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

CSE - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

COURSE STRUCTURE AND SYLLABUS

for

B. Tech. (Regular – Full Time)

(Effective for the Students Admitted into I Year from the Academic Year 2025 - 26 onwards)

and

B. Tech. (Lateral Entry Scheme)

(Effective for the Students getting Admitted into II Year through Later Entry Scheme from the Academic Year 2026 - 27 onwards)

ADITYA COLLEGE OF ENGINEERING :: MADANAPALLE
Punganur Road, Valasapalle (Post), Madanapalle, Annamayya (Dist.,) – 517325.
(An Autonomous Institution)

Department of CSE (Artificial Intelligence and Machine Learning)

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 emerge as a center of excellence in Artificial Intelligence and Machine Learning education and research, producing competent and socially responsible professionals who contribute to technological advancement and societal development.

Department Mission:

- ❖ Impart quality education in the domain of Artificial Intelligence and Machine Learning through a well-structured curriculum, innovative pedagogy, and hands-on learning.
- ❖ Foster a research-driven environment that promotes critical thinking, innovation, and problem-solving skills.
- ❖ Inculcate ethical values, professional responsibility, and leadership qualities among students through value-based education
- ❖ Encourage industry-academia collaboration for real-world exposure and lifelong learning.

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.

<u>Program Specific Outcomes (PSOs):</u>

On Successful completion, the graduate (Artificial Intelligence and Machine Learning) will be able to,

- ❖ Design and develop intelligent systems using Artificial Intelligence, Machine Learning, and Deep Learning techniques to solve domain-specific problems.
- ❖ Apply data-driven techniques, including data preprocessing, visualization, and predictive modeling, to support decision-making and innovation.

<u>Programme Educational Objectives (PEOs):</u>

After few years of graduation, the graduates of Artificial Intelligence and Machine Learning are expected to

- ❖ Demonstrate technical expertise in AI, Machine Learning, and computational technologies to solve complex engineering problems.
- ❖ Pursue successful careers in industry, academia, or entrepreneurship, and engage in lifelong learning through higher studies or professional development.
- ❖ Exhibit ethical behavior, effective communication, and teamwork in multidisciplinary environments while addressing societal challenges.
- ❖ Contribute to the development of innovative, sustainable, and inclusive AI solutions that address real-world problems in various sectors.

B.Tech. – C. S. E. - Artificial Intelligence and Machine Learning
Course Structure & Syllabus – ACEM R24 Regulations
(Applicable from the academic year 2024-25 onwards)

INDUCTION PROGRAMME

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

Group - B

B.Tech. – I Year I Semester

S. No.	Category	Course code	Name of the Course	L	T	P	Credits
1.	BS	24BSHB101T	Linear Algebra & Calculus	2	1	0	3
2.	BS	24BSHB104T	Chemistry	3	0	0	3
3.	HM	24HMHS101T	Communicative English	2	0	0	2
4.	ES	24ES01101T	Basic Civil & Mechanical Engineering	3	0	0	3
5.	ES	24ES05101T	Introduction to Programming	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.	ES	24ES05101P	Computer Programming 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. – 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	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.	PC	24PC05101T	Data Structures	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.	PC	24PC05101P	Data Structures 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. – II Year I Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	BS	24BSHB209T	Discrete Mathematics & Graph Theory	2	1	0	3
2.	BS	24BSHB212T	Optimization Techniques	2	0	0	2
3.	PC	24PC31201T	Artificial Intelligence	3	0	0	3
4.	PC	24PC05202T	Advanced Data Structures & Algorithms Analysis	2	1	0	3
5.	PC	24PC05203T	Object Oriented Programming Through JAVA	2	1	0	3
6.	PC	24PC05202P	Advanced Data Structures and Algorithms Analysis Lab	0	0	3	1.5
7.	PC	24PC05203P	Object-Oriented Programming Through JAVA 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	**12**	**4**	**10**	**21**

B. Tech. – II Year II Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	HM	24HMHS204L	Universal Human Values– Understanding Harmony and Ethical Human Conduct	2	1	0	3
2.	BS	24BSHB210T	Probability & Statistics	2	1	0	3
3.	PC	24PC31202T	Machine Learning	2	1	0	3
4.	PC	24PC05204T	Database Management Systems	2	1	0	3
5.	PC	24PC04204T	Digital Logic and Computer Organization	3	0	0	3
6.	PC	24PC31202P	Artificial Intelligence & Machine Learning Lab	0	0	3	1.5
7.	PC	24PC05204P	Database Management Systems Lab	0	0	3	1.5
8.	SE	24SE05203S	Full Stack Development - I	0	1	2	2
9.	HM	24HMHS205A	Environmental Science	2	0	0	--
			Total	**11+2**	**5**	**8**	**20**
Mandatory CommUnity Service Internship (24IPIN301L) of 08 Weeks duration during Summer Vacation							

