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

ELECTRICAL AND ELECTRONICS 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 Electrical and Electronics 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 produce accomplished engineers through eminence education and become a recognized center of excellence in academics, research and technological services in the area of Electrical and Electronics Engineering and related inter-disciplinary fields.

Department Mission:

- ❖ To facilitate the students to work with modern tools, state of art technologies, innovative research capabilities besides inculcating leadership abilities.
- ❖ To instigate students for propensity to research and innovation by exposing them to industry and societal needs to creating solutions for contemporary problems.
- ❖ To prepare the students professionally skilful, intellectually proficient and socially responsible.

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 (Electrical and Electronics Engineering) will be able to,

- ❖ Exhibit demonstrable knowledge in the field of Electrical and Electronics Engineering.
- ❖ Transform and excel as solution providers for industry and society challenges.

Programme Educational Objectives (PEOs):

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

- ❖ The graduates exhibit strong knowledge in basic sciences and electrical engineering to enable them for higher learning and employment.
- ❖ To prepare the graduates to design electrical, electronics and computing systems innovatively for mankind.
- ❖ To inculcate the graduate professionalism, ethics, effective communication skills and capability to succeed in multi-disciplinary fields.
- ❖ To motivate the graduates and faculty to do useful and application-oriented research.

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

INDUCTION PROGRAMME

S.No.	Name of the Course	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/D	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 and Mechanical Engineering	3	0	0	3
5.	PC	24PC02101T	Electrical Circuit Analysis – I	2	1	0	3
6.	BS	24BSHB104P	Chemistry Lab	0	0	2	1
7.	HM	24HMHS101P	Communicative English Lab	0	0	2	1
8.	ES	24ES03102P	Engineering Workshop	0	0	3	1.5
9.	PC	24PC02101P	Electrical Circuit Analysis – I Lab	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	24BSHB207T	Complex Variables & Numerical Methods	2	1	0	3
2.	HM	24HMHS204L	Universal Human Values– Understanding Harmony and Ethical Human Conduct	2	1	0	3
3.	PC	24PC02203T	Electromagnetic Field Theory	2	1	0	3
4.	PC	24PC02204T	Electrical Circuit Analysis - II	2	1	0	3
5.	PC	24PC02205T	DC Machines & Transformers	2	1	0	3
6.	PC	24PC02204P	Electrical Circuit Analysis - II and Simulation Lab	0	0	3	1.5
7.	PC	24PC02205P	DC Machines & Transformers Lab	0	0	3	1.5
8.	SE	24SE05201S	Data Structures	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/D	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	24PC04208T	Analog Circuits	2	1	0	3
3.	PC	24PC02206T	Power Systems - I	2	1	0	3
4.	PC	24PC02207T	Induction and Synchronous Machines	2	1	0	3
5.	PC	24PC02208T	Control Systems	2	1	0	3
6.	PC	24PC02207P	Induction and Synchronous Machines Lab	0	0	3	1.5
7.	PC	24PC02208P	Control Systems Lab	0	0	3	1.5
8.	SE	24SE05202S	Python Programming	0	1	2	2
9.	ES	24ES03102T	Design Thinking & Innovation	1	0	2	2
			Total	**11**	**5**	**10**	**21**
Mandatory Community Service Internship (24IPCP301L) 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	24PC02310T	Power Electronics	2	1	0	3
2.	PC	24PC05307T	Introduction to Quantum Technologies and Applications	3	0	0	3
3.	PC	24PC04309T	Digital Circuits	2	1	0	3
4.	PC	24PC02311T	Power Systems - II	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	24PC02310P	Power Electronics Lab	0	0	3	1.5
8.	PC	24PC04309P	Analog and Digital Circuits Lab	0	0	3	1.5
9.	SE	24SEHS201S	Soft Skills	0	1	2	2
10.	ES	24ES04301P	Tinkering Lab	0	0	2	1
11.	IP	24IPIN301L	Evaluation of Community Service Internship	-	-	-	2
			Total	**15**	**4**	**10**	**26**

Professional Elective – I (PE - I)

S. No.	Course code	Name of the Course	L	T	P
1.	24PE04301T	Signals and Systems	2	1	0
2.	24PE02301T	Electrical Safety and Risk Management	3	0	0
3.	24PE02302T	Utilization of Electrical Energy	2	1	0

Open Elective – I (OE - I)

S. No.	Course Code	Name of the Professional Elective	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.	24OE03301T	Sustainable Energy Technologies	ME	3	0	0
4.	24OE04301T	Electronic Circuits	ECE	2	1	0
5.	24OE05301T	Java Programming	CSE	2	1	0
6.	24OE31301T	Fundamentals of Artificial Intelligence	CSE(AI)	2	1	0
7.	24OE05302T	Quantum Technologies and Applications	CSE	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	24PC02312T	Electrical Measurements and Instrumentation	3	0	0	3
2.	PC	24PC04312T	Microprocessors and Microcontrollers	2	1	0	3
3.	PC	24PC02313T	Power System Analysis	2	1	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	24PC02312P	Electrical Measurements and Instrumentation Lab	0	0	3	1.5
8.	PC	24PC04312P	Microprocessors and Microcontrollers Lab	0	0	3	1.5
9.	SE	24SE02301S	Applications of Soft Computing Tools in Electrical Engineering	0	1	2	2
10.	MC	24MCHS309A	**Mandatory Non-credit Course** Paper Writing & IPR	2	0	0	-
			Total	**16+2**	**3**	**08**	**23**
Mandatory Industry Internship (24IPIN403L) of 6 to 8 weeks duration during Summer Vacation							

Professional Elective – II (PE - II)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE02303T	AI&ML for Electrical Engineers	2	1	0
2.	24PE02304T	Programmable Logic Controllers	2	1	0
3.	24PE02305T	Switchgear and Protection	3	0	0

Professional Elective –III (PE - III)

S. No.	Course code	Name of the Course	L	T	P
1.	24PE04309T	Communication Systems	2	1	0
2.	24PE02306T	Electric Drives	2	1	0
3.	24PE02307T	Renewable and Distributed Energy Technologies	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.	24OE03302T	Automation and Robotics	ME	3	0	0
4.	24OE04302T	Digital Electronics	ECE	2	1	0
5.	24OE05303T	Operating Systems	CSE & Allied	3	0	0
6.	24OE31302T	Introduction to Machine Learning		2	1	0
7.	24OEHB304T	Optimization Techniques for Engineers	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	24PC02414T	Power System Operation and Control	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	24SE02402S	Power System and Simulation Lab	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.	24PE04412T	Digital Signal Processing	2	1	0
2.	24PE02408T	Electric Vehicle Technology	3	0	0
3.	24PE02409T	HVDC & FACTS	3	0	0

Professional Elective – V (PE - V)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE02410T	Modern Control Theory	2	1	0
2.	24PE02411T	Switched Mode Power Conversion	3	0	0
3.	24PE02412T	Electrical Distribution System	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.	24OE03403T	3D Printing Technologies	ME	3	0	0
4.	24PC04312T	Microprocessors and Microcontrollers	ECE	2	1	0
5.	24PC05204T	Data Base Management Systems	CSE & Allied	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.	24OE03404T	Total Quality Management	ME	2	1	0
4.	24OE04403T	Transducers and Sensors	ECE	3	0	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 DEGREE OFFERED IN ELECTRICAL & ELECTRONICS ENGINEERING ELECTRIC VEHICLES

S. No.	Course Code	Name of the Course	L	T	P	Credits
1.	24HON0201T	E - Mobility	3	0	0	3
2.	24HON0202T	Battery Management Systems	3	0	0	3
3.	24HON0203T	Special Machines for Electric Vehicles	3	0	0	3
4.	24HON0204T	Grid Interface of Electric Vehicles	3	0	0	3
5.	24HON0205T	EV Charging Technologies	3	0	0	3
6.	24HON0206P	Project on Electric Vehicles	0	0	6	3
		Total	**15**	**0**	**6**	**18**

MINOR DEGREES OFFERED BY THE EEE TO OTHERS ENERGY SYSTEMS

S. No.	Course Code	Name of the Course	L	T	P	Credits
1.	24MES0201T	Energy Audit and Management	3	0	0	3
2.	24MES0202T	Energy Management in Building	3	0	0	3
3.	24MES0203T	Energy Storage Technologies	3	0	0	3
4.	24MES0204T	Energy Scenario and Energy Policy	3	0	0	3
5.	24MES0205T	Waste Energy Management	3	0	0	3
6.	24MES0206P	Project in Energy Systems	0	0	6	3
		Total	**15**	**0**	**6**	**18**

MICRO GRID TECHNOLOGY

S. No.	Course Code	Name of the Course	L	T	P	Credits
1.	24MGT0201T	Futuristic Power Systems	3	0	0	3
2.	24MGT0202T	Power Electronic Converters for Energy Sources	3	0	0	3
3.	24MGT0203T	Microgrid Power and Control Architecture	3	0	0	3
4.	24MGT0204T	Microgrid System Design	3	0	0	3
5.	24MGT0205T	Analysis of Smart Grid Systems	3	0	0	3
6.	24MGT0206P	Project in Micro Grid Technology	0	0	6	3
		Total	**15**	**0**	**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

Course Objectives:

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

CO1: Analyze the consistency and solution of systems of linear equations using matrix methods including echelon forms, normal forms, Gauss-Jordan method, and iterative techniques. (L4)

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

CO3: Interpret the implications of Mean Value Theorems and apply Taylor's and Maclaurin's series to approximate and analyze the behavior of functions in single-variable calculus. (L4)

CO4: Examine functions of several variables using partial derivatives, Jacobians, and series expansions, and determine critical points using methods like Lagrange multipliers. (L4)

CO5: Evaluate double and triple integrals in various coordinate systems and apply them to determine areas and volumes in multivariable contexts. (L4)

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, Eigen Vectors 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 Hall effect. (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) – coordination 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: Semi-conductors:

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)

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Reference Books:

1. Introduction to solid state physics , Charles kittel 7th Edition , 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. 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: 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: Describe the operation of rectifiers, regulators, and amplifiers, and analyse the functional blocks of power supplies and electronic instrumentation systems for signal processing applications. (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

Course Code	Category	Name of 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 & 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.

Course Outcomes (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 vernier scales.

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 reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

Unit III: Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Unit IV: Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Unit V: Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

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

Text Books:

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

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD, 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, dowhile) 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 -5: 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 to 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.

Course Outcomes (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:

1. 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 various 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 implemented 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

iv) 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

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

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: Week 9:

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 deallocation 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) 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, Pearson 1st 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

ii. 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,

iii. Mental health, Spiritual Health, HIV/AIDS,

- Conducting consumer Awareness. Explaining various legal provisions etc.
- Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population

iv. Education.

- 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-world applications.

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 Partial Differential Equations and Homogeneous Linear Partial differential 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's equations- 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 Coefficient's):

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 equations with 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, vector identities.

Unit V: Vector Integration:

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

Reference Books:

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:

Electromagnetic 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 the same 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 industry ready.

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 – Comprehension of these texts. (L5)

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

Unit I: Human Values: Gift of Magi (Short Story)

Listening: Identifying the topic, the context and specific pieces of information by listening to short 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 oneself 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: Parts of Speech, Basic Sentence Structures-forming questions

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

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

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

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

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

Writing: Structure of a paragraph - Paragraph writing (specific topics)

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 groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences-recognizing and interpreting specific context clues; strategies to use text clues for 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: Role plays 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 text stocon vey information, reveal trends /patterns/ relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters, Resumes

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

Vocabulary: Words often confused, Jargons

Unit V: Motivation: The Power of Intrapersonal Communication (An Essay) :

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts

Reading: Reading comprehension.

Writing: Writing structured essays on specific topics.

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

Vocabulary: Technical Jargons

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 (Units 4 & 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 Handbook 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
2. Edition.
3. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.

4. 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 basic knowledge 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. Appuu Kuttan 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
24PC02101T	PC	Electrical Circuit Analysis - I	2	1	0	3

Pre-Requisites: Basic Electrical and Electronic Engineering & Mathematics

Course Objectives:

To develop an understanding of the fundamental laws, elements of electrical circuits and to apply circuit analysis to DC and AC circuits.

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 and Mesh Analysis With independent & Dependent sources. (L3)

CO2: Interpret the various fundamental concepts of magnetic circuits and apply these concepts to analyse the composite magnetic circuits. (L4)

CO3: Determine the various electrical parameters of periodic functions and conduct steady state analysis on RLC Circuits with sinusoidal excitation. (L4)

CO4: Analyse the Series and Parallel Resonance circuits and determine the Q-Factor, BW and Selectivity. (L4)

CO5: Verify the various network theorems by applying KVL & KCL with AC & DC excitations. (L3)

Unit I: Introduction to Electrical Circuits:

Basic Concepts of passive elements of R, L, C and their V-I relations, Sources (dependent and independent), Kirchhoff's laws, Network reduction techniques (series, parallel, series - parallel, star-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis to DC networks with dependent and independent voltage and current sources, node and mesh analysis.

Unit II: Magnetic Circuits:

Basic definition of MMF, flux and reluctance, analogy between electrical and magnetic circuits, Faraday's laws of electromagnetic induction – concept of self and mutual inductance, Dot convention – coefficient of coupling and composite magnetic circuit, analysis of series and parallel magnetic circuits.

Unit III: Single Phase Circuits:

Characteristics of periodic functions, Average value, R.M.S. value, form factor, representation of a sine function, concept of phasor, phasor diagrams, node and mesh analysis. Steady state analysis of R, L and C circuits to sinusoidal excitations-response of pure resistance, inductance, capacitance, series RL circuit, series RC circuit, series RLC circuit, parallel RL circuit, parallel RC circuit.

Unit IV: Resonance and Locus Diagrams:

Series Resonance: Characteristics of a series resonant circuit, Q-factor, selectivity and bandwidth, expression for half power frequencies; Parallel resonance: Q-factor, selectivity and bandwidth; Locus diagram: RL, RC, RLC with R, L and C variables.

Unit V: Network Theorems (DC & AC Excitations):

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem

Text Books:

1. Engineering Circuits Analysis, Jack Kemmerly, William Hayt and Steven Durbin, Tata Mc Graw Hill Education, 2005, 6th edition.
2. Network Analysis, M. E. Van Valkenburg, Pearson Education, 2019, Revised 3rd Edition

Reference Books:

1. Fundamentals of Electrical Circuits, Charles K. Alexander and Mathew N.O. Sadiku, Mc Graw Hill Education (India), 2013, Fifth Edition
2. Electric Circuits (Schaum's outline Series), Mahmood Nahvi, Joseph Edminister, and K. Rao, Mc Graw Hill Education, 2017, 5th Edition.
3. Electric Circuits, David A. Bell, Oxford University Press, 2009, 7th Edition.
4. Introductory Circuit Analysis, Robert L Boylestad, Pearson Publications, 2023, 14th Edition.
5. Circuit Theory: Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., 2018, 7th Revised Edition.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ee81/preview
2. https://nptel.ac.in/courses/108104139
3. https://nptel.ac.in/courses/108106172
4. https://nptel.ac.in/courses/117106108

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	HS	**Communicative English Lab** (Common to all branches of Engineering)	0	0	2	1

Pre-Requisites: Basics of LSRW skills

Course Objectives:

The main objective of introducing this course Communicative English Laboratory is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in basic communication skills and also make them ready to face job interviews.

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 emphasis on LSRW skills. (L2)

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

CO3: Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension. (L4)

CO4: Evaluate and exhibit professionalism in participating in debates and group discussions. (L5)

CO5: Create effective Course Objectives. (L6)

List of Topics:

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. Group Discussions-methods & practice
6. Debates - Methods & Practice
7. PPT Presentations/ Poster Presentation
8. Interview Skills
9. E-mail Writing
10. Resume Writing, Cover letter, SOP

Suggested Software:

- Walden Infotech
- Young India Films

Reference Books:

1. Raman Meenakshi, Sangeeta - Sharma. *Technical Communication*. Oxford Press.2018.
2. Taylor Grant: *English Conversation Practice*, TataMcGraw-HillEducationIndia,2016 3. Hewing's, Martin. Cambridge *Academic English*(B2). CUP,2012.
3. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2^{nd}Ed),Kindle, 2013
4. T. Balasubramanyam, A Textbook of English Phonetics for Indian Students, (3^{rd} Ed) Trinity Press.

B.Tech. – I Year II Semester

Course Code	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 familiarize 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 including fitting, carpentry, foundry and welding. (L3)

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

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

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.

   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets. a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do 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 types of basic electrical circuits and make the following connections.

   a) Parallel and series b) Two-way switch c) Godown lighting

   d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Text Books:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019.
2. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
3. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & 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. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.

B.Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02101P	PC	Electrical Circuit Analysis - I Lab	0	0	3	1.5

Pre-Requisites: Basic Electrical and Electronics Engineering

Course Objectives:

To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics. It also gives practical exposure of the usage of different circuits with different conditions.

Course Outcomes (COs):

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

CO1: Conduct experiment and verify the KCL, KVL, Node analysis, Mesh analysis and various Network theorems. (L3)

CO2: Determine the electrical & magnetic parameters of various electrical & magnetic circuits with experimentation. (L3)

CO3: Verify the Locus diagram of RLC circuits and determine the Q-factor, BW & Selectivity (L3)

List of Experiments:

1. Verification of Kirchhoff's circuit laws.
2. Verification of node and mesh analysis.
3. Verification of network reduction techniques.
4. Determination of cold and hot resistance of an electric lamp
5. Determination of Parameters of a choke coil.
6. Determination of self, mutual inductances, and coefficient of coupling
7. Series and parallel resonance
8. Locus diagrams of R-L (L Variable) and R-C (C Variable) series circuits
9. Verification of Superposition theorem
10. Verification of Thevenin's and Norton's Theorems
11. Verification of Maximum power transfer theorem
12. Verification of Compensation theorem
13. Verification of Reciprocity and Millman's Theorems

Reference Books:

1. Engineering Circuits Analysis, Jack Kemmerly, William Hayt and Steven Durbin, Tata Mc Graw Hill Education, 2005, sixth edition.

2. Network Analysis, M. E. Van Valkenburg, Pearson Education, 2019, Revised Third Edition

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
24BSHB207T	BS	Complex Variables & Numerical Methods	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

CO1: Use limits and Cauchy-Riemann equations to evaluate complex function differentiability, and apply the Milne-Thomson method to construct analytic functions for solving electromagnetic and signal processing problems. (L4)

CO2: Apply contour integration and residue calculus techniques to evaluate complex integrals and solve engineering problems in signal processing and circuit analysis. (L4)

CO3: Apply and compare numerical methods such as Bisection, Regula-Falsi, Newton-Raphson, Jacobi, and Gauss-Seidel to solve nonlinear equations and systems of algebraic equations arising in engineering problems. (L4)

CO4: Apply finite difference methods and interpolation formulas (Newton's forward/backward, Lagrange) to analyse data, and use least squares curve fitting to model engineering data with linear, quadratic, and exponential trends. (L4)

CO5: Apply and compare numerical methods such as Taylor's series, Picard's method, Euler's methods, and Runge-Kutta methods to solve ordinary differential equations encountered in engineering problems. (L4)

Unit I: 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 II: 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.

Unit III: Solution of Algebraic & Transcendental Equations:

Introduction-Bisection Method-Iterative method, Regula-falsi method and Newton Raphson method System of Algebraic equations: Jacoby and Gauss Siedal method.

Unit IV: Interpolation:

Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Curve fitting: Fitting of straight line, second-degree and Exponential curve by method of least squares.

Unit V: Solution of Initial Value Problems to Ordinary Differential Equations:

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's and modified Euler's methods-Runge-Kutta methods (second and fourth order).

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2017, 44thEdition
2. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2018, 10thEdition.
2. B.V. Ramana, Higher Engineering Mathematics, by Mc Graw Hill publishers
3. R. K. Jainand S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science International
4. Ltd.,20215th Edition (9th reprint).

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ma14/preview
2. https://onlinecourses.nptel.ac.in/noc20_ma50/preview
3. http://nptel.ac.in/courses/111105090

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):

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

CO1: Analyze the interrelationship between right understanding, human relationships, and physical facilities to identify how these contribute to holistic development and fulfilment 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:

1. 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
2. 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 978-93-8703453-2

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&%20 Handouts/ UHV%20 Handout%201Introduction%20to%20Value%20Education.pdf*

2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202Harmony%20in%20the%20Human%20Being.pdf
3. *https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203Harmony%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%205Harmony%20in%20the%20Nature%20and%20Existence.pdf*
6. *https://fdp-si.aicte-india.org/download/FDP Teaching Material/3-days%20FDPSI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3S2A%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-humanvalues/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
23PC02203T	PC	Electromagnetic Field Theory	2	1	0	3

Pre-Requisites: Fundamentals of Physics and Mathematics

Course Objectives: The objective of the course is to

- To understand the concepts of vector analysis, basic principles of electrostatics.
- To understand the concepts of conductors and Dielectrics.
- To understand the basic principles of magneto statics for time invariant and time varying fields.
- To understand the concepts of self and mutual inductance.
- To understand the concepts of time varying fields.

Course Outcomes (COs):

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

CO1: Apply vector calculus and coordinate systems to analyse electrostatic fields and compute electric field, potential, and flux using Maxwell's equations, Gauss's law, and Laplace/Poisson equations. (L4)

CO2: Analyse the behaviour of conductors, dielectrics, and capacitors in electrostatic fields, and apply concepts of current density, polarization, boundary conditions, and energy storage to solve field-related problems. (L4)

CO3: Apply Biot-Savart's and Ampere's laws to compute magnetic fields, and analyse magnetic forces, dipoles, and torques in current-carrying conductors and moving charges. (L4)

CO4: Determine self and mutual inductance for standard geometries and evaluate energy stored and energy density in magnetic fields. (L4)

CO5: Explain electromagnetic induction and derive Maxwell's equations for time-varying fields, including displacement current, and compute energy flow using Poynting theorem and Poynting vector. (L4)

Unit 1: Vector Analysis:

Vector Algebra: Scalars and Vectors, Unit vector, Vector addition and subtraction, and distance vectors, Vector multiplication, Components of a vector.

Coordinate Systems: Rectangular, Cylindrical and Spherical coordinate systems.

Vector Calculus: Differential length, Area and Volume. Del operator, Gradient of a scalar, Divergence of a vector and Divergence theorem (definition only). Curl of a vector and Stoke's theorem (definition only), Laplacian of a scalar.

Electrostatics: Coulomb's law and Electric field intensity (EFI) – EFI due to Continuous charge distributions (line and surface charge), Electric flux density, Gauss's law (Maxwell's first equation, $.D=\rho_v$), Applications of Gauss's law, Electric Potential, Work done in moving a point charge in an electrostatic field (second Maxwell's equation for static electric fields, $\nabla XE=0$), Potential gradient, Laplace's and Poison's equations.

Unit II: Conductors – Dielectrics and Capacitance:

Behaviour of conductor in Electric field, Electric dipole and dipole moment – Potential and EFI due to an electric dipole, Torque on an Electric dipole placed in an electric field, Current density conduction and convection current densities, Ohm's law in point form, Behaviour of conductors in an electric field, Polarization, dielectric constant and strength, Continuity equation and relaxation time, Boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space, Capacitance of parallel plate, coaxial and spherical capacitors, Energy stored and density in a static electric field, Coupled and decoupled capacitors.

Unit III: Magneto statics, Ampere's Law and Force in Magnetic Fields:
Biot-Savart's law and its applications viz. Straight current carrying filament, circular, square, rectangle and solenoid current carrying wire – Magnetic flux density and Maxwell's second Equation ($\nabla.B=0$), Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor, point form of Ampere's circuital law, Maxwell's third equation $\nabla XH=J$). Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, Magnetic dipole, Magnetic torque, and moment.

Unit IV: Self and Mutual Inductance:
Self and mutual inductance – determination of self-inductance of a solenoid, toroid, coaxial cable and mutual inductance between a straight long wire and a square loop wire in the same plane – Energy stored and energy density in a magnetic field.

Unit V: Time Varying Fields:
Faraday's laws of electromagnetic induction, Maxwell's fourth equation, integral and point forms of Maxwell's equations, statically and dynamically induced EMF, Displacement current, Modification of Maxwell's equations for time varying fields, Poynting theorem and Poynting vector

Textbook:

1. "Elements of Electromagnetics" by Matthew N O Sadiku, Oxford Publications, 7th edition, 2018.
2. "Engineering Electromagnetics" by William H. Hayt& John. A. Buck Mc. Graw-Hill, 7th
3. Editon.2006.

Reference Books:

1. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt. Ltd, 2nd edition.
2. "Electromagnetic Field Theory" by Yaduvir Singh, Pearson India, 1st edition, 2011.
3. "Fundamentals of Engineering Electromagnetics" by Sunil Bhooshan, Oxford University Press, 2012.
4. Schaum's Outline of Electromagnetics by Joseph A. Edminister, Mahamood Navi, 4th Edition, 2014.

Web Resources:

1. https://archive.nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/117103065

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02204T	PC	Electrical Circuit Analysis - II	2	1	0	3

Pre-Requisites: Fundamentals of Electrical Circuits

Course Objectives:

- Understand and analyse balanced and unbalanced three-phase electrical circuits.
- Apply Laplace transform techniques for circuit analysis involving transients in RLC networks.
- Evaluate network parameters and analyse two-port networks using different parameter representations.
- Apply Fourier series techniques to analyse electrical circuits under periodic non-sinusoidal excitations.
- Design and analyse passive filters including low-pass, high-pass, band-pass, and band-stop types.

Course Outcomes (COs):

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

CO1: Analyse voltages, currents, and power relationships in balanced and unbalanced three-phase circuits by examining star and delta connections, phase sequence, and measurement techniques. (L4)

CO2: Analyse transient responses of R-L, R-C, and R-L-C circuits using Laplace transforms with various excitations and solve related problems. (L4)

CO3: Evaluate two-port network parameters, perform conversions between parameter sets, and solve problems on series, parallel, and cascaded network interconnections. (L4)

CO4: Analyse periodic waveforms using Fourier series to interpret harmonic content, and examine their effects on effective value, average value, and power factor in electrical circuits. (L4)

CO5: Design and evaluate constant-k filters and identify appropriate filter types for signal processing applications. (L4)

Unit I: Analysis of Three Phase Balanced Circuits:

Phase sequence, star and delta connection of sources and loads, relation between line and phase quantities, analysis of balanced three phase circuits, measurement of active and reactive power.

Analysis of Three Phase Unbalanced Circuits:

Loop method, Star-Delta transformation technique, two-wattmeter method for measurement of three phase power.

Unit II: Laplace Transforms:

Definition and Laplace transforms of standard functions– Shifting theorem – Transforms of derivatives and integrals, Inverse Laplace transforms and applications.

Transient Analysis: Transient response of R-L, R-C and R-L-C circuits (Series and parallel combinations) for D.C. and sinusoidal excitations – Initial conditions - Solution using differential equation approach and Laplace transform approach.

Unit III: Network Parameters:

Impedance parameters, Admittance parameters, Hybrid parameters, Transmission (ABCD) parameters, conversion of Parameters from one form to other, Conditions for Reciprocity and Symmetry, Interconnection of Two Port networks in Series, Parallel and Cascaded configurations-problems.

Unit IV: Analysis of Electric Circuits with Periodic Excitation:

Fourier series and evaluation of Fourier coefficients, Trigonometric and complex Fourier series for periodic waveforms, Application to Electrical Systems – Effective value and average value of non-sinusoidal periodic waveforms, power factor, effect of harmonics.

Unit V: Filters:

Classification of filters-Low pass, High pass, Band pass and Band Elimination filters, Constant-k filters -Low pass and High Pass, Design of Filters.

Text Books:

1. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, 8th Edition McGraw-Hill, 2013
2. Fundamentals of Electric Circuits, Charles K. Alexander, Mathew N. O. Sadiku, 3rd Edition, Tata McGraw-Hill, 2019.

Reference Books:

1. Network Analysis, M. E. Van Valkenburg, 3rd Edition, PHI, 2019.
2. Network Theory, N. C. Jagan and C. Lakshminarayana, 1st Edition, B. S. Publications, 2012.
3. Circuits and Networks Analysis and Synthesis, A. Sudhakar, Shyam Mohan S. Palli, 5th Edition, Tata McGraw-Hill, 2017.
4. Engineering Network Analysis and Filter Design (Including Synthesis of One Port Networks)- Durgesh C. Kulshreshtha Gopal G. Bhise, Prem R. Chadha, Umesh Publications 2012.
5. Circuit Theory: Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., 2018, 7th Revised Edition.

Web Resources:

1. https://archive.nptel.ac.in/courses/117/106/117106108/
2. https://archive.nptel.ac.in/courses/108/105/108105159/

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02205T	PC	DC Machines & Transformers	2	1	0	3

Pre-Requisites: Fundamentals of Electrical Circuits and Magnetic Circuits

Course Objectives:

- Understand the construction, principle of operation, EMF equation, characteristics, and applications of DC generators and DC motors.
- Learn the starting methods, speed control techniques, efficiency, and testing procedures of DC machines.
- Explore the construction, working principles, phasor diagrams, equivalent circuit, losses, and efficiency of single-phase transformers.
- Gain knowledge about testing methods of transformers, separation of losses, and parallel operation with equal and unequal voltage ratios.
- Study various three-phase transformer connections, vector groups, parallel operation, transients, and special connections like Scott connection

Course Outcomes (COs):

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

CO1: Describe the construction, operation, EMF equation, excitation methods, and characteristics of DC generators. (L4)

CO2: Analyse DC motor characteristics, efficiency, starting methods, speed control techniques, and testing procedures. (L4)

CO3: Develop phasor diagrams, equivalent circuits, and calculate regulation and efficiency of single-phase transformers. (L4)

CO4: Perform open circuit, short circuit, and Sumpner's tests on transformers and evaluate parallel operation conditions. (L5)

CO5: Analyze various three-phase transformer connections, vector groups, and special transformer arrangements like Scott connection. (L4)

Unit I: DC Generators:

Construction and principle of operation of DC machines – EMF equation for generator –Excitation techniques– characteristics of DC generators –applications of DC Generators, Back-emf and torque equations of DC motor – Armature reaction and commutation, Applications.

Unit II: Starting, Speed Control and Testing of DC Machines:

Characteristics of DC motors – losses and efficiency – applications of DC motors. Necessity of a starter – starting by 3-point and 4-point starters – speed control by armature voltage and field current control – testing of DC machines – brake test, Swinburne's test –Hopkinson's test–Field Test.

Unit III: Single-phase Transformers:

Introduction to single-phase Transformers (Construction and principle of operation)–emf equation – operation on no-load and on load –lagging, leading and unity power factors loads–phasor diagrams–equivalent circuit –regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – all day efficiency, Applications.

