Post Processing, Types of Composting, Critical Parameters, Problems with Composting; Recovery of Thermal Conversion Products: Pyrolysis, Gasification, RDF; Recovery of Energy from Conversion Products; Materials and Energy Recovery Systems.

Unit IV: Landfills:

Evolution of Landfills – Types and Construction of Landfills – Design Considerations – Life of Landfills – Landfill Problems – Lining of Landfills – Types of Liners – Leachate Pollution and Control – Monitoring Landfills – Landfills Reclamation.

Unit V: Hazardous Waste Management:

Sources and Characteristics, Effects on Environment, Risk Assessment – Disposal of Hazardous Wastes – Secured Landfills, Incineration – Monitoring – Biomedical Waste Disposal, E-Waste Management, Nuclear Wastes, Industrial Waste Management.

Text Books:

1. Tchobanoglous G., Theisen H. and Vigil S.A., Integrated Solid Waste Management, Engineering Principles and Management Issues, McGraw-Hill, 1993.
2. Vesilind P.A., Worrell W. and Reinhart D., Solid Waste Engineering, Brooks/Cole Thomson Learning Inc., 2002.

Reference Books:

1. Peavy H.S., Rowe D.R., and G. Tchobanoglous, Environmental Engineering, McGraw Hill Inc., New York, 1985.
2. Qian X., Koerner R.M. and Gray D.H., Geotechnical Aspects of Landfill Design and Construction, Prentice Hall, 2002.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE02404T	OE	**Electric Vehicles** (Common to CE, ECE, CSE, AI&DS, CSE-AI & CSE - AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Electrical and Electronic Fundamentals.
- Familiarity with Energy Storage Systems and Electric Machines.

Course Objectives:

- Remember and understand the differences between conventional vehicles and electric vehicles, electro mobility and environmental issues of EVs.
- Analyze various EV configurations, parameters of EV systems and electric vehicle dynamics.
- Analyze the basic construction, operation and characteristics of fuel cells and battery charging techniques in HEV systems.
- Design and analyze the various control structures for electric vehicles.

Course Outcomes (COs):

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

CO1: Describe the evolution, configuration, and system architecture of electric vehicles along with environmental impacts and comparison of EV technologies. (L3)

CO2: Analyze electric vehicle propulsion systems including motor configurations, transmission types, and vehicle dynamics for performance evaluation. (L4)

CO3: Examine fuel cell systems and hybrid electric vehicle technologies including modeling, performance characteristics, and system comparison. (L4)

CO4: Analyze battery charging systems and control strategies including charger architecture, wireless charging, and feedback controller design for EV applications. (L4)

CO5: Evaluate energy storage technologies and energy management systems in electric vehicles, including batteries, supercapacitors, SMES, and smart grid integration. (L5)

Unit I: Introduction to EV Systems and Energy Sources:

Past, Present and Future of EV – EV Concept – EV Technology – State-of-the-Art of EVs – EV Configuration – EV System – Fixed and Variable Gearing – Single and Multiple Motor Drive – In-wheel Drives – EV Parameters: Weight, Size, Force and Energy, Performance Parameters. Electro Mobility and the Environment – History of Electric Power Trains – Carbon Emissions from Fuels – Green Houses and Pollutants – Comparison of Conventional, Battery, Hybrid and Fuel Cell Electric Systems.

Unit II: EV Propulsion and Dynamics:

Choice of Electric Propulsion System – Block Diagram – Concept of EV Motors – Single and Multi-Motor Configurations – Fixed and Variable Geared Transmission – In-Wheel Motor Configuration – Classification – Electric Motors Used in Current Vehicle Applications – Recent EV Motors – Vehicle Load Factors – Vehicle Acceleration.

Unit III: Fuel Cells:

Introduction of Fuel Cells – Basic Operation – Model – Voltage, Power and Efficiency – Power Plant System – Characteristics – Sizing – Example of Fuel Cell Electric Vehicle – Introduction to HEV – Brake Specific Fuel Consumption – Comparison of Series-Parallel Hybrid Systems.

Unit IV: Battery Charging and Control:

Battery Charging: Basic Requirements – Charger Architecture – Charger Functions – Wireless Charging – Power Factor Correction. Control: Introduction – Modelling of Electro Mechanical System – Feedback Controller Design Approach – PI Controller's Designing – Torque-Loop, Speed Control Loop Compensation – Acceleration of Battery Electric Vehicle.

Unit V: Energy Storage Technologies:

Role of Energy Storage Systems – Thermal – Mechanical – Chemical – Electrochemical – Electrical – Efficiency of Energy Storage Systems – Super Capacitors – Superconducting Magnetic Energy Storage (SMES) – SOC – SoH – Fuel Cells – G2V – V2G – Energy Storage in Micro-grid and Smart Grid – Energy Management with Storage Systems – Battery SCADA.

Text Books:

1. C.C. Chan, K.T. Chau, Modern Electric Vehicle Technology, Oxford University Press Inc., New York, 2001, 1st Edition.
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2017, 1st Edition.

Reference Books:

1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press, 2021, 3rd Edition.
2. Francisco Díaz-González et al., Energy Storage in Power Systems, Wiley Publication, 2016.
3. A.G. Ter-Gazarian, Energy Storage for Power Systems, The Institution of Engineering and Technology (IET), 2nd Edition, 2011.
4. Mehrdad Ehsani, Yimi Gao et al., Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03404T	**OE**	**Total Quality Management** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Understanding of Management and Organizational Concepts.
- Familiarity with Problem-Solving and Process Improvement Basics.

Course Objectives:

- Familiarize the basic concepts of Total Quality Management.
- Expose with various quality issues in Inspection.
- Gain knowledge on quality control and its applications to real time.
- Understand the extent of customer satisfaction by the application of various quality concepts.
- Demonstrate the importance of Quality Standards in Production.

Course Outcomes (COs):

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

CO1: Apply the fundamental concepts of Total Quality Management, including quality dimensions, quality planning, and quality cost analysis for improving organizational quality performance. (L3)

CO2: Analyze the historical evolution of TQM, contributions of quality gurus, strategic planning concepts, and barriers in implementing Total Quality Management practices. (L4)

CO3: Analyze customer satisfaction, employee involvement, continuous process improvement, and supplier partnership concepts to enhance organizational quality systems. (L4)

CO4: Apply quality improvement tools such as benchmarking, QFD, Taguchi method, TPM, FMEA, Six Sigma, and other quality management tools for process enhancement. (L3)

CO5: Evaluate quality management systems including ISO 9000, ISO 14000, and QS 9000 standards, along with their implementation, documentation, and auditing processes. (L5)

Unit I: Introduction:

Definition of Quality, Dimensions of Quality, Definition of Total Quality Management, Quality Planning, Quality Costs – Analysis, Techniques for Quality Costs, Basic Concepts of Total Quality Management.

Unit II: Historical Review:

Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of Successful Quality Leader, Contributions of Gurus of TQM, Case Studies.

Unit III: TQM Principles:

Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention. Employee Involvement – Motivation, Empowerment Teams. Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen. Supplier Partnership – Partnering, Sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case Studies.

Unit IV: TQM Tools:

Benchmarking – Reasons to Benchmark, Benchmarking Process. Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits. Taguchi Quality Loss Function. Total Productive

Maintenance (TPM) – Concept, Improvement Needs. FMEA – Stages of FMEA. The Seven Tools of Quality, Process Capability, Concept of Six Sigma, New Seven Management Tools, Case Studies.

Unit V: Quality Systems:

Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

Text Books:

1. Dale H. Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata McGraw Hill Publishing Company Ltd., 2005.
3. Joel E. Ross, Total Quality Management, Third Edition, CRC Press, 2017.

Reference Books:

1. Narayana V. and Sreenivasan N.S., Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L. Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd., 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata McGraw Hill, 2015.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE05404T	**OE**	**Introduction to Computer Networks** (Common to CE, EEE & ECE)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Computers and Communication Fundamentals.
- Familiarity with Data Representation and Operating System Basics.

Course Objectives:

- Understand the basic concepts of Computer Networks.
- Introduce the layered approach for design of computer networks.
- Expose the network protocols used in Internet environment.
- Explain the format of headers of IP, TCP and UDP.
- Familiarize with the applications of Internet.
- Elucidate the design issues for a computer network.

Course Outcomes (COs):

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

CO1: Apply knowledge of software and hardware components to design and implement computer network solutions. (L3)

CO2: Design and develop error control, routing, and congestion control algorithms for efficient network communication. (L3)

CO3: Analyze the functionality of different layers in a computer network and their interaction in data communication.(L4)

CO4: Evaluate existing routing protocols based on performance metrics and network requirements. (L5)

CO5: Evaluate and select appropriate transport protocols based on application requirements and network conditions. (L5)

Unit I: Computer Networks and the Internet :

What Is the Internet? Network Edge, The Network Core, Delay, Loss, and Throughput in Packet Switched Networks, Reference Models, Multimedia Networks, Guided Transmission Media, Wireless Transmission.

Unit II: Data Link Layer, Access Networks, and LANs :

Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols. Introduction to the Link Layer, Error-Detection and Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks, Link Virtualization, Data Center Networking.

Unit III: Network Layer:

Routing Algorithms, Internetworking, The Network Layer in the Internet.

Unit IV: Transport Layer:

Connectionless Transport: UDP, The Internet Transport Protocols: TCP, Congestion Control.

Unit V: Application Layer:

Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS – The Internet's Directory Service, Peer-to-Peer Applications, Video Streaming and Content Distribution Networks.

Text Books:

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, 6th Edition, Pearson.
2. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6th Edition, Pearson, 2019.

Reference Books:

1. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill Publication.
2. Youlu Zheng, Shakil Akhtar, Networks for Computer Scientists and Engineers, Oxford Publishers, 2016.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04416T	OE	**Internet of Things** (Common to CE, EEE &ECE)	3	0	0	3

Pre-Requisites: Fundamentals of Electronics, Programming, Microcontrollers, and Computer Networks.

Course Objectives:

- Understand the basics of Internet of Things and protocols.
- Discuss the requirement of IoT technology.
- Introduce application areas where IoT can be applied.
- Understand the vision of IoT from a global perspective, understand its applications, determine its market perspective using gateways, devices and data management.

Course Outcomes (COs):

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

CO1: Apply IoT fundamentals including architecture, communication models, and protocols for IoT system design(L3)

CO2: Analyse microcontroller-based prototyping techniques to interface sensors and actuators with IoT systems(L4)

CO3: Analyse IoT architectures, reference models, and communication protocols such as MQTT, CoAP, and 6LoWPAN(L4)

CO4: Analyse device discovery mechanisms and cloud-based services for IoT applications(L4)

CO5: Evaluate UAV-based IoT systems, their components, and applications in real-world scenarios(L5)

Unit I: Introduction to IoT:

Definition and Characteristics of IoT, Physical Design of IoT, IoT Protocols, IoT Communication Models, IoT Communication APIs, Communication Protocols, Embedded Systems, IoT Levels and Templates.

Unit II: Prototyping IoT Objects using Microprocessor/Microcontroller:

Working Principles of Sensors and Actuators, Setting up the Board – Programming for IoT, Reading from Sensors, Communication through Bluetooth, Wi-Fi.

Unit III: IoT Architecture and Protocols:

Architecture Reference Model – Introduction, Reference Model and Architecture, IoT Reference Model, Protocols: 6LowPAN, RPL, CoAP, MQTT, IoT Frameworks – ThingSpeak.