B. Tech. – III Year I Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	PC	24PC31303T	Natural Language Processing	2	1	0	3
2.	PC	24PC05307T	Introduction to Quantum Technologies and Applications	3	0	0	3
3.	PC	24PC31304T	System Software Programming	2	1	0	3
4.	PC	24PC31305T	Computer Vision & Image Processing	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	24PC31305P	Computer Vision & NLP Lab	0	0	3	1.5
8.	PC	24PC31304P	AI & System Programming Lab	0	0	3	1.5
9.	SE	24SE05304S	Full Stack Development-II	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.	24PE30301T	Data Visualization	2	1	0
2.	24PE05302T	Soft Computing	3	0	0
3.	24PE30303T	Exploratory Data Analysis with Python	2	1	0
4.	24PE31301T	Computational Intelligence	2	1	0

Open Elective – I (OE - I)

S. No.	Course Code	Name of the Course	Offered by the Dept	L	T	P
1.	24OE01301T	Green Buildings	Civil	2	1	0
2.	24OE01302T	Construction Technology and Management		2	1	0
3.	24OE02301T	Electrical Safety Practices and Standards	EEE	3	0	0
4.	24OE03301T	Sustainable Energy Technologies	ME	3	0	0
5.	24OE04301T	Electronic Circuits	ECE	2	1	0
6.	24OE05302T	Quantum Technologies and Applications	CSE & Allied	3	0	0
7.	24OEHB301T	Mathematics for Machine Learning and AI	Mathematics	2	1	0
8.	24OEHB302T	Materials Characterization Techniques	Physics	2	1	0
9.	24OEHB303T	Chemistry of Energy Systems	Chemistry	3	0	0
10.	24OEHS301T	English for Competitive Examinations	Humanities	3	0	0
11.	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	24PC31307T	Cloud Computing for AI	3	0	0	3
2.	PC	24PC31308T	Big Data Analytics & AI Applications	2	1	0	3
3.	PC	24PC31309T	Full Stack AI Development	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	24PC31308P	Big Data & Cloud Computing Lab	0	0	3	1.5
8.	PC	24PC31309P	Full Stack AI Lab	0	0	3	1.5
9.	SE	24SEHS201S	Soft Skills	0	1	2	2
10.	IP	24MCHS309A	**Mandatory Non-credit Course:** Technical Paper Writing & IPR	2	0	0	-
11.	WS	24IPWS302L	Workshop	0	0	0	0
			Total	**16+2**	**3**	**8**	**23**
Mandatory Industry Internship (24IPIN403L) of 08 weeks duration during Summer Vacation							

Professional Elective – II (PE - II)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE31303T	Graph Neural Networks	2	1	0
2.	24PE30304T	Recommender Systems	3	0	0
3.	24PE30305T	Predictive Analytics	2	1	0
4.	24PE31304T	Blockchain for AI	3	0	0

Professional Elective –III (PE - III)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE30306T	AI for Finance	3	0	0
2.	24PE05310T	Introduction to Quantum Computing	3	0	0
3.	24PE30307T	Social Network Analysis	3	0	0
4.	24PE31307T	Cybersecurity & AI-driven Threat Detection	3	0	0

Open Elective –II (OE - II)

S. No.	Course Code	Name of the Course	Offered by the Dept	L	T	P
1.	24OE01303T	Disaster Management	Civil	2	1	0
2.	24OE01304T	Sustainability In Engineering Practices		2	1	0
3.	24OE02302T	Renewable Energy Sources	EEE	3	0	0
4.	24OE03302T	Automation and Robotics	ME	3	0	0
5.	24OE04302T	Digital Electronics	ECE	2	1	0
6.	24OEHB304T	Optimization Techniques for Engineers	Mathematics	2	1	0
7.	24OEHB305T	Mathematical Foundation of Quantum Technologies		2	1	0
8.	24OEHB306T	Physics of Electronic Materials and Devices	Physics	2	1	0
9.	24OEHB307T	Chemistry of Polymers and Applications	Chemistry	3	0	0
10.	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	24PC31410T	Generative AI & Prompt Engineering	2	1	0	3
2.	HM		**Management Elective – II (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	24SE05405S	Prompt Engineering	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	**16+2**	**2**	**2**	**21**

Management Course- 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.	24PE31408T	Explainable AI & Model Interpretability	3	0	0
2.	24PE31409T	AI for Robotics	3	0	0
3.	24PE31410T	AI in Cybersecurity	3	0	0
4.	24PE31411T	AI-driven Software Engineering & DevOps	3	0	0

Professional Elective – V (PE - V)

S. No.	Course Code	Name of the Course	L	T	P
1.	24PE31412T	AI for Smart Cities & IoT Systems	3	0	0
2.	24PE31413T	MLOps& AI Model Deployment	3	0	0
3.	24PE30412T	Data Wrangling	3	0	0
4.	24PE31414T	Healthcare AI	3	0	0

Open Elective – III (OE - III)

S. No.	Course Code	Name of the Course	Offered by the Dept	L	T	P
1.	24OE01405T	Building Materials and Services	Civil	3	0	0
2.	24OE01406T	Environmental Impact Assessment		3	0	0
3.	24OE02403T	Smart Grid Technologies	EEE	3	0	0
4.	24OE03403T	3D Printing Technologies	ME	3	0	0
5.	24PC04312T	Microprocessors and Microcontrollers	ECE	2	1	0
6.	24OEHB408T	Wavelet Transforms and its Applications	Mathematics	2	1	0
7.	24OEHB409T	Smart Materials and Devices	Physics	2	1	0
8.	24OEHB410T	Introduction to Quantum Mechanics		2	1	0