Unit IV: Testing of Transformers:

Open Circuit and Short Circuit tests – Sumpner's test – separation of losses— Parallel operation with equal and unequal voltage ratios– auto transformer – equivalent circuit –comparison with two winding transformers.

Unit V: Three-Phase Transformers:

Polyphase connections- Y/Y, Y/Δ, Δ/Y, Δ/Δ, open Δ and Vector groups – third harmonics inphase voltages– Parallel operation–three winding transformers- transients in switching –offload and on load tap changers–Scott connection.

Text Books:

1. Electrical Machinery by Dr. P S Bimbhra, 7th edition, Khanna Publishers, NewDelhi,1995.
2. Performance and analysis of AC machines by M.G. Say, CBS, 2002.

Reference Books:

1. Electrical Machines by D. P.Kothari, I .J .Nagarth, McGraw Hill Publications, 5thedition
2. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education2011.
3. Generalized Theory of Electrical Machines by Dr. P S Bimbhra, 7th Edition, Khanna Publishers,2021.
4. Theory & Performance of Electrical Machines by J.B.Gupta, S.K.Kataria & Sons, 2007.
5. Electric Machinery by Fitzgerald, A.E.,Kingsley, Jr.,C.,&Umans, S. D, 7th edition, McGraw-Hill Education, 2014.

Web Resources:

1. nptel.ac.in/courses/108/105/108105112
2. nptel.ac.in/courses/108/105/108105155

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02204P	PC	Electrical Circuit Analysis - II and Simulation Lab	0	0	3	1.5

Pre-Requisites: Fundamentals of Electrical Circuits

Course Objectives:

- To enable students to experimentally verify circuit laws and theorems using simulation tools.
- To provide practical exposure to the analysis of three-phase power systems (balanced and unbalanced).
- To develop proficiency in determining network parameters such as Z, Y, ABCD, and hybrid parameters.
- To facilitate the understanding of resonance and transient behaviour in RLC circuits.
- To encourage students to analyze and simulate complex electrical networks with software tools.

Course Outcomes (COs):

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

CO1: Measure and compute active and reactive power in balanced and unbalanced three- phase circuits using suitable methods. (L3)

CO2: Determine and interpret Z, Y, ABCD, and hybrid parameters of two-port networks using experimental techniques. (L4)

CO3: Apply simulation tools to demonstrate and solve circuits using basic electrical laws and theorems. (L3)

CO4: Analyse the behaviour of RLC circuits during resonance and transient conditions through simulation. (L4)

CO5: Analyse the effects of self-inductance and mutual inductance using circuit simulation tools. (L4)

List of Experiments:

Any 10 of the following Experiments are to be Conducted:

1. Measurement of Active Power and Reactive Power for balanced loads.
2. Measurement of Active Power and Reactive Power for unbalanced loads.
3. Determination of Z and Y parameters.
4. Determination of ABCD and hybrid parameters
5. Verification of Kirchhoff's current law and voltage law using simulation tools.
6. Verification of mesh and nodal analysis using simulation tools.
7. Verification of super position and maximum power transfer theorems using simulation tools.
8. Verification of Reciprocity and Compensation theorems using simulation tools.
9. Verification of Thevenin's and Norton's theorems using simulation tools.
10. Verification of series and parallel resonance using simulation tools.
11. Simulation and analysis of transient response of RL, RC and RLC circuits.
12. Verification of self-inductance and mutual inductance by using simulation tools.

Web Resources:

1. https://ems-iitr.vlabs.ac.in/List%20of%20experiments.html

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02205P	PC	DC Machines & Transformers Lab	0	0	3	1.5

Pre-Requisites: DC Machines & Transformers

Course Objectives:

- To determine the magnetization characteristics and critical conditions of DC generators.
- To understand and analyze the methods of speed control and performance evaluation of DC motors.
- To conduct various tests on DC machines to predict efficiency and evaluate machine performance.
- To perform different tests on single-phase transformers and determine their equivalent circuit parameters and efficiency.
- To examine the special operations of transformers such as parallel operation, Scott connection, and separation of core losses.

Course Outcomes (COs):

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

CO1: Determine the critical resistance, critical speed, and magnetization characteristics of a DC generator. (L3)

CO2: Perform speed control and load tests on DC motors and evaluate their performance through testing methods. (L3)

CO3: Conduct testing methods like Swinburne's, Hopkinson's, and field tests on DC machines to predict efficiency. (L4)

CO4: Perform open circuit and short circuit tests on single-phase transformers and evaluate equivalent circuits and efficiency. (L3)

CO5: Analyse the advanced operations of transformers such as Scott connection, parallel operation, and separation of core losses. (L4)

List of Experiments:

Any 10 of the following experiments are to be conducted:

1. Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.
2. Speed control of DC shunt motor by Field Current and Armature Voltage Control.
3. Brake test on DC shunt motor- Determination of performance curves.
4. Swinburne's test - Predetermination of efficiencies as DC Generator and Motor.
5. Hopkinson's test on DC shunt Machines.
6. Load test on DC compound generator-Determination of characteristics.
7. Load test on DC shunt generator-Determination of characteristics.
8. Fields test on DC series machines-Determination of efficiency.
9. Brake test on DC compound motor-Determination of performance curves.
10. OC & SC tests on single phase transformer.
11. Sumpner's test on single phase transformer.
12. Scott connection of transformers.
13. Parallel operation of Single-phase Transformers.
14. Separation of core losses of a single-phase transformer.

Web Resources:

1. https://ems-iitr.vlabs.ac.in/List%20of%20experiments

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE05201S	SE	Data structures	0	1	2	2

Pre-Requisites:

- Knowledge in Computer Programming.
- Background in programming C

Course Objectives:

- Provide knowledge on advance data structures frequently used in Computer Science domain
- Develop skills in algorithm design techniques popularly used
- Understand the use of various data structures in the algorithm design

Course Outcomes:

CO1: Apply array operations, implement searching & sorting algorithms and analyse their efficiency using practical examples. (L4)

CO2: Develop programs to manipulate linked lists and solve real-world problems such as handling student information and adding polynomials. (L4)

CO3: Implement stack operations using arrays and linked lists, and develop algorithms for Expression evaluation, backtracking, and list reversal including infix-to-postfix conversion and postfix evaluation. (L4)

CO4: Implement queue and deque operations using arrays and linked lists, including circular queues, and develop solutions for scheduling and related applications. (L4)

CO5: Implement binary tree and binary search tree operations including insertion, deletion, and traversals using linked lists. (L4)

Unit I: Introduction to Data Structures:

Definition and importance of Data structures, Abstract data types (ADTs) and its specifications, Arrays: Introduction, 1-D, 2-D Arrays, accessing elements of array, Row Major and Column Major storage of Arrays, Searching Techniques: Linear & Binary Search, Sorting Techniques: Bubble sort, Selection sort, Quick sort.

Sample experiments:

1. Program to find min & max element in an array.
2. Program to implement matrix multiplication.
3. Find an element in given list of sorted elements in an array using Binary search.
4. Implement Selection and Quick sort techniques.

Unit II: **Linked Lists**:

Singly linked lists: representation and operations, doubly linked lists and circular linked lists, Comparing arrays and linked lists, Applications of linked lists.

Sample Experiments:

1. Write a program to implement the following operations.
   a. Insert b. Deletion c. Traversal
2. Write a program to store name, roll no, and marks of students in a class using circular double linked list.
3. Write a program to perform addition of given two polynomial expressions using linked list.

Unit III: **Stacks**:

Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, Applications of stacks in expression evaluation, backtracking, reversing list etc.

Sample experiments:

1. Implement stack operations using a. Arrays b. Linked list
2. Convert given infix expression into post fix expression using stacks.
3. Evaluate given post fix expression using stack.
4. Write a program to reverse given linked list using stack.

Unit IV: Queues:

Introduction to queues: properties and operations, Circular queues, implementing queues using arrays and linked lists, Applications of queues scheduling, etc.

Deques: Introduction to deques (double-ended queues), Operations on deques and their applications.

Sample experiments:

1. Implement Queue operations using a. Arrays b. Linked list
2. Implement Circular Queue using a. Arrays b. Linked list
3. Implement Dequeue using linked list.

UNIT V: Trees:

Introduction to Trees, Binary trees and traversals, Binary Search Tree – Insertion, Deletion & Traversal

Sample experiments:

1. Implement binary tree traversals using linked list.
2. Write program to create binary search tree for given list of integers. Perform in-order traversal of the tree. Implement insertion and deletion operations.

Text Books:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.
2. Fundamentals of data structures in C, Ellis Horowitz, SartajSahni, Susan Anderson Freed, Silicon Press, 2008

Reference Books:

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3. Problem Solving with Algorithms and Data Structures by Brad Miller and David Ranum
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick

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 human health – 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.

Web Sources:
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 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 all branches of Engineering)	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:

1. https://www.slideshare.net/123ps/managerial-economics-ppt
2. https://www.slideshare.net/rossanz/production-and-cost-45827016 .
3. https://www.slideshare.net/darkyla/business-organizations-19917607
4. 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 CE, 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):

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

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

Text Books:

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

Reference Books:

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

Online Learning Resources:

1. https://www.slideshare.net/Knight1040/organizational- culture9608857
2. https://www.slideshare.net/AbhayRajpoot3/motivation - 165556714
3. https://www.slideshare.net/harshrastogi1/group-dynamics-159412405
4. 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 CE, 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:

1. https://www.slideshare.net/ShompaDhali/business-environment-53111245
2. https://www.slideshare.net/rbalsells/fiscal-policy-ppt
3. https://www.slideshare.net/aguness/monetary-policy-presentationppt
4. https://www.slideshare.net/DaudRizwan/monetary-policy-of-india-69561982
5. https://www.slideshare.net/ShikhaGupta31/indias-trade-policyppt
6. https://www.slideshare.net/viking2690/wto-ppt-60260883
7. https://www.slideshare.net/prateeknepal3/ppt-mo

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04208T	PC	Analog Circuits	2	1	0	3

Pre-Requisites: Basic Knowledge on Mathematics, electrical concepts and semiconductor devices

Course Objectives:

- Understanding and applying fundamental principles to design and analyze analog circuits.
- Understanding the concepts like biasing, amplifier design, feedback, and the behaviour of various electronic components, such as diodes, transistors, and op-amps.
- Design and implementation of applications of IC's and analyse various ADC's and DAC's
- Design electronic circuits for a given specification.

Course Outcomes (COs):

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

CO1: Design and implement diode clipping and clamping circuits, analyze their transfer characteristics, and apply DC biasing techniques for BJTs to establish stable operating points with thermal stability. *(L4)*

CO2: Apply small-signal modeling techniques using h-parameters to analyze BJT amplifier configurations and their frequency responses, and evaluate the characteristics and effects of different types of negative feedback in amplifiers. (L4)

CO3: Design various oscillator circuits using the Barkhausen criterion, and demonstrate the characteristics and applications of the 741 Op-Amp. (L3)

CO4: Design and implement basic Op-Amp applications including instrumentation amplifiers, converters, and waveform generators, and analyze comparators and multivibrator circuits. (L4)

CO5: Explain and apply the operation & applications of 555 timers and phase-locked loops, and design and analyse various ADCs & DACs along with their specifications. (L4)

Unit I: Diode clipping and Clamping Circuits:

Diode clippers, clipping at two independent levels, Transfer characteristics of clippers, clamping circuit operation.

DC biasing of BJTs: Load lines, Operating Point, Bias Stability, Collector-to-Base Bias, Self-Bias, Stabilization against Variations in V_{BE} and β for the Self-Bias Circuit, Bias Compensation, Thermal Runaway, Thermal Stability.

Unit II: Small Signals Modeling of BJT:

Analysis of a Transistor Amplifier Circuit using h- parameters, Simplified CE Hybrid Model, Analysis of CE, CC, CB Configuration using Approximate Model, Frequency Response of CE and CC amplifiers.

Feedback Amplifiers: Classification of Amplifiers, the Feedback Concept, General Characteristics of Negative-Feedback Amplifiers, Effect of Negative Feedback upon Output and Input Resistances, Voltage-Series Feedback, Current-Series Feedback, Current-Shunt Feedback, Voltage-Shunt Feedback.

Unit III: Oscillator Circuits:

Barkhausen Criterion of oscillation, Oscillator operation, R-C phase shift oscillator, Wien bridge Oscillator, Crystal Oscillator.

Operational Amplifiers: Introduction, Basic information of Op-Amp, Ideal Operational Amplifier, Block Diagram Representation of Typical Op-Amp, OP-Amps Characteristics: Introduction, DC and AC characteristics, 741 op-amp & its features.

Unit IV: OP-AMPS Applications:

Introduction, Basic Op-Amp Applications, Instrumentation Amplifier, AC Amplifier, V to I and I to V Converter, Sample and Hold Circuit, Log and Antilog Amplifier, Multiplier and Divider, Differentiator, integrator.

Comparators and Waveform Generators: Introduction, Comparator, Square Wave Generator, Monostable Multivibrator, Triangular Wave Generator, Sine Wave Generators.

Unit V: Timers and Phase Locked Loop:

Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger, PLL block schematic, principles and description of individual blocks, 565 PLL, Applications of VCO (566).

Digital To Analog and Analog to Digital Converters: Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A-D Converters – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

Text Books:

1. Electronic Devices and Circuits- J. Millman, C.Halkias, Tata Mc-Graw Hill, 2^{nd} Edition, 2010.
2. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2^{nd} Edition, 2003.

Reference Books:

1. Electronic Devices and Circuit Theory – Robert L.Boylestad and Lowis Nashelsky, Pearson Edition, 2021.
2. Electronic Devices and Circuits–G.K. Mithal, Khanna Publisher, 23^{rd} Edition, 2017.
3. Electronic Devices and Circuits – David Bell, Oxford, 5^{th}Edition, 2008.
4. Electronic Principles–Malvino, Albert Paul, and David J. Bates, McGraw-Hill/Higher Education, 2007.
5. Operational Amplifiers and Linear Integrated Circuits– Gayakwad R.A, Prentice Hall India, 2002.
6. Operational Amplifiers and Linear Integrated Circuits –Sanjay Sharma, Kataria & Sons, 2^{nd} Edition, 2010.
7. Design of Analog CMOS Integrated Circuits - Behzad Razavi

Web Resources:

1. https://nptel.ac.in/courses/122106025.
2. https://nptel.ac.in/courses/108102112.

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02206T	PC	Power Systems - I	2	1	0	3

Pre-Requisites: Basics of Electrical Systems

Course Objectives:

- To introduce the principles and layout of hydroelectric and thermal power stations including major components and operation.
- To provide knowledge on nuclear power generation, reactor types, radiation safety, and waste disposal methods.
- To impart an understanding of air and gas insulated substations, their configurations, and equipment layouts.
- To explain the design and operation of distribution systems and underground cables with associated technical parameters.
- To analyze economic aspects of power generation and compare various tariff structures used in power systems.

Course Outcomes (COs):

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

CO1: Interpret the layout and operation of hydroelectric and thermal power plants, and examine the function and interrelation of major components. (L4)

CO2: Explain the working principles of nuclear power stations, reactor types, and evaluate radiation effects and waste management. (L4)

CO3: Illustrate the layout of air-insulated and gas-insulated substations and compare various bus bar arrangements. (L3)

CO4: Analyse the components and design considerations of distribution systems and underground cables. (L4)

CO5: Examine economic aspects of power generation and compare different tariff methods to understand their impact on energy billing efficiency. (L4)

Unit I: Hydroelectric Power Stations & Thermal Power Stations:

Selection of site, general layout of a hydroelectric power plant with brief description of major components and principle of operation

Selection of site, general layout of a thermal power plant. Brief description of components: boilers, super heaters, economizers and electrostatic precipitators, steam turbines:
impulse and reaction turbines, condensers, feed water circuit, cooling towers and chimney.

Unit II: Nuclear Power Stations:

Location of nuclear power plant, working principle, nuclear fission, nuclear fuels, nuclear chain reaction, nuclear reactor components: moderators, control rods, reflectors and coolants, types of nuclear reactors and brief description of PWR, BWR and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.

Unit III: Substations:

Air Insulated Substations – indoor & outdoor substations, substations layouts of 33/11 kV showing the location of all the substation equipment. Bus bar arrangements in the substations: simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams.

Gas Insulated Substations (GIS) – advantages of gas insulated substations, constructional aspects of GIS, comparison of air insulated substations and gas insulated substations.

Unit IV: Distribution Systems & Underground Cables:

Classification of Distribution systems, A.C Distribution, overhead versus Underground system, Connection schemes of Distribution system, Requirements of Distribution system, Design considerations in Distribution system.

Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable. Capacitance of single and 3-Core belted Cables.

Unit V: Economic Aspects & Tariff:

Economic Aspects – load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor and plant use factor, base and peak load plants.

Tariff Methods– Costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, block rate, two-part, three–part, and power factor tariff methods, Time of Day (ToD) tariff and Time of Use (ToU) tariff.

Text Books:

1. S. N. Singh, Electric Power Generation, Transmission and Distribution, PHI Learning Pvt Ltd, New Delhi, 2nd Edition, 2010
2. J. B. Gupta, Transmission and Distribution of Electrical Power, S. K. Kataria and sons, 10th Edition, 2012

Reference Books:

1. I.J.Nagarath& D.P. Kothari, Power System Engineering, McGraw-Hill Education, 3rd Edition, 2019.
2. C.L.Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Publishers, 6th Edition, 2018.
3. V. K. Mehta and Rohit Mehta, Principles of Power System, S. Chand, 4th Edition, 2005.
4. Turan Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 1985.
5. Handbook of switchgear, BHEL, McGraw-Hill Education, 2007.

Web Resources:

1. https://nptel.ac.in/courses/108102047

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02207T	PC	Induction and Synchronous Machines	2	1	0	3

Pre-Requisites: Basics of Electrical Machines

Course Objectives:

- To understand the construction, principle of operation, and performance characteristics of three-phase induction motors.
- To analyze the testing methods, torque-slip behaviour, starting, and speed control techniques of three-phase induction motors.
- To comprehend the working principles, equivalent circuits, and starting methods of singlephase induction motors and special motors.
- To explain the construction, EMF equation, armature reaction, voltage regulation, and synchronization of synchronous generators.
- To analyze the operation, excitation effects, power development, and applications of synchronous motors.

Course Outcomes (COs):

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

CO1: Explain the construction and operation of squirrel cage and slip-ring induction motors, and examine their equivalent circuit, phasor diagram, and performance characteristics under various operating conditions. (L4)

CO2: Analyze the performance of three-phase induction motors through testing and evaluate methods of starting and speed control. (L4)

CO3: Explain the construction and working principles of single-phase induction motors and assess starting methods, equivalent circuits, and applications. (L4)

CO4: Describe the construction and working of synchronous generators and examine EMF generation, armature reaction, voltage regulation methods, and parallel operation techniques. (L4)

CO5: Explain the operating principles of synchronous motors, describe the effect of excitation on current and power factor, and interpret power development, hunting, starting methods, and applications. (L4)

Unit I: 3-phase Induction Motors:

Construction of Squirrel cage and Slip-ring induction motors– production of rotating magnetic field – principle of operation – rotor emf and rotor frequency – rotor current and power factor at standstill and during running conditions– rotor power input, rotor copper loss and mechanical power developed and their inter-relationship –equivalent circuit – phasor diagram, Applications.

Unit II: Performance of 3-Phase Induction Motors:

Torque equation – expressions for maximum torque and starting torque – torque-slip characteristics – double cage and deep bar rotors –No load, Brake test and Blocked rotor tests– circle diagram for predetermination of performance- methods of starting –starting current and torque calculations -speed control of induction motor with V/f control method, rotor resistance control and rotor emf injection technique –crawling and cogging – induction generator operation.

Unit III: Single Phase Motors:

Single phase induction motors – constructional features – double revolving field theory, Cross field theory – equivalent circuit- starting methods: capacitor start capacitor run, capacitor start induction run, split phase & shaded pole, AC series motor, Applications.

Unit IV: Synchronous Generator:

Constructional features of non-salient and salient pole type alternators- armature windings – distributed and concentrated windings – distribution& pitch factors – E.M.F equation –armature reaction – voltage regulation by synchronous impedance method – MMF method and Potier triangle method –two reaction analysis of salient pole machines -methods of synchronization- Slip test – Parallel operation of alternators.

Unit V: Synchronous Motor:

Synchronous motor principle and theory of operation – Effect of excitation on current and power factor– synchronous condenser –expression for power developed –hunting and its suppression – methods of starting, Applications.

Text Books:

1. Electrical Machinery, Dr. P. S. Bhimbra, Khanna Publishing, 2021, First Edition.
2. Performance and analysis of AC machines by M.G. Say, CBS, 2002.

Reference Books:

1. Electrical machines, D.P. Kothari and I.J. Nagrath, McGraw Hill Education, 2017, Fifth Edition.
2. Theory & Performance of Electrical Machines by J. B. Gupta, S.K.Kataria& Sons,2007.
3. Electric Machinery, A. E. Fitzgerald, Charles kingsley, Stephen D. Umans, McGraw- Hill, 2020, Seventh edition.

Web Resources:

1. https://nptel.ac.in/courses/108/105/108105131
2. https://nptel.ac.in/courses/108106072

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02208T	PC	Control Systems	2	1	0	3

Pre-Requisites: Laplace Transforms & inverse Laplace Transforms, Matrix basics and circuit analysis concepts.

Course Objectives:

- To introduce control system fundamentals, types, modeling techniques and servo mechanisms.
- To analyze the time-domain response of first and second order systems and design basic controllers.
- To examine the stability of control systems using Routh-Hurwitz and root locus techniques.
- To perform frequency domain analysis using Bode, Polar and Nyquist plots and apply compensation techniques.
- To understand state-space modeling, analyze system behavior using state-space methods, and assess controllability and observability.

Course Outcomes (COs):

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

CO1: Differentiate between open-loop and closed-loop control systems, develop mathematical models using differential equations and transfer functions, and apply block diagram and signal flow graph techniques for system analysis. (L4)

CO2: Analyse time domain responses of first and second order systems and design controllers to meet time domain specifications. (L4)

CO3: Describe system stability, use Routh's criterion and root locus methods to determine the impact of poles and zeros on system behaviour. (L4)

CO4: Determine frequency domain characteristics of control systems using Bode, Nyquist and Polar plots and design compensators. (L4)

CO5: Explain state variables and state models, derive transfer functions from state equations, and analyse system response, controllability, and observability using state-space methods. (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. Principle of operation of DC and AC Servo motor, Transfer function of DC servo motor - AC servo motor, 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, P, PI, PID Controllers.

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 – Lag, Lead, and Lag-Lead Compensator design in frequency Domain.

Unit V: State Space Analysis of Continuous Systems:

Concepts of state, state variables and state model, state models - differential equations & Transfer function models - Block diagrams. Diagonalizations, 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, Duality between controllability and observability.

Text Books:

1. Modern Control Engineering by Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 5th edition, 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, Mc Graw 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, Mc Graw 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.

Web Resources:

1. https://nptel.ac.in/courses/108102043
2. https://nptel.ac.in/courses/108106098.

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02207P	**PC**	**Induction and Synchronous Machines Lab**	**0**	**0**	**3**	**1.5**

Pre-Requisites: Basics of Electrical Machines

Course Objectives:

- To evaluate the performance characteristics of three-phase and single-phase induction motors through various tests.
- To understand speed control methods and starting techniques of induction motors.
- To conduct performance and regulation tests on synchronous generators and motors.
- To perform parallel operation of alternators and efficiency determination of synchronous and AC series motors.
- To analyze experimental results to understand the behaviour and performance improvements of AC machines.

Course Outcomes (COs):

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

CO1: Perform load tests, construct circle diagrams, and control the speed of induction motors to Assess their performance. (L3)

CO2: Evaluate starting techniques and methods for improving the efficiency of induction motors. (L3)

CO3: Conduct tests using various methods to determine regulation and reactance parameters of synchronous generators. (L4)

CO4: Analyse synchronous motor characteristics and performance through V-curves and efficiency tests. (L4)

CO5: Perform parallel operation of alternators and determine the efficiency of AC series motors under practical conditions. (L4)

List of Experiments:

Any 10 of the following experiments are to be conducted:

1. Brake test on three phase Induction Motor.
2. Circle diagram of three phase induction motor.
3. Speed control of three phase induction motor by V/f method.
4. Rotor resistance starter for slip ring Induction Motor.
5. Equivalent circuit of single-phase induction motor.
6. Power factor improvement of single-phase induction motor by using capacitors.
7. Load test on single phase induction motor.
8. Regulation of a three -phase alternator by synchronous impedance &MMF methods.
9. Regulation of three-phase alternator by Potier triangle method.
10. V and Inverted V curves of a three-phase synchronous motor.
11. Determination of Xd, Xq& Regulation of a salient pole synchronous generator.
12. Determination of efficiency of three phase alternator by loading with three phase induction motor.
13. Parallel operation of three-phase alternator under no-load and load conditions.
14. Determination of efficiency of a single-phase AC series Motor by conducting Brake test.

Reference:

1. https://ems-iitr.vlabs.ac.in/List%20of%20experiments.html

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02208P	PC	Control Systems Lab	0	0	3	1.5

Pre-Requisites: Fundamentals of Control Systems

Course Objectives:

- To enable students to analyze the behavior of second-order systems and understand system dynamics.
- To familiarize students with the working principles and characteristics of servo motors, synchros, and magnetic amplifiers.
- To apply and verify control strategies including PID controllers and compensation techniques in hardware and software platforms.
- To provide hands-on experience in simulation tools like MATLAB for control system design and analysis.
- To demonstrate practical implementation of state-space modeling techniques.

Course Outcomes (COs):

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

CO1: Apply time-domain analysis techniques to second-order systems and assess the effects of P, PI, PD, and PID controllers on system response. (L4)

CO2: Apply knowledge of control system components such as synchros, magnetic amplifiers, and servomotors to explain their characteristics and operation. (L3)

CO3: Implement and validate PID control and compensation techniques through simulation and real-time experimentation. (L3)

CO4: Simulate linear time-invariant systems and perform time and frequency domain analyses using MATLAB tools. (L3)

CO5: Develop and analyse state-space models of control systems using MATLAB. (L4)

List of Experiments:

Any 10 of the following experiments are to be Conducted:

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC Machine
6. Effect of P, PD, PI, PID Controller on a second order system
7. Lag and lead compensation – Magnitude and phase plot
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Linear system analysis (Time domain analysis, Error analysis) using MATLAB.
12. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using MATLAB
13. State space model for classical transfer function using MATLAB – Verification.

B. Tech. – II Year II 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: Fundamentals of C Programming Language

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
- 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 return values, 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 1: 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: Strings and Lists

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, BuiltIn 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, using zip () 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

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, Student 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
24IPCP301L	IP	**Community Service Internship** (Common for all branches of Engineering)	0	0	0	2

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 meaningful community 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 Internship during 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 Internship should 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 job training.

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 twofold one – o 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 Internship to 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 Internship to Colleges and Universities

- Improved institutional commitment.
- Improved student retention
- Enhanced community relations

Benefits of Community Service Internship to 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

- Reading Skill Program (Reading Competition)
- Preparation of Study Materials for the next class.
- Personality / Leadership Development
- Career Guidance for X class students
- Screening Documentary and other educational films
- Awareness Program on Good Touch and Bad Touch (Sexual abuse)
- Awareness Program on Socially relevant themes.

Programs for Women Empowerment

- Government Guidelines and Policy Guidelines
- Women's Rights
- Domestic Violence
- Prevention and Control of Cancer
- 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 Club, 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 Internship Activity

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.

1. 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.

2. 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.

1. Community Exit Report (One Week)

- During the last week of the Community Service Internship, 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 Internship, a daily logbook needs to be maintained by the student's 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
24PC02310T	PC	Power Electronics	2	1	0	3

Pre-Requisites: Basics of Electronic Devices and Circuits

Course Objectives:

- To understand the characteristics and operation of power electronic devices including diodes, thyristors, MOSFETs, IGBTs, and advanced devices.
- To design and analyze rectifiers, DC–DC converters, inverters, and AC controllers under various load conditions.
- To develop skills in evaluating performance and applying power electronic systems in modern power applications.

Course Outcomes (COs):

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

CO1: Describe the operating characteristics, switching behavior, and gate drive requirements of power semiconductor devices used in power electronic circuits. (L3)

CO2: Apply the principles of single-phase and three-phase rectifiers to analyze output characteristics, input current waveform, and power factor under different loading conditions. (L3)

CO3: Illustrate the operating principles and steady-state performance of DC–DC converters such as buck, boost, and buck–boost converters. (L3)

CO: Analyze the operation, control techniques, and performance characteristics of single-phase and three-phase inverters. (L4)

CO5: Evaluate the performance of AC voltage controllers and cycloconverters under different load conditions using output voltage, current, and power factor characteristics. (L5)

Unit I: Power Switching Devices:

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET, IGBT and GTO. Introduction to Galium Nitride and Silicon Carbide Devices.

Unit II: Rectifiers:

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape, power factor and effect of source inductance; Analysis of rectifiers with filter capacitance, Dual Converter -Numerical problems.

Unit III: DC-DC Converters:

Elementary chopper with an active switch and diode, concepts of duty ratio, control strategies and average output voltage: Power circuit, analysis and waveforms at steady state, duty ratio control and average output voltage of Buck, Boost and Buck- Boost Converters.

Unit IV: Inverters:

Single phase Voltage Source inverters – operating principle - steady state analysis, Simple forced commutation circuits for bridge inverters – Voltage control techniques for inverters and Pulse width modulation techniques, single phase current source inverter with ideal switches, basic series inverter, single phase parallel inverter – basic principle of operation only, Three phase bridge inverters (VSI) – 180-degree mode – 120-degree mode of operation - Numerical problems.

Unit V: AC Voltage Controllers & Cyclo Converters:

AC voltage controllers – Principle of phase control – Principle of integral cycle control - Single phase two SCRs in anti-parallel – With R and RL loads – modes of operation of Triac – Triac with R and RL loads – RMS load voltage, current and power factor - wave forms – Numerical problems. Cyclo converters - Midpoint and Bridge connections - Single phase to single phase step-up and step-down cyclo converters with Resistive and inductive load, Principle of operation, Waveforms, output voltage equation.

Text Books:

1. "M. H. Rashid, ―Power Electronics: Circuits, Devices and Applications‖, 2nd edition, Prentice Hall of India, 1998.
2. P.S. Bimbhra, ―Power Electronics‖, 4th Edition, Khanna Publishers, 2010.
3. M. D. Singh & K. B. Kanchandhani, ―Power Electronics‖, Tata Mc Graw Hill Publishing Company, 1998.