Unit IV: Device Discovery and Cloud Services for IoT:

Device Discovery Capabilities – Registering a Device, Deregister a Device, Introduction to Cloud Storage Models and Communication APIs – Web Server for IoT.

Unit V: UAV IoT:

Introduction to Unmanned Aerial Vehicles/Drones, Drone Types, Applications: Defense, Civil, Environmental Monitoring; UAV Elements and Sensors – Arms, Motors, Electronic Speed Controller (ESC), GPS, IMU, Ultrasonic Sensors; UAV Software – Ardupilot, Mission Planner; Internet of Drones (IoD) – Case Study: FlytBase.

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.
2. Handbook of Unmanned Aerial Vehicles, K. Valavanis, George J. Vachtsevanos, Springer, 2014.

Reference Books:

1. Jan Holler et al., From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2014.
3. The Internet of Things, Enabling Technologies and Use Cases – Pethuru Raj, Anupama C. Raman, CRC Press.
4. Francis da Costa, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, Apress Publications, 2013.

B. Tech. – IV Year I Semester

Course Code	Category	Name of The Course	L	T	P	C
24PE05310T	**OE**	**Introduction to Quantum Computing** (Common to all branches of Engineering	**3**	**0**	**0**	**3**

Pre-Requisites: Basics of Mathematics and Physics

Course Objectives:

- Introduce the principles and mathematical foundations of quantum computation.
- Understand quantum gates, circuits, and computation models.
- Explore quantum algorithms and their advantages over classical ones.
- Develop the ability to simulate and write basic quantum programs.
- Understand real-world applications and the future of quantum computing in AI, cryptography, and optimization.

Course Outcomes (COs):

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

CO1: Apply the fundamental concepts of quantum mechanics, including superposition, entanglement, and quantum states, in quantum computing applications. (L3)

CO2: Construct and analyze quantum circuits using standard gates. (L4)

CO3: Apply quantum algorithms like Deutsch-Jozsa, Grover's, and Shor's. (L3)

CO4: Develop simple quantum programs using Qiskit or similar platforms. (L5)

CO5: Analyze applications and challenges of quantum computing in real-world domains. (L4)

Unit I: Fundamentals of Quantum Mechanics and Linear Algebra:

Classical vs Quantum Computation, Complex Numbers, Vectors, and Matrices, Hilbert Spaces and Dirac Notation, Quantum States and Qubits, Superposition and Measurement, Tensor Products and Multi-Qubit Systems.

Unit II: Quantum Gates and Circuits:

Quantum Logic Gates: Pauli, Hadamard, Phase, Controlled Gates and CNOT. Unitary Operations and Reversibility, Quantum Circuit Representation, Quantum Teleportation, Simulation of Quantum Circuits.

Unit III: Quantum Algorithms and Complexity:

Quantum Parallelism and Interference, Deutsch and Deutsch-Jozsa Algorithms, Grover's Search Algorithm, Shor's Factoring Algorithm, Quantum Fourier Transform, Complexity Classes: BQP, P, NP, and QMA.

Unit IV: Quantum Programming and Simulation Platforms:

Introduction to Qiskit and IBM Quantum Experience, Writing Quantum Circuits in Qiskit, Measuring Qubits and Results, Classical-Quantum Hybrid Programs, Noisy Intermediate-Scale Quantum (NISQ) Systems, Limitations and Current State of Quantum Hardware.

Unit V: Applications and Future of Quantum Computing:

Quantum Machine Learning: Basics and Models, Quantum Cryptography and Quantum Key Distribution, Quantum Algorithms in AI and Optimization, Quantum Advantage and Supremacy, Ethical and Societal Impact of Quantum Technologies, Future Trends and Research Directions.

Text Books:

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB412T	OE	**Financial Mathematics** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Calculus, Probability, and Statistics.
- Familiarity with Algebra and Fundamental Financial Concepts.

Course Objectives:

- Provide mathematical foundations for financial modelling, risk assessment and asset pricing.
- Introduce stochastic models and their applications in pricing derivatives and interest rate modelling.
- Develop analytical skills for fixed-income securities, credit risk, and investment strategies.
- Equip students with computational techniques for pricing financial derivatives.

Course Outcomes (COs):

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

CO1: Apply fundamental financial concepts such as arbitrage, valuation, and risk to analyse andsolve basic financial problems. (L3)

CO2: Apply stochastic models, including Brownian motion and Stochastic Differential Equations (SDEs) to solve the financial problems. (L3)

CO3: Analyse option pricing models and mathematical techniques used in financial derivatives. (L4)

CO4: Evaluate interest rate models and bond pricing methodologies for financial decision - making. (L5)

CO5: Utilize computational techniques such as Monte Carlo simulations for financial modelling. (L3)

Unit I: Asset Pricing and Risk Management:

Fundamental Financial Concepts: Returns, Arbitrage, Valuation, and Pricing. Asset/Liability Management, Investment Income, Capital Budgeting, and Contingent Cash Flows. One-Period Model: Securities, Payoffs, and the No-Arbitrage Principle. Option Contracts: Speculation and Hedging Strategies, CAP Model, Efficient Market Hypothesis.

Unit II: Stochastic Models in Finance:

Random Walks and Brownian Motion. Introduction to Stochastic Differential Equations (SDEs): Drift and Diffusion. Ito Calculus: Ito's Lemma, Ito Integral, and Ito Isometry.

Unit III: Interest Rate and Credit Modelling:

Interest Rate Models and Bond Markets. Short-Rate Models: Vasicek, Cox-Ingersoll-Ross (CIR), Hull & White Models. Credit Risk Modelling: Hazard Function and Hazard Rate.

Unit IV: Fixed-Income Securities and Bond Pricing:

Characteristics of Fixed-Income Products: Yield, Duration, and Convexity. Yield Curves, Forward Rates, and Zero-Coupon Bonds. Stochastic Interest Rate Models and Bond Pricing PDE. Yield Curve Fitting and Calibration Techniques, Mortgage-Backed Securities.

Unit V: Exotic Options and Computational Finance:

Stochastic Volatility Models and the Feynman-Kac Theorem. Exotic Options: Barriers, Asians, and Lookbacks. Monte Carlo Methods for Derivative Pricing, Black-Scholes-Merton Model: Derivation and Applications.

Text Books:

1. Ales Cerny, Mathematical Techniques in Finance: Tools for Incomplete Markets, Princeton University Press.
2. S.R. Pliska, Introduction to Mathematical Finance: Discrete-Time Models, Cambridge University Press.

Reference Books:

1. Ioannis Karatzas & Steven E. Shreve, Methods of Mathematical Finance, Springer, New York.
2. John C. Hull, Options, Futures, and Other Derivatives, Pearson.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB413T	OE	**Sensors and Actuators for Engineering Applications** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Physics and Electrical Measurement Concepts.
- Familiarity with Basic Electronic Components and Signal Principles.

Course Objectives:

- Provide exposure to various kinds of sensors and actuators and their engineering applications.
- Impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators.
- Explain the operating principles of various sensors and actuators.
- Educate the fabrication of sensors.
- Explain the required sensor and actuator for interdisciplinary application.

Course Outcomes (COs):

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

CO1: Describe the principles, fabrication methods, and applications of sensors and actuators used in engineering systems. (L3)

CO2: Apply the working principles of temperature and mechanical sensors to measure thermal and mechanical parameters in practical applications. (L3)

CO3: Illustrate the operating principles and characteristics of optical and acoustic sensors used for detection and signal conversion. (L3)

CO4: Analyze the working principles and applications of magnetic and electromagnetic sensors and actuators in measurement and control systems. (L4)

CO5: Evaluate the performance and applications of chemical and radiation sensors for monitoring physical and environmental parameters. (L5)

Unit I: Introduction to Sensors and Actuators:

Sensors: Types of Sensors: Temperature, Pressure, Strain, Active and Passive Sensors, General Characteristics. Deposition: Chemical Vapor Deposition. Pattern: Photolithography. Etching: Dry and Wet Etching. Actuators: Functional Diagram of Actuators, Types of Actuators and Their Basic Principle: Pneumatic, Electromagnetic, Piezo-electric and Piezo-resistive Actuators, Applications of Actuators.

Unit II: Temperature and Mechanical Sensors:

Temperature Sensors: Types and Their Basic Principle of Working: Thermo-resistive Sensors: Thermistors, Thermo-electric Sensors: Thermocouples, PN Junction Temperature Sensors. Mechanical Sensors: Types and Their Basic Principle: Force Sensors: Strain Gauges, Tactile Sensors, Pressure Sensors: Piezoresistive, Variable Reluctance Sensor (VRP).

Unit III: Optical and Acoustic Sensors:

Optical Sensors: Basic Principle and Working of Photodiodes, Phototransistors and Photo Resistors Based Sensors, Photomultipliers, Infrared Sensors: Thermal, Passive Infra-Red, Fiber Based Sensors and Thermopiles. Acoustic Sensors: Principle and Working of Ultrasonic Sensors, Piezo-electric Resonators, Microphones.

Unit IV: Magnetic and Electromagnetic Sensors:

Motors as Actuators (linear, rotational, stepping motors), Magnetic Valves, Inductive Sensors (LVDT, RVDT, and Proximity), Hall Effect Sensors, Magneto-resistive Sensors, Magnetostrictive Sensors and Actuators.

Unit V: Chemical and Radiation Sensors:

Chemical Sensors: Principle and Working of Electrochemical, Thermochemical, Gas, pH, Humidity and Moisture Sensors. Radiation Sensors: Principle and Working of Ionization Detectors, Scintillation Detectors, Semiconductor Radiation Detectors and Microwave Sensors (resonant, reflection, transmission).

Text Books:

1. Sensors and Actuators – Clarence W. de Silva, CRC Press, 2nd Edition, 2015.
2. Sensors and Actuators, D.A. Hall and C.E. Millar, CRC Press, 1999.

Reference Books:

1. Sensors and Transducers – D. Patranabhis, Prentice Hall of India (Pvt) Ltd., 2003.
2. Measurement, Instrumentation, and Sensors Handbook – John G. Webster, CRC Press, 1999.
3. Sensors – A Comprehensive Survey – Henry Bolte, John Wiley.
4. Handbook of Modern Sensors, Stefan Johann Rupitsch, Springer.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB414T	**OE**	**Chemistry of Nanomaterials and Applications** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Chemistry, Materials Science, and Atomic Structure.
- Familiarity with Chemical Bonding and Basic Characterization Concepts.

Course Objectives:

- Understand basics and characterization of nanomaterials.
- Understand synthetic methods of nanomaterials.
- Apply various techniques for characterization of nanomaterials.
- Understand studies of nano-structured materials.
- Enumerate the applications of advanced nanomaterials in engineering.

Course Outcomes (COs):

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

CO1: Classify the nanostructure materials; describe scope of nanoscience and importance technology. (L3)

CO2: Describe the top-down approach, explain aerosol synthesis and plasma arc technique, differentiate chemical vapor deposition method and electrode position method, Discuss about high energy ball milling. (L4)

CO3: Discuss different technique for characterization of nanomaterial, explain electron microscopy techniques for characterization of nanomaterial, Describe BET method for surface area analysis. (L4)

CO4: Explain synthesis and properties and applications of nanomaterials, discuss about fullerenes and carbon nanotubes, Differentiate nanomagnetic materials and thermoelectric materials, nonlinear optical materials. (L4)

CO5: Illustrate advance engineering applications of Water treatment, sensors, electronic devices, medical domain, civil engineering, chemical engineering, metallurgy and mechanical engineering, food science, agriculture, pollutants degradation. (L3)

Unit I: Basics and Characterization of Nanomaterials:

Introduction, Scope of Nanoscience and Nanotechnology, Nanoscience in Nature, Classification of Nanostructured Materials, Importance of Nanomaterials.