9.	24OEHB411T	Green Chemistry and Catalysis for Sustainable Environment	Chemistry	3	0	0
10.	24OEHS404T	Employability Skills	Humanities	3	0	0

Open Elective – IV (OE - IV)

S. No.	Course Code	Name of the Course	Offered by the Dept	L	T	P
1.	24OE01407T	Geo-Spatial Technologies	Civil	2	1	0
2.	24OE01408T	Solid Waste Management		2	1	0
3.	24OE02404T	Electric Vehicles	EEE	3	0	0
4.	24OE03404T	Total Quality Management	ME	2	1	0
5.	24OE04403T	Transducers and Sensors	ECE	3	0	0
6.	24PE05310T	Introduction to Quantum Computing	CSE & Allied	3	0	0
7.	24OEHB412T	Financial Mathematics	Mathematics	2	1	0
8.	24OEHB413T	Sensors and Actuators for Engineering Applications	Physics	3	0	0
9.	24OEHB414T	Chemistry of Nanomaterials and Applications	Chemistry	3	0	0
10.	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 C.S.E - A.I. &M.L.

S. No.	Course Code	Name of the Course	L	T	P	Credits
1.	24HON3101T	Advanced Machine Learning & AI Systems	2	1	0	3
2.	24HON3102T	Deep Learning & Neural Networks Architectures	2	1	0	3
3.	24HON3103T	Reinforcement Learning & Decision Making	2	1	0	3
4.	24HON3104T	AI for Robotics & Automation	3	0	0	3
5.	24HON3105T	AI Ethics, Fairness & Explainability	3	0	0	3
6.	24HON3106P	AI & Machine Learning Lab	0	0	3	1.5
7.	24HON3107P	Robotics & Autonomous Systems Lab	0	0	3	1.5
Total			**12**	**3**	**6**	**18**

MINOR DEGREE OFFERED BY THE C. S. E. – A. I. & M. L. TO OTHERS

ARTIFICIAL INTELLIGENT AND MACHINE LEARNING

S. No.	Course Code	Name of the Course	L	T	P	Credits
1.	24MAI3101T	AI in Finance & Business Analytics	3	0	0	3
2.	24MAI3102T	Ethical AI & Responsible AI	3	0	0	3
3.	24PC31410T	Generative AI & Prompt Engineering	3	0	0	3
4.	24PE31410T	AI in Cybersecurity	3	0	0	3
5.	24PE31414T	Health Care AI	3	0	0	3
6.	24MAI3103P	Generative AI Lab	0	0	3	1.5
7.	24MAI3104P	AI Applications Lab	0	0	3	1.5
	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, Eigenvectors and Orthogonal Transformation:

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

Unit III: Calculus:

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

Unit IV: Partial differentiation and Applications (Multi Variable Calculus):

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

Unit V: Multiple Integrals (Multi Variable Calculus):

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

Text Books:

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

Reference Books:

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

B.Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB104T	BS	**Chemistry** (Common to EEE, ECE, CSE, AI&DS, CSE-AI, and 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 I 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 structuretalks.

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 isdiscussed

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 UniversityPress.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Online 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 I Semester

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

Part – A: Basic Civil Engineering

Pre-Requisites: Basic Knowledge in Physics & Chemistry

Course Objectives:

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

Course Outcomes (COs):

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

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

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

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

Unit I: Basics of Civil Engineering:

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

Unit II: Surveying:

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

Unit III: Transportation Engineering:

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

Text Books:

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

Reference Books:

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

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

Pre-Requisites: Nil

Course Objectives:

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

Course Outcomes (COs):

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

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

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

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

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

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

Unit I: Introduction to Programming and Problem Solving:

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

Unit II: Control Structures:

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

Unit III: Arrays and Strings:

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

Unit IV: Pointers & User Defined Data types:

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

Unit V: Functions & File Handling:

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

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

Text Books:

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

Reference Books:

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

B.Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB104P	BS	**Chemistry Lab** (Common to EEE, ECE, CSE, AI&DS, CSE-AI and 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 I Semester

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

Pre-Requisites: Basics of LSRW skills

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 emphasison 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 forbetter 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*,Tata McGraw-Hill Education India,2016
3. Hewing's, Martin. Cambridge *Academic English*(B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2^{nd}Ed), Kindle,2013
5. T. Balasubramanyam, A Textbook of English Phonetics for Indian Students, (3^{rd} Ed) Trinity Press.

B.Tech. – I Year I 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: Basic knowledge of engineering drawing, workshop safety practices, and an interest in hands-on fabrication and manufacturing processes.