Reference Books:

1. "Ned Mohan, ―Power Electronics‖, Wiley, 2011.
2. Robert W. Erickson and Dragan Maksimovic, ―Fundamentals of Power Electronics‖ 2nd Edition, Kluwer Academic Publishers, 2004.
3. Vedam Subramanyam, ―Power Electronics‖, New Age International (P) Limited, 1996.
4. V. R. Murthy, ―Power Electronics‖, 1st Edition, Oxford University Press, 2005.
5. P. C. Sen, ―Power Electronics‖, Tata Mc Graw-Hill Education, 1987.
6. J. M. D. Murphy ―Power Electronic Control of Alternating Current Motors‖.

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	3	0	0	3

Pre-Requisites: Basic Knowledge of Mathematics and physics

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 and Requirements:

What is required to build a quantum computer (conceptual overview)?,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 (brief conceptual comparison),Superconducting circuits, Trapped ions, Photonics, Visionvs 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. 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. 4. Alastair I.M. Rae, Quantum Physics: A Beginner's Guide, One world Publications, Revised Edition, 2005.
4. Eleanor G. Rieffel, Wolfgang H. Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
5. Leonard Susskind, Art Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books, 2014.
6. Bruce Rosenblum, Fred Kuttner, Quantum Enigma: Physics Encounters Consciousness, Oxford University Press, 2nd Edition, 2011.
7. Giuliano Benenti, Giulio Casati, Giuliano Strini, Principles of Quantum Computation and Information, Volume I: Basic Concepts, World Scientific Publishing, 2004.
8. K.B. Whaley et al., Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document, Quantum Flagship, European Commission, 2020.

9. Department of Science & Technology (DST), Government of India, National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers, MeitY/DST Publications, 2020 onward.

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
4. YouTube – Quantum Computing for the Determined by Michael Nielsen
5. Qiskit Textbook – IBM Quantum

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04309T	PC	Digital Circuits	2	1	0	3

Pre – Requisites: Basics of Electronic Devices

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 IC's.

Course Outcomes (COs):

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

CO1: Apply Boolean algebra, K-map techniques, and logic gate realizations to simplify and implement switching functions. (L3)

CO2: Apply combinational circuit concepts to design adders, subtractors, and code converters. (L3)

CO3: Analyze and compare combinational logic components such as decoders, encoders, multiplexers, and comparators for logic implementation. (L4)

CO4: Analyze the operation and performance of sequential circuits including flip-flops, counters, and shift registers. (L4)

CO5: Evaluate the performance and applications of programmable logic devices and standard digital ICs in system design. (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 I:

Binary Adders, Subtractors and BCD adder, Code converters - Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display.

Unit III: Combinational Logic Design II:

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:

ROM, Programmable Logic Devices (PLA and PAL). Digital IC's: Decoder (74x138), Priority Encoder (74x148), multiplexer (74x151) and de-multiplexer (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:

Fundamentals of Logic Design, Charles H Roth,Jr., 5th Edition, Brooks/cole Cengage Learning, 2004

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02311T	PC	Power Systems -II	2	1	0	3

Pre – Requisites: Basics Power Systems -I

Course Objectives:

- To study about line parameters and constants
- To study the performance of transmission lines
- To know about overhead line insulators, corona, sag and tension in transmission lines
- To study about symmetrical components and different types of faults in power system.
- To understand the concept of voltage control, compensation methods

Course Outcomes (COs):

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

CO1: Apply the concepts of transmission line parameters to determine resistance, inductance, and capacitance of single-phase and three-phase overhead transmission lines under different conductor configurations. (L3)

CO2: Analyze the performance of short, medium, and long transmission lines using line constants, regulation, efficiency, charging current, and Ferranti effect. (L4)

CO3: Illustrate the characteristics of overhead line insulators, sag, tension, and corona in transmission systems under practical operating conditions. (L3)

CO4: Analyze the construction and performance of underground cables and evaluate the behavior of power system transients in transmission networks. (L4)

CO5: Evaluate voltage control, power factor improvement, and compensation techniques for enhancing transmission line performance and load ability. (L5)

Unit I: Transmission Line Parameters:

Types of Conductors - Calculation of Resistance for Solid Conductors, Bundle Conductors, Skin effect, Proximity effect, Concept of GMR & GMD- Transposition of Power lines- Calculation of inductance for single phase and three phase, Single and Double circuit lines, Symmetrical and asymmetrical conductor configurations with and without transposition. Calculation of Capacitance for 2 wire and 3 wire systems, effect of ground on Capacitance, Capacitance calculations for symmetrical and asymmetrical single and three phase, single and double circuit lines, Numerical Problems

Unit II: Performance of Transmission Lines:

Classification of Transmission Lines-Short, medium and long line and their models representation - Nominal-T, Nominal-π and A, B, C, D Constants for symmetrical networks, Numerical Problems and solutions for estimating regulation and efficiency of all types of lines. Ferranti effect and Charging Current

Unit III: Overhead Line Insulators, Sag and Tension & Corona:

Types of Insulators, String efficiency and Methods for improvement, – Voltage Distribution, Calculation of String efficiency, Capacitance Grading and Static Shielding., Numerical Problems.

Sag and Tension Calculations with equal and unequal heights of towers, Effect of wind and ice on weight of conductor, Stringing chart, Sag template and its applications Numerical Problems. Corona-factors affecting corona, critical voltages and Power loss due to Corona. Radio Interference.

Unit IV: Underground Cables & Power System Transients:

Comparison between Underground and Overhead systems Construction of cables, Classification, Properties of insulating materials, Insulation resistance of single core cable, Capacitance of single core cable, Grading of cable. Types of system transients – Travelling or propagation of surges – Attenuation, Distortion, Reflection and Refraction co-efficients – Termination of lines with different types of conditions – Bewley‘s Lattice diagrams

Unit V: Voltage Control and Power Factor Improvement & Compensation in Power Systems:

Methods of voltage control, shunt and series capacitors / Inductors, tap changing transformers, synchronous phase modifiers, power factor improvement methods. Concepts of Load compensation Load ability characteristics of overhead lines – Uncompensated transmission line – Symmetrical line – Radial line with asynchronous load – Compensation of lines.

Text Books:

1. C.L. Wadhwa, ―Electrical Power Systems‖, New Age International Pub. Co, Third Edition, 2001.
2. D.P. Kothari and I.J. Nagrath, ―Modern Power System Analysis‖, Tata Mc Graw Hill Pub. Co.,New Delhi, Fourth edition, 2011.
3. B.R.Gupta,―Power System Analysis and Design‖, S.Chand Publishing.1998.

Reference Books:

1. Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, ―A Text book on Power System Engineering‖, Dhanpat Rai Publishing Company (P) Ltd, 2008.
2. John J. Grainger & W.D. Stevenson, ―Power System Analysis‖, Mc Graw Hill
3. International,1994.
4. Hadi Sadat, ―Power System Analysis‖, Tata Mc Graw Hill Pub. Co. 2002.
5. W.D. Stevenson, ―Elements of Power system Analysis‖, McGraw Hill International Student Edition.

Online Learning Resource:

1. https://onlinecourses.nptel.ac.in/noc22_ee17/preview

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02310P	PC	Power Electronics Lab	0	0	3	1.5

Pre-Requisites: Basics of Electronic Devices and Circuits

Course Objectives:

- This course is intended to acquire practical knowledge about the operation of various power converters.
- To understand the basics of triggering circuits required for various power converters.

Course Outcomes (COs):

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

CO1: Analyze the characteristics of power semiconductor devices (SCR, MOSFET, IGBT), and design gate firing circuits for SCR-based converters for controlled power conversion applications. (L4)

CO2: Evaluate the performance of single-phase and three-phase power converters with R and RL loads, including inverter operation and commutation techniques for efficient power control. (L5)

CO3: Apply and analyze commutation techniques in chopper circuits and power converters to achieve efficient and reliable power control in electronic systems. (L3)

List of Experiments

Choose Any Ten from the Following List:

1. Study of Characteristics of SCR, MOSFET & IGBT.
2. Gate firing circuits for SCR 's: (a) R triggering (b) R-C triggering.
3. Single Phase AC Voltage Controller with R and RL Loads.
4. Single Phase fully controlled bridge converter with R and RL loads
5. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E).
6. DC Jones chopper with R and RL Loads.
7. Single Phase Parallel inverter with R and RL loads.
8. Single Phase Cycloconverter with R and RL loads.
9. Single Phase Half controlled converter with R and RL load.
10. Single Phase Fully controlled converter with R and RL load.
11. Three Phase half-controlled bridge converter with R, RL-load.
12. Three Phase fully controlled bridge converter with R, RL-load.
13. Single Phase series inverter with R and RL loads.
14. Single Phase Bridge converter with R and RL loads.
15. Single Phase dual converter with RL loads.

Reference Books:

1. O.P. Arora, ―Power Electronics Laboratory: Theory, Practice and Organization (Narosa series in Power and Energy Systems)‖, Alpha Science International Ltd., 2007.
2. M. H. Rashid, ―Simulation of Electric and Electronic circuits using PSPICE‖, M/s PHI Publications.
3. PSPICE A/D user‘s manual – Microsim, USA.
4. PSPICE reference guide – Microsim, USA. MATLAB and its Tool Books user‘s manual and – Math works, USA.

Online Learning Resources/Virtual Labs:

http://vlabs.iitb.ac.in/vlabs-ev/labs/mit_bootcamp/power_electronics/labs/index.php

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04309P	PC	Analog And Digital Circuits Lab	0	0	3	1.5

Pre-Requisites: Fundamentals of Electronics Circuits

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. 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, flipflops, encoders, and decoders.

Course Outcomes (COs):

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

CO1: Explain the characteristics of diodes and transistors and construct rectifier, amplifier, and oscillator circuits for basic electronic applications. (L3)

CO2: Implement and analyze Op-Amp based applications along with combinational and sequential logic circuits using basic and universal gates. (L4)

CO3: Design and develop digital systems using multiplexers, comparators, and fundamental components such as adders, converters, flip-flops, encoders, and decoders. (L4)

Analog Circuits:

List of Experiments: (Any 06 Experiments are to be conducted)

1. CB Characteristics
2. CE Characteristics
3. CE Amplifier
4. CC Amplifier
5. Clippers
6. Clampers
7. Hartley & Colpitt‘s Oscillators.
8. RC Phase shift oscillator
9. Astable multivibrator
10. Monostable multivibrator
11. A to D Convertor
12. D to A Convertor
13. Op-Amp Applications-Adder, subtractor, comparator

Digital Circuits:

List of Experiments: (Any 6 Experiments are 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.

B. Tech. – III Year I 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:

- Basic understanding of English language and communication skills and Awareness of personal behavior and willingness for self-improvement
- Basic knowledge of group interaction and teamwork and Openness to participate in activities such as discussions, presentations, and role plays. Fundamental understanding of professional environment and social behavior

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 (COs):

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

CO1: Demonstrate intrapersonal skills by narrating personal strengths and weaknesses with clarity of thought and fluent self-expression. (L3)

CO2: Examine personal thoughts and assumptions using introspection and open mindedness to understand different perspectives and improve decision-making. (L4)

CO3: Analyze the meaning and features of problem-solving to identify issues clearly and break them into manageable components. (L4)

CO4: Analyze different types of emotions and evaluate how appropriate emotional expression (happiness, gratitude, confidence, compassion) influences personal and professional interactions. (L4)

CO5: Analyze the concepts and significance of professional etiquette to determine how corporate, social, and modern etiquette influence workplace behavior. (L4)

Unit I: Soft Skills & Communication Skills:

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

Note-:

1.The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.

2.Case studies may be given wherever feasible for example for Decision Making- The decision of King Lear.

Text Books:

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

Reference Books:

1. Sharma, Prashant, Soft Skills: Personality Development for Life Success, BPB Publications 2018.
2. Alex K,Soft SkillsS.Chand& Co, 2012 (Revised edition)

3. Gajendra Singh Chauhan& Sangeetha Sharma,Soft Skills: An Integrated Approach to Maximise PersonalityPublished by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, Soft Skills and Employability Skills, Cambridge University
5. Press, 2018
6. Dr. Rajiv Kumar Jain, Dr. Usha Jain,Life Skills (Paperback English) Publisher: Vayu Education of India, 2014

Online Learning Resources:

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y- bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7 KlJ
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-etiquettetraining-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

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):

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

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
24PE04301T	**PE**	**Signals and Systems**	**2**	**1**	**0**	**3**

Pre-Requisites: Basic Knowledge of Mathematics

Course Objectives:

- To understand the basic properties of signal & systems and LTI systems.
- To learn Fourier series representation of periodic signals.
- To study representation of signals in continuous and discrete time Fourier transform
- To analyze the sampling theorem and characterize signals & systems in time & frequency domain.
- To apply Laplace, transform and Z transform to study about the stability of systems.

Course Outcomes (COs):

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

CO1: Apply the basic properties of signal & systems and LTI systems. (L3)

CO2: Apply Fourier series to represent periodic signals. (L3)

CO3: Analyze and differentiate the representation of signals using continuous-time and discrete-time Fourier transforms. (L4)

CO4: Analyze the sampling theorem and characterize signals & systems in time & frequency domain(L4)

CO5: Evaluate the stability of systems by applying Laplace transform and Z transform. (L5)

Unit I: Signals and Systems:

Continuous and Discrete Time Signals, Transformations of the Independent Variable, Elementary Signals-Unit Impulse, Unit Step Functions, Ramp Signal, Rectangular function, Signum Function, Sinc & Sa Function, Exponential and Sinusoidal Signals, Classification of Signals & Systems, Continuous and Discrete Time Systems, Basic System Properties, Linear Time Invariant (LTI) Systems, Discrete-Time LTI Systems, Convolution Sum, Continuous Time LTI Systems, Convolution Integral, Properties of LTI Systems, Causal LTI Systems described by Differential and Difference Equations, Singularity Functions.

Unit II: Fourier Series Representation of Periodic Signals:

Response of LTI Systems to Complex Exponentials. Fourier Series Representation of Continuous Time Periodic Signals, Trigonometric, Polar, Exponential fourier Series & related problems, Convergence of the Fourier Series, Properties of Continuous Time Fourier Series, Fourier Series Representation of Discrete Time Periodic Signals, Properties of Discrete Time Fourier Series, Fourier Series and LTI Systems

Unit III: The Continuous-Time Fourier Transform:

Representation of aperiodic Signals, Continuous Time Fourier Transform, Fourier Transform for Periodic Signals, Properties of the Continuous Time Fourier Transform, Systems characterized by Linear constant coefficient differential equations, Discrete Time Fourier Transform - Representation of Aperiodic Signals, Discrete Time Fourier Transform, Frequency Response, Systems Characterized by Linear Constant-Coefficient Difference Equations.

Unit IV: Time & Frequency Characterization of Signals and Systems:

The Magnitude Phase Representation of the Fourier Transform, Magnitude Phase Representation of the Frequency Response of LTI Systems, Time-Domain Properties of Ideal Frequency Selective

Filters, Time Domain and Frequency Domain Aspects of Non-ideal Filters, Examples of Continuous time filters and Discrete time filters described by differential equations, First-Order and Second-Order Continuous and Discrete-Time Systems, Examples of Time and Frequency Domain Analysis of Systems,

Sampling: Representation of a Continuous Time Signal by Its Samples, Sampling Theorem, Reconstruction of a Signal from Its Samples Using Interpolation, Effect of under sampling: Aliasing, Discrete Time Processing of Continuous-Time Signals.

Unit V: Laplace and Z-Transforms:

The Laplace Transform, Region of Convergence for Laplace Transforms, Inverse Laplace Transform, Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot, Properties of the Laplace Transform, Some Laplace Transform Pairs, Analysis and Characterization of LTI Systems Using the Laplace Transform, System Function Algebra and Block Diagram Representations, Unilateral Laplace Transform, Z-Transform - Region of Convergence for the z-Transform, Inverse z-Transform, Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot, Properties of the z-Transform, Some Common z-Transform Pairs, Analysis and Characterization of LTI Systems Using z-Transforms, System Function Algebra and Block Diagram Representations, Unilateral z-Transforms.

Text Books:

1. Signals and Systems, Alan V. Oppenheim, Alan S. Willsky, & S. Hamid, 2nd Edition, Pearson Higher Education, 1997.
2. Principles of Linear Systems and Signals, B.P. Lathi, 2nd Edition, Oxford University Press, 2011.

Reference Books:

1. Signals & Systems, Simon Haykin and B. Van Veen, 2nd Edition, John Wiley, 2003.
2. Signals and systems, Narayana Iyer and K Satya Prasad, 1st Edition, CENGAGE Learning, 2011.
3. Signals, Systems and Transforms, C. L. Philips, J. M. Parr and Eve A. Riskin, 4th Edition, Pearson education, 2008.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02301T	PE	Electrical Safety and Risk Management	3	0	0	3

Pre-Requisites: Basics of Electrical Engineering

Course Objectives:

The course aims to provide a comprehensive understanding of electrical safety principles, including the effects of electric shock and methods for its prevention. It focuses on safe practices during the installation and operation of electrical plants and equipment across residential, commercial, and agricultural environments. The course also emphasizes safety in hazardous areas, proper earthing and neutral grounding techniques, and adherence to electrical safety management practices and IE rules to ensure reliable and secure operation of electrical systems.

Course Outcomes (COs):

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

CO1: Describe the hazards associated with electric current and voltage, the causes and effects of electrical shocks, and preventive measures for electrical safety. (L3)

CO2: Analyze the risks, safety procedures, and protective measures associated with the installation of electrical plant and equipment. (L4)

CO3: Analyze the safety requirements and precautionary measures in residential, commercial, and agricultural electrical installations to prevent electrical accidents. (L4)

CO4: Analyze electrical safety requirements in hazardous areas, including equipment classification, earthing, and neutral grounding methods. (L4)

CO5: Evaluate safety management practices, electrical safety standards, and the significance of statutory regulations governing electrical systems. (L5)

Unit I: Introduction to Electrical Safety, Shocks and Their Prevention:

Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over ‘s, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

Unit II: Safety During Installation of Plant and Equipment:

Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

Unit III: Electrical Safety in Residential, Commercial and Agricultural:
Installations:

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do ‘s and Don ‘ts for safety in the use of domestic electrical appliances.

Unit IV: Electrical Safety in Hazardous Areas:
Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipment's for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.
Equipment Earthing and System Neutral Earthing: Introduction, Distinction between system grounding and Equipment Grounding, Equipment Earthing, Functional Requirement of earthing system, description of a earthing system, neutral grounding (System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals.

Unit-V: Safety Management of Electrical Systems:
Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.
Review of IE Rules and Acts and their Significance: Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and firefighting facility. The Electricity Act, 2003, (Part1, 2, 3,4 & 5)

Text Books:
1. S. Rao, Prof. H.L. Saluja, ―Electrical safety, fire safety Engineering and safety management‖, Khanna Publishers. New Delhi, 1988. (units-I to V)
2. www.apeasternpower.com/downloads/elecact2003.pdf (Part of unit-V)

Reference Books:
1. Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02302T	PE	Utilization of Electrical Energy	2	1	0	3

Pre-Requisites: Basics of Power Systems

Course Objectives:

The course aims to develop understanding and application of electric drives for various industrial applications. It focuses on the principles and techniques of electric heating, welding, illumination design, and electric traction systems including braking methods. The course also introduces the fundamentals and applications of electrolytic processes used in industrial practices.

Course Outcomes (COs):

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

CO1: Describe the selection, characteristics, and performance of electric drives, including motor ratings, operating characteristics, and types of industrial loads. (L3)

CO2: Analyze the principles and applications of electric heating and welding processes, including resistance, induction, dielectric heating, and arc and resistance welding systems. (L4)

CO3: Apply the principles of illumination to evaluate lighting systems, light sources, and design considerations for effective lighting applications. (L3)

CO4: Analyze electric traction systems, including track electrification, traction motors, speed-time curves, and electric braking methods. (L4)

CO5: Evaluate electrolytic processes, including Faraday's laws, electrodeposition, metal extraction, refining processes, and fuel cell applications. (L5)

Unit I: Electric Drives:

Type of electric drives – rating and choice of motor - starting and running characteristics – particular applications of electric drives - types of industrial loads - Continuous - intermittent and variable loads

Unit II: Electric Heating & Welding:

Introduction: Advantages and methods of electric heating - resistance heating - induction heating and dielectric heating.

Electric Welding: Classification- resistance and arc welding - electric welding equipment - comparison between AC and DC Welding.

Unit III: Illumination:

Introduction - terms used in illumination - laws of illumination - sources of light. Discharge lamps – mercury vapor and sodium vapor lamps–comparison between tungsten filament lamps and fluorescent tubes–compact fluorescent lamp–LED-Basic principles of light control-Types and design of good lighting system and practice - flood light

Unit IV: Electric Traction:

Traction systems: System of electric traction and track electrification - Review of existing electric traction systems in India - Special features of traction motor - Speed-time curves for different services - methods of electric braking - plugging - rheostatic braking - regenerative braking. Introduction to Magnetic Levitation vehicles.

Unit V: Electrolytic Process:

Introduction - Basic principles - Faradays laws of electrolysis - Energy efficiency – Electrodeposition -Factors governing deposition Processes - Deposition of Alloys – Extraction and refining of metals. Fuel Cell

Text Books:

1. C.L Wadhwa, Generation Distribution and Utilization of Electrical Energy, New age International Publishers.
2. J. B. Gupta, Utilization of Electrical Power and Electric Traction, S. K. Kataria and sons, 2002
3. G. C. Garg (2005), Utilization of Electrical Power & Electric traction, 8th edition, Khanna publishers, New Delhi.
4. N. V. Suryanarayana, Utilization of Electrical Power including Electric drives and Electric traction, New Age International (P) Limited, Publishers, 1996.

Reference Books:

1. Partab (2007), Art & Science of Utilization of electrical Energy, 2nd edition, Dhanpat Rai Sons, New Delhi.
2. Alan. V. Oppenheim, Ronald. W. Schafer, John R Buck, Discrete Time Signal Processing,
3. PrenticeHall,2nd edition,2006. E.Opensha Taylor, Utilization of Electric Energy, Orient Longman,1971.

Online Learning Resources:

1.**https://nptel.ac.in/courses/108105060**

2. **https://nptel.ac.in/courses/112105221**

3. https://vssut.ac.in/lecture_notes/lecture1426861925.pdf

4.https://vpmpee.wordpress.com/uee-3340903/

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 modelling 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, students 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, and 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:

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, Building Requirements.

Unit V: Material Conservation:

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 kimings, 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:

1. 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 in construction.

Course Outcomes (COs):

On successful completion of the course, students 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:

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, and 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:

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
3. Pandey, I.M (2021) Financial Management 12th edition. Pearson India Education Services Pvt. Ltd.

Reference Books:

1. Brien, J.O. and Plotnick, F.L., CP Min 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: Pearson New International Edition 8th Edition Stephens Nunnally.
4. Rhoden, M and Cato B, Construction Management and Organizational Behaviour, WileyBlackwell, 2016.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/105/104/105104161/
2. 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
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:
- Demonstrate The Importance the Impact of Solar Radiation, Solar PV Modules
- Understand The Principles of Storage in PV Systems
- Discuss Solar Energy Storage Systems and Their Applications.
- Get Knowledge in Wind Energy and Bio-Mass
- Gain Insights in Geothermal Energy, Ocean Energy and Fuel Cells.

Course Outcomes (COs):
On successful completion of the course, Students 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 1: Solar Radiation & Solar PV Modules and PV Systems:
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 titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. 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 SystemsDesign 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 & Solar Energy Storage and Applications:
Flat plate and concentrating collectors, classification of concentrating collectors, orientation. 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 & Bio-Mass:

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement. 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 Energy, Ocean Energy & Fuel Cells:

Origin, Applications, Types of Geothermal Resources, Relative Merits. Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges. Introduction, Applications, Classification, Different Types of Fuel Cells Such as 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 Krieth& John F Kreider / Taylor &Francis
2. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
3. Renewable Energy Technologies -Ramesh & Kumar /Narosa
4. Non-conventional Energy Source- G.D Roy/Standard Publishers

Online Learning Resources:

1. https://nptel.ac.in/courses/112106318
2.https://youtube.com/playlist?list=PLyqSpQzTE6MZgdjYukayF6QevPv7WEr
3. https://youtu.be/zx04Kl8y4dE?si=VmOvp_OgqisILTAF

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE04301T	OE	**Electronic Circuits** (Common to CE, EEE, CSE, AI&DS, CSE-AI, & CSE- AI&ML)	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:

On successful completion of the course, 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 & Multistage amplifiers:

Classification of Amplifiers - Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model. Different Coupling Schemes used in Amplifiers - RC coupled amplifiers, Transformer Coupled Amplifier, Direct Coupled Amplifier; Multistage RC coupled BJT amplifier (Qualitative treatment only).

Unit IV: Feedback Amplifiers & 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). Classification of oscillators, Condition for oscillations, RC Phase shift Oscillators, Generalized analysis of LC Oscillators-Hartley and Colpitts Oscillators, Wien Bridge Oscillator.

Unit V: **Op-Amp & Applications of Op-Amp:**

Classification of IC'S, basic information of Op-amp, ideal and practical Op-amp, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential. **S**umming, 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, LousisNashelsky and K.Lal Kishore, 12th edition, 2006, 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.

B. Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE04301T	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:
The main objective of the course is to 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, Students 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, access control, 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:
Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style. Data Types,
Variables, and Operators: Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf () Method, Static Variables and Methods, Attribute Final,
Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.
Control Statements: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

Unit II: Classes and Objects:
Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class,

Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

Unit III: Arrays:

Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

Unit IV: Packages and Java Library:

Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java .lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class. **Exception Handling:** Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions. **Java I/O and File:** Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java (Text Book 2)

Unit V: String Handling in Java:

Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter thread Communication - Suspending, Resuming, and Stopping of Threads. Java Database Connectivity: Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result Set Interface **Java FX GUI:** Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, 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, 11thedition, Herbert Schildt,TMH

Online Learning Resources:

1. *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
24OE031301T	OE	**Fundamentals of Artificial Intelligence** (Common to CE, EEE, & ECE)	2	1	0	3

Pre requisites:

- Basic Knowledge of Programming and Problem-Solving Concepts.
- Familiarity with Logic, Probability, and Discrete 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, Students 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:

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:

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:

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 Henny 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
24OE005302T	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):
On successful completion of the course, Students will be able to:
CO1: Apply the fundamental principles of quantum theory such as superposition, entanglement, uncertainty principle, and wave-particle duality to explain the behavior 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 concept of 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. Gover‘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
4. 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: Analyse 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 & 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 References:

1. MIT– Mathematics for Machine Learning https://ocw.mit.edu
2. Stanford CS229 – Machine Learning Course https://cs229.stanford.edu/
3. Deep AI – Mathematical Foundations for AI https://deepai.org

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 the 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 Scherer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).

Unit II: Microscopy technique -1 –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: Microscopy Technique -2 - 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 Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy

Unit IV: Spectroscopy Techniques:

Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

Unit V: Electrical & 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 – Science.
3. Practical Guide to Materials Characterization: Techniques and Applications - Khalid Sultan – Wiley – 2021.
4. Materials Characterization Techniques -Sam Zhang, Lin Li, Ashok Kumar -CRC Press - 2008

NPTEL courses link :

1. https://nptel.ac.in/courses/115/103/115103030/
2. https://nptel.ac.in/content/syllabus_pdf/113106034.pdf
3. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/

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:

- Make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
- Understand the basic concepts of processing and limitations of Fuel cells & their applications
- Impart knowledge to the students about fundamental concepts of photo chemical cells, reactions and applications.
- Necessity of harnessing alternate energy resources such as solar energy and its basic concepts.
- Impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification 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 Photo electrochemical Conversions:

Photochemical cells Introduction and applications of photochemical reactions, specificity of photo electrochemical 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 Hand Book 7th Edition, by US Department of Energy (EG&G technical services and corporation) Hand book of solar energy and applications by Arvind Tiwari and Shyam.
2. Solar energy fundamental, technology and systems by Klaus Jagar et.al. 4. Hydrogen storage by Levine Klebonoff

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-Article definite indefinite-Degrees of Comparison-Adverbs-types- errors-Conjunctions-usage- repositions-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-precise 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, New Delhi, 2014.
2. Philip Sunil Solomon, English for Success in Competitive Exams, Oxford 2016
3. Shalini Verma, Word Power Made Handy, S Chand Publications
4. Neira, Anjana Dev & Co. Creative Writing: A Beginner's Manual. Pearson Education India, 2008.
5. Abhishek Jain, Vocabulary Learning Techniques Vol.I &II, RR Global Publishers 2013.
6. Michel Swan, Practical English Usage, Oxford,2006.

Online Resources:

1. https://www.grammar.cl/english/parts-of-speech.htm
2. https://academicguides.waldenu.edu/writingcenter/grammar/partsofspeech
3. https://learnenglish.britishcouncil.org/grammar/english-grammar-reference/active-passivevoice
4. https://languagetool.org/insights/post/verb-tenses/
5. https://www.britishcouncil.in/blog/best-free-english-learning-resources-british-council
6. https://www.careerride.com/post/social-essays-for-competitive-exams-586.aspx

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 and Initiate Solution design, Prototype for Proof of Concept.
- To enhance the ability of analyzing Customer and Market segmentation, estimate Market size, develop and validate Customer Persona

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 (Personalized for students – 16industries to choose from), Venture Activity

Unit II: Problem & 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 & Opportunity Assessment and Sizing:

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 & 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 and analysing financial performance. 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-a-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, McGrawHill, 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).

References:

1. Simon Sinek,Start with Why, Penguin Books limited. (2011)
2. Brown Tim,Change by Design Revised & Updated: How Design Thinking
3. Transforms Organizations and Inspires Innovation, Harper Business.(2019)
4. Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited Saras D. Sarasvathy, (2008) Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd.

E-Resources:

1. Learning resource- Ignite 5.0 Course Wadhwani platform (Includes 200+ components of custom created modular content + 500+ components of the most relevant curated content)

B. Tech. – III Year II Semester

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02312T	PC	Electrical Measurements and Instrumentation	3	0	0	3

Pre requisites: Fundamentals of Basic Electrical Engineering

Course Objectives:

- To study about the working principle of electrical measuring instruments
- To study the performance of instrumental transformers, power factor, frequency and energy meters
- To study the functioning of DC and AC bridges
- To study the basics of digital volt meters and transducers
- To understand the concept of sensors and data acquisition systems

Course Outcomes (COs):

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

CO1: Explain the principles and operation of measuring instruments for voltage, current, frequency, and electrical energy in AC and DC systems. (L3)

CO2: Analyze the working principles of electrical bridges for measuring resistance, inductance, and capacitance in various electrical circuits. (L4)

CO3: Apply the principles of digital voltmeters and electrical transducers for measurement and instrumentation applications. (L3)

CO4: Analyze the characteristics and working of transducers and sensors used in electrical measurement and data acquisition systems. (L4)

CO5: Evaluate modern data acquisition systems, PLC, SCADA, and micro sensor-based technologies for industrial measurement and automation applications. (L5)

Unit I: Measuring instruments & Digital Meters:

Fundamentals: True Value, Errors (Gross, Systematic, Random); Static Characteristic of Instruments (Accuracy, Precision, Sensitivity, Resolution & threshold); Error Analysis- Simple problems; Statistical treatment of data-Simple problems.