Unit II: Synthesis of Nanomaterials:

Top-Down Approach: Inert Gas Condensation, Arc Discharge Method, Aerosol Synthesis, Plasma Arc Technique, Ion Sputtering, Laser Ablation, Laser Pyrolysis, Chemical Vapour Deposition Method, Electrodeposition Method, High Energy Ball Milling Method. Bottom-Up Approach: Sol-Gel Synthesis, Microemulsions or Reverse Micelles, Co-precipitation Method, Solvothermal Synthesis, Hydrothermal Synthesis, Microwave Heating Synthesis, Sonochemical Synthesis.

Unit III: Techniques for Characterization:

Diffraction Technique, Spectroscopy Techniques, Electron Microscopy Techniques for the Characterization of Nanomaterials, BET Method for Surface Area Analysis, Dynamic Light Scattering for Particle Size Determination.

Unit IV: Studies of Nano-Structured Materials:

Synthesis, Properties and Applications of: Fullerenes, Carbon Nanotubes, 2D-Nanomaterial (Graphene), Core-Shell, Magnetic Nanoparticles, Thermoelectric Materials, Non-Linear Optical Materials.

Unit V: Advanced Engineering Applications of Nanomaterials:

Applications of Nanoparticles, Nanorods, Nanowires in: Water Treatment, Sensors, Electronic Devices, Medical Domain, Civil Engineering, Chemical Engineering, Metallurgy and Mechanical Engineering, Food Science, Agriculture, Pollutants Degradation.

Text Books:

1. NANO: The Essentials, T. Pradeep, MaGraw-Hill, 2007.
2. Textbook of Nanoscience and Nanotechnology, B.S. Murty et al., University Press, 2012.

Reference Books:

1. Concepts of Nanochemistry, Ludovico Cademartiri and Geoffrey A. Ozin, Wiley-VCH, 2011.
2. Nanostructures & Nanomaterials; Synthesis, Properties & Applications, Guozhong Cao, Imperial College Press, 2007.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHS405T	OE	**Literary Vibes** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of English Language and Reading Comprehension.
- Familiarity with Literary Forms such ss Poetry, Prose, Drama, and Fiction.

Course Objectives:

- Inculcate passion for aesthetic sense and reading skills.
- Encourage respecting others' experiences and creative writing.
- Explore emotions, communication skills and critical thinking.
- Educate how books serve as the reflection of history and society.
- Provide practical wisdom and duty of responding to events of the times.

Course Outcomes (COs):

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

CO1: Analyze the themes, poetic devices, and social relevance of the prescribed poems to interpret literary expression and meaning. (L4)

CO2: Analyze the plot, themes, characterization, and literary elements of Twelfth Night to interpret dramatic techniques and contextual significance. (L4)

CO3: Examine the themes, characterization, and narrative techniques in the prescribed short stories to interpret human values and social perspectives. (L4)

CO4: Evaluate the ideas, style, and autobiographical elements in the prescribed prose essays and autobiographical writings to relate literary texts to personal and social contexts. (L5)

CO5: Analyze the plot, themes, characterization, and literary features of Hard Times to interpret the social concerns and artistic vision of the novelist. (L4)

Unit I: Poetry:

- Ulysses – Alfred Lord Tennyson
- Ain't I a Woman? – Sojourner Truth
- The Second Coming – W.B. Yeats
- Where the Mind is Without Fear – Rabindranath Tagore

Unit II: Drama – Twelfth Night (William Shakespeare):

- Shakespeare – Life and Works
- Plot & Sub-plot and Historical Background of the Play
- Themes and Criticism
- Style and Literary Elements
- Characters and Characterization

Unit III: Short Story:

- The Luncheon – Somerset Maugham
- The Happy Prince – Oscar Wilde
- Three Questions – Leo Tolstoy
- Grief – Anton Chekhov

Unit IV: Prose – Essay and Autobiography:

- My Struggle for an Education – Booker T. Washington

- The Essentials of Education – Richard Livingston
- The Story of My Life – Helen Keller
- Student Mobs – J.B. Priestley

Unit V: Novel – Hard Times (Charles Dickens):

- Charles Dickens – Life and Works
- Plot and Historical Background of the Novel
- Themes and Criticism
- Style and Literary Elements
- Characters and Characterization

Text Books:

1. Charles Dickens, Hard Times, (Sangam Abridged Texts), Vantage Press, 1983.
2. DENT J.C., William Shakespeare, Twelfth Night, Oxford University Press, 2016.

Reference Books:

1. W.J. Long, History of English Literature, Rupa Publications India, 2015.
2. R.K. Kaushik and S.C. Bhatia, Essays, Short Stories and One Act Plays, Oxford University Press, 2018.
3. Dhanvel S.P., English and Soft Skills, Orient Blackswan, 2017.
4. New Horizon, Pearson Publications, New Delhi, 2014.

B.Tech. – IV Year
II Semester

B. Tech. – IV Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPIN404L	IP	**Internship** (Common to all branches of Engineering)	0	0	0	4

Pre-Requisites:

- Fundamental knowledge of core engineering concepts, laboratory practices, tools, and relevant software for applying technical skills in practical environments.
- Ability to work collaboratively in teams with basic proficiency in technical communication, including report writing and presentations.
- Awareness of professional ethics, safety practices, organizational processes, and readiness to learn and adapt in workplace settings.

Course Objectives:

- To provide practical exposure to professional environments for applying engineering knowledge and technical skills to real-world problems.
- To develop the ability to work effectively in multidisciplinary teams and understand organizational structure and processes.
- To enhance communication skills for preparing technical reports, delivering presentations, and engaging in professional interactions.
- To build analytical skills for studying practices, workflows, and technologies to identify inefficiencies and suggest improvements.
- To cultivate critical thinking and professional ethics for evaluating solutions, project outcomes, and personal growth in a societal and environmental context.

Course Outcomes (COs):

On successful completion of the Internship, the student will be able to:

CO1: Apply engineering knowledge and technical skills to perform assigned tasks and solve real-world problems in professional environments. *(*L3*)*

CO2: Collaborate with multidisciplinary teams to understand organizational processes and effectively contribute to project execution. *(*L3*)*

CO3: Communicate technical information effectively through reports, presentations, and professional interactions with supervisors and team members. *(*L3*)*

CO4: Analyse practices, workflows, and technologies to identify inefficiencies and propose appropriate improvements. *(*L4*)*

CO5: Evaluate processes, project outcomes, and personal professional development based on technical, economic, environmental, ethical, and societal considerations. *(*L5*)*

B. Tech. – IV Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPPR401L	IP	**Project** (Common to all branches of Engineering)	0	0	0	8

Pre-Requisites:

- Fundamental knowledge of core engineering concepts, tools, and relevant software, along with awareness of sustainability principles and environmental considerations in engineering practice.
- Ability to work collaboratively in teams with basic skills in problem-solving and technical communication, including report writing and presentations.

Course Objectives

- To provide opportunities for applying engineering knowledge and technical skills in developing sustainable solutions to real-world problems.
- To develop the ability to analyze project requirements, team dynamics, and organizational processes with a focus on sustainability and effective project execution.
- To enhance skills in analyzing and communicating technical information through reports, presentations, and professional interactions, incorporating sustainability perspectives.
- To build competency in evaluating engineering designs, methodologies, and technologies based on sustainability, ethical, environmental, and societal considerations.
- To foster creativity and innovation in designing and developing sustainable engineering solutions aligned with global sustainable development goals.

Course Outcomes (COs):

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

CO1: Apply engineering knowledge and technical skills to develop sustainable solutions for real-world problems considering resource efficiency and environmental impact. *(L3)*

CO2: Analyze team dynamics, organizational processes, and sustainability aspects to plan, manage, and execute project activities effectively in multidisciplinary environments. *(L4)*

CO3: Analyze and communicate technical information effectively through project reports, presentations, and professional interactions, incorporating sustainability considerations. *(L4)*

CO4: Evaluate design approaches, methodologies, and technologies to identify problems and justify appropriate engineering solutions based on sustainability, ethical, environmental, and societal considerations. *(L5)*

CO5: Design and develop innovative and sustainable engineering solutions or prototypes for real-world problems by integrating appropriate tools and techniques aligned with sustainable development goals. *(L6)*

HONOURS DEGREE OFFERED IN ECE

Honours - VLSI Specialization

Course Code	Name of The Course	L	T	P	C
24HON0401T	Analog IC Design	3	0	0	3

Pre-Requisites: Basics of VLSI

Course Objectives:

- To understand the sources and types of power dissipation in CMOS VLSI circuits.
- To study circuit techniques for low power digital design.
- To analyze low-power adder and multiplier architectures and memory circuit techniques.
- To explore architectural-level techniques for power reduction.
- To understand low-power implementation techniques at gate and library level.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Analyse MOSFET characteristics, biasing techniques, and current mirrors for analog circuit design. (L4)

CO2: Design and analyse single-stage amplifiers and evaluate their performance using feedback and Cascode configurations. (L6)

CO3: Analyse the design and performance of differential amplifiers in analog circuits. (L4)

CO4: Analyse the characteristics and compensation techniques of operational amplifiers. (L4)

CO5: Evaluate the design principles and performance of bandgap reference circuits. (L5)

Unit I: Low Power CMOS VLSI Design:

Introduction: Sources of Power Dissipation, Static Power Dissipation, Active Power Dissipation. Circuit Techniques for Low Power Design: Design for Low Power, Multiple Vth techniques, Dynamic Vth techniques.

Unit II: Low Power Adder Architectures:

Standard Adder Cells, Review of CMOS Adder Architectures and performance comparison, Low Voltage Low Power Design Techniques, Current Mode Adders.

Unit III: Multipliers and Memories:

Review of Multiplier Architectures, Braun, Booth and Wallace Tree Multipliers and their performance comparison. Sources of power dissipation in SRAMs, Low power SRAM circuit techniques, Sources of power dissipation in DRAMs, Low power DRAM circuit techniques.

Unit IV: Architectural Techniques for Low Power:

Parameters affecting power dissipation, Variable frequency, Dynamic Voltage Scaling, Dynamic Voltage and Frequency Scaling (DVFS), Reduced VDD, Architectural clock gating, Power gating, Multi-voltage, Optimizing memory power.

Unit V: Low Power Implementation Techniques:

Library Selection, Clock Gating, Timing Impact due to Clock Gating, Gate-level power optimization techniques, Power Optimization for Sleep Mode.