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

b) **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.a) tyreV-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two-wheeler

4. **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

5. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
6. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap Joint and Butt joint.
7. **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 I Semester

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

Pre-Requisites: Nil

Course Objectives:

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

Course Outcomes (COs):

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

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

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

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

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

Unit I: Week 1:

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

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

Week 2:

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

Suggested Experiments /Activities:

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

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

Developing the algorithms/flowcharts for the following sample programs

i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa
iii) Simple interest calculation

Week 3:

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

Suggested Experiments/Activities:

Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.

i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron’s formulae
iv) Distance travelled by an object

Unit – II:
Week 4:
Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.
Suggested Experiments/Activities:
Tutorial4: Operators and the precedence and as associativity:
Lab4: Simple computational problems using the operator' precedence and associativity
i) Evaluate the following expressions.
a. A+B*C+(D*E) + F*G b. A/B*C-B+A*D/3
c. A+++B---A d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float
Week 5:
Objective: Explore the full scope of different variants of "if construct" namely if-else, null-else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".
Suggested Experiments/Activities:
Tutorial 5: Branching and logical expressions:
Lab 5: Problems involving if-then-else structures.
i) Write a C program to find the max and min of four numbers using if-else.
ii) Write a C program to generate electricity bill.
iii) Find the roots of the quadratic equation.
iv) Write a C program to simulate a calculator using switch case.
v) Write a C program to find the given year is a leap year or not.
Week 6:
Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.
Suggested Experiments/Activities:
Tutorial 6: Loops, while and for loops
Lab 6: Iterative problems e.g., the sum of series
i) Find the factorial of given number using any loop.
ii) Find if the given number is a prime or not.
iii) Compute sine and cos series
iv) Checking a number palindrome
v) Construct a pyramid of numbers.

Unit III:
Week 7:
Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.
Suggested Experiments/Activities:
Tutorial 7: 1 D Arrays: searching.
Lab 7:1D Array manipulation, linear search
i) Find the min and max of a 1-D integer array.
ii) Perform linear search on1D array.

iii) The reverse of a 1D integer array
iv) Find 2’s complement of the given binary number.
v) Eliminate duplicate elements in an array.

Week 8:

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

Suggested Experiments/Activities:

Tutorial 8: 2 D arrays, sorting and Strings.

Lab 8: Matrix problems, String operations, Bubble sort

i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

Unit IV:

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 de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C

Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation

Lab 9: Pointers and structures, memory dereference.

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc () and display failed students list
iv) Read student name and marks from the command line and display the student details along with the total.
v) Write a C program to implement realloc ()

Week 10:

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

Suggested Experiments/Activities:

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

Lab10: Bitfields, linked lists

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

i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

Unit V:

Week 11:

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

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

i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

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

i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

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

i) Write a C program to swap two numbers using call by reference.
ii) Demonstrate Dangling pointer problem using a C program.
iii) Write a C program to copy one string into another using pointer.
iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

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

i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-line arguments.
v) Find no. of lines, words and characters in a file
vi) Write a C program to print the last n characters of a given file.

Text Books:

1. Ajay Mittal, Programming in C: A practical approach, 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
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, student 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. – 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 for all branches of Engineering)	2	1	0	3

Pre-Requisites: Basis 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 anddivergence. (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 Coefficients):

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

Unit III: Partial Differential Equations:

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential 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
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) – co ordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

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

Unit III: Dielectric and Magnetic Materials:

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

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

Unit IV: Quantum Mechanics and Free Electron Theory:

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

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

Unit V: Semiconductors:

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

Text Books:

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

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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 II 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: Demonstrate the construction, working principle & operation of various DC & AC Machines and Permanent Magnet Moving Coil (PMMC) & Moving Iron (MI) Instruments. (L2)

CO3: Illustrate the generation of Electrical power, Electricity billing and Equipment Safety Measures. (L2)

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, Person Publications, 2018, Second Edition. E. Hughes, Electrical and Electronic Technology, Pearson , 2010
4. 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: Analyze the applications of the diode and transistors. (L4)

CO3: Explain about number systems, codes, logic gates and the working mechanism of combinational and sequential circuits. (L2)

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 II 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: Understand the principles of engineering drawing, including engineering curves, scales, orthographic and isometric projections. (L2)

CO2: Draw and interpret orthographic projections of points, lines, planes and solids in front, top and side views. (L2)

CO3: Draw projection of solids in various positions in first quadrant. (L2)

CO4: Explain principles behind development of surfaces. (L2)

CO5: Draw the conversion of the isometric views to orthographic views and vice versa.(L2)

Unit I: Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regularpolygons by general methods.

Curves: construction of ellipse, parabola and hyperbola by general method, Cycloids, Involutes, Normal andtangent 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 II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05101T	PC	**Data Structures** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	2	1	0	3

Pre-Requisites: Basic Knowledge in C-Language

Course Objectives:

- To provide the knowledge of basic data structures and their implementations.
- To understand the importance of data structures in context of writing efficient programs.
- To develop skills to apply appropriate data structures in problem solving.

Course Outcomes (COs):

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

CO1: Implement linear data structures using Abstract Data Types (ADTs) and apply basic searching and sorting techniques to solve computational problems with appropriate time and space complexity considerations. (L3)

CO2: Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation. (L4)

CO3: Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems. (L3)

CO4: Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between deques and priority queues and apply them appropriately to solve data management challenges. (L3)

CO5: Design novel solutions to small scale programming challenges involving data structures such as stacks, queues, Trees. Recognize scenarios where hashing is advantageous, and design hash-based solutions for specific problems. (L4)

Unit I: Introduction to Linear Data Structures:

Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures. Searching Techniques: Linear & Binary Search, Sorting Techniques: Bubble sort, Selection sort, Insertion Sort.

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.

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.