Indicating Instruments: Three forces in Electromechanical indicating instrument (Deflecting, controlling & damping forces); Moving iron type (attraction and repulsion), PMMC, Electrodynamometer Type instruments: Torque equation (Expression only, no derivation), shape of scale – simple problems on torque equations; Measurement of voltage and current - Extension of Range of ammeter and voltmeter – problems on extension of range of ammeter and voltmeter.

Unit II: Measurement of Power, Power Factor and Energy:

Instrument transformers: Types, CT and PT – Ratio and phase angle errors; (Expression only, no derivation)

Measurement of Power: Principle and Operation of Single-phase dynamometer wattmeter, expression (Expression only no derivation) for deflecting and control torques, errors and compensations.

Measurement of Power Factor: Principle and operation of Single-phase Electrodynamometer Power factor meter.

Measurement of Frequency: Principle and Operation of single-phase frequency meter- vibrating reed type, - ferro dynamic type meter.

Measurement of Energy: Principle and Operation of Single-phase induction type energy meter, driving and braking torques (expression only no derivation), errors and compensations, testing by phantom loading.

Unit III: D.C&A.C Bridges:

Measurement of Resistance: Methods of measuring low, medium and high resistances –Sensitivity of Whetstone's bridge– Kelvin's double bridge for Measuring low resistance, Megger for measurement of high resistance.

Measurement of Inductance: - Maxwell 's bridge, Anderson 's bridge.

Measurement of Capacitance: De Sauty bridge. Wien 's bridge–Schering bridge–Numerical problems.

Unit-IV: Digital Volt Meters and Transducers:

Digital Voltmeters: Ramp type, Dual Slope integrating type, successive approximation, Potentiometric type DVMs.

Classification of Transducers: Active/passive, analog/digital- Strain Gauge-gauge factor (Elementary treatment only)-applications of strain gauge, Q-Meter.

Unit-V: Transducers, Sensors and Data Acquisition:

Definition of Transducers, Classification of Transducers, Advantages of Electrical Transducers, Characteristics and Choice of Transducers; Principle Operation of Resistor, Inductor and Capacitive Transducers; LVDT and its Applications, Strain Gauge and Its Principle of Operation, Gauge Factor, Thermistors, Thermocouples, Piezo Electric Transducers, Photo electric Transducers, Hall effect, Photo Diodes. Optocoupler.

Silicon based Micro Sensors: Pressure sensor, Gyro sensor, Accelerometer, Flow sensor, Proximity sensor, Temperature sensor, Humidity sensor. (Elementary treatment only)

Introduction to PLC and SCADA Systems: Data acquisition systems (DAS) and interfacing techniques.

Text Books:

1. Electrical & Electronic Measurement & Instruments by A.K. Sawhney Dhanpat Rai & Co. Publications, 2007.
2. Electrical Measurements and measuring Instruments–by E.W.Golding and F.C. Widdis, 5th Edition, Reem Publications, 2011.
3. Buckingham and Price, ―Electrical Measurements‖, Prentice – Hall

Reference Books:

1. Electronic Instrumentation by H.S.Kalsi,Tata Mcgrawhill, 3rd Edition, 2011.
2. Electrical Measurements: Fundamentals, Concepts, Applications–by Reissl and, M.U, New Age
3. International (P) Limited, 2010.
4. Electrical & Electronic Measurement & Instrumentation by R.K.Rajput, 2nd Edition, S. Chand & Co., 2nd Edition, 2013.
5. Sensor Technology: Hand Book by JonS. Wilson, ELSEVIER publications,2005

Online Learning Resource:

1. https://onlinecourses.nptel.ac.in/noc22_ee112/preview

B. Tech. – III Year II 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

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:

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, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rdEdition,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 II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02313T	PC	Power System Analysis	2	1	0	3

Pre- Requisites: Basics of Power Systems

Course Objectives:

- The use of per unit values and graph theory concepts, solving a problem using computer.
- Formation of Ybus and Zbus of a Power System network, power flow studies by various methods.
- Different types of faults and power system analysis for symmetrical and also unsymmetrical faults.
- Analysis of power system for steady state and transient stability and also methods to improve stability.

Course Outcomes (COs):

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

CO1: Apply per-unit system concepts and graph theory to form Y-bus matrix and model power system networks using different formation techniques. (L3)

CO2: Analyze Z-bus formation and modification algorithms for various network changes in power system analysis. (L4)

CO3: Apply numerical methods for load flow analysis using Gauss-Seidel, Newton-Raphson, and Fast Decoupled techniques for power system studies. (L3)

CO4: Analyze symmetrical and unsymmetrical fault conditions using symmetrical component theory for short circuit studies in power systems. (L4)

CO5: Evaluate power system stability under steady state, transient, and dynamic conditions using swing equation, equal area criterion, and stability improvement techniques. (L5)

Unit I: Per-Unit System and YBus Formation:

Per-Unit representation of Power system elements - Per-Unit equivalent reactance network of a three phase Power System - Graph Theory: Definitions, Bus Incidence Matrix, YBus formation by Direct and Singular Transformation Methods, Numerical Problems.

Unit II: Formation of ZBus:

Formation of ZBus: Partial network, Algorithm for the Modification of ZBus Matrix for addition element for the following cases: Addition of element from a new bus to reference, Addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old busses - Modification of ZBus for the changes in network.

Unit III: Power Flow Analysis:

Static load flow equations – Load flow solutions using Gauss Seidel Method: Algorithm and Flowchart. Acceleration Factor, Load flow Solution for Simple Power Systems (Max. 3Buses): Newton Raphson Method in Polar Co-Ordinates Form: Load Flow Solution- Jacobian Elements, Algorithm and Flowchart. Decoupled and Fast Decoupled Methods. - Comparison of Different Methods.

Unit IV: Short Circuit Studies:

Short Circuit Current and MVA Calculations, Fault levels, Application of Series Reactors. Symmetrical Component Theory: Positive, Negative and Zero sequence components, Positive, Negative and Zero sequence Networks. Symmetrical Fault Analysis: LLLG faults with and without fault impedance, Unsymmetrical Fault Analysis: LG, LL and LLG faults with and without fault impedance, Numerical Problems.

Unit V: Stability Analysis:

Elementary concepts of Steady State, Dynamic and Transient Stabilities. Derivation of Swing Equation, Power Angle Curve and Determination of Steady State Stability. Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation. Numerical methods for solution of swing equation - Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers.

Text Books:

1. Computer Methods in Power System Analysis by G.W.Stagg and A.H.El-Abiad, Mc Graw-Hill, 2006.
2. Modern Power system Analysis by I.J.Nagrath&D.P.Kothari, Tata McGraw-Hill Publishing Company, 4th Edition, 2011.

Reference Books:

1. Power System Analysis by Grainger and Stevenson, McGraw Hill, 1994.
2. Power System Analysis by Hadi Saadat, McGraw Hill, 1998.
3. Power System Analysis and Design by B.R.Gupta, S. Chand & Company, 2005.

Online Learning Resource:

1. https://onlinecourses.nptel.ac.in/noc22_ee120/preview

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02312P	PC	Electrical Measurements and Instrumentation Lab	0	0	3	1.5

Pre requisites: Fundamentals of Basic Electrical Engineering

Course Objectives:

- Calibration of various electrical measuring instruments
- Accurate determination of inductance and capacitance using AC Bridges
- Measurement of resistance for different range of resistors using bridges
- Performance of transducers and sensors

Course Outcomes (COs):

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

CO1: Determine unknown resistance, inductance, and capacitance using AC and DC bridges, and explain the calibration of single-phase energy meters. (L3)

CO2: Analyze the measurement of electrical quantities including power, power factor in single-phase circuits, and real and reactive power in three-phase circuits, and extend the range of ammeters and voltmeters. (L5)

CO3: Describe the working principles of transducers and sensors and their application in measuring physical parameters such as distance, temperature, current, voltage, and humidity. (L3)

Choose any Ten from the following List:

1. Measurement of resistance using Wheatstone bridge and Kelvin‘s Double Bridge.
2. Measurement of inductance using Maxwell ‘s bridge, Anderson bridge.
3. Measurement of capacitance using De-Sauty's bridge, Schering bridge.
4. Calibration of single-phase energy meter using direct loading method.
5. Calibration of energy meter using Phantom load kit.
6. Measurement of Power using 3-Voltmeter and 3-Ammeter methods in a single-phase Circuit.
7. Measurement to Real and Reactive Power in a three-phase circuit.
8. Extension of range of given Ammeter and Voltmeter.
9. Measurement of displacement using LVDT.
10. Study of CRO: Measurement of voltage, current, frequency using Lissajous patterns.
11. Measurement of different ranges of temperatures using i) RTD ii) Thermocouple
12.Measurement of strain with the help of strain gauge transducers

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04312P	PC	**Microprocessors and Microcontrollers Lab** (Common to EEE & ECE)	0	0	3	1.5

Pre requisites: Basics of Digital Electronics

Course Objectives:

- To become skilled in 8086 Assembly Language programming.
- To understand the detailed software and hardware structure of the microprocessor.
- Train their 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 of the experiments are to be conducted)

1. Programs for 16 Bit Arithmetic Operations (Using various addressing modes)
   a) Write an ALP to Perform Addition and Subtraction of Multi precision numbers.
   b) Write an ALP to Perform Multiplication and division of signed and unsigned Hexadecimal numbers.
   c) Write an ALP to find square, cube and factorial of a given number.
2. Programs Involving Bit Manipulation Instructions
   a) Write an ALP to find the given data is positive or negative.
   b) Write an ALP to find the given data is odd or even.
   c) Write an ALP to find Logical ones and zeros in a given data.
3. Programs on Arrays for 8086
   a) Write an ALP to find Addition/subtraction of N no's.
   b) Write an ALP for finding largest/smallest no.
   c) Write an ALP to sort given array in Ascending/descending order.\ 4. Programs on String Manipulations for 8086
   a) Write an ALP to find String length.
   b) Write an ALP for Displaying the given String.
   c) Write an ALP for Comparing two Strings.
   d) Write an ALP to reverse String and Checking for palindrome.
5. Programs for Digital Clock Design Using 8086
   a) Write an ALP for Designing clock using INT 21H Interrupt.
   b) Write an ALP for Designing clock using DOS Interrupt Functions.

c) Write an ALP for Designing clock by reading system time.

6. Interfacing Stepper Motor with 8086

a) Write an ALP to 8086 processor to Interface a stepper motor and operate it in clockwise by choosing variable step-size.

b) Write an ALP to 8086 processor to Interface a stepper motor and operate it in Anti-clockwise by choosing variable step-size.

7. Interfacing ADC/DAC with 8086

a) Write an ALP to 8086 processor to Interface ADC.

b) Write an ALP to 8086 processor to Interface DAC and generate Square Wave/Triangular Wave/Step signal.

8. Communication between Two Microprocessors

a) Write an ALP to have Parallel communication between two microprocessors using 8255

b) Write an ALP to have Serial communication between two microprocessor kits using 8251.

9. Programs using Arithmetic and Logical Instructions for 8051

a) Write an ALP to 8051 Microcontroller to perform Arithmetic operations like addition, subtraction, b) Multiplication and Division.

c) Write an ALP to 8051 Microcontroller to perform Logical operations like AND, OR and XOR. Programs related to Register Banks.

10. Programs to Verify Timers/Counters of 8051

a) Write a program to create a delay of 25msec using Timer0 in mode 1 and blink all the Pins of P0.

b) Write a program to create a delay of 50 µsec using Timer1 in mode 0 and blink all the Pins of P2.

c) Write a program to create a delay of 75msec using counter0 in mode 2 and blink all the Pins of P1.

d) Write a program to create a delay of 80 µsec using counter1 in mode 1 and blink all the Pins of P3.

11. UART Operation in 8051

a) Write a program to transfer a character serially with a baud rate of 9600 using UART.

b) Write a program to transfer a character serially with a baud rate of 4800 using UART.

c) Write a program to transfer a character serially with a baud rate of 2400 using UART.

12. Interfacing LCD with 8051

a) Develop and execute the program to interface16*2 LCD to 8051.

b) Develop and execute the program to interface LCD to 8051 in 4-bit or 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 edition2006.

3. The 8051 Microcontroller and Embedded Systems: Using Assembly and C by Muhammad AliMazidi, Janice Gillispie Mazidi, Second Edition.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE02301S	SE	Applications of Soft Computing Tools in Electrical Engineering	0	1	2	2

Pre-Requisites: Basics of Power Systems & Power Electronics

Course Objectives:

- Understand the basic concepts of Electrical Engineering.
- Apply the concepts to design MATLAB models.
- Analyse various Electrical engineering applications through MATLAB.
- Develop real time models using MATLAB.

Course Outcomes (COs):

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

CO1: Explain the fundamental concepts of Electrical Engineering. (L3)
CO2: Apply Electrical Engineering concepts to design MATLAB-based models. (L4)
CO3: Analyze Electrical Engineering applications using MATLAB simulations. (L4)
CO4: Develop real-time simulation models using MATLAB tools. (L5)
CO5: Design and implement a virtual Phasor Measurement Unit (PMU) using MATLAB. (L5)

Theory:

MATLAB-Introduction, different tool boxes, creation of program files, creation of Simulink files, GUI, commonly used blocks, Sim power system toolbox, control system toolbox, Sim Drive lines, Creation of functions, Project implementation through
MATLAB

Choose Any Ten from The Following List:

1. Transient analysis of given electrical network
2. Simulation of 1-phase and 3-phase transformers
3. Study of the dynamics of second order system
4. Implementation of buck and boost dc-dc converters
5. Study on the design of PI controllers and stability analysis for a DC-DC buck Converter
6. Sine-PWM techniques for single-phase half-bridge, full-bridge and three-phase inverters
7. Economic Load Dispatch of (i) Thermal Units and (ii) Thermal Plants using Conventional method
8. Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)
9. Reactive Power Control in a transmission system (Ferranti effect, Effect of shunt Inductor)
10. Fault studies using Zbus matrix
11. Design of virtual PMU
12. Wide area control of Two area Kundur system

Online Learning Resources/Virtual Labs:

1. **http://vem-iitg.vlabs.ac.in/**
2. **https://vp-dei.vlabs.ac.in/Dreamweaver/**

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24MCHS309A	MC	Technical Paper Writing and Intellectual Proper Rights	2	0	0	-

Pre requisites:

- Basic Knowledge of Academic Writing and Research Fundamentals.
- Familiarity with Technical Communication and Ethical Practices.

Course Objectives:

- To enable the students to practice the basic skills of research paper writing
- To make the students understand the importance of IP and to educate them on the basic concepts of Intellectual Property Rights.
- To practice the basic skills of performing quality literature review
- To help them in knowing 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:

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 your 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:

publication mechanism: types of journals- indexing-seminars- conferences- proof reading –plagiarism style; seminar & conference paper writing; Methodology-discussion-results- citation rules

Unit IV: Conduction to Intellectual Property:

Introduction, types of intellectual property, international organizations, ncies and treaties, importance of intellectual property rights de Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting evaluating trade mark, trade mark registration processes.

Unit V: Law of Copy Rights:

Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right 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. P.Naryan,*Intellectual Property Law*, 3rd Ed ,Eastern Law House, 2007.
4. Adrian Wallwork. *English for Writing Research Papers*Second Edition. Springer Cham Heidelberg New York ,2016
5. Dan Jones, Sam Dragga, *Technical Writing Style*

Online Resources

1. https://theconceptwriters.com.pk/principles-of-technical-writing/
2. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html
3. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html
4. https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper-journal/
5. https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf
6. https://lawbhoomi.com/intellectual-property-rights-notes/
7. https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf

Professional Elective – II (PE – II)

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02303T	PE	AI & ML for Electrical Engineers	2	1	0	3

Pre-Requisites: Basics of Mathematics & Programming Skills

Course Objectives:

- To provide basic knowledge of Artificial Intelligence, its approaches, architectures, and expert systems.
- To understand Machine Learning, Artificial Neural Networks, and Fuzzy Logic techniques for intelligent decision making.
- To apply AI methods for solving practical electrical engineering problems such as load forecasting, load flow studies, and motor speed control.

Course Outcomes (COs):

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

CO1: Explain the fundamental concepts of Artificial Intelligence, including reasoning systems, knowledge representation, rule-based systems, and expert systems. (L3)

CO2: Describe machine learning techniques such as supervised, unsupervised, and reinforcement learning along with optimization methods for data-driven problem solving. (L3)

CO3: Analyze artificial neural network models including perceptron, ADALINE, MADALINE, and backpropagation networks for pattern recognition and learning tasks. (L4)

CO4: Evaluate fuzzy logic systems including fuzzy sets, membership functions, fuzzification, defuzzification, and fuzzy rule-based controller design. (L4)

CO5: Assess the applications of AI techniques in power system and control engineering problems such as load forecasting, economic load dispatch, and motor speed control. (L5)

Unit I: Introduction to Artificial Intelligence:

Introduction and motivation - Approaches to AI - Architectures of AI - Symbolic Reasoning System - Rule based Systems - Knowledge Representation - Expert Systems.

Unit II: Overview of Machine Learning:

The Motivation & Applications of Machine Learning: Learning Associations, Classification, Regression; Supervised Learning; Unsupervised Learning; Reinforcement Learning; Gradient Descent: Batch Gradient Descent, Stochastic Gradient Descent; Data pre-processing; Under fitting and Overfitting issues.

Unit III: Artificial Neural Networks:

Basics of ANN - Comparison between Artificial and Biological Neural Networks - Basic Building Blocks of ANN - Artificial Neural Network Terminologies - McCulloch Pitts Neuron Model - Learning Rules - ADALINE and MADALINE Models - Perceptron Networks (Continuous and Discrete) – Perceptron Convergence Theorem - Back Propagation Neural Networks - Associative Memories – BAM and Hopfield networks.

Unit IV: Fuzzy Logic:

Classical Sets - Fuzzy Sets - Fuzzy Properties, Operations and relations - Fuzzy Logic System - Fuzzification - Defuzzification - Membership Functions - Fuzzy Rule base - Fuzzy Logic Controller Design.

Unit V: Applications of AI Techniques:

Load forecasting, Load flow studies, Economic load dispatch, Speed control of DC Motor, Speed Control of Induction Motors.

Text Books:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Neural Networks using MATLAB", McGraw Hill Edition, 2006.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, WILEY India Edition, 2012.
3. Ethem Alpaydin, ―Introduction to Machine Learning‖, MIT Press, 3rd edition, 2014
4. Russell. S and Norvig. P, ―Artificial Intelligence - A Modern Approach‖, 4 th edition, Pearson, 2022

References Books:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", Springer International Edition, 2013.
2. Yung C. Shin and Chengying Xu, "Intelligent System - Modeling, Optimization & Control, CRC Press, 2009.
3. Kevin P. Murphy, ―Machine Learning: A Probabilistic Perspective‖, MIT Press, 2012

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02304T	PE	Programmable Logic Controllers	2	1	0	3

Pre requisites: Basics of Industrial Instrumentation and Control Systems

Course Objectives:

- To Understand the basic functions and types of PLCs, Easy Veep software, its applications
- To Understand Classification of PLCs and applications
- To Design PLC Programming for various applications
- To Analyze PLC Troubleshooting aspects

Course Outcomes (COs):

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

CO1: Explain the basic functions of PLCs, types of PLC systems, hardware components, and comparison with mechanical relays in industrial automation. (L3)

CO2: Analyze PLC computational tools, logic diagrams, data handling, and communication between PLC, PC, and HMI systems. (L4)

CO3: Evaluate PLC development concepts including Boolean logic operations, arithmetic functions, counters, timers, and industrial programming instructions. (L4)

CO4: Analyze PLC programming instructions and control strategies including bit logic, math operations, communication protocols, and robotic interface applications. (L4)

CO5: Apply industrial applications of PLC systems in process automation, troubleshooting, control system tuning, and manufacturing industries. (L5)

Unit I: Introduction to PLCs:

Basic functions of PLCs, Mechanical relays versus PLC, Different types of PLC's – Allen-Bradley – Micro logix: ML1000, ML1100, SLC500, Compact Logix, Mitsubishi FX series, HMI's, Processor and I/O cards.

Unit II: PLC Computational Tool:

Introduction to Easy Veep software, Link between mechanical, electrical and programming documentation, Logic diagrams, Flip-Flop Logic, M8000, M8001 internal bits interpretation, Binary code, data table, manipulation and search engine in Mitsubishi environment Communication between PC and PLC, Communication between PC and HMI, PLC and HMI Serial Local network, Introduction to SLC500.

Unit III: Artificial Neural Networks:

Basics of ANN - Comparison between Artificial and Biological Neural Networks - Basic Building Blocks of ANN - Artificial Neural Network Terminologies - McCulloch Pitts Neuron Model - Learning Rules - ADALINE and MADALINE Models - Perceptron Networks (Continuous and Discrete) – Perceptron Convergence Theorem - Back Propagation Neural Networks - Associative Memories – BAM and Hopfield networks.

Unit IV: Fuzzy Logic:

Classical Sets - Fuzzy Sets - Fuzzy Properties, Operations and relations - Fuzzy Logic System Fuzzification - Defuzzification - Membership Functions - Fuzzy Rule base - Fuzzy Logic Controller Design.

Unit V: Applications of AI Techniques:

Load forecasting, Load flow studies, Economic load dispatch, Speed control of DC Motor, Speed Control of Induction Motors.

Text Books:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Neural Networks using MATLAB", McGraw Hill Edition, 2006.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, WILEY India Edition, 2012.
3. Ethem Alpaydin, ―Introduction to Machine Learning‖, MIT Press, 3rd edition, 2014
4. Russell. S and Norvig. P, ―Artificial Intelligence - A Modern Approach‖, 4th edition, Pearson, 2022

References:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", Springer International Edition, 2013.
2. Yung C. Shin and Chengying Xu, "Intelligent System - Modeling, Optimization & Control, CRC Press, 2009.
3. Kevin P. Murphy, ―Machine Learning: A Probabilistic Perspective‖, MIT Press, 2012

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02305T	PE	Switchgear and Protection	3	0	0	3

Pre requisites: Fundamentals of Power Systems

Course Objectives:

- The study of different Circuit Breakers and Relays.
- The protection of Generators and Transformers.
- To discuss the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- The protection of various feeder bus bars from abnormal conditions and over voltages & importance on neutral grounding for overall protection.

Course Outcomes (COs):

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

CO1: Explain the principles of circuit breakers, arc interruption mechanisms, ratings, selection criteria, and operation of different types of circuit breakers. (L3)

CO2: Describe the operation and characteristics of electromagnetic, static, and microprocessor-based relays used for power system protection. (L4)

CO3: Assess protection schemes for generators and transformers, including faults, differential protection, and numerical design of current transformers. (L4)

CO4: Evaluate protection schemes for feeders, transmission lines, and busbars using overcurrent, distance, and differential protection methods. (L4)

CO5: Analyze concepts of overvoltage protection, lightning arresters, insulation coordination, and neutral grounding techniques in power systems. (L5)

Unit I: Circuit Breakers:

Circuit Breakers: Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages - Restriking Phenomenon, Average, Max. RRRV, Current Chopping and Resistance Switching - CB ratings and Specifications, Selection of CB: Types and Numerical Problems. – Auto reclosures. Description and Operation of- Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breakers.

Unit II: Electromagnetic, Static and Numerical Relays:

Basic Requirements of Relays – Primary and Backup protection - Construction details of – Attracted armature, balanced beam, inductor type and differential relays – Universal Torque equation – Characteristics of over current, Direction and distance relays. Static Relays – Advantages and Disadvantages – Definite time, Inverse and IDMT static relays – Comparators –Amplitude and Phase comparators. Microprocessor based relays – Advantages and Disadvantages – Block diagram for over current (Definite, Inverse and IDMT), Distance Relays, Impedance Relays and Reactance Relays with their Flow Charts.

Unit III: Protection of Generators and Transformers:

Protection of generators: Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on percentage winding unprotected. Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CTs Ratio, Buchholtz relay Protection.

Unit IV: Protection of Feeders, Transmission Lines and Busbars:

Protection of Feeders (Radial & Ring main) using over current Relays. Protection of Transmission lines – 3 Zone protection using Distance Relays. Carrier current protection. Protection of Bus bars - Differential protection, Differential Pilot wire protection.

Unit V: Protection Against over Voltages:

Generation of Over Voltages in Power Systems. -Protection against Lightning Over Voltages - Valve type and Zinc-Oxide Lighting Arresters - Insulation Coordination –BIL. Neutral Grounding, Grounded and Ungrounded Neutral Systems. - Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance – Arcing Grounds and Grounding Practices.

Text Books:

1. Switchgear and Protection – by Sunil S Rao, Khanna Publishers.
2. Power System Protection and Switchgear by Badari Ram, D.N Viswakarma, TMH Publications.

Reference Books:

1. Protective Relaying Principles and Applications – J Lewis Blackburn, CRC Press.
2. Numerical Protective Relays, Final Report 2004 – 1009704 EPRI, USA.
3. Protective Relaying Theory and Applications - Walter A Elmore, Marcel Dekker.
4. Transmission network Protection by Y.G. Paithankar, Taylor and Francis, 2009.
5. Power System Protection- P. M. Anderson, Wiley Publishers.

Online Learning Resource:

1. https://onlinecourses.nptel.ac.in/noc22_ee101/preview

Professional Elective – III (PE – III)

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04309T	PE	Communication Systems	2	1	0	3

Pre-Requisites: Fundamentals of Signals & Systems

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 principles of amplitude modulation techniques and demodulation methods to analyze analog communication systems. (L3)

CO2: Apply angle modulation concepts such as FM and PM, including bandwidth analysis and demodulation techniques(L3)

CO3: Analyze pulse analog modulation and multiple access techniques (FDMA, TDMA, CDMA, SDMA) for efficient signal transmission. (L4)

CO4: Analyze digital communication techniques including PCM, DPCM, Delta modulation and digital modulation schemes such as ASK, PSK, QPSK, and M-PSK. (L4)

CO5: Evaluate wireless communication systems including cellular networks, GSM architecture, and compare different generations of mobile communication systems. (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 side band 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- Narrow band frequency modulation (NBFM); and Wide band FM (WBFM), Phase modulation, Pre-emphasis & De-emphasis, Illustrative Problems.

Unit III: Digital communications - I (Qualitative Approach only):

Pulse analog modulation techniques, Generation and detection of Pulse amplitude modulation, Pulse width modulation, Pulse position modulation

Multiple Access Techniques: Introduction to multiple access techniques, FDMA, TDMA, CDMA, SDMA: Advantages and applications.

Unit IV: Digital Communications - II (Qualitative Approach only):

Pulse Code Modulation, DPCM, Delta modulation, Adaptive delta modulation, Overview of ASK, PSK, QPSK, BPSK and M-PSK techniques.

Unit V: Wireless Communications (Qualitative Approach only):

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.Rapport, ―Wireless Communications‖, Pearson Education, 2nd Edition,2002.

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02306T	PE	Electric Drives	2	1	0	3

Pre-Requisites: Fundamentals of Power Electronics

Course Objectives:

- To understand the fundamentals of electric drives, their dynamics, braking methods, speed control, and selection of suitable drives for different applications.
- To study the operation and control of DC motor drives using converters and choppers, and analyze their speed–torque characteristics.
- To learn the performance and control of induction motor, synchronous motor, stepper motor, and BLDC motor drives for industrial applications.

Course Outcomes (COs):

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

CO1: Describe the fundamental concepts of electric drives, including drive dynamics, torque equations, braking methods, modes of operation, and control strategies. (L3)

CO2: Analyze the performance of single-phase and three-phase converter-fed DC motor drives under continuous and discontinuous conduction modes. (L4)

CO3: Evaluate the operation and characteristics of DC chopper-fed drives, including multi-quadrant operation and closed-loop control of DC motors. (L4)

CO4: Analyze and examine the performance and control of induction motor drives using AC voltage controllers, variable frequency control, and inverter-fed systems. (L4)

CO5: Assess the operation and control of synchronous, stepper, and BLDC motor drives including self-controlled and closed-loop drive systems. (L5)

Unit I: Introduction to Electric Drives:

Electrical drives — block diagram, advantages of electric drive, parts of electric drives, choice of electrical drives, the status of DC and AC drives. Dynamics of electrical drives-fundamental torque equations, speed- torque conventions, and multi-quadrant operation; Equivalent values of drive parameters - loads with rotational and translational motion; Load torques — components, nature and classification. Concept of steady-state stability. Electric braking methods — regenerative, dynamic and plugging. Modes of operation of electrical drives — steady state, acceleration including starting and deceleration including stopping. Speed control and drive classifications, closed-loop control of drives — current limit control, torque control, speed control and position control (Block diagram only).

Unit II: Single-Phase and Three Phase Converter fed DC Drives:

Control of DC separately excited motor by single-phase and three-phase half and full bridged converters — voltage and current waveforms for continuous and discontinuous conduction, speed torque expressions and characteristics. Single phase half-controlled rectifier fed DC series motor — voltage and current waveforms for continuous and discontinuous conduction, speed-torque expressions and characteristics. Multi-quadrant operation of DC separately excited DC motor fed from fully controlled rectifier - mechanical reversible switch in armature, dual converter and field current reversal.

Unit III: DC Chopper fed Drives:

Control of DC separately excited motor by one, two and four quadrant choppers - voltage and current waveforms for continuous conduction (motoring, regenerative and dynamic braking), speed-torque expressions and characteristics. Chopper control of DC series motor—operation, speed-torque expressions and characteristics. Closed loop chopper control of separately excited DC motor (Block diagram only).

Unit IV: Induction Motor Drives:
Three phase induction motors — Introduction, Stator variable voltage control — speed-torque characteristics, AC voltage controllers and efficiency of induction motor under voltage control. Stator variable voltage and variable frequency control — slip speed control, torque-power limitations and modes of operation. Voltage Source Inverters (VSIs) and Current Source Inverters (CSIs) fed induction motor and closed loop operation of induction motor drives (Block diagram only). Comparison of VSI and CSI fed drives. Static rotor resistance control, slip power recovery schemes – static scherbius and kramer drive, speed-torque characteristics.

Unit V: Synchronous and Stepper Motor Drives:
Synchronous Motor Drives: Separate control and self-control of synchronous motors — operations of self- controlled synchronous motors by VSI and CSI. Load commutated CSI fed Synchronous motor—operation and speed torque characteristics. Closed loop control operation of synchronous motor drives (Block diagram only). Stepper Motor Drives: Variable reluctance and permanent magnet operation — features of stepper motor — torques Vs stepping rate characteristics and drive circuits. BLDC motor operation and control.