Text Books:

1. Kiat Seng Yeo and Kaushik Roy, Low-Voltage, Low-Power VLSI Subsystems, Tata McGraw Hill, 2009.

2. Soudris D., Piguet C. and Goutis C., Designing CMOS Circuits for Low Power, Kluwer Academic Publishers, 2002.

Reference Books:

1. Abdellatif Bellaouar, Mohamed Elmasry, Low-Power Digital VLSI Design: Circuits and Systems, Springer, 2012.

2. Jan Rabaey, Low Power Design Essentials, Springer, 2009.

Course Code	Name of the Course	L	T	P	C
24HON0402T	Digital IC Design	3	0	0	3

Pre-Requisites: Basics of Digital Electronics & VLSI

Course Objectives:

- To understand CMOS logic design principles and their application in digital IC design.
- To study static and dynamic CMOS logic families and their performance characteristics.
- To analyze interconnect parasitics and their impact on digital circuit performance.
- To design arithmetic and sequential building blocks at the transistor level.
- To explore issues in memory design including SRAM and DRAM cell architectures.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Analyse MOSFET characteristics, CMOS inverter operation, delay, and power consumption in digital circuits. (L4)

CO2: Design combinational and sequential logic circuits using static and dynamic CMOS design techniques. (L6)

CO3: Analyse timing issues in digital circuits including clock skew, jitter, and synchronization techniques. (L4)

CO4: Design arithmetic building blocks such as adders, multipliers, and shifters with power considerations. (L6)

CO5: Analyse semiconductor memory architectures including RAM, ROM, and memory peripheral circuitry. (L4)

Unit I: CMOS Logic Design:

Review of MOSFET device physics, CMOS inverter – static and dynamic characteristics, Noise margins, Power dissipation, Short circuit power. Static CMOS logic: Complementary CMOS, ratioed logic, pass transistor logic. Introduction to digital IC design flow.

Unit II: Dynamic and Domino Logic:

Dynamic CMOS logic – precharge/evaluate, charge sharing, Domino logic, NP domino logic, Zipper CMOS. Comparison of static and dynamic logic families. Clocking and latching strategies.

Unit III: Interconnects and Timing:

Interconnect parasitics – resistance, capacitance, inductance modeling, Elmore delay model, repeater insertion. Signal integrity – crosstalk, noise budget. Clock distribution and clock skew, synchronization issues.

Unit IV: Arithmetic Building Blocks:

Adder topologies: ripple carry, carry lookahead, carry select, carry save. Multipliers: array multiplier, Wallace tree. ALU design. Shifters and data path elements. Pipelining in arithmetic circuits.

Unit V: Memory Design:

SRAM cell design – 6T cell, read/write operation, sense amplifiers, pre-charge circuits. DRAM cell operation, refresh mechanisms. ROM and CAM structures. Memory organization and peripheral circuits: row/column decoders, multiplexers.

Text Books:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolić, Digital Integrated Circuits – A Design Perspective, 2nd Edition, Pearson Education, 2003.

2. Weste N. and Harris D., CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition, Addison-Wesley, 2011.

Reference Books:

1. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, 3rd Edition, McGrawHill, 2003.

2. Ken Martin, Digital Integrated Circuit Design, Oxford University Press, 2000

Course Code	Name of the Course	L	T	P	C
24HON0403T	Low power VLSI	3	0	0	3

Pre-Requisites: Basics of VLSI

Course Objectives:

- To understand the fundamentals of power dissipation mechanisms in VLSI circuits.
- To study technology and circuit-level strategies for reducing leakage and dynamic power.
- To analyze logic and architectural level power optimization methodologies.
- To explore system-level and software-level power management techniques.
- To study power analysis and estimation methodologies used in industry EDA flows.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Analyse low-power CMOS VLSI design techniques for minimizing power dissipation. (L4)
CO2: Analyse CMOS adder architectures and evaluate low-power design techniques(L4)
CO3: Analyse multiplier architectures and low-power design techniques for memory systems(L4).
CO4: Evaluate architectural techniques for minimizing power dissipation in digital systems. (L5)
CO5: Apply low-power design techniques to optimize power consumption in digital circuits. (L3)

Unit I: Power Dissipation Fundamentals:

Sources of power: dynamic (switching) power, short-circuit power, leakage power. CMOS power equation derivation. Activity factor, glitching power. Technology trends and power challenges in deep submicron design. Power density and thermal considerations.

Unit II: Circuit and Technology Level Techniques:

Transistor sizing for power-delay tradeoff. Multi-threshold CMOS (MTCMOS), Variable threshold CMOS (VTCMOS). Transistor stacking effect. Power supply reduction: constant throughput and variable voltage approaches. Body biasing techniques.

Unit III: Logic Level Power Optimization:

Logic transformation for low power: factoring, decomposition. Technology mapping for minimum power. Hazard and glitch filtering. Retiming for power reduction. State encoding in FSMs for low switching activity. Clock gating strategies.

Unit IV: Architectural Level Power Reduction:

Pipelining and parallelism for supply voltage reduction. Memory hierarchy optimization. Bus encoding techniques for low power. Dynamic voltage and frequency scaling (DVFS) algorithms. Power-aware scheduling and resource binding in HLS.

Unit V: Power Analysis and System-level Management:

Power estimation methods: probabilistic, simulation-based. Industrial EDA power analysis flows. Power integrity: IR drop, electromigration. System-level power management: power states, OS-driven power control, power gating domains, UPF/CPF flow overview.

Text Books:

1. Kiat Seng Yeo and Kaushik Roy, Low-Voltage, Low-Power VLSI Subsystems, Tata McGraw Hill, 2009.

2. Gary Yeap, Practical Low Power Digital VLSI Design, Springer, 1998.

Reference Books:

1. Anantha Chandrakasan and Robert Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.

2. Jan Rabaey, Low Power Design Essentials, Springer, 2009

Honours - VLSI Specialization

Course Code	Name of the Course	L	T	P	C
24HON0404T	Testing and Verification	3	0	0	3

Pre-Requisites: Basics of VLSI

Course Objectives:

- To analyze VLSI testing concepts, fault modeling, and defect analysis for ensuring chip reliability.
- To explore fault simulation techniques and algorithms for efficient fault detection in digital circuits.
- To examine test generation techniques for combinational and sequential circuits, fault modeling, and scan chain-based testing.
- To study and apply test generation algorithms for digital circuits and understand design-for-testability techniques.
- To apply Design for Testability (DFT) techniques, including BIST architectures and test algorithms for embedded memory.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Analyse fault models, defect mechanisms, and testing methods to improve VLSI chip quality and yield. (L4)

CO2: Apply serial, parallel, and deductive fault simulation algorithms for testing and diagnosis of faults in digital systems. (L3)

CO3: Implement ATPG and path sensitization methods for fault detection in combinational and sequential circuits, including scan chain-based testing. (L3)

CO4: Apply D, FAN, and PODEM algorithms for fault detection and implement design-for- testability techniques in digital circuits. (L3)

CO5: Evaluate DFT methodologies, generate test patterns, and implement Built-In Self-Test (BIST) for efficient fault detection. (L5)

Unit I: VLSI Testing Fundamentals:

Role of testing in VLSI design flow, Testing at different levels of abstraction. Fault, error, defect, diagnosis, yield. Types of testing, Rule of Ten, Defects in VLSI chip. Modelling basic concepts, Functional modelling at logic level and register level, structure models, logic simulation, delay models. Various types of faults, Fault equivalence and Fault dominance in combinational and sequential circuits.

Unit II: Fault Simulation:

Fault simulation applications, General fault simulation algorithms – Serial and parallel fault simulation, Deductive fault simulation algorithms.

Unit III: Test Generation for Combinational Circuits:

Combinational circuit test generation, Structural Vs Functional test, ATPG, Path sensitization methods. Difference between combinational and sequential circuit testing, five and eight valued algebra, and Scan chain-based testing method.

Unit IV: Test Generation Algorithms and DFT:

D-algorithm procedure and problems, PODEM Algorithm and problems, FAN Algorithm and problems. Comparison of D, FAN and PODEM Algorithms. Design for Testability (DFT): Ad-hoc design, Generic scan-based design.

Unit V: BIST and Memory Testing:

Classical scan-based design, System level DFT approaches. Test pattern generation for BIST, Circular BIST. BIST Architectures. Testable memory design – Test algorithms – Test generation for Embedded RAMs.

Text Books:

1. M. Abramovici, M. Breuer, and A. Friedman, Digital Systems Testing and Testable Design, IEEE Press, 1990.
2. M. Bushnell and V. Agrawal, Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits, Kluwer Academic Publishers, 2000.

Reference Books:

1. Stroud, A Designer's Guide to Built-in Self-Test, Kluwer Academic Publishers, 2002.
2. V. Agrawal and S.C. Seth, Test Generation for VLSI Chips, Computer Society Press, 1989

Honours - VLSI Specialization

Course Code	Name of the Course	L	T	P	C
24HON0405T	FPGA architectures	3	0	0	3

Pre-Requisites: Basics of VLSI

Course Objectives:

- To explore the evolution, design flow, and applications of FPGAs in modern digital systems.
- To design and implement digital systems using Programmable Logic Devices (PLDs) for complex operations.
- To study FPGA/CPLD architectures, programming technologies, and commercially available FPGA families.
- To analyze the architecture, functionality, and performance impact of FPGAs and CPLDs.
- To understand FPGA routing architectures, routing strategies, and their implementation in modern FPGA families like Kintex-7, Virtex-7, and Artix-7.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Analyse FPGA architecture, design flow, and applications in digital circuit implementation. (L4)

CO2: Design and implement digital circuits such as universal logic blocks, memory units, floating point multipliers, and barrel shifters using PLDs. (L6)

CO3: Analyse FPGA/CPLD programming technologies and compare architectures such as Xilinx, Actel, and Altera. (L4)

CO4: Evaluate FPGA/CPLD building blocks, routing structures, and delay models for efficient digital system design. (L5)

CO5: Analyse FPGA routing structures and apply routing strategies in real-time FPGA devices such as Kintex-7, Virtex-7, and Artix-7. (L4)

Unit I: Introduction to FPGAs:

Evolution of programmable devices, FPGA Design flow, Applications of FPGA. Comparison of FPGAs with ASICs and standard cell designs. FPGA programming and configuration methods.

Unit II: Design Examples using PLDs:

Design of Universal block, Memory, Floating point multiplier, Barrel shifter. Implementation of common digital functions using PLDs. Design entry and synthesis for PLDs.

Unit III: FPGAs and CPLDs – Architectures and Families:

Programming Technologies, commercially available FPGAs: Xilinx's Vertex and Spartan families, Actel's FPGA, Altera's FPGA/CPLD. Architecture comparison, programming technologies (SRAM, antifuse, flash).

Unit IV: Building Blocks of FPGAs/CPLDs:

Configurable Logic Block (CLB) functionality, Routing structures, Input/Output Block (IOB), Impact of logic block functionality on FPGA performance, Model for measuring delay. Switch matrices and programmable interconnects.

Unit V: Routing Architectures and Case Studies:

Routing terminology, General strategy for routing in FPGAs, Routing for row-based FPGAs, Introduction to segmented channel routing, Routing for symmetrical FPGAs, Example of routing in a symmetrical FPGA. FPGA architectural assumptions: the logic block, the connection block, connection block topology, the switch block, switch block topology. CASE STUDY – Applications using Kintex-7, Virtex-7, Artix-7.

Text Books:

1. S. Brown and J. Rose, FPGA and CPLD Architectures: A Tutorial, IEEE Design and Test of Computers, 1996.
2. Clive Maxfield, The Design Warrior's Guide to FPGAs, Elsevier/Newnes, 2004.