Unit IV: Queues, Deques and Graphs:

Queues: Introduction to queues: properties and operations, implementing queues using arrays and linked lists, Applications of queues in breadth-first search, scheduling, etc. **Deques:** Introduction to deques (double-ended queues), Operations on deques and their applications, **Graphs**: Basic Terminology and Representations.

Unit V: Trees & Hashing:

Trees: Introduction to Trees, Binary Search Tree –Insertion, Deletion & Traversal.

Hashing: Brief introduction to hashing and hash functions, Collision resolution techniques: chaining and open addressing, Hash tables: basic implementation and operations, Applications of hashing in unique identifier generation, caching, etc.

Text Books:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2ndEdition, 2002.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, 2008.

Reference Books:

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders, 1st edition, 2008.
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft, 1st edition, 2002.
3. Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum, 1st edition, 2006.
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, 3rd edition, 2006.
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick, 3rd edition, 2001.

B.Tech. – I Year II 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	2	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.

Online Resources:

1.www.vlab.co.in

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

B.Tech. – I Year II 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 performed using both Hardware and Software

B.Tech. – I Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05101P	**PC**	**Data Structures Lab** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	**0**	**0**	**3**	**1.5**

Pre-Requisites: Basic Knowledge in C-Language

Course Objectives:

The course aims at strengthening the ability of the students to identify and apply suitable data structure for the given real-world problem. It enables them to gain knowledge in practical applications of data structures.

Course Outcomes (COs):

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

CO1: Explain the role of linear data structures in organizing & accessing data efficiently in algorithms. (L2)

CO2: Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation. (L4)

CO3: Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems. (L3)

CO4: Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between deques and priority queues and apply them appropriately to solve data management challenges. (L3)

CO5: Recognize scenarios where hashing is advantageous, and design hash-based solutions for specific problems. (L3)

List of Experiments:

Exercise 1: Array Manipulation

i) Write a program to reverse an array.
ii) C Programs to implement the Searching Techniques –Linear & Binary Search
iii) C Programs to implement Sorting Techniques –Bubble, Selection and Insertion Sort

Exercise 2: Linked List Implementation

i) Implement a singly linked list and perform insertion and deletion operations.
ii) Develop a program to reverse a linked list iteratively and recursively.
iii) Solve problems involving linked list traversal and manipulation.

Exercise 3: Linked List Applications

i) Create a program to detect and remove duplicates from a linked list.
ii) Implement a linked list to represent polynomials and perform addition.
iii) Implement a double-ended queue (deque) with essential operations.

Exercise 4: Double Linked List Implementation

i) Implement a doubly linked list and perform various operations to understand its properties and applications.
ii) Implement a circular linked list and perform insertion, deletion, and traversal.

Exercise 5: Stack Operations

i) Implement a stack using arrays and linked lists.
ii) Write a program to evaluate a postfix expression using a stack.
iii) Implement a program to check for balanced parentheses using a stack.

Exercise 6: Queue Operations

i) Implement a queue using arrays and linked lists.
ii) Develop a program to simulate a simple printer queue system.
iii) Solve problems involving circular queues.

Exercise 7: Stack and Queue Applications

i) Use a stack to evaluate an infix expression and convert it to postfix.
ii) Create a program to determine whether a given string is a palindrome or not.
iii) Implement a stack or queue to perform comparison and check for symmetry.

Exercise 8: Binary Search Tree

i) Implementing a BST using Linked List.
ii) Traversing of BST.

Exercise 9: Hashing

i) Implement a hash table with collision resolution techniques.
ii) Write a program to implement a simple cache using hashing.

Text Books:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2ndEdition, 2002.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, 2008

Reference Books:

1. Algorithms and Data Structures: The Basic Toolbox byKurt Mehlhorn and Peter Sanders, 1st edition, 2002.
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft, 1st edition, 2008.
3. Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum, 1st edtion, 2006.
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, 3rd edition 2006.
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms by Robert Sedgewick, 3rd edition, 2001.

B.Tech. – I Year II 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 II 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,

a. Conducting consumer Awareness. Explaining various legal provisions etc.

b. Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population

iv. Education.

a. Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

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

General Guidelines:

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

B. Tech. – II Year
I Semester

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB209T	BS	**Discrete Mathematics & Graph Theory** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	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: Apply propositional and predicate logic, including well-formed formulas, tautologies, equivalences, normal forms, and inference theories to analyse and design algorithms, software verification, and automated reasoning systems. (L4)

CO2: Use principles of inclusion-exclusion, pigeonhole, and function theory, and analyse algebraic structures such as semigroups, monoids, and groups to solve problems in computing and information systems.

CO3: Analyse and enumerate combinations and permutations, including repetitions and constraints, and apply binomial and multinomial theorems to solve counting problems in computing and engineering contexts. (L4)

CO4: Analyse and solve recurrence relations using substitution, generating functions, and characteristic roots methods to model and address problems in computer science and engineering. (L4)

CO5: Examine graphs, trees, and their properties including spanning trees, planar graphs, and Euler/Hamiltonian circuits to solve problems in networking, data structures, and optimization. (L4)

Unit I: Mathematical Logic:

Introduction, Statements and Notation, Connectives, Well-formed formulas, Tautology, Duality law, Equivalence, Implication, Normal Forms, functionally complete set of connectives, Inference Theory of Statement Calculus, Predicate Calculus, Inference theory of Predicate Calculus.