Text Books:

1. Gopal K. Dubey, Fundamentals of Electric Drives, Narosa Publications, Alpha Science International Ltd, 2nd Edition, 2002.
2. M. H. Rashid (2003), Power Electronic Circuits, Devices and applications, 3rd edition, Prentice Hall of India, New Delhi, India.
3. Krishnan, Ramu. Electric motor drives: modeling, analysis, and control, 1st Edition, Pearson, 2015.

Reference Books:

1. M. D. Singh, K. B. Khanchandani (2008), Power Electronics, 2nd Edition, Tata McGraw Hill Publications, New Delhi.
2. Vedam Subramanyam (2008), Thyristor Control of Electric drives, 1st Edition, Tata McGraw Hill Publications, New Delhi, India.
3. S. K. Pillai (2007), A First course on Electrical Drives, 2nd Edition, New Age International (P) Ltd., NewDelhi
4. P.C. Sen, Principles of Electrical Machines and Power Electronics, Wiley, 3rdEdition, 2013.

Online Learning Resources:

1. https://web.iitd.ac.in/~amitjain/Drives_VTR.pdf
2. https://sde.uoc.ac.in/sites/default/files/de_videos/Electrical%20Drives%20and%20Controls_0.pdf
3. https://nptel.ac.in/courses/108/104/108104140/
4. https://nptel.ac.in/courses/108/102/108102046/
5. https://swayam.gov.in/nd1_noc19_ee65/preview

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02307T	PE	Renewable and Distributed Energy Technologies	3	0	0	3

Pre-Requisites: Fundamentals of Power Systems

Course Objectives:

- To This course explores each of the principal renewable energy sources in turn. Each technology is examined in terms of the relevant physical principles; the main technologies involved; environmental impact; the size of the potential renewable resource; and the future prospects of green energy.
- This Distributed Generation course is intended to provide knowledge of the benefits of renewable energy generation, availability of distributed generation technology, electricity generation technologies, issues related to grid interconnection, and methods of analyzing the

Course Outcomes (COs):

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

CO1: Describe the fundamentals of renewable energy systems, solar energy principles, and photovoltaic technologies including solar thermal and solar electric power generation. (L3)

CO2: Examine wind energy, biomass energy, and tidal energy systems with respect to resource availability, energy conversion, and performance characteristics. (L4)

CO3: Investigate energy storage systems, fuel cell technologies, and hydrogen energy systems for sustainable and efficient energy management. (L4)

CO4: Analyze distributed generation systems and their grid integration including optimal placement, inverter interfaces, and energy storage components. (L4)

CO5: Assess the technical, economic, control, and power quality impacts of distributed generation on modern power systems. (L5)

Unit I: Energy Scenario and Solar Energy:

Introduction: Fundamentals of renewable energy sources, Types of energy, Renewable and Non-renewable energy, SWOT analysis, Global warming and climate change, World energy transformation by 2050, Prospects of renewable energy in the world, Renewable energy availability in India.

Solar Energy Fundamentals: Solar Spectrum, propagation of solar radiation from the sun to earth; solar radiation geometry: sun-earth geometry, extra-terrestrial and terrestrial radiation.

Solar Thermal: Solar Collectors, Solar parabolic trough, Solar tower, Solar cooker, Solar water heater, Solar dryer, Solar Pond.

Solar Electric Power Generation: A Generic PV Cell, PV Materials, Equivalent Circuits for PV Cells, Modules and Arrays; I-V Curve under Standard Testing Conditions; Impact of Temperature and Insolation on I-V curves; Shading Impacts on I-V curves; Maximum Power Point Trackers (MPPT).

Unit II: Wind and other Energy Systems:

Wind Energy: Air, Wind, Global and Local Wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Classification of wind energy conversion system (WECS)- Horizontal axis- single, double and multiblade system. Vertical axis- Savonius and darrieus types.

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft).

Tidal Power: fundamental characteristics of tidal power, harnessing tidal energy, advantages, and limitations.

Unit III: Energy Storage and Green Energy:

Energy Storage: Stationary Battery Storage – Basics of Lead-Acid batteries, Battery Storage Capacity, Coulomb efficiency instead of energy efficiency, Battery Sizing. Different Battery storage technologies and comparison of their performance. Introduction to Super capacitors.

Green Energy: Historical Development, Basic Operation of a Fuel Cell, Fuel Cell Thermodynamics, Entropy and the theoretical efficiency of Fuel Cells, Gibbs Free Energy and Fuel Cell efficiency, Electrical output of an Ideal Cell, Electrical Characteristics of Real Fuel Cells, Types of Fuel Cells, H_2: Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.

Unit IV: Introduction to DG and its Grid Integration:

Introduction: Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

Grid integration of DGs: Different types of interfaces - Inverter based DGs and rotating machine-based interfaces Aggregation of multiple DG units. Energy storage elements: Batteries, ultracapacitors, flywheels.

Unit V: Technical Impact, Economic and Control aspects of DG:

Impacts of DGs: Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems

Economic and Control aspects of DGs: Market facts, issues, and challenges - Limitations of DGs. Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis.

Text Book:

1. Muhammad Kamran, Muhammad Rayyan Fazal, "*Renewable Energy Conversion Systems*", First Edition, Elsevier Academic Press, 2021.
2. G. D. Rai, *Non-Conventional Sources of Energy*, Khanna Publisher, 2004

Reference Books:

1. G N Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa, 2002.
2. Mukund R Patel, Wind and Solar Power Systems: Design, Analysis, and Operation, 2nd Edition, Taylor & Francis, 2006.
3. H. Lee Willis, Walter G. Scott, ―Distributed Power Generation – Planning and Evaluation‖, Marcel Decker Press, 2000.
4. Gilbert M. Masters, ―Renewable and Efficient Electric Power Systems‖, 2nd Edn., IEEE Press, Wiley, 2013.
5. N. Jenkins, J.B. Ekanayake and G. Strbac, ―Distributed Generation‖, 1st Edn, The Institution of Engineering and Technology, London, 2010.

Online Learning Resources*:*

1.https://archive.nptel.ac.in/courses/121/106/121106014/#
2.https://onlinecourses.nptel.ac.in/noc22_ch27/preview
3. https://www.nptelvideos.com/lecture.php?id=8517

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. Behaviour 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. Lab: 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, Etc., and Wind-Resistant Features in Design. Codal Provisions, Design Wind Speed, Pressure Coefficients. Coastal Zoning Regulations for Construction and Reconstruction in Coastal Areas. Innovative Construction Materials and Techniques, Traditional Construction Techniques in Coastal Areas.

Unit IV: Seismology and Earthquake Effects:

Causes of Earthquakes, Plate Tectonics, Faults, Seismic Waves; Magnitude, Intensity, Epicentre, Energy Release, and Ground Motions. Earthquake Effects– On Ground, Soil Rupture, Liquefaction, Landslides. Performance of Ground and Buildings in Past Earthquakes– Behaviour of Various Types of Buildings and Structures, Collapse Patterns; Behaviour of Non-Structural Elements Such as Services, Fixtures, and Mountings – Case Studies. Seismic Retrofitting– Weakness in Existing Buildings, Aging, Concepts in Repair, Restoration, and Seismic Strengthening.

Unit V: Planning and Design Considerations for Seismic Safety:

General Planning and Design Considerations; Building forms, Horizontal and Vertical Eccentricities, Mass and Stiffness Distribution, Soft Storey Effects, etc.; Seismic Effects Related to Building Configuration. Plan and Vertical Irregularities, Redundancy, and Setbacks. Construction Details– Various Types of Foundations, Soil Stabilization, Retaining Walls, Plinth Fill, Flooring, Walls, Openings, Roofs, Terraces, Parapets, Boundary Walls, 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.
3. BimalKanti Paul, Environmental Hazards and Disasters: Contexts, Perspectives and Management, 2nd Edition, Wiley-Blackwell, 2020.

Online Learning Resources:

1. https://nptel.ac.in/courses/124107010
2. 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:

Introduction and Definition of Sustainability - Carbon Cycle - Role of Construction Material: Concrete and Steel, Etc. - CO2Contribution 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 Via-A-Vis Operational Energy in Conditioned Building - Life Cycle Energy Use

Unit IV: Green Buildings:

Control of Energy Use in Building - ECBC Code, Codes in Neighbouring 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, 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 (3e), Yesdee Publication Pvt. Ltd, 2012.

Online Learning Resources:

1. 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
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 prductivity 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, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

Unit IV: Manipulator Kinematics:

Manipulator Kinematics, Homogenous transformations as applicable to rotation and transition - D-H notation, forward 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:

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. Chaironze, Kogam Page Ltd. 1983 London.
3. Robotic Engineering, Richard D. Klafter, Prentice Hall
4. Robotics, Fundamental Concepts and analysis – Ashitave Ghosal, Oxford Press, 1/e, 2006
5. Robotics and Control, Mittal R K &Nagrath I J, TMH.

Online Learning Resources:

1. https://www.youtube.com/watch?v=yxZm9WQJUA0&list=PLRLB5WCqU54UJG45UnazS Ymn mhl-gt76o
2. https://www.youtube.com/watch?v=6f3bvIhSWyM&list=PLRLB5WCqU54X5Vy4DwjfSO DT3Z JgwEjyE

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE4302T	OE	**Digital Electronics** (Common to CE, EEE, CSE, AI&DS, CSE-AI, & CSE- AI&ML)	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 IC's.

Course Outcomes (COs):

On successful completion of the Course, Student 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 I:

Binary Adders, Subtractors and BCD adder, Code converters - Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display.

Unit III: Combinational Logic Design II:

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:

ROM, Programmable Logic Devices (PLA and PAL).

Digital IC's: Decoder (74x138), Priority Encoder (74x148), multiplexer (74x151) and de-multiplexer (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, ZviKohavi and NirahK.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.

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 calls, 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. Interprocess 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 onwrite, 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. (Topics: Inter-process Communication and File systems.)

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:

1. https://nptel.ac.in/courses/106/106/106106144/
2. 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:

- To introduce the fundamental concepts and types of machine learning.
- To develop a deep understanding of supervised and unsupervised learning algorithms.
- To understand mathematical foundations of learning models and algorithms.
- To evaluate model performance using appropriate statistical and analytical tools.
- To apply machine learning techniques to solve real-world problems using tools such as Scikitlearn.

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 and Linear Models:

Definition and Scope of Machine Learning, Applications and Types of Learning: Supervised, Unsupervised, Reinforcement, Linear Regression: Least Squares, Cost Function, Gradient Descent, Polynomial Regression and Overfitting, Evaluation Metrics: RMSE, MAE, R^2 Score, Bias-Variance Trade off.

Unit II: Classification Algorithms:

Classification Overview and Decision Boundaries, Logistic Regression: Sigmoid Function and Cost, K-Nearest Neighbours (KNN), Naïve Bayes Classifier, Decision Trees and Random Forests, Model Evaluation: Confusion Matrix, Precision, Recall, F1-Score.

Unit III: Support Vector Machines and Ensemble Methods:

Support Vector Machines: Concepts, Kernels, Hyperplane and Margin Concepts, Kernel Tricks: RBF and Polynomial, Ensemble Learning: Bagging, Boosting, and Voting, Gradient Boosting, AdaBoost, and XG Boost, Model Tuning and Hyperparameter Optimization.

Unit IV: Unsupervised Learning Techniques:

Clustering Overview: Applications, K-Means Clustering Algorithm, Hierarchical Clustering, DBSCAN and Density- Based Methods, Principal Component Analysis (PCA) for Dimensionality Reduction, Silhouette Score, Davies-Bouldin Index for Cluster Validation.

Unit V: Advanced Topics and Applications:

Reinforcement Learning Basics and Markov Decision Processes, Introduction to Neural Networks and Deep Learning, Cross-Validation Techniques: k-Fold, Leave-One-Out, Feature Engineering and Feature Selection, Deployment of ML Models (Flask, Streamlit, etc.), Case Studies: Medical Diagnosis, Spam Detection, Credit Scoring.

Text Books:

1. Tom Mitchell, Machine Learning, McGraw-Hill Education.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O‘Reilly Media.
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer.

Online Learning Resources:

1. Coursera – Machine Learning by Andrew Ng (Stanford University)
2. Scikit-learn Documentation
3. Kaggle Learn – Machine Learning

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB304T	OE	**Optimization Techniques for Engineers** (Common to all branches of Engineering)	2	1	0	3

Pre requisites:

- Basic Knowledge of Algebra, Matrices, and Calculus.
- Familiarity with Mathematical Modeling and Problem-Solving Techniques.

Course Objectives:

- To understand and apply the concepts and tools of Operations Research and Linear Programming for solving industrial and real-world problems.
- To analyse and solve transportation and nonlinear programming problems using appropriate mathematical techniques and optimization methods.
- To develop problem-solving skills in geometric programming and other optimization techniques for engineering and industrial applications.

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 and Interpret solutions are transportation models to 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 the problems involving non-linear constraints and objectives. (L3)

CO5: Apply the concept of unconstrained geometric programming for solving the 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 in Linear Programming: 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 Techniques:

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 Techniques:

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. Panth, Introduction to Optimization Techniques, (7-e) Jain Brothers, New Delhi.

Reference Books:

1. Harvey M. Wagner, Principles of Operation Research, Printice-Hall of India Pvt. Ltd. New Delhi.
2. Peressimi A.L., Sullivan F.E., Vhl, J. J. Mathematics of Non-linear Programming, Springer – Verlag.

Web Reference:

1. https://onlinecourses.nptel.ac.in/noc24_ee122/preview
2. https://archive.nptel.ac.in/courses/111/105/111105039/
3. https://onlinecourses.nptel.ac.in/noc21_ce60/preview

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 and understand statistical interpretation
- 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).
3. John von Neumann and Robert T Beyer, Mathematical Foundations of Quantum Mechanics, Princeton Univ. Press (1996).

Web Resources:

1.https://eclass.uoa.gr/modules/document/file.php/CHEM248/Griffiths%20%20Introduction%20to%20 Quantum%20Mechanics%203rd%20ed%202018.pdf

2. https://fisica.net/mecanicquantica/Shankar%2%20Principles%20of%20quantum0mechanics.pdf

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 to 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, Interband luminescence, Direct and indirect gap materials.

Photoluminescence: General Principles of photoluminescence, Excitation and relaxation, OLED, Quantum-dot. Electro-luminescence: General Principles of electroluminescence, 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.,4thedition, 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, DhanpatRai and Co., New Delhi., 2012.
4. An Introduction to Electronic Materials for Engineers-Wei Gao, Zhengwei Li, Nigel Sammes, World Scientific Publishing Co. Pvt. Ltd. 2nd Edition,2011

NPTEL course links:

1. https://nptel.ac.in/courses/113/106/113106062/
2. https://onlinecourses.nptel.ac.in/noc20_ph24/preview

B. Tech. – III Year 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.
- Impart knowledge to the students 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 & Modified Cellulosic:

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 cellulosic: 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. reparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, 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

References 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 & Writing Reviews:

Compare and Contrast – Argumentative Essay – Exploratory Essay – Features and Analysis of Sample Essays – Writing Book Report, Summarizing, Book/film Review- 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 Paperback – January 2010 Pearson Education; First edition (1 January 2010)
2. Pease, Allan & Barbara. The Definitive Book of Body Language RHUS Publishers, 2016.

Reference Books:

1. Alice Savage, Masoud Shafiei Effective Academic Writing,2Ed.,2014 Oxford University Press.
2. Shalini Verma, Body Language, S Chand Publications 2011.
3. Sanjay Kumar and Pushpalata, Communication Skills 2E 2015, Oxford.
4. Sharon Gerson, Steven Gerson, Technical Communication Process and Product, Pearson, New Delhi, 2014
5. Elbow, Peter. Writing with Power. OUP USA, 1998

Online Learning Resources:

1.https://youtu.be/NNhTIT81nH8
2.https://www.youtube.com/watch?v=478ccrWKY-A
3.https://www.youtube.com/watch?v=nzGo5ZC1gMw
4.https://www.youtube.com/watch?v=Qve0ZBmJMh4
5.https://courses.lumenlearning.com/publicspeakingprinciples/chapter/chapter-12-nonverbalaspects-of- delivery/
6.https://onlinecourses.nptel.ac.in/noc21_hs76/preview
7.https://archive.nptel.ac.in/courses/109/107/109107172/#
8.https://archive.nptel.ac.in/courses/109/104/109104107/

B. Tech. – IV Year I Semester

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC02414T	PC	Power System Operation and Control	2	1	0	3

Pre requisites: Basics of Power Systems

Course Objectives:

- To understand the principles of optimal operation of power systems, including economic load dispatch and hydrothermal scheduling for efficient energy management.
- To analyze the dynamic behaviour of power systems through modelling of turbines, generators, and load frequency control in single and multi-area systems.
- To explore reactive power compensation techniques and the fundamental concepts of power system deregulation for improved stability, control, and market operation.

Course Outcomes (COs):

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

CO1: Analyze the optimal operation of thermal and hydro power stations using input–output characteristics, cost curves, incremental cost methods, and transmission loss coefficients. (L4)

CO2: Evaluate hydro-thermal scheduling and optimal power flow problems using Newton's method and linear programming techniques for economic operation of power systems. (L5)

CO3: Analyze the dynamic and steady-state behavior of load frequency control systems in single-area and two-area power systems including turbine-governor modeling and tie-line control. (L4)

CO4: Assess reactive power control and compensation techniques in transmission systems including shunt, series, and load compensation methods. (L5)

CO5: Analyze power system deregulation concepts including electricity markets, pricing mechanisms, transmission charges, and demand-side management strategies. (L4)

Unit I: Optimum Operation Thermal Power Station:

Optimum Operation of Thermal Power Station: Heat Rate Curve – Cost Curve – Incremental Fuel Rate – Incremental Fuel Cost and Production Cost, Input – Output Characteristics of Thermal Power Stations and Hydro Power Stations. Optimum Generation Allocation of Thermal Units without Transmission Line Losses and Optimum Generation Allocation with effect of Transmission Line Losses. Transmission Line Loss Formula, Loss coefficients, Numerical Problems.

Unit II: Economic Operation of Hydro – Thermal Scheduling:

Optimum Operation of Hydrothermal Power Stations: Hydrothermal Coordination Methods Optimal power flow problem formulation for loss and cost minimization, Solution of optimal power flow problem using Newton's method and Linear Programming technique – Numerical problems.

Unit III: Load Frequency Control:

Modelling of Turbine & Governor: The first order Turbine model, Block Diagram representation of Steam Turbines and approximate Linear models, Mathematical Modelling of Speed Governing Systems – Derivation of small Signal Transfer function – Block Diagram.

Single Area Load Frequency Control: Necessity of Keeping Frequency constant, Definition of Control Area – Single Area Control Block Diagram representation of an Isolated Power System – Steady State Analysis – Dynamic Response – Controlled & Uncontrolled case.

Two Area Load Frequency Control: Load Frequency control of Two Area system – Controlled and Uncontrolled case, Tie – Line Bias Control. Proportional Plus Integral Control of Single Area and Its

Block Diagram Representation, Steady State Response – Load Frequency Control and Economic Dispatch Control.

Unit IV: Reactive Power Control:
Overview of Reactive Power Control – Reactive Power Compensation in Transmission Systems – Advantages and Disadvantages of Different Types of Compensating Equipment for Transmission Systems; Load Compensation – Specifications of Load Compensator, Uncompensated and Compensated Transmission Lines: Shunt and Series Compensation.

Unit V: Power System Deregulation:
Principle of economics, utility functions, power exchanges, electricity market models, market power indices, ancillary services, transmission and distribution charges, principles of transmission charges, transmission pricing methods, demand-side management, regulatory framework – Numerical problems.

Text Books:
1. Modern Power System Analysis, D.P.Kothari and I.J.Nagrath, Tata McGraw Hill Publishing Company Ltd.,
2. Electric Energy Systems Theory: An Introduction, Olle I. Elgerd, TMH Publishing Company Ltd., New Delhi, 2nd edition, 1983.

Reference Books:
1. Power Generation, Operation and Control, Allen J. Wood and Bruce F. Wollenberg, John Wiley & Sons, Inc., New York, 2nd edition, 1996.
2. Reactive Power Control in Electric Systems, T J E Miller, John Wiley & Sons, New York, 1982.
3. Power System Analysis Operation and Control, Abhijit Chakrabarti and Sunita Halder, PHI Learning Pvt Ltd., 3rd Edition, 2010.

Online Learning Resources*:*
1. https://archive.nptel.ac.in/courses/108/104/108104052/
2. http://kcl.digimat.in/nptel/courses/video/108104191/L01.html
3. https://nptel.ac.in/courses/108101040

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE02402S	SE	Power Systems and Simulation Lab	0	1	2	2

Pre requisites: Basics of Power Systems

Course Objectives:

- To do the experiments (in machines lab) on various power system concepts like determination of sequence impedance, fault analysis, finding of sub transient reactance 's.
- To draw the equivalent circuit of three winding transformer by conducting a suitable experiment.
- To develop the MATLAB program for formation of Y and Z buses. To develop the MATLAB programs for Gauss-Seidel and fast decoupled load flow studies.
- To develop the SIMULINK model for single area load frequency problem.

Course Outcomes (COs):

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

CO1: Determine and analyze sequence impedances of cylindrical rotor and salient pole synchronous machines to study their behavior under various fault conditions. (L3)

CO2: Explain and interpret fault analysis (LG, LL, LLG, and LLLG) on synchronous machines and their impact on system stability and performance. (L2)

CO3: Develop and evaluate load flow analysis using Gauss-Seidel, Newton-Raphson, and Fast Decoupled methods, including formulation of YBus and ZBus for power system networks. (L5)

CO4: Model load frequency control for single-area and two-area systems using uncontrolled and PI-controlled approaches to assess system performance. (L4)

CO5: Simulate load frequency control for single-area and two-area systems using uncontrolled and PI-controlled approaches for performance evaluation. (L6)

Choose any Ten from the Following List:

1. Determination of Sequence Impedances of Cylindrical Rotor Synchronous Machine
2. Determination of Sequence Impedances of salient pole Synchronous Machine
3. LG Fault Analysis on an un loaded alternator
4. LL Fault Analysis on conventional phases
5. LLG Fault Analysis
6. LLLG Fault Analysis
7. Determination of Sub transient reactance of salient pole synchronous machine
8. Equivalent circuit of three winding transformer.
9. YBus formation using Soft Tools
10. ZBus formation using Soft Tools
11. Gauss-Seidel load flow analysis using Soft Tools
12. Newton-Raphson load flow analysis using Soft Tools
13. Fast decoupled load flow analysis using Soft Tools
14. Solve the Swing equation and plot the swing curve
15. Develop a model for a uncontrolled single area load frequency control problem and simulate the same using Soft Tools.
16. Develop a model for PI controlled single area load frequency control problem and simulate the same using Soft Tools.
17. Develop a model for a uncontrolled two area load frequency control problem and simulate the same using Soft Tools.

18. Develop a model for PI controlled two area load frequency control problem and simulate the same using Soft Tools.

Online Learning Resource:

1. https://www.ee.iitb.ac.in/~vlabsync/template/vlab/index.html#

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)	2	0	0	-

Pre requisites: Nill

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- ―My Mother doesn‘t Work. Share the Load-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. A.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. Wtatt, Robin and Massood, Nazia, Broken Mirrors: The dowry Problems in India,London : Sage Publications, 2011
2. Datt, R. and Kornberg, J.(eds), Women in Developing Countries, Assessing Strategies for
3. Empowerment, London: Lynne Rienner Publishers, 2002
4. Brush, Lisa D., Gender and Governance, New Delhi, Rawat Publication, 2007
5. Singh, Direeti, Women and Politics World Wide, New Delhi, Axis Publications, 2010
6. Raj Pal Singh, Anupama Sihag, Gender Sensitization: Issues and Challenges (English, Hardcover), Raj Publications, 2019
7. A.Revathy& Murali, Nandini, A Life in Trans Activism(Lakshmi Narayan Tripathi). The University of Chicago Press, 2016

Online Resources:

1. Understanding Gender chrome-extension: //kdpelmjpfafjppnhbloffcjpeomlnpah/https://www.arvindguptatoys.com/arvindgupta/kamlagender1.pdf https://onlinecourses.swayam2.ac.in/nou24_hs53/preview
2. Gender Roles and Relations https://www.plannedparenthood.org/learn/gender-identity/sex-gender-identity/what-are-genderroles-and-stereotypes https://www.verywellmind.com/understanding-gender-roles-and-their-effect-on-our-relationships7499408 https://onlinecourses.swayam2.ac.in/cec23_hs29/preview
3. Gender and Labour https://www.economicsobservatory.com/what-explains-the-gender-division-of-labour-and-how-canit-be-redressed https://onlinecourses.nptel.ac.in/noc23_mg67/preview
4. Gender-based Violence https://eige.europa.eu/gender-based-violence/what-is-gender-basedviolence?language_content_entity=en https://www.worldbank.org/en/topic/socialsustainability/brief/violence-against-women-and-girls https://onlinecourses.swayam2.ac.in/nou25_ge38/preview
5. Gender and Culture https://gender.study/psychology-of-gender/culture-impact-gender-roles-identities/https://sociology.iresearchnet.com/sociology-of-culture/gender-and-culture/

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPIN403L	IP	**Evaluation of Industry 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: Fundamentals of Business Ethics

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 '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 behaviour. 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 frame work - 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, KarunakaraReaddy. 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:

1. https://onlinecourses.nptel.ac.in/noc21_mg46/
2. https://archive.nptel.ac.in/courses/110/105/110105138/
3. https://onlinecourses.nptel.ac.in/noc21_mg54/
4. https://onlinecourses.nptel.ac.in/noc22_mg54/
5. https://archive.nptel.ac.in/courses/109/106/109106117/

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: Basics of Management Information Systems

Course Objectives:

- To provide knowledge on emerging concept on E-Business related aspect.
- 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 the students aware on 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's, 2005
2. Dave Chaffey.E-Commerce E-Management, Second Edition, Pearson, 2012.
3. Henry Chan. E-Commerce Fundamentals and Application, Raymond Leatham Wiley India 2007
4. S. Jaiswal. E-Commerce Galgotia Publication Pvt Ltd., 2003.

Online Resources:

1.https://www.slideshare.net/fatimahAlkreem/ebusinessppt-679357712.
2.https://www.slideshare.net/VikramNani/e-commerce-business-models
3.https://www.slideshare.net/RiteshGoyal/electronic-payment-system
4.https://www.slideshare.net/WelingkarDLP/electronic-security
5.https://www.slideshare.net/Ankitha2404/emarketing-ppt

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: Nill

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 identify 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 - Human Resource Planning (HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process - Employee Training and Development - methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration.

Unit IV: Strategic & Project Management:

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management -** Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

Unit V: Contemporary Issues in Management:

Customer Relations Management (CRM) - Total Quality Management (TQM) - Six Sigma Concept- Supply Chain Management (SCM) - Enterprise Resource Planning (ERP) - Performance Management – employee engagement and retention - Business Process Re-engineering and Bench Marking - Knowledge Management – change management – sustainability and corporate social responsibility.

Text Books:

1. Frederick S. Hillier, Mark S. Hillier. Introduction to Management Science, October 26, 2023
2. A.R Aryasri, Management Science, TMH, 2019

Reference Books:

1. Stoner, Freeman, Gilbert.*Management*, Pearson Education, New Delhi, 2019.
2. Koontz & Weihrich, *Essentials of Management*, 6/e, TMH, 2005.
3. Thomas N.Duening & John M.Ivancevich, *Management Principles and Guidelines*, Biztantra.
4. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004. 5. Samuel C.Certo, *Modern Management*, 9/e, PHI, 2005

Online Resources:

1. https://www.slideshare.net/slideshow/introduction-to-management-anorganization231308043/231308043
2. https://nptel.ac.in/courses/112107238
3. https://archive.nptel.ac.in/courses/110/104/110104068/
4. https://archive.nptel.ac.in/courses/110/105/110105069/
5. https://onlinecourses.nptel.ac.in/noc24_mg112/

Professional Elective-IV (PE – IV)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04412T	PE	Digital Signal Processing	2	1	0	3

Pre requisites: Basics of Fourier transforms & 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 Discrete Fourier Transform and Fast Fourier Transform 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 concepts of discrete-time signals, systems, and Z-transform techniques to analyse LTI systems and solve difference equations(L3)

CO2: Analyse DFT and FFT techniques to perform spectral analysis and convolution operations in digital signal processing(L4)

CO3: Analyse the design of IIR filters using analog approximations and transformation techniques with different realizations(L4)

CO4: Examine different FIR filter design approaches and differentiate their performance based on windowing techniques(L4)

CO5: Evaluate DSP processor architecture (TMS320C5X) and assess its suitability for real-time signal processing applications(L5)

Unit I: Introduction to Discrete Time Signals and Systems:

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, Illustrative Problems, analysis of linear time-invariant systems in the z-domain, pole-zero stability.

Unit II: 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.

Fast Fourier Transform: Introduction, 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, Hanging, 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, New Delhi, 2004.
2. MH 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.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee99/preview,
2. https://nptel.ac.in/courses/108105055

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02408T	PE	Electric Vehicle Technology	3	0	0	3

Pre-Requisites: Basics of Power Electronics

Course Objectives:

- To provide students with a strong foundation in electric vehicle technology, including history, environmental benefits, vehicle classifications, and comparison with conventional transportation systems.
- To develop analytical understanding of electric drive-train configurations, traction systems, electric drives, and various energy storage technologies used in modern electric vehicles.
- To enable students to evaluate energy management strategies, charging infrastructure, communication protocols, and real-world applications of electric vehicle systems.

Course Outcomes (COs):

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

CO1: Describe the fundamentals of electric vehicles, including their history, environmental impact, and comparison with conventional, hybrid, electric, and fuel cell vehicles. (L3)

CO2: Analyze electric drive-train topologies and power flow control strategies used in electric traction systems. (L4)

CO3: Analyze the control techniques of electric drives used in EVs, including BLDC, induction motor, PMSM, and SRM drives. (L4)

CO4: Analyze energy storage systems in electric vehicles, including batteries, supercapacitors, fuel cells, and hybrid energy storage modeling. (L4)

CO5: Assess energy management strategies, charging infrastructure, and communication protocols used in electric vehicles along with case studies. (L5)

Unit I: Introduction to Electric Vehicles:

History of electric vehicles, social and environmental importance of electric vehicles, impact of modern drive-trains on energy supplies.

Unit II: Electric Drive-Trains:

Basic concept of electric traction, Introduction to various electric drive-train topologies, Power flow control in electric drive-train topologies.

Unit III: Electric Drives & Control:

Introduction to electric components used in electric vehicles, Control of BLDC Motor, Control of Induction Motor Drive, Permanent Magnet (PM) motor Drive & Switched Reluctance Motor (SRM) Drive.