Reference Books:

1. Parag K. Lala, Principles of Modern Digital Design, Wiley-Interscience, 2007.
2. Pong P. Chu, FPGA Prototyping by VHDL Examples, Wiley-Interscience, 2008

Course Code	Name of the Course	L	T	P	C
24HON0406P	Analog and Digital IC Design Lab	0	0	3	1.5

Pre-Requisites: Basics of Digital Electronics & VLSI

Course Objectives:

- To provide hands-on experience with schematic entry and simulation of analog and digital IC circuits using industry standard EDA tools.
- To design and simulate fundamental analog building blocks such as amplifiers and current mirrors.
- To implement digital combinational and sequential circuits at the transistor level.
- To understand layout design rules and perform DRC/LVS checks.
- To extract parasitics and perform post-layout simulation for performance verification.

Course Outcomes (COs):

On successful completion of the course, Students will be able to:

CO1: Construct and evaluate single-stage and multi-stage amplifiers with various loads and feedback techniques. (L6)

CO2: Apply current sources, sinks, and mirrors for effective biasing of analog circuits. (L3)

CO3: Implement and compare parallel adders, shift registers, and multipliers for performance optimization. (L4)

CO4: Construct and analyse CMOS inverters and logic gates under different design constraints and logic styles. (L6)

CO5: Implement and compare parallel adders, shift registers, and multipliers for performance optimization. (L3)

List of Experiments:

Part A: Analog IC Design Experiments

1. DC characteristics of CMOS Inverter – VTC, noise margins, and switching threshold.
2. Transient analysis of CMOS Inverter – propagation delay measurement.
3. Design and simulation of CMOS Current Mirror.
4. Design and simulation of CMOS Differential Amplifier (differential and common mode gain).
5. Design and simulation of a two-stage CMOS Op-Amp.

Part B: Digital IC Design Experiments

6. Design and simulation of CMOS NAND and NOR gates (2-input and 3-input).
7. Design and simulation of CMOS XOR gate and full adder.
8. Design and simulation of D Flip-Flop and JK Flip-Flop using CMOS transistors.
9. Design and simulation of a 4-bit ripple counter using CMOS logic.

Part C: Layout and Physical Design

10. Layout design of CMOS Inverter – DRC and LVS verification.
11. Layout design of CMOS NAND gate – parasitic extraction and post-layout simulation.
12. Layout design of a basic SRAM cell (6T).

Tools / Software:

Cadence Virtuoso / Microwind / LTspice / Ngspice (as per availability).

Reference Books:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits – A Design Perspective, Pearson Education, 2003.
2. Weste N. and Harris D., CMOS VLSI Design: A Circuits and Systems Perspective, Addison-Wesley, 2011.

Course Code	Name of the Course	L	T	P	C
24HON0407P	Physical Design Automation Lab	0	0	3	1.5

Pre-Requisites: Basics of VLSI

Course Objectives:

- To introduce the VLSI physical design flow from net list to GDSII using industry-standard EDA tools.
- To understand floor planning, placement, and clock tree synthesis concepts and their implementation.
- To perform routing, timing analysis, and sign-off verification for digital IC designs.
- To explore static timing analysis (STA) and methods to resolve timing violations.
- To understand power analysis, IR drop analysis, and electromigration checks.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Apply graph-based algorithms to solve problems such as spanning trees, shortest paths, and Steiner trees in VLSI design. (L3)

CO2: Implement and analyse line sweep and extended line sweep methods for geometric problem solving. (L4)

CO3: Apply partitioning techniques using algorithms like Kernighan–Lin and simulated annealing for circuit optimization. (L3)

CO4: Apply floor planning algorithms to optimize area, performance, and layout efficiency in VLSI design. (L3)

CO5: Implement and analyse two-terminal and multi-terminal routing algorithms for optimal interconnection in circuits. (L4)

List of Experiments:

1. RTL to gate-level netlist: Logic synthesis using Synopsys Design Compiler / Cadence Genus.
2. Design import and technology file setup in Cadence Innovus / Synopsys ICC.
3. Floor planning: die area specification, power rings, and macro placement.
4. Placement: standard cell placement and legalization.
5. Clock Tree Synthesis (CTS): clock buffer insertion and skew minimization.
6. Routing: global routing, detailed routing, and routing DRC fixing.
7. Static Timing Analysis (STA): setup and hold analysis using Synopsys PrimeTime.
8. Timing violation fixing: ECO (Engineering Change Order) techniques.
9. Power analysis and IR drop analysis.
10. Physical verification: DRC, LVS, and antenna rule check.
11. GDSII generation and sign-off flow.
12. Mini-project: Complete physical design of a small digital block (e.g., 8-bit ALU or UART).

Tools / Software:

Cadence Innovus / Synopsys IC Compiler / Synopsys Design Compiler / Synopsys PrimeTime (as per availability). Opensource alternatives: Open ROAD / OpenLane flow.

Reference Books:

1. Lavagno L., Martin G., and Scheffer L., Electronic Design Automation for Integrated Circuits Handbook, CRC Press.
2. Shelar R. and Papaefthymiou M., An Introduction to Standard Cell Based Layout, IEEE Press.

MINOR DEGREES OFFERED IN ECE TO OTHERS

Minor Degree - Embedded Systems and IoT

Course Code	Name of the Course	L	T	P	C
24MEI0401T	Embedded Systems Technology	3	0	0	3

Pre-Requisites: Basics of Microprocessors and Microcontrollers

Course Objectives:

- To introduce the fundamental concepts and classifications of embedded systems.
- To explore the architecture and processor models used in embedded system design.
- To study different communication interfaces and protocols in embedded systems.
- To understand rapid prototyping using platforms like Arduino and sensor modules.
- To develop embedded GUI interfacing and analyze case studies of real-world embedded applications.

Course Outcomes (COs):

On successful completion of the course, the Student will be able to:

CO1: Understand the basics of embedded systems, including history, classification, and processor selection. (L2)

CO2: Analyze different embedded processor architectures such as ARM, RISC, and application-specific processors. (L4)

CO3: Evaluate various communication interfaces and protocols such as UART, USB, SPI, I2C, and Zigbee. (L5)

CO4: Implement rapid prototyping techniques using Arduino, sensors, and wearable system modules. (L3)

CO5: Develop and interface embedded GUI systems such as LCDs, touchscreens, and VGA cameras for real-world applications. (L5)

Unit I: Introduction to Embedded Systems:

Introduction to Embedded Systems, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Embedded Processor Requirements, Features, Types, RISC Processors, Harvard Architecture, Super Harvard Architecture, Selection of Processors & Microcontrollers.

Unit II: Architecture of Embedded System Processor:

Embedded processor models, ARM core processor, Application specific processor like network processors, multimedia processors, industrial processors, superscalar processor, Advanced RISC processors. Architecture of Embedded OS, Categories of Embedded OS, Application Software, Communication Software, Development and Testing Tools.

Unit III: Communication Interfaces:

Need for Communication Interfaces, OSI Reference Model, Basic of Networks, Network Topology, RS232/UART, RS422/RS485, USB, Infrared, Ethernet, IEEE 802.11, Bluetooth, SPI, I2C, CAN, WiFi, FlexRay, LIN Bus, Zigbee.

Unit IV: Rapid Prototyping:

Arduino platform, hardware and software, Sensor modules, Robo Control modules, 3D printing module, ADC module, wearable systems, etc.

Unit V: Embedded GUI Interfacing:

Arduino based graphic LCD, Touch screen, Joy stick, VGA camera interfacing and programming in Python. Creative applications of Arduino. Design Examples & Case Studies of Embedded System: Digital Thermometer, Navigation Systems, Smart Card, RF Tag.

Text Books:

1. David Simon, “An Embedded Software Primer”, Pearson Publication, 2021.

2. Frank Vahid, “Embedded System — A Unified Hardware Software Introduction”, John Wiley and Sons, 2005.

Reference Books:

1. Tammy Noergaard, “Embedded System Architecture”, Elsevier Publication, 2014.

Minor Degree - Embedded Systems and IoT

Course Code	Name of the Course	L	T	P	C
24MEI0402T	Real Time Embedded Systems Design and Analysis	3	0	0	3

Pre-Requisites: Basics of Real Time Operating Systems

Course Objectives:

- To understand the fundamental concepts of Real-Time Operating Systems (RTOS), kernel architecture, and synchronization mechanisms.
- To study real-time embedded software development using Linux, RT Linux, and RTOS programming techniques.
- To explore real-time task scheduling techniques, including table-driven, cyclic, EDF, and RMA scheduling.
- To analyze real-time hardware architectures, software stacks, and best practices for embedded system programming.
- To examine real-time communication protocols, database systems, and validation techniques for embedded systems.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Explain the architecture of RTOS, task scheduling, and synchronization mechanisms such as semaphores, mutexes, and message queues. (L2)

CO2: Demonstrate proficiency in real-time embedded software development using Linux, RT Linux, and various RTOS platforms. (L3)

CO3: Apply real-time scheduling algorithms to optimize task execution and system performance. (L3)

CO4: Analyze real-time embedded hardware architectures and software stacks for efficient system integration. (L4)

CO5: Implement real-time communication protocols and perform validation and verification of embedded systems using case studies. (L5)

Unit I: Introduction to RTOS:

Overview of RTOS, Architecture of Kernel, Task & Task Scheduler, ISR, Semaphore, Mutex, Mailbox, Message Queues, Event Registers, Pipes, Signals, Timers, Memory Management, Priority Inversion Problem.

Unit II: Real Time Embedded Software:

Linux, RT Linux, multiprocessor software developments, data flow graph, Study and programming of RTOS like RTX51, Free RTOS etc. Timing diagram analysis for fixed and dynamic priority software services.

Unit III: Real Time Scheduling:

Scheduling Real-Time Tasks: Types of Schedulers, Table-driven scheduling, Cyclic schedulers, EDF, RMA, Priority Pre-emptive Scheduler, State Machine for Linux and VxWorks, Comparison of Cyclic Executive, Introduction to Worst Case Analysis, Example of scheduling, Real-Time Scheduling and Rate Monotonic Least Upper Bound.

Unit IV: Overview of Real-time Hardware Architectures and Software Stacks

Embedded Linux on the Raspberry Pi, ARM A-Series System-on-Chip processors, Tracing Linux kernel and network stack events. Best Practices for RTES Programming, System Integration Testing (Hardware, Firmware, and Software).

Unit V: Real Time Communication & Verification:

RT Services Communication and Synchronization, Performance of two Real-Time communication Protocols, Real time communication over network, Real Time database. Verification and Validation of RTES project: Using Point-to-point Serial and TCP/IP for Embedded Systems, Case Study of Coding for Sending Application Layer Byte Streams on a TCP/IP Network Using RTOS. Building a simple Linux multi-service system using POSIX real-time extensions on Raspberry Pi 3b.

Text Books:

1. “Embedded Real-time Systems”, Prasad, Dreamtech Wiley Publication, 2003.

2. “Real-Time Systems: Theory and Practice”, Rajib Mall, Pearson, 2008.

Reference Books:

1. “Real-Time Systems Design and Analysis”, Philip Laplante, 2nd Edition, Prentice Hall, 2013.