Unit II: Set Theory:

The Principle of Inclusion- Exclusion, Pigeon hole principle and its application, Functions composition of functions, Inverse Functions, Recursive Functions, Lattices and its properties. Algebraic structures: Algebraic systems-Examples and General Properties, Semi groups and Monoids, groups, sub groups, homomorphism, Isomorphism.

Unit III: Elementary Combinatorics:

Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions, Binomial Coefficients, The Binomial and Multinomial Theorems.

Unit IV: Recurrence Relations:

Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence relations, Solving Recurrence Relations by Substitution and Generating functions, The Method of Characteristic roots, Solutions of in homogeneous, Recurrence Relations.

Unit V: Graphs:

Basic Concepts, Isomorphism and Sub graphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multi graphs and Euler Circuits, Hamiltonian Graphs.

Textbooks:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2002.
2. Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, McGraw Hill Education (India) Private Limited.

Reference Books:

1. JoeL.Mott, Abraham Kandel and Theodore P. Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Pearson Education.
2. NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science.

Online Learning Resources:

1. http://www.cs.yale.edu/homes/aspnes/classes/202/notes.pdf

B. Tech. – II Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB212T	**BS**	**Optimization Techniques** (Common to CSE-AI & CSE-AI&ML)	**2**	**0**	**0**	**2**

Pre-Requisites: Basic Knowledge of Mathematics

Course Objectives: The objectives of the course are to

- To provide the basic knowledge about Optimization, importance, application areas of in the industry, Linear Programming.
- To impart different optimization models under typical situations in the business organization like transportation, assignment.
- To understand the process of sequencing in a typical industry.
- To describe different game strategies under cut- throat competitive business environment.
- To develop networks of activities of projects and to find out optimal modes of completing projects using network modelling evaluation techniques.

Course Outcomes (COs):

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

CO1: Formulate and solve linear programming problems using graphical, simplex, Big-M, and two-phase methods to optimize resource usage and algorithmic decision-making in applications such as scheduling, routing, and machine learning. (L4)

CO2: Solve transportation and assignment problems using methods like the Hungarian algorithm to optimize task allocation, resource distribution, and scheduling in computing systems and operations research. (L4)

CO3: Apply job sequencing techniques, including Johnson's algorithm, to optimize task scheduling and processing sequences in computing and manufacturing systems. (L4)

CO4: Analyse two-person zero-sum games using pure and mixed strategies, and apply game theory concepts to optimize competitive strategies in algorithms, network security, and resource allocation. (L4)

CO5: Construct and analyse CPM and PERT networks to find critical paths and scheduling for effective project management in software and systems engineering. (L4)

Unit I: Introduction:

Meaning, Nature, Scope & Significance of Optimization - Typical applications. The Linear Programming Problem – Introduction, Formulation of Linear Programming problem, Limitations of L.P.P, Graphical method, Simplex method: Maximization and Minimization model (exclude Duality problems), Big-M method and Two-Phase method.

Unit II: Transportation Problem:

Introduction, Transportation Model, finding initial basic feasible solutions, Moving towards optimality, Unbalanced Transportation problems, Transportation problems with maximization, Degeneracy.

Assignment Problem–Introduction, Mathematical formulation of the problem, Solution of an Assignment problem, Hungarian Algorithm, Multiple Solution, Unbalanced Assignment problems, Maximization in Assignment Model.

Unit III: Sequencing and Scheduling Models:
Sequencing–Job sequencing, Johnsons Algorithm for n-Jobs and Two machines, n-Jobs and Three Machines, n-jobs through machines, Two jobs and Machines Problems.

Unit IV: Game Theory:
Concepts, Definitions and Terminology, Two Person Zero Sum Games, Pure Strategy Games (with Saddle Point), Principal of Dominance, Mixed Strategy Games (Game without Saddle Point), Significance of Game Theory in Managerial Application.

Unit V: Project Management:
Network Analysis – Definition –objectives -Rules for constructing network diagram-Determining Critical Path– Earliest &Latest Times–Floats-Application of CPM and PERT techniques in Project Planning and Control–PERT Vs CPM. (exclude Project Crashing).

Textbooks:

1. Operations Research/R. Pannerselvam, PHI Publications.
2. Operations Research/S.D. Sharma- Kedarnath
3. Operations Research /A.M. Natarajan, P. Balasubramani, A. Tamilarasi / Pearson Education.
4. Engineering Optimization: Theory and practice/ S.S.Rao, New Age International (P) Limited

Reference Books:

1. Quantitative Techniques in Management/NDVohra,TataMcGrawHill,4thEdition, 2011.
2. Introduction to O.R/Hiller & Libermann (TMH).
3. Operations Research: Methods &Problems/Maurice Saseini, Arhur Yaspan & Lawrence Friedman. Pearson
4. QuantitativeAnalysisForManagement/BarryRender,RalphM.Stair,JrandMichael
5. E. Hanna
6. Operations Research/ Wagner/PHI Publications.