Unit IV: Energy Storage:

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its modeling, SOC, Different Types of Batteries, Super Capacitor based energy storage and its analysis, Fuel Cells, Hybridization of different energy storage devices.

Unit V: Energy Management Strategies & Charging Infrastructure:

Introduction to energy management strategies used in electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies, Types of EV charging Infrastructure & Standardized Communication protocols for EV charging.

Text Books:

1.Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, ―Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design‖, CRC Press, 2 nd Edition, 2017. (Unit-I, II)

2.Ali Emadi, ―Advanced Electric Drive Vehicles (Energy, Power Electronics, and Machines)‖, CRC Press, 2015. (Unit-III)

3.John G. Hayes and A. Goodarzi, ―Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles‖, Wiley, 2018. (Unit-IV & V)

Reference Books:

1.James Larminie, John Lowry, ―Electric Vehicle Technology Explained‖, Wiley, 2 nd Edition 2012.

Web Resources:

1. https://nptel.ac.in/courses/108106170
2. https://onlinecourses.nptel.ac.in/noc22_ee53
3. https://onlinecourses.nptel.ac.in/noc21_ee112

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02409T	PE	HVDC and FACTS	3	0	0	3

Pre requisites: Basics of Power Electronics

Course Objectives:

- High voltage DC transmission systems
- Flexible AC transmission systems
- Various configurations of the above, Principle of operation, Characteristics of various FACTS devices

Course Outcomes (COs):

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

CO1: Analyze conventional and emerging power transmission systems, including HVDC, FACTS, and control mechanisms such as AGC, excitation control, and transformer tap changing. (L4)

CO2: Analyze the operation and performance of HVDC transmission systems, including converter circuits, rectifier and inverter characteristics, and equivalent circuit models. (L4)

CO3: Examine the control strategies of HVDC transmission systems, including constant current, constant ignition angle, constant extinction angle, and power flow control methods. (L4)

CO4: Evaluate the operating principles and performance of FACTS controllers for reactive power compensation in transmission systems. (L5)

CO5: Assess the operation and control of advanced FACTS devices such as UPFC and IPFC for real and reactive power flow control in power systems. (L5)

Unit I: Introduction:

Electrical Transmission Networks, Conventional Control Mechanisms-Automatic Generation Control, Excitation Control, Transformer Tap-Changer Control, Phase-Shifting Transformers; Advances in Power- Electronic Switching Devices, Principles and Applications of Semiconductor Switches; Limitations of Conventional Transmission Systems, Emerging Transmission Networks, HVDC and FACTS. Concepts of virtual inertia

Unit II: High Voltage Dc Transmission – I:

Types of HVDC links - Monopolar, Homopolar, Bipolar and Back-to-Back, Advantages and disadvantages of HVDC Transmission, Analysis of Graetz circuit, Analysis of bridge circuit without overlap, Analysis of bridge with overlap less than 600, Rectifier and inverter characteristics, complete characteristics of rectifier and inverter, Equivalent circuit of HVDC Link.

Unit III: High Voltage DC Transmission – II:

Desired features and means of control, control of the direct current transmission link, Constant current control, Constant ignition angle control, Constant extinction angle control, Converter firing- angle control- IPC and EPC, frequency control and Tap changer control, Starting, Stopping and Reversal of power flow in HVDC links.

Unit IV: Flexible AC Transmission Systems-I:

Types of FACTS Controllers, brief description about various types of FACTS controllers, Operation of 6- pulse converter, Transformer Connections for 12-pulse, 24-pulse and 48-pulse operation, principle of operation of various types of Controllable shunt VAR Generation, Principle of switching converter type shunt compensator, principles of operation of various types of Controllable Series VAR Generation, Principle of Switching Converter type series compensator.

Unit V: Flexible AC Transmission Systems-II:
Unified Power Flow Controller (UPFC) – Principle of operation, Transmission Control Capabilities, Independent Real and Reactive Power Flow Control; Interline Power Flow Controller (IPFC) Principle of operation and Characteristics, UPFC and IPFC control structures (only block diagram description), objectives and approaches of voltage and phase angle regulators

Text Books:
1.Narain G. Hingorani and Laszlo Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, Wiley-Interscience, New Jersey, 2000.
2.E.W. Kimbark, Direct current transmission, Vol. I, Wiley Interscience, New York, 1971.

Reference Books:
1.K R Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International Publishers, New Delhi, 2007.
2.AnriqueAcha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez and César Angeles-Camacho, FACTS: Modelling and Simulation in Power Networks, John Wiley & Sons, West Sussex, 2004.
3.R Mohan Mathur and Rajiv K Varma, Thyristor-Based FACTS Controllers for Electrical Transmission Systems, IEEE Press, Wiley-Interscience, New Jersey, 2002.

Online Learning Resources:
1.https://nptel.ac.in/courses/108104013
2.https://nptel.ac.in/courses/108107114

Professional Elective -V (PE – V)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02410T	PE	Modern Control Theory	2	1	0	3

Pre requisites: Basics of Control Systems

Course Objectives:

- To familiarize the state space representation in controllable, observable, diagonal and Jordan canonical forms.
- Introduce the concept of controllability and observability tests through canonical forms and design of state feedback controller by pole placement technique and State Observer design.
- Analysis of a nonlinear system using describing function approach.
- Illustrate the Lypanov ‘s method of stability analysis for linear and non-linear continuous time autonomous systems.
- Formulation of Euler Laugrange equation for the optimization of typical functional and solutions.

Course Outcomes (COs):

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

CO1: Describe state space representation of linear systems using canonical forms and determine state transition matrix for system solution. (L3)

CO2: Evaluate controllability and observability of linear systems and design state feedback controllers using pole placement techniques. (L5)

CO3: Examine nonlinear systems using phase plane analysis and describing function techniques to understand system behavior. (L4)

CO4: Evaluate stability of linear and nonlinear systems using Lyapunov stability theory and direct method of analysis. (L5)

CO5: Analyze optimization problems in control systems using calculus of variations and Euler–Lagrange formulation. (L4)

Unit I: State Space Analysis:

State Space Representation – Canonical forms – Controllable canonical form – Observable canonical form Jordan Canonical Form - Solution of state equation – State transition matrix.

Unit II: Controllability - Observability and Design of Pole Placement:

Tests for controllability and observability for continuous time systems – Time varying case – Minimum energy control – Time invariant case – Principle of duality – Controllability and observability form Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability – Design of state feedback control through pole placement.

Unit III: Nonlinear Systems:

Introduction to nonlinear systems - Types of nonlinearities. Introduction to phase–plane analysis - Singular points; Describing function - basic concepts - Describing functions of non- linearities.

Unit IV: Stability Analysis by Lyapunov Method:

Stability in the sense of Lyapunov – Lyapunov‘s stability and Lyapunov‘s instability theorems – Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.

Unit V: Calculus of Variations:

Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints –Euler lagrangine equation.

Text Books:

1.Modern Control System Theory – by M. Gopal - New Age International Publishers - 2ndedition - 1996

2.Modern Control Engineering – by K. Ogata - Prentice Hall of India - 3rd edition - 1998.

Reference Books:

1.Automatic Control Systems by B.C. Kuo - Prentice Hall Publication.

2.Control Systems Engineering by I.J. Nagarath and M.Gopal - New Age International (P) Ltd.

3. Digital Control and State Variable Methods – by M. Gopal - Tata Mc Graw–Hill Companies - 1997.

4. Systems and Control by Stainslaw H. Zak - Oxford Press - 2003.

5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02411T	PE	Switched Mode Power Conversion	3	0	0	3

Pre requisites: Basics of Power Electronics

Course Objectives:

- Understand basic concepts of DC-DC converters
- Understand the concepts of resonant converters and their classification, various types of multilevel inverters, power conditioners, UPS and filters.
- Apply various modulation and harmonic elimination techniques over the converters.
- Analyze the state space modelling of various types of converters.
- Design inductor and transformer for various power electronic applications.

Course Outcomes (COs):

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

CO1: Describe the operating principles and state-space modelling of DC–DC converters including buck, boost, buck-boost, and Cuk converters. (L3)

CO2: Analyze the operation and control of switching mode power converters including flyback, forward, Luo, half-bridge, and full-bridge converters using PWM techniques. (L4)

CO3: Analyze the operation and characteristics of resonant converters including ZVS, load resonant, series, and parallel resonant inverters with respect to voltage control and switching behavior. (L4)

CO4: Analyze DC–AC inverter systems using various modulation techniques such as SPWM, SVPWM, harmonic elimination methods, and multilevel inverter configurations. (L4)

CO5: Assess power conditioning systems including UPS, filters, and their design considerations for mitigating power quality issues in power electronic applications. (L5)

Unit I: DC-DC Converters:

Principles of step-down and step-up converters – Analysis and state space modelling of Buck, Boost, Buck- Boost and Cuk converters – Numerical Examples

Unit II: Switching Mode Power Converters:

Analysis and state space modelling of flyback, Forward, Luo, Half bridge and full bridge converters- control circuits and PWM techniques – Numerical Examples

Unit III: Resonant Converters:

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS, Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control – Numerical Examples

Unit IV: DC-AC Converters:

Single phase and three phase inverters, control using various (sine PWM, SVPWM and advanced modulation) techniques, various harmonic elimination techniques- Multilevel inverters- Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

Unit V: Power Conditioners, UPS & Filters:

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications Selection of capacitors.

Text Books:

1.Power Electronics: Essentials and Applications by L. Umanand, Wiley, 2009

2.M.H. Rashid – Power Electronics handbook, Elsevier Publication, 2001.

3.Course material on Switched Mode Power Conversion by V Ramanarayanan, Dept. of Electrical Engg. IISc. Bangalore.

Reference Books:

1.Philip T. Krein, ―Elements of Power Electronics‖, Oxford University Press, 2012

2.Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design, 3rd Edition, John Wiley and Sons, 2006

3.M.H. Rashid, Power Electronics circuits, devices and applications, 3rd Edition Prentice Hall of India New Delhi, 2007.

Online Learning Resources:

1.https://nptel.ac.in/courses/108108036

2.https://nptel.ac.in/courses/108105180

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE02412T	PE	Electrical Distribution System	2	1	0	3

Pre requisites: Basics of Power Systems

Course Objectives:

- To know about fundamental aspects of distribution system, principle of distribution substations.
- To know about classification of various loads.
- To understand difference between conventional load flow studies of power system and distribution system load flow.
- To know about evaluation of voltage droop and power loss calculations, distribution automation and management system, SCADA.

Course Outcomes (COs):

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

CO1: Describe the fundamentals of electrical distribution systems, including sub-transmission networks, substation bus schemes, feeder types, and factors influencing system design. (L3)

CO2: Analyze distribution system substations and load characteristics including feeder loading, transformer loading, load factor, and optimal substation placement. (L4)

CO3: Apply distribution system load flow techniques including line models, voltage regulators, and forward/backward sweep methods to solve power flow problems. (L3)

CO4: Analyze voltage drop, power loss, and capacitor placement techniques in distribution systems for improved efficiency and performance. (L4)

CO5: Evaluate distribution automation systems including SCADA, GIS, AMR, outage management, and smart grid functionalities. (L5)

Unit I: Distribution System Fundamentals:

Brief description about electrical power transmission and distribution systems, Different types of distribution sub-transmission systems, Substation bus schemes, Factors effecting the substation location, Factors effecting the primary feeder rating, types of primary feeders, Factors affecting the primary feeder voltage level, Factors effecting the primary feeder loading.

Unit II: Distribution System Substations and Loads:

Substations: Rating of a distribution substation for square and hexagonal shaped distribution substation, Service area with ―n‖ primary feeders, K constant, Radial feeder with uniformly and nonuniformly distributed loading. Benefits derived through optimal location of substations.

Loads: Various types of loads, Definitions of various terms related to system loading, Distribution transformer loading, feeder loading, Relationship between the Load Factor and Loss Factor, Modelling of star and delta connected loads.

Unit III: Distribution System Load Flow:

Exact line segment model, Modified line model, approximate line segment model, Step-Voltage Regulators, Line drop compensator, Forward/Backward sweep distribution load flow algorithm – Numerical problems

Unit IV: Voltage Drop and Power Loss Calculation:

Analysis of non-three phase primary lines, concepts of four-wire multi-grounded common-neutral distribution system, Percent power loss calculation, Distribution feeder cost calculation methods, Capacitor installation types, Series and Shunt Capacitors, Types of three-phase capacitor-bank connections, Procedure for best capacitor location, Economic justification for capacitors – Numerical problems.

Unit V: Distribution Automation:

Distribution automation, distribution management systems, distribution automation system functions, Basic SCADA system, Consumer Information Service (CIS) – Geographical Information System (GIS) – Automatic Meter Reading (AMR), Outage management, decision support applications, substation automation, control feeder automation.

Text Books:

1.Distribution System Modelling and Analysis, William H. Kersting, CRC Press, Newyork, 2002.
2.Electric Power Distribution System Engineering, Turan Gonen, McGraw-Hill Inc., New Delhi, 1986.

Reference Books:

1.Control and automation of electrical power distribution systems, James Northcote-Green and Robert Wilson, CRC Press (Taylor & Francis), New York, 2007.
2.Biswarup Das, Power distribution Automation, IET publication, 2016.
3.Dr. M. K. Khedkar, Dr. G.M. Dhole, Electric Power Distribution Automation, Laxmi Publications, First edition, 2017.

Online Learning Resource:

1.https://onlinecourses.nptel.ac.in/noc22_ee126/preview

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:

- To understand the properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
- To analyze the composition, manufacturing process, and properties of cement and admixtures.
- To apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
- To evaluate masonry, mortars, finishing techniques, and formwork systems.
- To 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 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 Finishing 's Mortars:

Lime and Cement Mortars Brick Masonry – Types – Bonds; Stone Masonry – Types; Composite Masonry – Brick-Stone Composite; Concrete, Reinforced Brick. Finishers: Plastering, Pointing, Painting, Claddings – Types – Tiles – ACP. form Work: Types: Requirements – Standards – Scaffolding – Design; Shoring, Underpinning.

Unit V: Building Services:

Plumbing Services: Water Distribution, Sanitary – Lines &Fittings; Ventilations: Functional Requirements Systems of Ventilations. Air-Conditioning - Essentials andTypes; Acoustics – Characteristic – 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 andArun Kumar Jain - Laxmi Publications (P) ltd., New Delh
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

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/105/102/105102088/

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):
On successful completion of the Course, Student will be able to

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 E-I-A Impact Evaluation and Analysis, Preparation of Environmental Base Map, Classification of Environmental Parameters-Criteria for The Selection of EIA Methodology, E I A 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 Actives. Procurement of Relevant Soil Quality, Impact Prediction, Assessment of Impact Significance, Identification and Incorporation of Mitigation Measures. E I Ain 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, Wildlife and Risk Assessment:

Introduction - Assessment of Impact of Development Activities on Vegetation and Wildlife, Environmental Impact of Deforestation – Causes and Effects of Deforestation - 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. Environmental Legislation Objectives, Evaluation of Audit Data and Preparation of Audit Report. Post Audit Activities, 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.Mc-Graw 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

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/124/107/124107160/

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 postprocessing 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, other related technologies, 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), Stereo lithography (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: Working Principle, Materials, Advantages, Limitations and Applications of Three Dimensional Printing (3DP) Ballastic Particle Manufacturing (BPM) and 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 – The 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: Need for software, MIMICS, Magics, Surgi Guide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, Solid View, 3DView, etc., software, 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 applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

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.

Online Learning Resources:

1. NPTEL Course on Rapid Manufacturing.
2. https://nptel.ac.in/courses/112/104/112104265/
3. https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/
4. https://slideplayer.com/slide/6927137/
5. https://www.mdpi.com/2073-4360/12/6/1334
6.https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%2 %20FDM.pdf
7. https://lecturenotes.in/subject/197
8. https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdfcompressed.pdf
9. https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
10.https://www.youtube.com/watch?v=NkC8TNts4B4.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04312T	OE	**Microprocessors and Microcontrollers** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites: Basics of Electronics

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:

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, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rdEdition,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.

References:

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. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05204T	PC	**Data Base Management System** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites: Data Structures and Algorithms

Course Objectives:

- To introduce the fundamental concepts of database systems and data modelling.
- To provide knowledge on relational databases and SQL for data retrieval and manipulation.
- To understand database design principles using normalization and ER modelling.
- To study transaction management, concurrency control, and database recovery.
- To explore emerging database technologies and architectures including NoSQL.

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 to Databases:

Database System Applications and Purpose, View of Data: Data Abstraction and Data Independence, Database Users and Administrators, DBMS Architecture and Data Models, ER Model: Entities, Attributes, Relationships, ER Diagrams, Reduction of ER Model to Tables

Unit II: Relational Model and Algebra:

Structure of Relational Databases, Relational Model Concepts and Integrity Constraints, Relational Algebra: Selection, Projection, Set Operations, Joins, Tuple Relational Calculus, Introduction to SQL: DDL, DML, DCL, Advanced SQL: Sub queries, Joins, Views, Indexes

Unit III: Database Design and Normalization:

Schema Design and Logical Database Design, Functional Dependencies, Normal Forms: 1NF, 2NF, 3NF, BCNF, Decomposition and Lossless Join, Dependency Preservation, Multi-Valued and Join Dependencies.

Unit IV: Transaction Management and Concurrency Control:

Concept of a Transaction, ACID Properties, Serializability and Schedules, Concurrency Control:

Lock-Based, Timestamp-Based Protocols, Deadlock Handling, Recovery Techniques: Log-Based, Shadow Paging

Unit V: Advanced Topics and NoSQL Databases:
Distributed Databases and Parallel Databases, Introduction to NoSQL: Types – Document, Columnar, Key-Value, Graph, CAP Theorem, MongoDB: Basics and CRUD Operations, Big Data and New SQL Overview, Case Studies on Real- World Databases

Text Books:
1.Abraham Silberschatz, Henry F. Korth, S. Sudarshan – Database System Concepts, 7th Edition, McGraw Hill
2.Ramez Elmasri, Shamkant B. Navathe – Fundamentals of Database Systems, 7th Edition, Pearson Education

Reference Books:
1.C.J. Date – An Introduction to Database Systems, 8th Edition, Addison-Wesley
2.Raghu Ramakrishnan, Johannes Gehrke – Database Management Systems, 3rd Edition, McGraw Hill
3.Pramod J. Sadalage & Martin Fowler – NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson

Online Resources & Courses:
1. NPTEL – Database Management Systems by IIT Madras
2. Coursera – Databases by Stanford University
3. Khan Academy – Intro to SQL
4. MongoDB University – Free Courses on NoSQL Databases
5. W3Schools SQL Tutorial
6. Geeks for Geeks – DBMS Concepts and Practice Problems

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 understanding of Computer Security concepts
- Introductory knowledge of Programming and Databases

Course Objectives:

- To introduce the concept of cybercrime and its impact on information security, and provide an overview of cybercriminal behaviour and various classifications of cybercrimes.
- To explore the methodologies used by cybercriminals to plan and execute attacks, including techniques like social engineering, botnets, and cloud-related threats.
- To understand the security risks associated with mobile and wireless devices, and examine countermeasures for securing mobile computing in organizational environments.
- To familiarize students with the tools and techniques used in committing cybercrimes, such as phishing, malware, DoS/DDoS attacks, and code-based exploits.
- To analyze the implications of cybercrime for organizations, including the cost of cyber-attacks, intellectual property issues, and challenges posed by social computing and web-based threats.

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, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Unit II: Cyber Offenses: How Criminals Plan Them:

Introduction, 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:

Introduction, 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, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

Unit IV: Tools and Methods Used in Cybercrime:

Introduction, 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:

Introduction, 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.DavidIrwin.CRC Press T&F Group

Online Learning Resources:

1.http://nptel.ac.in/courses/106105031/40
2.http://nptel.ac.in/courses/106105031/39
3.http://nptel.ac.in/courses/106105031/38

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 provide fundamental knowledge of wavelets, wavelet basis functions, and continuous and discrete wavelet transforms for signal analysis.
- To develop understanding of multiresolution analysis, scaling functions, and implementation of discrete wavelet transforms using multi rate digital filters.
- To enable students to analyze, design, and apply various wavelet families for time-frequency analysis and engineering applications.

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 the multi resolution analysis ad scaling functions. (L5)

CO3: Implement discrete wavelet transforms with multirate digital filters. (L3)

CO4: Understand multi resolution 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 Wavelets Transforms‖, Prentice Hall, (1997).

2.James S. Walker, ―A Primer on Wavelets and their Scientific Applications‖, CRC Press, (1999)..

Reference Books:

1.RaghuveerRao, ―Wavelet Transforms‖, Pearson Education, Asia

2.C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc.

Online Resources:

1.http://users.rowan.edu/~polikar/WAVELETS/WTtutorial.html

2.http://www.wavelet.org/

3.http://www.math.hawaii.edu/~dave/Web/Amara's%20Wavelet%20Page.htm

4.https://jqichina.wordpress.com/wp-content/uploads/2012/02

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:

- To provide exposure to smart materials and their engineering applications.
- To impart knowledge on the basics and phenomenon behind the working of smart materials
- To explain the properties exhibited by smart materials
- To educate various techniques used to synthesize and characterize smart materials
- To 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, chromo active, 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, chromo active 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 and 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.YaserDahman, 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.MahmoodAliofkhazraei, Handbook of functional nanomaterials, Vol (1&2), Nova Publishers, 2014
3.Handbook of Smart Materials, Technologies, and Devices: Applications of Industry,4.0,Chaudhery MustansarHussain, Paolo Di Sia, Springer,2022.
4.Fundamentals of Smart Materials,Mohsen Shahinpoor, Royal Society of Chemistry, 2020

NPTEL course link:

1. https://onlinecourses.nptel.ac.in/noc22_me17/preview

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:

- To understand the fundamental differences between classical and quantum mechanics.
- To study wave-particle duality, uncertainty principle, and their implications.
- To learn and apply Schrödinger equations to basic quantum systems.
- To use operator formalism and mathematical tools in quantum mechanics.
- To 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:

Introduction: 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 equation, 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 – definition. 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 AM 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. MessaiaNoth-Holland Pub. Co., Amsterdam,(1961).
2.A Text Book of Quantum Mechanics. P.M.Mathews and K.Venkatesam, Tata McGraw Hill, New Delhi,(1976).
3.Introduction to Quantum Mechanics. R.H.Dicke and J.P.Witke, Addison-Wisley Pub.Co.Inc.,London, (1960).
4.Quantum Mechanics. S.L.Gupta, V.Kumar, H.V.Sarama and R.C.Sharma, Jai PrakashNath& Co, Meerut, (1996).

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 (Fourth Edn.) 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:

- To understand principle and concepts of green chemistry.
- To understand the types of catalysis and industrial applications.
- To apply green solvents in chemical synthesis.
- To enumerate different sourced of green energy.
- To apply alternative greener methods foe 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 1: 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 and atom uneconomic 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 of Heterogeneous Catalysis, Zeolite and the Bulk Chemical Industry, Heterogeneous Catalysis in the 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: Super critical carbon dioxide, super critical water, Polyethylene glycol (PEG), Ionic liquids, Recycling of green solvents.

Unit IV: Emerging Greener Technologies:

Biomass as renewable resource, Energy: Energy from Biomass, Solar Power, Chemicals from Renewable Feedstock 's, 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), Examples of Photochemical Reactions, Microwave-assisted Reactions and Sono chemical 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

References:

1.Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and AckmezMudhoo, CRC Press, 2010.
2.Edited by AlvisePerosa and Maurizio Selva , Hand Book 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:

- To encourage all round development of the students by focusing on productive skills
- To make the students aware of Goal setting and writing skills
- To enable them to know the importance of presentation skills in achieving desired goals.
- To help them develop organizational skills through group activities To 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,2014. Cambridge Publisher.
2.Alka Wadkar. Life Skills for Success, Sage Publications, 2016.

Reference Books:

1.Gangadhar Joshi. Campus to Corporate Paperback, Sage Publications. 2015
2.Sherfield Montogomery Moody, Cornerstone Developing Soft Skills, Pearson Publications. 4 Ed. 2008
3.Shikha Kapoor. Personality Development and Soft Skills - Preparing for Tomorrow .1 Edition, Wiley, 2017.
4.M. Sen Gupta, Skills for Employability, Innovative Publication, 2019.
5.Steve Duck and David T McMahan, The Basics f Communication Skills A Relational Perspective, Sage press, 2012.

Online Learning Resources:

1. https://youtu.be/gkLsn4ddmTs
2. https://youtu.be/2bf9K2rRWwo
3. https://youtu.be/FchfE3c2jzc
4. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
5. https://www.youtube.com/c/skillopedia/videos
6. https://onlinecourses.nptel.ac.in/noc25_hs96/preview
7. https://onlinecourses.nptel.ac.in/noc21_hs76/preview
8. https://archive.nptel.ac.in/courses/109/107/109107172/#
9. https://archive.nptel.ac.in/courses/109/104/109104107/

Open Elective - IV (OE – IV)

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:

- To understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
- To analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
- To apply network analysis techniques for geocoding, shortest path analysis, and location-allocation problems.
- To evaluate surface and geostatistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
- To 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—Neighbourhood - Operations: Aggregation, Filtering – Extended Neighbourhood-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: Customisation, Web Gis, Mobile Mapping:
Customisation 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, Srinivasa Raju, ―An Introduction to Geographical Information Systems, Pearson Education, 2nd Edition, 2007.
3.John Peter Wilson, The Handbook of Geographic Information Science, Blackwell Pub.,2008

Online Learning Resources:
1. https://archive.nptel.ac.in/courses/105/105/105105202/
2.https://onlinecourses.nptel.ac.in/noc19_cs76/preview

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:
- To understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
- To analyze engineering systems for solid waste collection, storage, and transportation.
- To apply resource and energy recovery techniques for sustainable solid waste management.
- To evaluate landfill design, construction, and environmental impact mitigation strategies.
- To 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:

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 Composing - 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 SA _Integrated Solid Waste Management, Engineering Principles and Management Issues‘McGraw-Hill, 1993.
2. Vesilind PA, 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 RM and Gray DH, _Geotechnical Aspects of Landfill Design and Construction‘Prentice Hall, 2002.

Online Learning Resources:

1.https://archive.nptel.ac.in/courses/105/103/105103205/
2.https://archive.nptel.ac.in/courses/120/108/120108005/

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:

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 Eition, 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
4.Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

Online Learning Resources:
1. https://www.youtube.com/watch?v=VD6tXadibk0
2. https://www.investopedia.com/terms/t/total-quality-management-tqm.asp
3. https://blog.capterra.com/what-is-total-quality-management/
4. https://nptel.ac.in/courses/110/104/110104080/
5. https://onlinecourses.nptel.ac.in/noc21_mg03/preview
6. https://nptel.ac.in/courses/110/104/110104085/
7. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mg39/

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE04403T	OE	**Transducers and Sensors** (Common to CE, EEE, CSE.AI&DS, CSE-AI, CSE-AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Electrical Measurements and Instrumentation Fundamentals.
- Familiarity with Basic Electrical and Electronic Components.

Course Objectives:

- To understand characteristics of Instrumentation System and the operating principle of motion transducers.
- To explore working principles, and applications of different temperature transducers and Piezo-electric sensors.
- To provide knowledge on flow transducers and their applications.
- To study the working principles of pressure transducers.
- To introduce working principle and applications of force and sound transducers.

Course Outcomes (COs):

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

CO1: Analyse the characteristics of instrumentation systems and operating principles of motion transducers for measurement applications. (L4)

CO2: Analyse the working principles and applications of temperature transducers and piezo-electric sensors. (L4)

CO3: Apply flow transducers and evaluate their performance in practical measurement systems. (L3)

CO4: Analyse the working principles and performance of pressure transducers in industrial applications. (L4)

CO5: Evaluate force and sound transducers for suitable measurement and sensing applications. (L5)

Unit I: Introduction:

General Configuration and Functional Description of measuring instruments, Static and Dynamic Characteristics of Instrumentation System, Errors in Instrumentation System, Active and Passive Transducers and their Classification.

Motion Transducers: Resistive strain gauge, LVDT, RVDT, Capacitive transducers, Piezo-electric transducers, seismic displacement pick-ups, vibrometers and accelerometers.

Unit II: Temperature Transducers:

Standards and calibration, fluid expansion and metal expansion type transducers - bimetallic strip, Thermometer, Thermistor, RTD, Thermocouple and their characteristics.

Hall effect transducers, Digital transducers, Proximity devices, Bio-sensors, Smart sensors, Piezo-electric sensors.

Unit III: Flow Transducers:

Bernoulli 's principle and continuity, Orifice plate, Nozzle plate, Venture tube, Rotameter, Anemometers, Electromagnetic flow meter, Impeller meter and Turbid flow meter.

Unit IV: Pressure Transducers:

Standards and calibration, different types of manometers, elastic transducers, diaphragm bellows, bourdon tube, capacitive and resistive pressure transducers, high- and low-pressure measurement.

Unit V: Force and Sound Transducers:
Proving ring, hydraulic and pneumatic load cell, dynamometer and gyroscopes. Sound level meter, sound characteristics, Microphone.

Text Books:

1 A.K. Sawhney, ―A course in Electrical and Electronics Measurements and Instrumentation‖, Dhanpat Rai& Co. 3rd
edition Delhi, 2010.
2.Rangan C.S, Sarma G.R and Mani V S V, ―Instrumentation Devices and Systems‖, TATA McGraw Hill publications, 2007.

Reference Books:

1.Doebelin. E.O, ―Measurement Systems Application and Design‖,McGraw Hill International, New York, 2004.
2.NakraB.C and ChaudharyK.K , ―Instrumentation Measurement and Analysis‖, Second Edition, Tata McGraw-Hill Publication Ltd.2006.

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 (Textbook 2), Reference Models, Multimedia Networks, Guided Transmission Media, Wireless Transmission.

Unit II: The Data Link Layer, Access Networks, and LANs:

Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols(Textbook 1) Introduction to the Link Layer, Error-Detection and -Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks, Link Virtualization: A Network as a Link Layer, Data Center Networking, Retrospective: A Day in the Life of a Web Page (Packet).

Unit III: The Network Layer:

Routing Algorithms, Internetworking, The Network Layer in The Internet.

Unit IV: The Transport Layer:

Connectionless Transport: UDP (Textbook 2), The Internet Transport Protocols: TCP, Congestion Control.

Unit V: The 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.

Online Learning Resources:

1.https://nptel.ac.in/courses/106105183/25
2.https://www.nptelvideos.in/2012/11/computer-networks.html
3.https://nptel.ac.in/courses/106105183/3

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE04416T	PE	**Internet of Things** (Common to CE, EEE, & ECE)	3	0	0	3

Pre-Requisites: Fundamentals of Microprocessor & Microcontroller

Course Objectives:

- Understand the basics of Internet of Things and protocols.
- Discuss the requirement of IoT technology
- Introduce some of the 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: 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- Thing Speak.