Minor Degree - Embedded Systems and IoT

Course Code	Name of the Course	L	T	P	C
24MEI0403T	Principles of IoT	3	0	0	3

Pre-Requisites: Basics in Networking and Programming

Course Objectives:

- To introduce the fundamental concepts, characteristics, and design principles of the Internet of Things (IoT).
- To explore IoT components, communication protocols, and networking techniques.
- To understand IoT system management, including platform design and application development.
- To study networking and computing in IoT, including Python-based IoT programming and cloud integration.
- To analyze IoT cloud platforms, data analytics, and real-world IoT applications in smart cities, homes, and industries.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Understand the fundamentals of IoT, including its architecture, characteristics, and challenges. (L2)

CO2: Analyze IoT communication protocols and networking techniques used in wireless sensor networks and M2M communication. (L4)

CO3: Design and manage IoT platforms, including device integration, service models, and application development. (L5)

CO4: Implement IoT networking and computing techniques, including cloud storage, APIs, and Python-based IoT programming. (L3)

CO5: Develop and evaluate IoT applications in real-world domains such as smart cities, connected vehicles, and industrial automation. (L5)

Unit I: Introduction & Basics of IoT:

Definition, Characteristics, Physical and Logical Designs, challenges, Technological trends in IoT, IoT Examples, M2M.

Unit II: IoT Components, Communication and Networking:

Introduction to Sensing and Networking: Sensing & actuation, Wireless Sensor Network, Sensor nodes, Communication Protocols, M2M Communication, Networking Hardware, Networking Protocols.

Unit III: IoT System Management:

Network Operator Requirements, IoT Platform Design Specification – Requirements, Process, Domain Model, Service, IoT Level, Function, Operational view, Device and Component Integration, Application development.

Unit IV: Networking and Computing:

File Handling, Python Packages for IoT, IoT Physical Servers – Cloud Storage Models, Communication APIs.

Unit V: IoT Clouds, Data Analytics and Applications:

RESTful Web API, Amazon Web Services for IoT, Apache Hadoop, Batch Data Analysis, Chef, Chef Case Studies, Puppet, NETCONF-YANG. IoT Applications: Case studies – smart cities, smart home, connected vehicles, Industrial IoT.

Text Books:

1. Kamal, R., “Internet of Things – Architecture and Design Principles,” 1st Edition, McGraw Hill, 2017.

2. Simone Cirani, “Internet of Things – Architectures, Protocols and Standards”, Wiley, 2018.

Reference Books:

1. Alessandro Bassi, “Enabling Things to Talk – Designing IoT solutions with the IoT Architectural Reference Model”, Springer, 2013.

Minor Degree - Embedded Systems and IoT

Course Code	Name of the Course	L	T	P	C
24PE04418T	Wireless Sensor Networks	3	0	0	3

Pre-Requisites: Basics of Communication Systems

Course Objectives:

- To introduce the fundamental concepts and architecture of wireless sensor networks.
- To explore various network architectures, optimization techniques, and design principles for wireless sensor networks.
- To study MAC protocols, routing techniques, and addressing mechanisms for efficient sensor network communication.
- To understand the infrastructure establishment of sensor networks, including topology control and synchronization.
- To provide knowledge on sensor network platforms, programming challenges, and simulation tools.

Course Outcomes (COs):

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

CO1: Apply the concepts of wireless sensor networks to analyze node architecture, characteristics, constraints, and enabling technologies. (L3)

CO2: Analyze sensor network architectures, design principles, and physical layer considerations for efficient communication. (L4)

CO3: Analyze MAC protocols, routing techniques, and standards such as IEEE 802.15.4 and ZigBee for efficient networking of sensors. (L4)

CO4: Analyze infrastructure establishment techniques including topology control, clustering, synchronization, and localization. (L4)

CO5: Evaluate sensor network platforms, hardware components, and software tools for effective implementation of WSN applications(L5).

Unit I: Overview of Wireless Sensor Networks:

Single-Node Architecture – Hardware Components, Network Characteristics, unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks, Types of wireless sensor networks.

Unit II: Architectures:

Network Architecture, Sensor Networks Scenarios, Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts.

Unit III: Networking Sensors:

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts – SMAC, B-MAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols, Energy-Efficient Routing, Geographic Routing.

Unit IV: Infrastructure Establishment:

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Unit V: Sensor Network Platforms and Tools:

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

Text Books:

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks – An Information Processing Approach", Elsevier, 2007.

Reference Books:

1. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley & Sons, 2011.

2. Kazem Sohraby, Daniel Minoli & Taieb Znati, "Wireless Sensor Networks – Technology, Protocols, and Applications", John Wiley, 2007.

3. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

Minor Degree - Embedded Systems and IoT

Course Code	Name of the Course	L	T	P	C
24MEI0404T	Industrial Internet of things	3	0	0	3

Pre-Requisites: Basics of Embedded systems

Course Objectives:

- To understand the fundamental concepts of the Industrial Internet of Things (IIoT), its market potential, and applications in various industries.
- To study the methodologies, networking protocols, and wireless communication technologies used in IIoT deployments.
- To explore data-driven analytics in IIoT, including big data processing, machine learning algorithms, and neural networks.
- To analyze IP and non-IP protocols used in IIoT, such as WPAN, Bluetooth, Zigbee, and MQTT.
- To examine IoT cloud platforms, data analytics techniques, and their applications in industrial robotics and asset monitoring.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Apply the concepts of Industrial IoT (IIoT) to analyze sensors, device placement, and communication system design for industrial applications. (L3)

CO2: AnalyzeIIoT methodologies including operating systems, networking protocols, and wireless sensor networks for remote monitoring systems. (L4)

CO3: Apply data-driven analytics techniques including data preprocessing and machine learning algorithms for IIoT applications. (L3)

CO4: Analyze IP and Non-IP protocols such as IEEE 802.15.4, ZigBee, MQTT, CoAP, and REST for efficient IoT communication. (L4)

CO5: Evaluate IoT cloud platforms, localization techniques, and IoRT architectures for real-world industrial and robotic applications. (L5)

Unit I: Introduction to IIoT:

Market Size and Potential: Definition, IoT vs IIoT, Next Generation Sensors, Sensor calibration and validate sensor measurements, placement of IoT devices, sensors, low-cost communication system design. Top application areas include manufacturing, oil & gas, Embedded systems in the Automotive and Transportation market segment.

Unit II: IIoT Methodology:

Top operating systems used in IIoT deployments, Networking and wireless communication protocols used in IIoT deployments. Smart Remote Monitoring Unit, components of monitoring system, control and management, Wireless Sensor Network (WSN).

Unit III: Data Driven Analytics of IIoT:

Implementing industrial IoT Data flow, big data and how to prepare data for machine learning algorithms, Machine Learning algorithms, supervised learning & unsupervised learning algorithms, Basics of neural network, activation functions, back-propagation.

Unit IV: IP and Non-IP Protocols for IoT:

WPAN, IEEE 802.15.4, Bluetooth, NFC, 6LoWPAN; RFID, Zigbee, Wireless HART Protocol, MQTT, IP and Non-IP Protocols, REST, CoAP.

Unit V: IoT Clouds, Data Analytics and Robotics:

Develops a physics-based and data-driven digital equipment model to monitor assets and systems. Introduction to device localization and tracking; different types of localization techniques, RFID and fingerprinting, Device diversity/heterogeneity issue in IIoT networks. Internet of Robotic Things (IoRT): Introduction to stationary and mobile robots, Brief introduction to localization, mapping, planning, and control of robotic systems; Introduction to cloud-enabled robotics; Applications of IIoT in robotics; Architectures for IoRT, Examples and case studies.

Text Books:

1. "Industry 4.0: The Industrial Internet of Things", Alasdair Gilchrist, Apress, 2016.

2. "Introduction to Industrial Internet of Things and Industry 4.0", Sudip Misra, Chandana Roy, Anadarup Mukherjee, CRC Press, 2021.

Reference Books:

1. "Hands-on Industrial Internet of Things", Giacomo Veneri, Antonio Capasso, Packt Press, 2018.

Minor Degree - Embedded Systems and IoT

Course Code	Name of the Course	L	T	P	C
24MEI0405P	Principles of IoT Lab	0	0	0	1.5

Pre-Requisites: Basics of Embedded systems

Course Objectives:

- To understand the fundamentals of IoT through hands-on experiments with sensors, actuators, and microcontrollers.
- To develop skills in interfacing various sensors and actuators with microcontrollers like Arduino, ESP32, and Raspberry Pi.
- To explore IoT communication frameworks such as HTTP, MQTT, and cloud-based data logging platforms like ThingSpeak.
- To gain experience in remote monitoring and control of IoT devices using mobile and web applications.
- To learn UAV/Drone integration with IoT through flight controller programming and GPS-based navigation.

Course Outcomes (COs):

On successful completion of the course, Students will be able to:

CO1: Demonstrate the ability to control and monitor sensors and actuators using microcontrollers and IoT platforms. (L3)

CO2: Implement IoT-based applications using cloud services like ThingSpeak and mobile applications like Blynk. (L3)

CO3: Develop web-based IoT applications using HTTP and MQTT protocols for remote device management. (L5)

CO4: Apply IoT principles in real-world applications such as home automation, security systems, and industrial monitoring. (L3)

CO5: Integrate UAV/Drone technologies with IoT for automated navigation and data acquisition. (L5)

List of Experiments: (Any 10 Experiments are to be conducted)

1. Serial Monitor, LED, Servo Motor Controlling: Controlling actuators through Serial Monitor. Creating different LED patterns and controlling them using push button switches. Controlling servo motor with the help of joystick.

2. Distance Measurement of an object: Calculate the distance to an object with the help of an ultrasonic sensor and display it on an LCD.

3. LDR Sensor, Alarm and Temperature/Humidity Measurement: Controlling relay state based on ambient light levels using LDR sensor. Basic Burglar alarm security system with PIR sensor and buzzer. Displaying humidity and temperature values on LCD.

4. Experiments using Raspberry Pi: Controlling relay state based on input from IR sensors. Interfacing stepper motor with Raspberry Pi. Advanced burglar alarm security system with PIR sensor, buzzer and keypad. Automated LED light control based on input from PIR and LDR.

5. IoT Framework: Upload humidity & temperature data to ThingSpeak, periodically logging ambient light level to ThingSpeak.

6. Controlling LEDs, relay & buzzer using Blynk app.

7. HTTP Based: Introduction to HTTP. Hosting a basic server from ESP32 to control various digital actuators (LED, buzzer, relay) from a simple web page.

8. Displaying various sensor readings on a simple web page hosted on the ESP32.

9. MQTT Based: Controlling LEDs/Motors from an Android/Web app. Controlling AC Appliances from an android/web app with the help of relay.

10. Displaying humidity and temperature data on a web-based application.

11. UAV/Drone: Demonstration of UAV elements, Flight Controller, Mission Planner flight planning design.

12. Python program to read GPS coordinates from Flight Controller.

Reference Books:

1. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley Publications, 2012.

2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2014.

3. The Internet of Things, Enabling technologies and use cases – Pethuru Raj, Anupama C. Raman, CRC Press.

Online Learning Resources:

https://www.arduino.cc/ | https://www.raspberrypi.org/

Minor Degree - Embedded Systems and IoT

Course Code	Name of the Course	L	T	P	C
24MEI0406P	Industrial Internet of Things Lab	0	0	0	1.5

Pre-Requisites: Basics of Embedded systems

Course Objectives:

- To understand the fundamental concepts of IIoT, including its architecture, challenges, and differences from IoT.
- To explore IIoT components such as sensors, actuators, and control systems for industrial applications.
- To study various communication technologies and protocols like IEEE 802.15.4, ZigBee, BLE, and MQTT for IIoT applications.
- To learn data visualization techniques and methods for connecting IIoT devices to the web.
- To analyze data retrieval techniques and M2M interactions for IIoT-based automation.
- To gain hands-on experience with PLCs, SCADA, and real-time control systems used in industrial automation.