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, Web server for IoT.

UNIT V: UAV IoT:

Introduction toUnmanned Aerial Vehicles/Drones, Drone Types, Applications: Defense, Civil, Environmental Monitoring; UAV elements and sensors- Arms, motors, Electronic Speed Controller (ESC), GPS, IMU, Ultra sonic sensors; UAV Software –Arudpilot, Mission Planner, Internet of Drones (IoD)- Case study FlytBase.

Text Books:

1.Vijay Madisetti and ArshdeepBahga, ― Internet of Things (A Hands-on-Approach)‖, 1st Edition, VPT, 2014.
2.Handbook of unmanned aerial vehicles, K Valavanis;George J Vachtsevanos, New York, Springer, Boston, Massachusetts : Credo Reference, 2014. 2016.

Reference Books:

1.Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, ― From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence‖, 1st Edition, Academic Press, 2014.
2.ArshdeepBahga, 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 daCosta, ―Rethinking the Internet of Things: A Scalable Approach to Connecting Everything‖, 1st Edition, Apress Publications, 2013
5. Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 9781-4493-9357-1
6. DGCA RPAS Guidance Manual, Revision 3 – 2020
7. Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, John Baichtal

Online Learning Resources:

1.https://www.arduino.cc/
2.https://www.raspberrypi.org/
3.https://nptel.ac.in/courses/106105166/5
4.https://nptel.ac.in/courses/108108098/4

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 Physics & Mathematics

Course Objectives:

- To introduce the fundamental concepts of quantum mechanics and linear algebra needed to understand quantum computing systems
- To develop knowledge of quantum gates, circuits, algorithms, and programming using modern tools like Qiskit.
- To explore real-world applications, current limitations, and future possibilities of quantum computing technologies.

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.

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
4.YouTube – Quantum Computing for the Determined by Michael Nielsen
5.Qiskit Textbook – IBM Quantum

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:
- To provide mathematical foundations for financial modelling, risk assessment and asset pricing.
- To introduce stochastic models and their applications in pricing derivatives and interest rate modelling.
- To develop analytical skills for fixed-income securities, credit risk, and investment strategies.
- To 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 and solve 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 Look backs. 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.IoannisKaratzas& Steven E. Shreve, Methods of Mathematical Finance, Springer, New York.

2.John C. Hull, Options, Futures, and Other Derivatives, Pearson.

Web References:

1. MIT– Mathematics for Machine Learning https://ocw.mit.edu

2.Coursera – Financial Engineering and Risk Management (Columbia University) https://www.coursera.org/

3. National Stock Exchange (NSE) India – Financial Derivatives https://www.nseindia.com/

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:
- To provide exposure to various kinds of sensors and actuators and their engineering applications.
- To impart knowledge on the basic laws and phenomenon behind the working of sensors and Actuators
- To explain the operating principles of various sensors and actuators
- To educate the fabrication of sensors
- To 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 of sensors (Principles only), Deposition: Chemical Vapor Deposition, Pattern: photolithography and Etching: Dry and Wet Etching. Actuators: Functional diagram of actuators, Types of actuators and their basic principle of working: Pneumatic, Electromagnetic, Piezo-electric and Piezo-resistive actuators, Applications of Actuators.

Unit II: Temperature and Mechanical Sensors:

Temperature Sensors: Types of temperature sensors and their basic principle of working: Thermo-resistive sensors: Thermistors, Thermo-electric sensors: Thermocouples, PN junction temperature sensors

Mechanical Sensors: Types of Mechanical sensors and their basic principle of working: 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 Electro-chemical, Thermo-chemical, 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 Sensors- Henry Bolte, John Wiley.
4.Handbook of modern sensors, Springer, Stefan Johann Rupitsch.

NPTEL course link:
1. https://onlinecourses.nptel.ac.in/noc21_ee32/preview

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:

- To understand basics and characterization of nanomaterials.
- To understand synthetic methods of nanomaterials.
- To apply various techniques for cauterization of nanomaterials.
- To understand Studies of Nano-structured Materials
- To 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, and chemical vapour deposition method, electrodeposition method, high energy ball milling method.

Synthetic Methods: Bottom-Up approach, Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and 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 the following nanomaterials -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 Nano Particle, nanorods, nano wires, 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, P Shankar, Baldev Rai, BB Rath and James Murday, Univ. Press, 2012.

Reference Books:

1.Concepts of Nano chemistry; LudovicoCademrtiri and Geoffrey A. Ozin& 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:

- To inculcate passion for aesthetic sense and reading skills
- To encourage respecting others 'experiences and creative writing
- To explore emotions, communication skills and critical thinking
- To educate how books serve as the reflection of history and society
- To 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:

1.Ulysses- Alfred Lord Tennyson
2.Ain 't I woman? -Sojourner Truth
3.The Second Coming-W.B. Yeats
4.Where the Mind is Without Fear-Rabindranath Tagore

Unit II: Drama: Twelfth Night- William Shakespeare:

1.Shakespeare -life and works
1.Plot & sub-plot and Historical background of the play
2.Themes and Criticism
3.Style and literary elements
4.Characters and characterization

Unit III: Short Story:

1.The Luncheon - Somerset Maugham
2.The Happy Prince-Oscar Wild
3.Three Questions – Leo Tolstoy
4.Grief –Antony Chekov

Unit IV: Prose: Essay and Autobiography:

1.My struggle for an Education-Booker T Washington
2.The Essentials of Education-Richard Livingston

3.The story of My Life-Helen Keller
4.Student Mobs-JB Priestly

Unit V: Novel: Hard Times- Charles Dickens:
1.Charles Dickens-Life and works
2.Plot and Historical background of the novel
3.Themes and criticism
4.Style and literary elements
5.Characters and characterization

Text Books:
1.Charles Dickens.Hard Times. (Sangam Abridged Texts) Vantage Press, 1983
2.DENT JC.William Shakespeare. Twelfth Night. Oxford University Press,2016.

Reference Books:
1.WJ Long.History of English Literature, Rupa Publications India; First Edition (4 October 2015)
2.RK Kaushik And SC Bhatia. Essays, Short Stories and One Act Plays, Oxford University Press .2018.
3.Dhanvel, SP. English and Soft Skills, Orient Blackswan,2017.
4.New Horizon, Pearson publications, New Delhi 2014
5.Vimala Ramarao, Explorations Volume-II, Prasaranga Bangalore University,2014.
6.Dev Neira, Anjana & Co. Creative Writing: A Beginner's Manual.Pearson India, 2008.

Online Resources:
1. https://www.litcharts.com/poetry/alfred-lord-tennyson/ulysses https://www.litcharts.com/lit/ain-t-i-a-woman/summary-and-analysis
2. https://englishliterature.education/articles/poetry-analysis/the-second-coming-by-w-b-yeats-critical-analysis- summary-and-line-by-line-explanation/#google_vignette
3.https://sirjitutorials.com/where-the-mind-is-without-fear-poem-notes-explanation/
4. https://www.litcharts.com/lit/twelfth-night/themes
5.https://smartenglishnotes.com/2021/11/28/the-luncheon-summary-characters-themes-and-irony/

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 Course, 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 - Electric Vehicles

Honours Degree – Electric Vehicles

Course Code	Name of the Course	L	T	P	C
24HON0201T	**E – Mobility**	**3**	**0**	**0**	**3**

Pre-Requites: Basics of Power Electronics

Course Objectives:

- To Understand the fundamental concepts and principles of Electric vehicles
- To Apply the concepts to implement battery technology
- To Apply the concepts to implement charging technology
- To Understand the future trends in EVs

Course Outcomes (COs):

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

CO1: Understanding the Fundamentals of Electric Vehicles and Vehicle Dynamics. Choose suitable motors and analyse different power electronics in EVs. (L2)

CO2: Analyzing Battery Technologies for Electric Vehicles. (L4)

CO3: Understanding and Evaluating Charging Technologies for Electric Vehicles. (L2)

CO4: Exploring Future Trends and Innovations in Electric Vehicles. (L5)

CO5: Understanding E-Mobility, Policy, and Integration with Smart Grids. (L2)

Unit I: Introduction:

Introduction to electric vehicles: EV verses gasoline vehicles, vehicle dynamics fundamentals, e-drivetrain, Electric motor, Power electronic in electric vehicles, Regenerative braking.

Unit II: Battery Technology:

Battery Technology for EVs: Storage technologies for EV, Battery working principles, Battery losses, Li-ion batteries, Battery pack and battery management system.

Unit III: Charging Technology:

Charging Technology of EVs: AC charging - Type 1,2,3, DC charging, Fast charging and its limitations, Smart charging and applications, Vehicle to X(V2X), X2V technology.

Unit IV: Future Trends in EVs:

Future trends in e-Vehicles: Wireless charging of EV, On-road charging of EV, Battery swap technology, Solar powered EVs, Charging EVs from renewables.

Unit V: E-Mobility:

E-mobility: electrification challenges, business, connected mobility and autonomous mobility case study in Indian Roadmap Perspective, Policy- EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs.

Text Books:

1.Iqbal Hussain, ―Electric & Hybrid Vehicles – Design Fundamentals‖, Second Edition, CRC Press, 2011.

2.James Larminie, ―Electric Vehicle Technology Explained‖, John Wiley & Sons, 2003.

Reference Books:

1.Mehrdad Ehsani, Yimin Gao, Ali Emadi, ―Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals‖, CRC Press, 2010.
2.Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
3.Sandeep Dhameja, ―Electric Vehicle Battery Systems‖, Newnes, 2000
4.Tariq Muneer and Irene Illescas García, ―The automobile, In Electric Vehicles: Prospects and Challenges‖, Elsevier, 2017.

Online Learning Resources:

1.https://nptel.ac.in/courses/108106170

B.Tech. EEE– Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON0202T	Battery Management Systems	3	0	0	3

Pre-Requites: Basics of Physics

Course Objectives:

- To Understand the basics of batteries and its parameters
- To Apply the concepts to create Battery Management System
- To Create Physical and Simulation models for Battery Management System
- To Design different Battery Management Systems

Course Outcomes (COs):

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

CO1: Understand the role of battery management system (L2)

CO2: Identify the requirements of Battery Management System. (L2)

CO3: Interpret the concept associated with battery charging / discharging process. (L3)

CO4: Analyze various parameters of battery and battery pack. (L4)

CO5: Design the model of battery pack. (L5)

Unit I: Introduction:

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging

Unit II: Battery Management System:

Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power

Unit III: Battery State of Charge and State of Health Estimation:

Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium-ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing

Unit IV: Modelling and Simulation:

Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach, Physics-based modelling approach, simulating an electric vehicle, Vehicle range calculations, Simulating constant power and voltage, Simulating battery packs

Unit V: Design of Battery Management Systems:

Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system

Text Books:

1.Plett, Gregory L. Battery management systems, Volume I: Battery modelling. Artech House, 2015.

2.Plett, Gregory L. Battery management systems, Volume II: Equivalent-circuit methods. Artech House, 2015.

Reference Books:

1.Bergveld, H.J., Kruijt, W.S., Notten, P.H.L ―Battery Management Systems -Design by Modelling‖ Philips Research Book Series 2002.

2.Davide Andrea,‖ Battery Management Systems for Large Lithium-ion Battery Packs‖ Artech House, 2010

3.Pop, Valer, et al. Battery management systems: Accurate state-of-charge indication for battery-powered applications. Vol. 9. Springer Science & Business Media, 2008.

B.Tech. EEE– Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON0203T	Special Machines for Electric Vehicles	3	0	0	3

Pre-Requites: Basics of Electrical Machines

Course Objectives:

- To Understand various Motor Drives useful for EV applications
- To Apply the concepts to implement various designs
- To nalyze performance of various Motor Drives
- To Evaluate the usage of specific drive for EV application

Course Outcomes (COs):

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

CO1: Understanding the Fundamentals of Permanent Magnet (PM) Brushless Motor Drives. (L2)
CO2: Analyzing Switched Reluctance Motor (SRM) Drives. (L4)
CO3: Evaluating Stator-Permanent Magnet (PM) Motor Drives. (L4)
CO4: Understanding and Designing Magnetic-Gear Motor Drives. (L2)
CO5: Exploring Advanced Magnet less and Multiphase Motor Drives. (L5)

Unit I: Permanent Magnet (PM) Brushless Motor Drives:

Structure of PM Brushless Machines, Principle of PM Brushless Machines Modeling of PM Brushless Machines, Inverters for PM Brushless Motors Motor Control, Design Criteria of PM Brushless Motor Drives for EVs, Design Examples of PM Brushless Motor Drives for EVs, Application, Advantages and Limitations for EVs.

Unit II: Switched Reluctance Motor Drive:

Structure of SR Machines, Principle of SR Machines, SR Converters Topologies, SR Motor Control, Design Criteria of SR Motor Drives for EVs, Examples of SR Motor Drives for EVs, Application, Advantages and Limitations for EVs.

Unit III: Stator-PM Motor Drives:

Doubly-Salient PM Motor Drives, Flux-Reversal PM Motor Drives, Flux-Switching PM Motor Drives, Hybrid-Excited PM Motor Drives Flux-Mnemonic PM Motor Drives, Design Criteria of Stator-PM Motor Drives for EVs, Application, Advantages and Limitations for EVs.

Unit IV: Magnetic-Geared Motor Drives:

Principle of MG Machines, Modelling of MG Machines, Inverters for MG Motors, MG Motor Control, Design Criteria of MG Motor Drives for EVs, Application, Advantages and Limitations for EVs

Unit V: Advanced Magnet less Motor Drives and Multiphase Motor Drives:

Introduction of Advanced Magnet less technology, Synchronous Reluctance Motor Drives, Doubly-Salient DC Motor Drives, Flux-Switching DC Motor Drives, Design Criteria of Advanced Magnet less Motor Drives for EVs, Application, Advantages and Limitations for EVs. Multiphase Induction Motor drives – principle, operation and control, Multiphase PMSM machine – principle, operation and control, Fault tolerant operation of multiphase drives

Text Books:

1.Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, ―Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design‖, CRC Press, 2004.

2.James Larminie and John Loury, ―Electric Vehicle Technology – Explained‖, John Wiley & Sons Ltd, 2003.

Reference Books:

1.Sandeep Dhameja, ―Electric Vehicle Battery Systems‖, Butterworth – Heinemann, 2002.

2.Ronald K Jurgen, ―Electric and Hybrid – Electric Vehicles‖, SAE, 2002.

3.Ron Hodkinson and John Fenton, ―Light Weight Electric/Hybrid Vehicle Design‖, Butterworth – Heinemann, 2001.

4.Iqbal Husain, ―Electric and Hybrid Vehicles- Design Fundamentals‖ CRC Press, 2011.

B.Tech. EEE– Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON0204T	Grid Interface of Electric Vehicles	3	0	0	3

Pre-Requites: Basics of Electrical Machines

Course Objectives:

- To Understand the Grid interfacing concept of EVs
- To Analyze the EV impact on grid
- To Design new types of charging facilities for EVs
- To Evaluate the role of EV as ancillary service

Course Outcomes (COs):

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

CO1: Understanding the Fundamentals of Smart Grid and Electric Vehicle Integration Analyze Impact of EV on smart grid. (L2)

CO2: Analyzing the Impact of EVs and V2G on the Smart Grid and Renewable Energy Systems. (L3)

CO3: Applying Power Conversion Technologies for Smart Grids and Electric Vehicles. (L4)

CO4: Designing Control and Management Strategies for PEV Parking Lots. (L5)

CO5: Evaluating the Role of PEVs as Ancillary Services in Smart Grids. (L4)

Unit I: Introduction to Smart Grid and PEV:

Introduction to smart grid and microgrid, Impact of PEVs on Distributed Energy Resources in the Smart Grid, V2G Technology and PEVs Charging Infrastructures

Unit II: Impact of V2G and G2V on the Smart Grid and Renewable Energy Systems:

Types of Electric Vehicles, Motor Vehicle Ownership and EV Migration, Impact of Estimated EVs on Electrical Network, Impact on Drivers and the Smart Grid, Standardization and Plug-and-Play

Unit III: Power Conversion Technology in the Smart Grid and EV:

Impacts of EV Penetration on Grid Power Profile, Requirements of Its Control and Monitoring, Hybrid EV Powertrain Architectures, Control, Monitoring and Management Strategies of EV, V2G Communication System, System model of EV, Case study of three phase fault and its impact

Unit IV: Planning, Control and Management Strategies for Parking Lots for PEVs:

Introduction to PEV Charging Facility, Long-Term Planning for PEV Parking Lots, Control and Management of PEV Parking Lots - stages of implementation

Unit V: PEV as Ancillary Service in Smart Grid:

Introduction to Ancillary Services, PEV Charger Optimization, PEV as ancillary source, Control Strategies for PEVs to Follow the Individual Operation Values, Systems and Control Algorithm for Smart PEV Chargers, Avoiding the Harmonic Propagation Within the Grid, Case study

Textbooks:

1.Lu, J. and Hossain, J., Vehicle-to-grid: linking electric vehicles to the smart grid. Institution of Engineering and Technology, 2015.

2.Rajakaruna, S., Shahnia, F. and Ghosh, A. eds., Plug In Electric Vehicles in Smart Grids: Integration Techniques. Springer, 2014.

Reference Books:
1.Rajakaruna, S., Shahnia, F. and Ghosh, A. eds., Plug in electric vehicles in smart grids: charging strategies. Springer, 2014.
2.Salman, S.K., Introduction to the Smart Grid: Concepts, Technologies and Evolution (Vol. 94). IET., 2017.

B.Tech. EEE– Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON0205T	EV Charging Technologies	3	0	0	3

Pre-Requites: Basics of Electrical Machines

Course Objectives:

- To Understand the Battery Basics and Key Parameters
- To Analyze Battery Modeling Techniques and Capacity Estimation
- To Design Charging Infrastructure and Regulatory Frameworks
- To Evaluate the role Power Electronics in EV Charging Systems

Course Outcomes (COs):

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

CO1: Understanding Battery Basics and Key Parameters. (L2)
CO2: Analyzing Battery Modeling Techniques and Capacity Estimation. (L3)
CO3: Exploring Charging Infrastructure and Regulatory Frameworks. (L4)
CO4: Evaluating Battery Charging Techniques and Performance. (L3)
CO5: Understanding Power Electronics in EV Charging Systems. (L3)

Unit I: Battery Basics:

Battery parameters- Cell and Battery Voltages, Charge (or Amp hour) Capacity, Energy Stored, Specific Energy, Energy Density, Specific Power, Amp hour (or Charge) Efficiency, Energy Efficiency, Self-discharge Rates, Battery Geometry, Battery Temperature, Heating and Cooling Needs 35 3.2.12 Battery Life and Number of Deep Cycles Types of batteries- lead-acid, nickel based sodium based, lithium batteries, metal-air batteries. Refilled Batteries.

Unit II: Battery Modeling:

The Purpose of Battery Modelling, Electrochemical model, black box model, equivalent circuit model - Battery Equivalent Circuit, Modelling Battery Capacity, simulating a Battery at a Set Power, Calculating the Peukert Coefficient, Approximate Battery Sizing, Battery state of charge estimation.

Unit III: Charging Infrastructure:

EV supply equipment, charging standards, classification of charging infrastructure, connecting EVs to the electricity grid, regulatory framework for EV charging connections, communication protocols for smart charging, Battery Management System.

Unit IV: Battery Charging Techniques:

Basic Terms for Evaluating Charging Performances, Charging Algorithms for Li-Ion Batteries, Optimal Charging Current Profiles for Lithium-Ion battery, Lithium Titanate Oxide Battery with Extreme Fast Charging Capability. Super Capacitors for battery charging.

Unit V: Power Electronics in EV Charging:

Active front end rectifiers - Forward converters, half and full bridge DC-DC converters, power factor correction converters, decreasing impact on the grid and switches, bidirectional battery chargers, wireless charging.

Text Books:

1James Larminie, John Lowry, ―Electric Vehicle Technology Explained‖, Wiley, 2012.
2RuiXiong, Weixiang Shen, ―Advanced Battery management Technologies for Electric Vehicle‖, Wiley, 2018

Reference Books:

1. Handbook of Electric Vehicle Charging Infrastructure Implementation, NITI Aayog, Government of India.
2. Chris Mi, M. AbulMasrur, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Wiley, 2017
3. Bruno Scrosati, Jurgen Garche, Werner Tillmetz, Advances in Battery Technologies for Electric Vehicles, Wood head Publishing Series in Energy, 2015
4. Sheldon S. Williamson , Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013

B.Tech. EEE – Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON0206P	Project on Electric Vehicles	0	0	6	3

Pre-Requisites:

- Fundamental knowledge of electrical engineering, power electronics, electric machines, energy storage systems, and control systems relevant to electric vehicle (EV) technology.
- Ability to work in teams with basic skills in problem-solving, simulation tools (MATLAB/Simulink or equivalent), and technical communication including report writing and presentations focused on EV Systems.

Course Objectives:

- To provide opportunities for applying engineering knowledge and technical skills in designing and developing electric vehicle-based solutions for real-world transportation and energy challenges.
- To develop the ability to analyze EV system requirements, drivetrain configurations, battery systems, and charging infrastructure for effective project execution.
- To enhance skills in analyzing and communicating technical information related to electric vehicles through reports, presentations, and professional interactions.
- To build competency in evaluating EV technologies, architectures, and components based on performance, safety, environmental, and sustainability considerations.
- To foster creativity and innovation in designing and developing electric vehicle systems aligned with clean energy and sustainable mobility goals.

Course Outcomes (COs):

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

CO1: Apply engineering knowledge and technical skills to develop electric vehicle-based solutions considering energy efficiency, battery utilization, and environmental impact. (L3)

CO2: Analyze EV system components, team processes, and project requirements to plan and execute electric vehicle projects in multidisciplinary environments. (L4)

CO3: Analyze and communicate technical information related to electric vehicles effectively through reports, presentations, and professional interactions. (L4)

CO4: Evaluate electric vehicle architectures, subsystems, and technologies to justify appropriate design solutions based on performance, safety, and sustainability considerations. (L5)

CO5: Design and develop innovative electric vehicle systems or prototypes by integrating propulsion, battery, and charging technologies aligned with sustainable mobility goals. (L6)

Minors Degree in Energy Systems & Micro Grid Technology

Minor Degree - Energy Systems

Course Code	Name of the Course	L	T	P	C
24MES0201T	Energy Audit and Management	3	0	0	3

Pre requisites: Basics of Thermodynamics

Course Objectives:

- To understand the basic concepts of Energy Audit and Management, Principles and objectives of Energy management and Basics of Thermal, Electrical energy management
- To apply the fundamental concepts for development of energy management systems
- To Design Energy Audit reports
- To analyze designed energy management systems

Course Outcomes (COs):

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

CO1: Describe the fundamentals of energy auditing, including mass and energy balances, measurement principles, and evaluation of energy conservation opportunities in industries. (L3)

CO2: Analyze energy audit methodologies including types of audits, benchmarking, energy performance evaluation, and audit instruments and techniques. (L4)

CO3: Examine energy management principles including energy management systems, program design, auditor responsibilities, and audit reporting with case studies. (L4)

CO4: Evaluate thermal energy management techniques including boilers, turbines, waste heat recovery, cogeneration, and building energy efficiency systems. (L5)

CO5: Assess electrical energy management strategies including supply-side improvements, demand-side management, power quality control, and efficient electrical system utilization. (L5)

Unit I: Introduction:

Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportunities.

Unit II: Energy Audit Concepts:

Need of Energy audit - Types of energy audit – Energy management (audit) approach - understanding energy costs - Bench marking – Energy performance - Matching energy use to requirement - Maximizing system efficiencies - Optimizing the input energy requirements - Duties and responsibilities of energy auditors- Energy audit instruments - Procedures and Techniques.

Unit III: Principles and Objectives of Energy Management:

Design of Energy Management Programs - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Some case study and potential energy savings.

Unit IV: Thermal Energy Management:

Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery - Thermal insulation - Heat exchangers and heat pumps - Building Energy Management.

Unit V: Electrical Energy Management:

Supply side Methods to minimize supply-demand gap- Renovation and modernization of power plants - Reactive power management – HVDC - FACTS - Demand side - Conservation in motors - Pumps and fan systems – Energy efficient motors. Demand side management.

Text Books:

1. Hamies, Energy Auditing and Conservation; Methods Measurements, Management and Case study, Hemisphere, Washington, 1980.
2. Energy Management: W.R.Murphy, G.Mckay

Reference Books:

1. Energy Management Principles: C.B.Smith
2. Efficient Use of Energy: I.G.C.Dryden
3. Energy Economics A.V.Desai
4. Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com).

Online Learning Resources:

1. https://nptel.ac.in/courses/108106022

Minor Degree - Energy Systems

Course Code	Name of the Course	L	T	P	C
24MES0202T	Energy Management in Building	3	0	0	3

Pre requisites: Basics of Building Services Engineering

Course Objectives:

- To understand the significance of energy management in buildings, Ventilation and Air conditioning aspects, Climate influence, energy usage estimation and technological options for energy management
- To apply the Energy management concepts for building designs
- To analyze different conditions for preparation of efficient energy management system for a building
- To design efficient energy management systems for buildings

Course Outcomes (COs):

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

CO1: Describe the significance of energy use in buildings, including indoor activities, environmental control, and concepts of energy-efficient building design. (L3)

CO2: Analyze indoor environmental requirements such as thermal comfort, ventilation, air quality, lighting, and acoustic conditions for energy-efficient building operation. (L4)

CO3: Examine climatic factors including solar radiation, temperature, wind, and sun-earth relationships affecting building energy performance and design. (L4)

CO4: Evaluate building end-use energy requirements including heat transfer, envelope performance, lighting systems, and thermal behavior of building components. (L5)

CO5: Assess energy management strategies in buildings including energy auditing, targeting, and design modifications for energy-efficient structures under Indian climatic conditions. (L5)

Unit I: Overview of the Significance of Energy use and Energy Processes in Building:

Indoor activities and environmental control - Internal and external factors on energy use and the attributes of the factors - Characteristics of energy use and its management - Macro aspect of energy use in dwellings and its implications – Concepts of energy efficient building.

Unit II: Indoor Environmental Requirement and Management:

Thermal comfort – Ventilation and air quality - Air-conditioning requirement - Visual perception – Illumination requirement - Auditory requirement – Concept of sick building syndrome – Significance in energy management in buildings.

Unit III: Climate:

Solar radiation and their influences - The sun-earth relationship and the energy balance on the earth‘s surface – Climate – Wind - Solar radiation - Temperature – Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings.

Unit IV: End-Use:

Energy utilization and requirements – Lighting and day lighting – End-use energy requirements – Status of energy use in buildings – Estimation of energy use in a building - Heat gain and thermal performance of building envelope – Steady and non-steady heat transfer through the glazed window and the wall – Standards for thermal performance of building envelope – Evaluation of the overall thermal transfer – Concepts of window management.

Unit V: Energy Management Options:

Energy audit and energy targeting – Technological options for energy management – Modifications for energy efficient buildings for Indian conditions. Energy Management for large tower buildings.

Text Books:

1. Heating and Cooling of Buildings – Design for Efficiency, J. Krieder and A. rabl, McGraw Hill, 1994.
2. Mechanical and Electrical Equipment for Buildings, S. M. Guinnes and Reynolds, Wiley, 1989.

Reference Books:

1. Energy Design for Architects, Shaw, Aee Energy Books, 1991.
2. Energy Conservation in Buildings – Royal Institute of Architecture, Canada.
3. Publication of CBRI, Roorkee – Energy Management in Buildings.

Minor Degree - Energy Systems

Course Code	Name of the Course	L	T	P	C
24MES0203T	Energy Storage Technologies	3	0	0	3

Pre-Requisites: Basics of Batteries

Course Objectives:

- To provide students with a strong foundation in battery fundamentals, including characteristics, performance parameters, testing methods, charging techniques, and state estimation concepts such as State of Charge (SoC) and State of Health (SoH).
- To develop analytical understanding of primary and secondary battery technologies, advanced energy storage systems, supercapacitors, and fuel cells for evaluating their construction, operation, performance, and practical applications.
- To enable students to assess modern energy storage solutions for renewable energy integration, smart grids, transportation, and hybrid energy systems with a focus on efficiency, sustainability, and emerging technologies.

Course Outcomes (COs):

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

CO1: Describe battery fundamentals including characteristics, performance parameters, testing methods, charging techniques, and state estimation concepts such as SoC and SoH. (L3)

CO2: Analyze primary battery systems including construction, performance, and rating of alkaline, silver oxide, and various lithium-based primary cells. (L4)

CO3: Examine advanced battery technologies including lead-acid, NiMH, lithium-ion, Li-polymer, Li-air, Li-S, Na-ion, and sodium-based high-temperature batteries. (L4)

CO4: Evaluate energy storage systems for renewable energy integration including microgrids, smart grids, SMES, SC-SB, DSSC, and other hybrid storage technologies. (L5)

CO5: Assess supercapacitors and fuel cell technologies including design, operation, performance characteristics, and hybrid energy storage applications in transportation and advanced systems. (L5)

Unit I: Batteries:

Types-battery characteristics - voltage, current, capacity, volumetric energy density, specific energy density, charge rate, cycle life, internal resistance, energy efficiency, shelf life, battery management system, SoC, SoH estimation techniques. Testing of batteries, battery charging method, Factors affecting the battery performance.

Unit II: Primary Batteries:

Fabrication, performance aspects, packing and rating of alkaline manganese, silver oxide cells. Lithium primary batteries-Lithium/Manganese Dioxide, Lithium/Carbon Monofluoride, Lithium/Thionyl chloride, Lithium/Sulfur Dioxide, Lithium/Iodine, Lithium-Aluminum/Iron Disulfide.

Unit III: Advanced Batteries:

Advanced Lead Acid Battery -design, performance aspects, Pb-Acid batteries for transportation, nickel metal hydride batteries, zinc- alkaline batteries, ZEBRA Battery (Na/NiCl2) -NaS Battery-Lithium-Ion Battery-Lithium- Polymer Battery, Li-air batteries, Li-S batteries, Sodium -ion batteries.

Unit IV: Storage for Renewable Energy Systems:

Solar energy, Wind energy, pumped hydro energy, Energy storage in Micro-grid and Smart grid, Energy Management with storage systems, Battery SCADA, increase of energy conversion efficiencies by introducing energy storage. Superconducting Magnetic Energy Storage (SMES), charging methodologies, Photo galvanic cells, semiconductor solar batteries (SC-SB), thermo-ionic converter s, dye-sensitized solar cells (DSSC).

Unit V: Supercapacitors and Fuel Cells:

Fundamentals of electrochemical Supercapacitors, electrode and electrolyte interfaces and their capacitances, charge-discharge characteristics, energy/power density, design, fabrication, operation and evaluation, thermal management. Supercapacitors for transportation applications - aqueous and organic based supercapacitors, Pseudo and asymmetric supercapacitors. Advance battery-supercapacitors hybrids for auto, space and marine applications. Fuel Cells working Principle and Construction.

Text Books:

1. Dell, Ronald M. Rand and David A. J., ―Understanding Batteries‖, Royal Society of Chemistry, 2001. R23 Regulations
2. Vladimir S. Bagotsky, Alexander M. Skundin, Yurij VM. Volfkovich., ―Electrochemical power sources: Batteries, fuel cells, and supercapacitors‖, John Wiley & Sons, Inc.,2015.

Reference Books:

1. Lindon David, ―Handbook of Batteries‖, McGraw Hill, 2002.
2. Kiehne H. A., ―Battery Technology Handbook‖, Expert Verlag, Renningen Malsheim, 2003.
3. AuliceScibioh M. and Viswanathan B., ―Fuel Cells – Principles and Applications‖, University Press, 2006.
4. A.G.Ter-Gazarian, ―Energy Storage for Power Systems‖, The Institution of Engineering and Technology (IET) Publication

Minor Degree - Energy Systems

Course Code	Name of the Course	L	T	P	C
24MES0204T	Energy Scenario and Energy Policy	3	0	0	3

Pre-Requisites: Basics Energy Systems

Course Objectives:

- To Understand the basic concepts of Energy scenario and Energy policy
- To Apply the concepts to strengthen energy system
- To Analyze the different scenarios around the globe
- To Implement suitable Energy policy for existing systems

Course Outcomes (COs):

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

CO1: Describe the global energy scenario including energy resources, consumption patterns, economic development indicators, and depletion impacts on world economies. (L3)

CO2: Analyze international energy policies of major countries and global agreements influencing energy security and sustainability. (L4)

CO3: Examine the Indian energy scenario including sector-wise consumption, energy policies, renewable energy status, and power sector reforms. (L4)

CO4: Evaluate global energy issues such as energy security, pricing, productivity, and policy frameworks affecting national and international energy systems. (L5)

CO5: Assess energy conservation policies including Energy Conservation Act 2001, Electricity Act 2003, renewable energy initiatives, and sustainable development strategies. (L5)

Unit I: Global Energy Scenario:

Role of energy in economic development and social transformation - Energy and GDP - GNP and its dynamics - Energy sources and overall Energy demand and availability - Energy consumption in various sectors and its changing pattern - Depletion of energy sources and impact exponential rise in energy consumption on economies of countries

Unit II: Energy Polices:

International Energy Polices of G-8 Countries - G-20 Countries - OPEC Countries - EU Countries - International Energy Treaties (Rio, Montreal, Kyoto) - INDO-US Nuclear Deal.

Unit III: Indian Energy Scenario:

Energy resources and Sector wise energy Consumption pattern Impact of energy on economy and development - National and State Level Energy polices and Issues - Status of Nuclear and Renewable Energy and Power Sector reforms. Energy policy 2030

Unit IV: Energy Policy:

Global Energy Issues - Energy Security - Energy Vision Energy Pricing and Impact of Global Variations Energy Productivity (National and Sector wise productivity).

Unit V: Energy Conservation:

Act – 2001 and its features - Electricity Act – 2003 and its features - Energy Crisis - Future energy options - Need for use of new and renewable energy sources - Energy for Sustainable development.

Text Books:

1. Energy for a sustainable World: Jose Golden berg, Thomas Johan son, AKN. Reddy, Robert Williams (Wiley Eastern). 2. Energy Policy, B.V. Desai (Wiley Eastern)

Reference Books:

1. Modeling approach to long term demand and energy implication, J.K.Parikh
2. Energy Policy and Planning, B.Bukhootsow
3. TEDDY Year Book Published by Tata Energy Research Institute(TERI) World Energy Resources, Charles E. Brown, _International Energy Outlook' - EIA annual Publication
4. BEE Reference book: no. 1/2/3/4

Online Learning Resources:

1. https://nptel.ac.in/courses/10910616

Minor Degree - Energy Systems

Course Code	Name of the Course	L	T	P	C
24MES0205T	Waste Energy Management	3	0	0	3

Pre requisites: Basics Environmental Studies

Course Objectives:

- To provide students with comprehensive knowledge of waste characterization, classification, and management practices for agricultural, industrial, municipal, biomedical, hazardous, and electronic wastes.
- To develop analytical skills in evaluating thermo-chemical and bio-chemical waste-to-energy conversion technologies such as incineration, pyrolysis, gasification, anaerobic digestion, fermentation, and biogas production.
- To enable students to assess energy recovery systems, waste heat utilization methods, and the environmental, health, and sustainability impacts of modern waste-to-energy technologies through real-world case studies.

Course Outcomes (COs):

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

CO1: Describe the characterization, classification, and management of various wastes including agricultural, industrial, municipal, and biomedical wastes. (L3)

CO2: Analyze thermo-chemical conversion processes such as incineration, pyrolysis, and gasification for energy recovery from waste materials. (L4)

CO3: Examine bio-chemical conversion technologies including anaerobic digestion, fermentation, algal biomass production, and biogas generation from waste. (L4)

CO4: Evaluate energy production systems from waste plastics and waste heat recovery technologies along with their efficiency and applications. (L5)

CO5: Assess environmental and health impacts of waste-to-energy systems and analyze case studies of industrial, hazardous, and e-waste management practices. (L5)

Unit I: Characterization of Wastes:

Agricultural residues and wastes including animal wastes; industrial wastes; municipal solid wastes. Waste processing types and composition of various types of wastes; Characterization of Municipal Solid Waste, Industrial waste and Biomedical Waste, waste collection and transportation; waste processing-size reduction, separation; waste management hierarchy, waste minimization and recycling of Municipal solid waste.

Unit II: Thermo Chemical Conversion:

Incineration, pyrolysis, gasification of waste using gasifiers, environmental and health impacts of incineration; strategies for reducing environmental impacts. Energy production from wastes through incineration, energy production through gasification of wastes, Energy production through pyrolysis and gasification of wastes, syngas utilization.

Unit III: Bio-Chemical Conversion:

Anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, anaerobic digestion biogas production, and present status of technologies for conversion of waste into energy, design of waste to energy plants for cities, small townships and villages. Energy production from wastes through fermentation and trans esterification.

Cultivation of algal biomass from waste water and energy production from algae, Energy production from organic wastes through anaerobic digestion and fermentation.

Unit IV: Energy Production from Waste Plastics, Gas Cleanup Waste, Heat Recovery:
Concept of conversion efficiency, energy waste, waste heat recovery classification, advantages and applications, commercially viable waste heat recovery devices.

Unit V: Environmental and Health Impacts-Case Studies:
Environmental and health impacts of waste to energy conversion, Industrial waste management – Hazardous waste management – E-waste management -EV Batteries – Mobile Chargers - case studies of commercial waste to energy plants, waste to energy- potentials and constraints in India, eco-technological alternatives for waste to energy conversions.

Text Books:
1. Parker, Colin and Roberts, ―Energy from Waste – An Evaluation of Conversion Technologies‖, Elsevier Applied Science, 1985.
2. Khandelwal, K. C. and Mahdi, S. S., ―Biogas Technology - A Practical Hand Book‖, Vol. I & amp; II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Reference Books:
1. Robert C. Brown, ―Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power‖, John Wiley and Sons, USA, 2019
2. Sergio Capareda, ―Introduction to Biomass Energy Conversions‖, CRC Press, USA, 2013.
3. Krzysztof J Ptasinski, ―Efficiency of Biomass Energy: An Exergy Approach to Biofuels, Power, and Biorefineries, John Wiley & Sons, USA, 2013.
4. Vesilind, P.A., and Worrell W. A, ―Solid Waste Engineering, 2nd Ed‖, Cengage India, 2016.

Minor Degree - Energy Systems

Course Code	Name of the Course	L	T	P	C
24MES0206P	Project in Energy Systems	3	0	0	3

Pre-Requisites:

- Fundamental knowledge of energy systems including renewable and non-renewable energy sources, power generation, and energy conversion processes.
- Basic understanding of electrical engineering concepts such as power systems, electrical machines, power electronics, and energy storage systems.
- Ability to apply engineering mathematics, simulation tools (MATLAB/Simulink or equivalent), and data analysis techniques for energy-related problems.
- Skills in technical communication, teamwork, and report writing for engineering project development.

Course Objectives:

- To provide opportunities to apply engineering knowledge for designing and developing solutions in energy systems.
- To enable students to analyze energy generation, conversion, storage, and management systems for real-world applications.
- To develop skills in evaluating sustainable and efficient energy technologies considering technical, economic, and environmental aspects.
- To enhance ability in designing innovative energy system models, simulations, and prototypes using modern tools.
- To foster research-oriented thinking for addressing challenges in renewable energy and sustainable power systems.

Course Outcomes (COs):

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

CO1: Apply engineering knowledge to design and develop solutions for energy system-related problems including generation, conversion, and utilization. (L3)

CO2: Analyze different energy systems including renewable, conventional, and hybrid systems for performance evaluation and optimization. (L4)

CO3: Investigate energy storage, conversion, and management techniques using analytical and simulation-based approaches. (L4)

CO4: Evaluate energy system designs based on technical efficiency, economic viability, environmental impact, and sustainability considerations. (L5)

CO5: Design and develop innovative energy system models or prototypes integrating renewable energy technologies and smart energy management strategies. (L6)

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Course Code	Name of the Course	L	T	P	C
24MGT0201T	Futuristic Power Systems	3	0	0	3

Pre-Requisites: Basics of Power Systems

Course Objectives:

- To explore the state of the art and future trends in power systems.
- To understand the technical, economic and social challenges in power system evolution.
- To realize the role and importance of Microgrids if futuristic power systems

Course Outcomes (COs):

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

CO1: Apply engineering knowledge to design microgrid systems integrating renewable energy sources and distributed generation. (L3)

CO2: Analyze renewable energy integration issues, forecasting techniques, and grid compatibility for microgrid operation. (L4)

CO3: Investigate energy storage systems and their role in load management, power quality improvement, and system stability. (L4)

CO4: Evaluate microgrid and smart grid architectures, including control strategies, economic benefits, and implementation approaches. (L5)

CO5: Assess communication infrastructure and cybersecurity aspects in smart microgrid systems using relevant standards and protocols. (L5)

Unit I: Introduction:

Present status of worldwide scenario of electricity generation, transmission and distribution; Energy infrastructure Resilience and Security; Social, Technical and economic challenges; Major trends driving power system evolution; State of the art technologies in power system.

Unit II: Renewable Energy Integration:

Review of renewable energy (RE) resources and systems: Solar- PV, Solar Thermal, Wind, Biomass, Micro-hydro and Fuel Cell, comparison of various RE resources; Renewable Energy Policies and present status of integration with existing grid; Large scale integration of renewable energy-Technical challenges, enabling technologies, international requirements; Renewable energy forecasting

Unit III: Energy Storage Systems (ESS):

Review of energy storage components: Battery, VRB, Ultra-capacitor, Fuel Cells, Pumped Hydro-Storage and flywheels, comparison of ESS technologies; Importance of ESS in futuristic power systems; Aggregated ESS, Distributed ESS; Applications of ESS: Energy Management (Load Leveling and Peak Shifting), Fluctuation Suppression (Intermittency Mitigation), Uninterruptible Power System Low-Voltage Ride Through; Placement of the ESS to Improve Power Quality, Voltage Regulation Using ESS, ESS as Spinning Reserve.

Unit IV: Micro-grid and Smart-Grid:

Micro-grid evolution: Micro-grid concept, importance in futuristic power system, basic architectures and control, objectives and state of the art technologies; Microgrid as a building block of Smart-grid; Smart-grid concept, Smart Grid versus conventional electrical networks, Smart-grid infrastructure, Smart Grid communication system and its cyber security, International standard IEC 61850 and its application to Smart-grid; Microgrids /smart grid and Electric Vehicles integration. Technical, Economic, Environmental and Social Benefits of Microgrid Operation. Microgrids for Rural Electrification, Review of Microgrid Best Practices through Case Studies: Strategic Planning, Operations: Commercial and Financial Considerations; Technical and Social Context.

Unit V: Communication and IT Infrastructure:
Requirements of Communication and IT infrastructure in futuristic power systems: various communication protocols, comparison of performance; IEEE standard: IEEE 802.11 Mesh Networking, IEEE 802.15.4Wireless Sensor Networks; Communications Technologies for Smart metering; Cyber security issues and mitigation techniques.

Text Books:
1. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014
2. Energy Storage for Sustainable Microgrid by David Wenzhong Gao, Elsevier, 2015
3. Introduction to the Smart Grid- Concepts, Technologies and Evolution by Salman K. Salman, IET, 2017
4. Energy Storage Systems and Components by Alfred Rufer, CRC Press, 2018

Reference Books:
1. Energy Efficiency and Renewable Energy Handbook Edited by D. Yogi Goswami and Frank Kreith, 2nd Edition- 2016, CRC
2. Clean Energy Microgrids, Edited by Shin'ya Obara and Jorge Morel IET, 2017
3. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elsevier WoodHead Publishing, 2018
4. Smart Microgrids: Lessons from Campus Microgrid Design and Implementation edited by Hassan Farhangi, CRC Press 2017

Website Reference / Video Courses:
1. NPTEL Web Course on: DC Microgrid And Control System Prof. Avik Bhattacharya, IIT Roorkee
2. NPTEL Web Course on Electronics and Distributed Generation Dr. Vinod John Department of Electrical Engineering IISc Bangalore
3. NPTEL Web Course on Introduction to Smart Grid, PROF. N.P. PADHY Department of Electrical Engineering IIT Roorkee PROF. PREMALATA JENA Department of Electrical Engineering
4. NPTEL Web Course on Electric vehicles and Renewable energy, Prof. Ashok Jhunjhunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha and Prof. L Kannan, IIT Madras

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Course Code	Name of the Course	L	T	P	C
24MGT0202T	Power Electronic Converters for Energy Sources	3	0	0	3

Pre requisites: Basics of Power Electronics

Course Objectives:

- To illustrate the design philosophies used in the domain of microgrid power converters.
- To explore the control implementations in power converters for voltage, current and power regulation for various DC and AC energy sources

Course Outcomes (COs):

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

CO1: Select and size power electronic converter components including capacitors, magnetic elements, power devices, and heatsinks for efficient converter design. (L3)

CO2: Design and analyze DC–DC converters such as buck, boost, and bidirectional converters with appropriate control strategies including PI, voltage, and current mode control. (L4)

CO3: Design and evaluate DC–AC inverter systems for standalone and grid-connected applications using suitable control and synchronization techniques. (L4)

CO4: Analyze power converter unit (PCU) topologies for solar photovoltaic and wind energy systems with appropriate design considerations. (L4)

CO5: Evaluate PCU designs for energy storage systems along with auxiliary circuits, protection, sensor interfaces, and embedded control systems. (L5)

Unit I: Selection of components for Power Electronics Converters (PEC):

Selection and Sizing of capacitors and magnetic components for PECs, design of Magnetic Components; Selection and sizing of Power Devices, commonly used software tools for selection and sizing; Heatsink- selection and sizing.

Unit II: Design and Control of DC-DC Converters:

Design of Buck and Boost converters, Design examples; Design of Bidirectional Converters. Design of gate driver circuits; Review of DC-DC converter modelling; Closed loop PI controller design for buck and boost converters; Current control mode and voltage control mode.

Unit III: Design and Control of DC-AC Converters:

Design of Inverter for standalone applications; Design of grid connected Inverter with different grid synchronization strategies- ZCD, PLL; Strategies for Control of voltage, current and power output.

Unit IV: Design of PCU for SPV and Wind Application:

Various topologies of Power Converter Unit (PCU) for SPV and Wind energy systems. Design considerations of PCU for SPV and Wind energy Systems and Design Examples. R23 Regulations

Unit V: Design of PCU for ESS Applications and Design of Auxiliary System and Interfaces:

Design consideration for BDC converter based PCU for batteries and Ultra-capacitors. Design of current and voltage sensor interfaces; Design considerations for auxiliary power supplies; Design of protection and snubber components: Introduction to Digital Signal Processors (DSP) and microcontroller interfaces

Text Books:

1. Power Electronic Converters for Microgrids by Suleiman M. Sharkh, Mohammad A. Abusara, Georgios I. Orfanoudakis Babar Hussain, IEEE and Wiley, 2014
2. Control Circuits In Power Electronics Practical Issues In Design And Implementation Edited by Miguel Castilla, IET, 2016
3. Control and Dynamics in Power Systems and Microgrids by Lingling Fan, CRC Press, 2017
4. Integrated Power Electronic Converters and Digital Control, by Ali Emadi, Alireza Khaligh, Zhong Nie, and Young Joo, Lee 2009, CRC Press.

Reference Books:

1. Cooperative Synchronization in Distributed Microgrid Control by Ali Bidram, Vahidreza Nasirian Ali Davoudi, and Frank L. Lewis, Springer, 2017
2. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elseiver WoodHead Publishing, 2018
3. Smart Microgrids- Lessons from Campus Microgrid Design and Implementation edited by Hassan Farhangi, CRC Press 2017
4. Energy Storage Systems and Components by Alfred Rufer, CRC Press, 2018
5. Microgrids Design and Implementation edited by Antonio Carlos Zambroni de Souza and Miguel Castilla, Springer, 2019
6. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014
7. Energy Storage for Sustainable Microgrid by David Wenzhong Gao, Elsevier, 2015

Minor Degree - Micro Grid Technology

Course Code	Name of the Course	L	T	P	C
24MGT0203T	Microgrid Power and Control Architecture	3	0	0	3

Pre requisites: Fundamentals of Power Systems

Course Objectives:

- To study various power and control architectures adopted in DC and AC Microgrids
- To explore various control strategies used in power control
- To take insight into operations stability and protection issues related to Microgrids

Course Outcomes (COs):

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

CO1: Describe microgrid power architectures including AC, DC, and hybrid systems and compare their suitability for different applications. (L3)

CO2: Analyze AC microgrid control strategies including synchronization methods, droop control, power flow control, and hierarchical control architectures. (L4)

CO3: Analyze DC microgrid and hybrid microgrid control strategies including power sharing, source optimization, and communication-based control architectures. (L4)

CO4: Evaluate operational control strategies in microgrids including energy management, load management, islanding, and optimal system operation. (L5)

CO5: Evaluate stability and protection issues in AC and DC microgrids including fault analysis, adaptive protection schemes, and stability improvement methods. (L5)

Unit I: Microgrid Power Architecture:

Types of Microgrid system, AC and DC and Hybrids Microgrids, Application based Suitability of Microgrid type; Review of power architecture of various Microgrids deployed world-wide. Comparison of various Microgrid power architectures.

Unit II: AC Microgrid and Control Architecture:

Black-start operation, Grid Synchronisation- various Grid synchronization methods, Grid forming and grid following operations; Power Control- Real and reactive power control in AC Microgrid, simple droop control and other variants of droop control, Unit Power Flow Control, Feeder power flow control and Mixed mode control, source optimization; Centralized, decentralised, distributed and hierarchical control architecture, Local and system / supervisory level control strategies, Multi Agent System (MAS) Based Control; Control approaches used in AC Microgrids deployed worldwide. Microgrid standards IEEE 1547 series. Communication in AC Microgrids

Unit III: DC Microgrid and Control Architecture:

Power sharing in DC Microgrids, source optimization; Control approaches: Centralized, decentralised, distributed and hierarchical control architecture. Control approaches used in hybrid Microgrids. Communication in DC/Hybrid Microgrids

Unit IV: Operational Control in Microgrids:

Energy management in Microgrids, coordinated control, load management, grid synchronisation and islanding, Ant islanding schemes; Various Architectural and Operational Challenges in Microgrid, Optimal operation of Microgrids.

Unit V: Microgrid Stability & Protection:

Steady-state and dynamic stability in AC and DC Microgrids, Methods to improve the stability in Microgrids; introduction to small signal and large signal stability analysis in Microgrids. Fault scenarios in DC and AC Microgrids, Protection in DC and AC Microgrids, adaptive protection, Fault current source (FCS) based protection; Protection challenges in islanded and autonomous modes of operation and ways to mitigate.

Text Books:

1. Microgrids Design and Implementation edited by Antonio Carlos Zambroni de Souza and Miguel Castilla, Springer, 2019
2. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014
3. Cooperative Synchronization in Distributed Microgrid Control by Ali Bidram, Vahidreza Nasirian Ali Davoudi, and Frank L. Lewis, Springer, 2017
4. Control Circuits in Power Electronics Practical Issues In Design And Implementation Edited by Miguel Castilla, IET, 2016

Reference Books:

1. Control and Dynamics in Power Systems and Microgrids by Lingling Fan, CRC Press, 2017
2. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elseiver Woodhead Publishing, 2018
3. Urban DC Microgrid Intelligent Control and Power Flow Optimization by Manuela Sechilariu and Fabrice Locment, 2016
4. Elsevier Integrated Power Electronic Converters and Digital Control, by Ali Emadi, Alireza Khaligh, Zhong Nie, and Young Joo, Lee 2009,
5. CRC Press. Island Power Systems by Lukas Sigrist, Enrique Lobato, Francisco M. Echavarren Ignacio Egido, and Luis Rouco, CRC Press, 2016

Website Reference / Video Courses:

1. NPTEL Web Course on: DC Microgrid and Control System Prof. Avik Bhattacharya, IIT Roorkee
2. NPTEL Web Course on Electronics and Distributed Generation Dr. Vinod John Department of Electrical Engineering IISc Bangalore
3. NPTEL Web Course on Introduction to Smart Grid, PROF. N.P. PADHY Department of Electrical Engineering IIT Roorkee PROF. PREMALATA JENA Department of Electrical Engineering
4. NPTEL Web Course on Electric vehicles and Renewable energy, Prof. Ashok Jhunjhunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha and Prof. L Kannan, IIT Madras

Minor Degree - Micro Grid Technology

Course Code	Name of the Course	L	T	P	C
24MGT0204T	**Microgrid System Design**	**3**	**0**	**0**	**3**

Pre requisites: Fundamentals of Power systems

Course Objectives:

- To illustrate the design philosophies used in the domain of Microgrid.
- To explore the selection of power and control architecture of Microgrids
- To study the design aspects of AC Microgrid, DC Microgrid and their auxiliary systems

Course Outcomes (COs):

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

CO1: Apply engineering principles to select and size renewable energy sources and energy storage systems for microgrid applications. (L3)

CO2: Analyze microgrid power and control architecture by evaluating sensor selection, interface design, and embedded control implementation. (L4)

CO3: Analyze communication architectures for microgrids including network selection, data transfer protocols, and microcontroller-based implementation. (L4)

CO4: Evaluate the design and implementation of AC and DC microgrid systems including power conditioning units, control strategies, and protection schemes. (L5)

CO5: Evaluate islanding detection, black-start capability, and autonomous operation strategies in microgrid systems. (L5)

Unit I: Selection/ Sizing of Microgrid:

Energy Resources Factors affecting the selection and sizing of energy resources for Microgrid applications, dependency on type of loads connected, Selection/ Sizing: Renewable energy resources, Energy Storage components. Hybrid combination of RES and ESS.

Unit II: Selection of Power and Control Architecture:

Factors affecting the selection of Microgrid power and control architecture; Design Consideration for control implementation; Sensors: Selection of sensors and design of sensor Interfaces, design of control Interfaces. Design considerations for DSP/ Microcontroller interfaces

Unit III: Selection and Design of Communication Architecture:

Design considerations for selection of communication network for Microgrid applications; Design and implementation of communication links/ interfaces. Microg4controller programming for Data transfer on communication network. Practical design considerations for Communication networks.

Unit IV: Design of DC and AC Microgrid:

Design DC Power Conditioning Units for RES and ESS, Unidirectional and Bidirectional Converter design, implementation of Control loop with DSP; Programming for Power sharing and Energy Management algorithms; Design of Protection system for DC Microgrid Design AC Power Conditioning Units for RES and ESS, Unidirectional and Bidirectional Converter design, implementation of Control loop with DSP; Grid Synchronization. Programming for Power sharing and Energy Management algorithms; Design of Protection system for AC Microgrid.

Unit V: Islanding in Microgrids:

Selection and implementation of Islanding detection and anti-islanding scheme; Black- start and Autonomous operations in Microgrids;

Text Books:

1. Microgrids Design and Implementation edited by Antonio Carlos Zambroni de Souza and Miguel Castilla, Springer, 2019
2. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014
3. Power Electronic Converters For Microgrids by Suleiman M. Sharkh, Mohammad A. Abusara, Georgios I. Orfanoudakis Babar Hussain, IEEE and Wiley, 2014

Reference Books:

1. Energy Storage for Sustainable Microgrid by David Wenzhong Gao, Elsevier, 2015
2. Cooperative Synchronization in Distributed Microgrid Control by Ali Bidram, Vahidreza Nasirian Ali Davoudi, and Frank L. Lewis, Springer, 2017
3. Energy Efficiency and Renewable Energy Handbook Edited by D. Yogi Goswami and Frank Kreith, 2nd Edition- 2016, CRC
4. Control Circuits In Power Electronics Practical Issues in Design and Implementation Edited by Miguel Castilla, IET, 2016
5. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elseiver WoodHead Publishing, 2018
6. Urban DC Microgrid Intelligent Control and Power Flow Optimization by Manuela Sechilariu and Fabrice Locment, 2016 Elsevier
7. Integrated Power Electronic Converters and Digital Control, by Ali Emadi, Alireza Khaligh, Zhong Nie, and Young Joo, Lee 2009, CRC Press.

Minor Degree - Micro Grid Technology

Course Code	Name of the Course	L	T	P	C
24MGT0205T	Analysis of Smart Grid Systems	3	0	0	3

Pre requisites: Fundamentals of Power systems

Course Objectives:

- To provide students with a comprehensive understanding of smart grid architecture, communication systems, standards, and emerging developments in modern electrical power networks.
- To develop analytical and problem-solving skills in numerical methods, power flow studies, voltage stability, economic dispatch, optimal power flow, and forecasting techniques for smart grid operation.
- To enable students to evaluate smart grid security, monitoring systems, distributed generation, and energy storage integration for reliable, efficient, and sustainable power system management.

Course Outcomes (COs):

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

CO1: Describe smart grid concepts including architecture, domains, communication protocols, standards, and Indian smart grid initiatives. (L3)

CO2: Analyze numerical methods for nonlinear equations and their applications in power flow analysis, voltage stability, and load flow studies. (L4)

CO3: Evaluate smart grid security aspects including contingency analysis, network sensitivity, and system monitoring techniques. (L5)

CO4: Analyze smart grid operation and planning including economic dispatch, optimal power flow, load forecasting, and control center functions. (L4)

CO5: Evaluate distributed generation and energy storage integration in smart grids including modeling, control, and application aspects. (L5)

Unit I: Introduction:

Conventional power systems and Smart grid, definition of smart grid, need for smart grid, Smart grid architecture, smart grid domains, enablers of smart grid, Communication architecture and protocols for smart grid, smart grid priority standards and regulation, smart-grid activities in India.

Unit II: Systems of Non-Linear Equations:

Fixed point iteration, Newton Raphson Iteration, Continuation methods, Power system application: power flow, regulating transformer, Fast decoupled load flow, PV curves and continuation power flow, three phase power flow

Unit III: Smart Grid Security Analysis:

Concept of security, Security analysis and monitoring, factors affecting power system security, detection of network problems, an overview of security analysis. Contingency analysis for generator and line outages by Interactive Linear Power Flow (ILPF) method, Fast decoupled inverse Lemma based approach, network sensitivity factors, Contingency selection, concentric relaxation and bounding.

Unit IV: Smart Grid Operation and Planning:

Economic Dispatch, Optimal Power Flow, Load forecasting, Operation of smart grid system, Load Dispatch Centre functions, preventive, Emergency and Restorative, control objectives of a smart distribution system, Operational bottlenecks in smart grid. Planning Aspects of smart grid, Planning and operation Standards.

Unit V: Distributed Generation in Smart Grid:

Renewable-based Distributed generations, Energy Storage Technologies, Modeling, Control of energy storage system, Short- mid -long term application of energy storage system in smart grids.

Text Books:

1. Muhammad Kamran, Fundamentals of Smart Grid Systems, Academic Press, 2022
2. Mariesa L Crow, Computetional methods for Electric Power Systems, CRC Press, NW, 2016, 3rd Edition.
3. Francisco D´ıaz-Gonz´alez, Andreas Sumper and Oriol Gomis-Bellmunt, Energy Storage in Power Systems, John Wiley & Sons Ltd, 2016

Reference Books:

1. Prabha Kundur, Power System Stability and Control, McGraw Hill Education, 2006, 1st Edition.
2. Math H. J. Bollen, Fainan Hassan, Integration of Distributed Generation in the Power System, Wiley, 2011
3. A. Mahaboob Subahani, G. R. Kanagachidambaresan, M. Kathiresh, Integration of Renewable Energy Sources with Smart Grid, Willey, 2021
4. J. Ekanayake, N. Jenkins, K. Liyanage, J. Wu, A. Yokoyama, Smart Grid: Technology and Applications, John Wiley & Sons, 2015, 1st Edition.
5. Ali Keyh i, Design of smart power grid renewable energy systems, Wiley, 2019, 3rd Edition.

Other Online Learning Resource:

1. https://nptel.ac.in/courses/108/104/108104052/

Minor Degree - Micro Grid Technology

Course Code	Name of the Course	L	T	P	C
24MGT0206P	Project in Micro Grid Technology	3	0	0	3

Pre requisites:

- Fundamental knowledge of power systems, distributed generation, and renewable energy sources such as solar and wind energy systems.
- Basic understanding of power electronics, electrical machines, energy storage systems, and control systems.
- Familiarity with simulation tools (MATLAB/Simulink, PSCAD, or equivalent) for modeling and analysis of power systems.
- Skills in problem-solving, data analysis, teamwork, technical communication, and report writing.

Course Objectives:

- To enable students to apply engineering concepts for designing and developing microgrid-based energy solutions.
- To provide understanding of distributed energy resources and their integration into microgrid systems.
- To develop ability to analyze microgrid operation under grid-connected and islanded modes.
- To enhance skills in evaluating energy management, control strategies, and stability issues in microgrids.
- To foster innovation in designing sustainable and resilient microgrid systems for real-world applications.

Course Outcomes (COs):

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

CO1: Apply engineering knowledge to design and develop microgrid systems integrating renewable and distributed energy resources. (L3)

CO2: Analyze the operation and performance of microgrids under grid-connected and islanded conditions. (L4)

CO3: Investigate energy management, control strategies, and power flow in microgrid systems using analytical and simulation tools. (L4)

CO4: Evaluate microgrid performance based on stability, reliability, power quality, and economic considerations. (L5)

CO5: Design and develop innovative microgrid models or prototypes incorporating renewable energy sources and energy storage systems. (L6)