Course Outcomes (COs):

On successful completion of the course, Students will be able to:

CO1: Explain the architecture, challenges, and fundamental concepts of IIoT and differentiate it from IoT. (L2)

CO2: Demonstrate the interfacing of sensors and actuators with microcontrollers like Raspberry Pi and NodeMCU for industrial automation. (L3)

CO3: Implement communication protocols such as MQTT, ZigBee, and Bluetooth to enable seamless IIoT connectivity. (L3)

CO4: Develop web-based dashboards for real-time visualization and control of IIoT devices. (L5)

CO5: Retrieve, analyze, and transmit industrial data using web-based interactions and M2M communication. (L4)

.

(All modules are to be conducted and minimum one project to be completed)

Module I: Introduction & Architecture:

What is IIoT and connected world? The difference between IoT and IIoT, Architecture of IIoT, IoT node, Challenges of IIoT. Practice: Introduction to Arduino, Introduction to Raspberry Pi.

Module II: IIoT Components:

Fundamentals of Control System – components, closed loop & open loop system. Introduction to Sensors: Ultrasonic, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11), Digital and Electro Mechanical switches. Practice: 1. Measurement of temperature & pressure values using Raspberry Pi/NodeMCU. 2. Modules and Sensors Interfacing (IR sensor, Ultrasonic, Soil moisture) using Raspberry Pi/NodeMCU. 3. Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry Pi/NodeMCU.

Module III: Communication Technologies of IIoT:

Communication Protocols: IEEE 802.15.4, ZigBee, Bluetooth, BLE, NFC, RFID, Industry standard MQTT, wireless network communication. Practice: Demonstration of MQTT communication.

Module IV: Visualization and Data Types:

Connecting Arduino/Raspberry Pi to the Web: setting up the development environment, options for Internet connectivity, configuring board for IoT. Practice: 1. Visualization of diverse sensor data using dashboard. 2. Sending alert message to the user.

Module V: Retrieving Data:

Extraction from Web: Grabbing content from a web page, Sending data on the web, Types of IoT interaction, Machine to Machine interaction (M2M). Practice: 1. Device control using mobile apps or web pages. 2. Machine to Machine communication.

Module VI: Control & Supervisory Level of Automation:

Programmable Logic Controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). Practice: 1. Digital logic gates programming using ladder diagram. 2. Implementation of Boolean expression using ladder diagram. 3. Simulation of PLC to understand the process control concept.

Suggested Projects:

IIoT based smart energy meter | Smart Agriculture system | Automation using controller via Bluetooth | Temperature controlled Fan/Cooler | Automatic streetlight | Smart Baggage Tracker.

Text Books:

1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.), Springer Publication.
2. Industrial Internet of Things: Cybermanufacturing System, Sabina Jeschke et al., Springer Publication.
3. Industrial IoT: Challenges, Design Principles, Applications, and Security, Ismail Butun (editor).

Minor Degree - Electronic Systems

Course Code	Name of the Course	L	T	P	C
24OE04301T	Electronic Circuits	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Semiconductor Devices and Electronic Components.
- Familiarity with Fundamental Circuit Analysis Concepts.

Course Objectives:

- To understand semiconductor diodes, their characteristics and applications.
- To explore the operation, configurations, and biasing of BJTs.
- To study the operation, analysis, and coupling techniques of BJT amplifiers.
- To learn the operation, applications and uses of feedback amplifiers and oscillators.
- To analyze the characteristics, configurations, and applications of operational amplifiers.

Course Outcomes (COs):

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

CO1: Apply the concepts of semiconductor diodes and their applications in rectifiers, clipping, and clamping circuits. (L3)

CO2: Apply the operating principles of BJT and biasing techniques to analyze transistor circuits as amplifiers and switches. (L3)

CO3: Analyze the performance of single-stage and multistage amplifiers using different configurations and coupling schemes. (L4)

CO4: Analyze feedback amplifiers and oscillator circuits based on their characteristics and configurations(L4)

CO5: Evaluate the performance of operational amplifiers and their applications in analog circuit design. (L5)

Unit I: Semiconductor Diode and Applications:

Introduction, PN junction diode – structure, operation and VI characteristics, Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Positive and Negative Clipping and Clamping circuits (Qualitative treatment only). Special Diodes: Zener and Avalanche Breakdowns, VI Characteristics of Zener diode, Zener diode as voltage regulator, Construction, operation and VI characteristics of Tunnel Diode, LED, Varactor Diode, Photo Diode.

Unit II: Bipolar Junction Transistor (BJT):

Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch and Amplifier, Transistor Biasing and Stabilization – Operating point, DC & AC load lines, Biasing – Fixed Bias, Self Bias, Bias Stability, Bias Compensation using Diodes.

Unit III: Single Stage and Multistage Amplifiers:

Classification of Amplifiers, Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model. Multistage amplifiers: Different Coupling Schemes – RC coupled amplifiers, Transformer Coupled Amplifier, Direct Coupled Amplifier; Multistage RC coupled BJT amplifier (Qualitative treatment only).

Unit IV: Feedback Amplifiers and Oscillators:

Concepts of feedback, Classification of feedback amplifiers, Effect of feedback on amplifier characteristics, Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations (Qualitative treatment only). Oscillators: Classification of oscillators, Condition for oscillations, RC Phase shift Oscillators, Generalized analysis of LC Oscillators – Hartley and Colpitts Oscillators, Wien Bridge Oscillator.

Unit V: Operational Amplifiers:

Classification of ICs, basic information of Op-amp, ideal and practical Op-amp, 741 op-amp and its features, modes of operation – inverting, non-inverting, differential. Applications of Op-amp: Summing, scaling and averaging amplifiers, Integrator, Differentiator, phase shift oscillator and comparator.

Text Books:

1. Electronics Devices and Circuits, J. Millman and Christos C. Halkias, 3rd Edition, Tata McGraw Hill, 2006.

2. Electronics Devices and Circuits Theory, David A. Bell, 5th Edition, Oxford University Press, 2008.

Reference Books:

1. Electronics Devices and Circuits Theory, R.L. Boylestad, Louis Nashelsky and K. Lal Kishore, 12th Edition, Pearson, 2006.

2. Electronic Devices and Circuits, N. Salivahanan and N. Suresh Kumar, 3rd Edition, TMH, 2012.

3. Microelectronic Circuits, S. Sedra and K.C. Smith, 5th Edition, Oxford University Press.

Minor Degree - Electronic Systems

Course Code	Name of the Course	L	T	P	C
24OE04302T	Digital Electronics	2	1	0	3

Pre-Requisites:
- Basic Knowledge of Binary Number Systems and Boolean Algebra.
- Familiarity with Logic Gates and Basic Electronic Circuits.

Course Objectives:
- To learn Boolean algebra, logic simplification techniques, and combinational circuit design.
- To analyze combinational circuits like adders, subtractors, and code converters.
- To explore combinational logic circuits and their applications in digital design.
- To understand sequential logic circuits, including latches, flip-flops, counters, and shift registers.
- To gain knowledge about programmable logic devices and digital ICs.

Course Outcomes (COs):

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

CO1: Apply Boolean algebra, logic simplification techniques, and combinational circuit design to solve digital logic problems. (L3)
CO2: Analyse combinational circuits such as adders, subtractors, and code converters for efficient digital system design. (L4)
CO3: Analyse various combinational logic circuits and their applications in digital systems. (L4)
CO4: Analyse sequential logic circuits including latches, flip-flops, counters, and shift registers. (L4)
CO5: Evaluate programmable logic devices and digital ICs for designing reliable digital systems. (L5)

Unit I: Logic Simplification and Combinational Logic Design:
Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations, Minimization of Switching Functions: Karnaugh map method, Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.

Unit II: Introduction to Combinational Design:
Binary Adders, Subtractors and BCD adder, Code converters – Binary to Gray, Gray to Binary, BCD to Excess-3, BCD to Seven Segment display.

Unit III: Combinational Logic Design:
Decoders, Encoders, Priority Encoder, Multiplexers, Demultiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers.

Unit IV: Sequential Logic Design:
Latches, Flip-flops: S-R, D, T, JK and Master-Slave JK FF, Edge triggered FF, set up and hold times, Ripple counters, Shift registers.

Unit V: Programmable Logic Devices and Digital ICs:
ROM, Programmable Logic Devices (PLA and PAL). Digital ICs: Decoder (74x138), Priority Encoder (74x148), Multiplexer (74x151) and Demultiplexer (74x155), Comparator (74x85).

Text Books:

1. Digital Design, M. Morris Mano & Michel D. Ciletti, 5th Edition, Pearson Education, 1999.
2. Switching theory and Finite Automata Theory, Zvi Kohavi and Nirah K. Jha, 2nd Edition, Tata McGraw Hill, 2005.

Reference Books:

1. Fundamentals of Logic Design, Charles H. Roth Jr., 5th Edition, Brooks/Cole Cengage Learning, 2004.

Minor Degree - Electronic Systems

Course Code	Name of the Course	L	T	P	C
24MES0401T	**Principles of Communication Engineering**	**3**	**0**	**0**	**3**

Pre-Requisites: Basics of Electronics & Signals

Course Objectives:

- To understand the fundamentals of communication systems and amplitude modulation techniques.
- To learn about the angle modulation techniques and bandwidth considerations in communication systems.
- To gain knowledge on pulse analog modulation and multiple access techniques used in digital communication systems.
- To examine pulse modulation and digital modulation techniques used in modern communication systems.
- To study wireless communication systems, cellular networks, and GSM technology.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Apply the fundamental concepts of communication systems to analyze amplitude modulation techniques and their performance. (L3)

CO2: Analyze angle modulation techniques and evaluate bandwidth requirements in communication systems. (L4)

CO3: Apply pulse analog modulation methods and examine multiple access techniques in digital communication systems. (L3)

CO4: Analyze and compare pulse modulation and digital modulation techniques used in modern communication systems. (L4)

CO5: Evaluate wireless communication systems, cellular networks, and GSM technology. (L5)

Unit I: Analog Communication – I:

Elements of communication systems, need for modulation, Modulation Methods, Baseband and carrier communication, Amplitude Modulation (AM), Generation of AM signals, Rectifier detector, Envelope detector, sideband and carrier power of AM, Double Sideband Suppressed Carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Single Sideband (SSB) transmission, VSB Modulation.

Unit II: Analog Communication – II:

Angle Modulation & Demodulation: Concept of instantaneous frequency, Generalized concept of angle modulation, Bandwidth of angle modulated waves – Narrowband FM (NBFM) and Wideband FM (WBFM), Phase modulation, Pre-emphasis & De-emphasis, Illustrative Problems.

Unit III: Digital Communications – I (Qualitative Approach):

Pulse Analog Modulation Techniques: Generation and detection of Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM). Multiple Access Techniques: Introduction to multiple access techniques, FDMA, TDMA, CDMA, SDMA: Advantages and applications.

Unit IV: Digital Communications – II (Qualitative Approach):

Pulse Code Modulation (PCM), DPCM, Delta modulation, Adaptive delta modulation. Overview of ASK, PSK, QPSK, BPSK and M-PSK techniques.

Unit V: Wireless Communications (Qualitative Approach):

Introduction to wireless communication systems, Examples of wireless communication systems, comparison of 2G and 3G cellular networks, Introduction to wireless networks, Differences between wireless and fixed telephone networks, Introduction to Global System for Mobile (GSM), GSM services and features.

Text Books:

1. H. Taub, D. Schilling and Gautam Sahe, “Principles of Communication Systems”, TMH, 2007, 3rd Edition.

2. George Kennedy and Bernard Davis, “Electronics & Communication System”, 4th Edition, TMH, 2009.

3. Wayne Tomasi, “Electronic Communication System: Fundamentals Through Advanced”, 2nd Edition, PHI, 2001.

Reference Books:

1. Simon Haykin, “Principles of Communication Systems”, John Wiley, 2nd Edition.

2. Sham Shanmugam, “Digital and Analog Communication Systems”, Wiley-India Edition, 2006.

3. Theodore S. Rappaport, “Wireless Communications”, Pearson Education, 2nd Edition, 2002.

Minor Degree - Electronic Systems

Course Code	Name of the Course	L	T	P	C
24MES0402T	Electronic Instrumentation	3	0	0	3

Pre-Requisites: Basics of Electronic Circuits

Course Objectives:

- To study the working principle, operation, and applications of analog and digital measuring instruments.
- To explore the working principles, construction, and applications of oscilloscopes in signal analysis.
- To learn about the bridge circuits for measurement of resistance, inductance, and capacitance.
- To understand the principles and operation of various signal generators used in electronic applications.
- To gain knowledge about the operation and applications of transducers in measurement systems.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Apply the concepts of measuring and digital instruments to perform accurate electrical measurements using PMMC meters, multimeters, and digital instruments. (L3)

CO2: Analyze the operation and performance of oscilloscopes including CRT, CRO blocks, and advanced oscilloscopes. (L4)

CO3: Analyze various DC and AC bridges for measurement of electrical parameters and evaluate associated errors. (L4)

CO4: Analyze the working principles and characteristics of different signal generators used in instrumentation systems. (L4)

CO5: Evaluate different types of transducers and select suitable transducers for real-time measurement applications. (L5)

Unit I: Measuring Instruments:

Introduction, Errors in Measurement, Accuracy, Precision, Resolution and Significant figures. Basic PMMC Meter – construction and working, DC and AC Voltmeters – Multirange, Range extension, DC Ammeter, Multimeter for Voltage, Current and Resistance measurements. Digital Instruments: Digital Voltmeters – Introduction, DVMs based on V–T, V–F and Successive approximation principles, Resolution and sensitivity, General specifications, Digital Multimeters, Digital frequency meters, Digital measurement of time.

Unit II: Oscilloscopes:

Introduction, Block diagram of CRO, Basic principle of CRT, CRT Construction and features, vertical amplifiers, horizontal deflection system – sweep, trigger pulse, delay line, sync selector circuits. Dual beam and dual trace CROs, Sampling and Digital storage oscilloscopes.

Unit III: Bridges:

DC Bridges for Measurement of resistance – Wheatstone bridge, Kelvin's Bridge. AC Bridges for Measurement of inductance – Maxwell's bridge, Hay's Bridge, Anderson bridge. Measurement of capacitance – Schearing Bridge, Wien Bridge. Errors and precautions in using bridges.

Unit IV: Signal Generators:

Introduction, Fixed and variable AF oscillator, Standard signal generator, Laboratory type signal generator, AF sine and square wave generator, Function generator, Square and Pulse generator, Sweep frequency generator.

Unit V: Transducers:

Introduction, Types of Transducers, Electrical transducers, Selecting a transducer, Resistive transducer, Strain gauges, Piezoelectric transducer, Photoelectric transducer, Photovoltaic transducer, Temperature transducers – RTD, LVDT.

Text Books:

1. H.S. Kalsi, “Electronic Instrumentation”, Third Edition, Tata McGraw Hill, 2010.

2. A.D. Helfrick and W.D. Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, PHI, 6th Edition, 2010.

Reference Books:

1. A.K. Sawhney, Dhanpat Rai & Co., “A course in Electrical and Electronic Measurements and Instrumentation”, 9th Edition, 2010.

2. David A. Bell, “Electronic Instrumentation & Measurements”, PHI, 2nd Edition, 2006.

Minor Degree - Electronic Systems

Course Code	Name of the Course	L	T	P	C
24PC04312T	Microprocessors and Microcontrollers	2	1	0	3

Pre-Requisites: Basics of Digital Electronics and Programming

Course Objectives:

- To comprehend the architecture, operation, and configurations of the 8086 microprocessors.
- To get familiar with 8086 programming concepts, instruction set, and assembly language development tools.
- To study the interfacing of 8086 with memory, peripherals, and controllers for various applications.
- To learn the architecture, instruction set, and programming of the 8051 microcontrollers.
- To understand microcontroller interfacing techniques, peripheral programming, and processor comparisons.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Learn the fundamental architectural concepts of microprocessors. Apply knowledge of 8086 architecture to identify the roles of Bus Interface Unit (BIU) and Execution Unit (EU) in instruction execution. (L3)

CO2: Analyse the 8086-instruction set and addressing modes to develop assembly language programs for arithmetic and logical operations (L4)

CO3: Examine and Interfacing of Peripheral devices with the 8086 microprocessors. (L4)

CO4: Analyse the fundamentals of 8051 and the function of SFRs and I/O ports in executing control operations. (L4)

CO5: Evaluate the interfacing of peripheral devices with the 8086 microprocessors for efficient system performance(L5)

Unit I: 8086 Architecture:

Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing Unit, execution Unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

Unit II: 8086 Programming:

Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

Unit III: 8086 Interfacing:

Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDs, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237A DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

Unit IV: Microcontroller – 8051 Architecture:

Architecture of 8051 – Special Function Registers (SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming.

Unit V: 8051 Interfacing:

Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation. Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

Text Books:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V. Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition, 1994.

2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd Edition, McGraw Hill Education, 2017.

3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd Edition, Pearson, 2012.

Reference Books:

1. Ramesh S. Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th Edition, Penram International Publishing, 2013.

2. Kenneth J. Ayala, The 8051 Microcontroller, 3rd Edition, Cengage Learning, 2004.

Minor Degree - Electronic Systems

Course Code	Name of the Course	L	T	P	C
24MES0403P	Electronic Circuits and Digital Electronics Lab	0	0	3	1.5

Pre-Requisites: Basics of Electronics

Course Objectives:

- To study the characteristics and applications of semiconductor diodes and transistors.
- To design and analyze rectifiers, amplifiers, and oscillator circuits.
- To implement basic Op-Amp applications.
- To develop the ability to design and implement combinational and sequential logic circuits.
- To utilize universal gates for logic circuit realization and clock generation.
- To design and implement essential digital components like adders, multiplexers, flip-flops, encoders, and decoders.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Interpret the characteristics of diodes and transistors for circuit design. (L2)
CO2: Construct and evaluate rectifiers, amplifiers, and oscillator circuits. (L5)
CO3: Implement basic Op-Amp applications. (L3)
CO4: Construct and implement combinational and sequential circuits using logic gates. (L3)
CO5: Design digital systems using universal gates, multiplexers, and comparators. (L5)

Electronic Circuits – List of Experiments: (Any 06 to be conducted)

1. P-N Junction Diode Characteristics
2. Zener Diode as Voltage Regulator
3. Half Wave Rectifiers (without and with filter)
4. Full Wave Rectifiers (without and with filter)
5. CB Characteristics
6. CE Characteristics
7. CE Amplifier
8. CC Amplifier
9. Clippers
10. Clampers
11. Hartley & Colpitt’s Oscillators
12. Op-Amp applications – Adder, Subtractor, Comparator

Digital Electronics Lab – List of Experiments: (Any 06 to be conducted)

1. Realization of Boolean Expressions using Gates
2. Design and realization of logic gates using universal gates
3. Generation of clock using NAND / NOR gates
4. Design a 4-bit Adder / Subtractor
5. Design and realization of a 4-bit Gray to Binary and Binary to Gray Converter
6. Design and realization of 8x1 MUX using 2x1 MUX
7. Design and realization of 4-bit Comparator
8. Design and realization of Flip-Flops
9. Design and realization of Encoders
10. Design and realization of Decoders
11. Design and realization of Comparator

Minor Degree - Electronic Systems

Course Code	Name of the Course	L	T	P	C
24PC04312P	Microprocessors and Microcontrollers Lab	0	0	3	1.5

Pre-Requisites: Basics of Digital Electronics and Programming

Course Objectives:

- To become skilled in 8086 Assembly Language programming.
- To understand the detailed software and hardware structure of the microprocessor.
- To train practical knowledge through laboratory experiments.
- To understand and learn 8051 Microcontroller.
- To acquire knowledge on microprocessors and microcontrollers, interfacing various peripherals, and configuring.

Course Outcomes (COs):

On successful completion of the course, Student will be able to:

CO1: Apply 8086 assembly language programming to perform arithmetic, bit manipulation, and array operations using various addressing modes. (L3)

CO2: Develop and execute assembly language programs for string manipulation and real-time applications such as digital clock design using interrupts. (L3)

CO3: Analyse and implement interfacing techniques of peripherals such as stepper motors, ADC/DAC, and communication modules with 8086 microprocessors. (L4)

CO4: Apply 8051 microcontroller programming to perform arithmetic, logical operations, timer/counter-based tasks, and serial communication using UART(L3)

CO5: Design and implement embedded system applications by interfacing external devices like LCD and evaluating system performance. (L5)

List of Experiments: (Any TEN to be conducted)

1. Programs for 16-bit Arithmetic Operations (using various addressing modes): Addition and Subtraction of Multi-precision numbers; Multiplication and Division of signed/unsigned Hexadecimal numbers; Square, cube and factorial of a given number.

2. Programs Involving Bit Manipulation Instructions: Find if given data is positive or negative; find if given data is odd or even; find logical ones and zeros in given data.

3. Programs on Arrays for 8086: Addition/subtraction of N numbers; finding largest/smallest number; sort given array in Ascending/Descending order.

4. Programs on String Manipulations for 8086: String length; Displaying a given String; Comparing two strings; Reverse string and check for palindrome.

5. Programs for Digital Clock Design Using 8086: Clock using INT 21H Interrupt; Clock using DOS Interrupt Functions; Clock by reading system time.

6. Interfacing Stepper Motor with 8086: Clockwise operation with variable step-size; Anti-clockwise operation with variable step-size.

7. Interfacing ADC/DAC with 8086: Interface ADC; Interface DAC and generate Square Wave / Triangular Wave / Step signal.

8. Communication between Two Microprocessors: Parallel communication between two microprocessors using 8255; Serial communication between two microprocessor kits using 8251.

9. Programs using Arithmetic and Logical Instructions for 8051: Arithmetic operations (addition, subtraction, multiplication, division); Logical operations (AND, OR, XOR); Programs related to Register Banks.

10. Programs to Verify Timers/Counters of 8051: Delay using Timer0 mode 1 (25ms); Delay using Timer1 mode 0 (50µs); Delay using Counter0 mode 2 (75ms); Delay using Counter1 mode 1 (80µs).

11. UART Operation in 8051: Transfer a character serially at baud rates 9600, 4800, and 2400.

12. Interfacing LCD with 8051: Interface 16×2 LCD to 8051; Interface LCD to 8051 in 4-bit or 8-bit mode.