Online Learning Sources

1. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview
2. https://onlinecourses.nptel.ac.in/noc20_ma23/preview
3. https://onlinecourses.nptel.ac.in/noc19_ma29/preview

II B. Tech. – I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31201T	PC	**Artificial Intelligence** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites:

- Knowledge in Computer Programming.
- A course on “Mathematical Foundations of Computer Science”.
- Background in linear algebra, data structures and algorithms, and probability

Course Objectives:

- The student should be made to study the concepts of Artificial Intelligence, learn the methods of solving problems using Artificial Intelligence.
- The student should be made to introduce the concepts of Expert Systems.
- To understand the applications of AI, namely game playing, theorem proving, and machine learning.
- To learn different knowledge representation techniques.

Course Outcomes (COs):

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

CO1: Apply foundational concepts of Artificial Intelligence to model intelligent agents, and analyze agent structures, rationality, and environment types in order to formulate and solve basic AI problems. (L4)

CO2: Apply search strategies to solve real-life problems in a state space representation using AI techniques like searching and game playing. (L3)

CO3: Understand the knowledge representation issues, concept learning and apply Bayesian learning using Bayes theorem and Naive Bayes classifier. (L3)

CO4: Apply inference techniques in first order logic and analyse various learning paradigms for intelligent decision-making. (L4)

CO5: Apply the architecture and components of expert systems and analyse the roles and functionalities of typical expert systems including the use of expert system shells. (L4)

Unit I: Introduction:

AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

Unit II: Searching and Game Playing Techniques:

Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A*, AO* Algorithms, Problem reduction, Game Playing - Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions.

Unit III: Representation of Knowledge:

Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules-based deduction systems. Reasoning under uncertainty, review of probability, Bayes’ probabilistic interferences and Dempster Shafer Theory.

Unit IV: Logic Concepts:

First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning.

Unit V: Expert Systems:

Architecture of expert systems, Roles of expert systems – Knowledge Acquisition Meta knowledge Heuristics. Typical expert systems – MYCIN, DART, XCON: Expert systems shells.

Text Books:

1. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education.
2. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill

Reference Books:

1. David Poole, Alan Mackworth, Randy Goebel," Computational Intelligence: a logical approach", Oxford University Press.
2. G. Luger, "Artificial Intelligence: Structures and Strategies for complex Problem Solving", Fourth Edition, Pearson Education.
3. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.
4. Artificial Intelligence, Saroj Kaushik, CENGAGE Learning.

Online Resources:

1. https://ai.google/
2. https://swayam.gov.in/nd1_noc19_me71/preview

II B. Tech. – I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05202T	PC	**Advanced Data Structures & Algorithm Analysis** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	2	1	0	3

Pre-Requisites: Understanding of Basic Data Structures and Programming Skills

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 (COs):

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

CO1: Analyse the time and space complexity of algorithms using asymptotic notations and apply appropriate tree data structures for solving hierarchical data problems. (L4)

CO2: Apply and analyse advanced data structures such as heap trees and graph representations, and utilize divide and conquer strategies to design efficient algorithms for complex computational problems. (L4)

CO3: Apply greedy and dynamic programming strategies to solve optimization problems, and analyse their efficiency and suitability for various algorithmic scenarios including shortest paths, spanning trees, and resource allocation. (L4)

CO4: Apply backtracking and branch & bound techniques to solve combinatorial and optimization problems, and analyse their computational complexity and practical applicability. (L4)

CO5: Apply fundamental concepts of computational complexity to identify NP-Hard and NP-Complete problems, and analyse the complexity of decision problems in graph theory and scheduling. (L4)

Unit I: Introduction, AVL Tress and B-Trees:

Introduction to Algorithm Analysis, Space and Time Complexity analysis, Asymptotic Notations. AVL Trees –Creation, Insertion, Deletion operations and Applications B-Trees –Creation, Insertion, Deletion operations and Applications

Unit II: Heap Trees, Graphs, Divide and Conquer:

Heap Trees (Priority Queues)-Min and Max Heaps, Operations and Applications

Graphs-Terminology, Representations, Basic Search and Traversals, Connected Components & Biconnected Components, applications

Divide and Conquer: The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication, Convex Hull

Unit III: Greedy Method and Dynamic Programming:

Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths

Dynamic Programming: General Method, all pairs shortest paths, Single Source Shortest Paths – General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, String Editing, Travelling Salesperson problem

Unit IV: Backtracking and Branch and Bound:

Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem

Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem

Unit V: NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem

NP Hard Graph Problems: Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP)

NP Hard Scheduling Problems: Scheduling Identical Processors, Job Shop Scheduling

Text Books:

1. Fundamentals of Data Struct ures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh 2nd Edition Universities Press
2. Computer Algorithms/C++ Ellis Horowitz, SartajSahni, SanguthevarRajasekaran2nd Edition University Press

Reference Books:

1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
2. An introduction to Data Structures with applications, Trembley & Sorenson, McGraw Hill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997.
4. Data Structures using C & C++: Langsam, Augenstein&Tanenbaum, Pearson, 1995
5. Algorithms + Data Structures & Programs:,N.Wirth, PHI

II B. Tech. – I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05203T	PC	**Object-Oriented Programming Through Java** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	2	1	0	3

Pre-Requisites: Basic Programming Language

Course Objectives:

- To Identify Java language components and how they work together in applications
- To Learn the fundamentals of object-oriented programming in Java, including defining Classes, invoking methods, using class libraries.
- To Learn how to extend Java classes with inheritance and dynamic binding and how to
- To Use exception handling in Java applications
- To Understand how to design applications with threads in Java
- To Understand how to use Java apis for program development

Course Outcomes (COs):

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

CO1: Apply object-oriented programming principles to develop structured Java programs using appropriate data types, operators, and control statements, and analyse program behaviour for correctness and efficiency. (L4)

CO2: Apply object-oriented programming concepts to define and manipulate classes, objects, constructors and methods in Java, and analyse their behaviour with respect to access control, method overloading, overriding, and object referencing. (L4)

CO3: Apply and analyse arrays, inheritance, and interface mechanisms in Java to implement modular, reusable, and dynamic object-oriented programs. (L4)

CO4: Apply built-in Java packages, exception handling mechanisms, and file I/O operations to develop reliable and efficient Java programs, and analyse the structure and behaviour of Java library classes and runtime errors. (L4)

CO5: Apply Java's built-in string handling, multithreading, JDBC, and JavaFX capabilities to develop interactive, database-connected, and concurrent applications, and analyse their runtime behaviour, synchronization, and user interface structure. (L4)

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 & Inheritance:
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, Exception Handling and Java I/O and File:
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.

Unit V: String Handling in Java, Multithreaded Programming and Java FX GUI:
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, ResultSet 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, DebasisSamanta, MonalisaSarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

References Books:

1. The complete Reference Java, 11th edition, Herbert Schildt, TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

II B. Tech. – I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05202P	PC	Advanced Data Structures & Algorithm Analysis Lab (Common to CSE, AI&DS, CSE-AI & CSE-AI&ML)	0	0	3	1.5

Pre-Requisites: Understanding of Basic Data Structures and Programming Skills

Course Objectives:

The objective of the course is to

- Acquire practical skills in constructing and managing Data structures
- Apply the popular algorithm design methods in problem-solving scenarios

Course Outcomes (COs):

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

CO1: Apply and analyse AVL trees, B-Trees, and Heap Trees to perform insertion, deletion, and traversal operations for efficient data organization and retrieval. (L4)

CO2: Implement graph traversal algorithms (BFS, DFS) and apply them to find connected and bi-connected components in various representations; analyse their performance on different input sizes. (L4)

CO3: Apply sorting algorithms such as Quick Sort and Merge Sort and evaluate their performance across best, worst, and average cases for different input sizes. (L4)

CO4: Apply Greedy, Dynamic Programming, and Backtracking approaches to solve optimization problems such as 0/1 Knapsack, Job Sequencing, Travelling Salesperson, N- Queens, and Optimal Binary Search Trees, and analyse the effectiveness of each approach. (L4)

Experiments covering the Topics:

- Operations on AVL trees, B-Trees, Heap Trees
- Graph Traversals
- Sorting techniques
- Minimum cost spanning trees
- Shortest path algorithms
- 0/1 Knapsack Problem
- Travelling Salesperson problem
- Optimal Binary Search Trees
- N-Queens Problem
- Job Sequencing

Suggested Experiments/Activities:

1. Construct an AVL tree for a given set of elements which are stored in a file. And implement insert and delete operation on the constructed tree. Write contents of tree into a new file using in-order.
2. Construct B-Tree an order of 5 with a set of 100 random elements stored in array. Implement searching, insertion and deletion operations.
3. Construct Min and Max Heap using arrays, delete any element and display the content of the Heap.
4. Implement BFT and DFT for given graph, when graph is represented by
   a) Adjacency Matrix b) Adjacency Lists
5. Write a program for finding the bi-connected components in a given graph.

6. Implement Quick sort and Merge sort and observe the execution time for various input sizes (Average, Worst and Best cases).
7. Compare the performance of Single Source Shortest Paths using Greedy method when the graph is represented by adjacency matrix and adjacency lists.
8. Implement Job sequencing with deadlines using Greedy strategy.
9. Write a program to solve 0/1 Knapsack problem Using Dynamic Programming.
10. Implement N-Queens Problem Using Backtracking.
11. Use Backtracking strategy to solve 0/1 Knapsack problem.
12. Implement Travelling Sales Person problem using Branch and Bound approach.
    Tutorial 1: Problem-solving using Computers.

Text Books:

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, Cengage Learning.

II B. Tech. – I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05203P	PC	**Object Oriented Programming Through Java Lab** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	0	0	3	1.5

Pre-Requisites: Basic Programming Language

Course Objectives:

- Practice object-oriented programming in the Java programming language
- Implement Classes, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrate inheritance, Exception handling mechanism, JDBC connectivity
- Construct Threads, Event Handling, implement packages, Java FX GUI

Course Outcomes (COs):

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

CO1: Applying Java fundamentals, developers can create robust, efficient, and scalable applications. (L3)

CO2: Apply fundamental OOP principles such as encapsulation, inheritance, polymorphism, and abstraction to solve programming problems effectively. (L3)

CO3: Applying Java libraries and APIs, developers can efficiently solve real-world problems and build robust applications. (L3)

CO4: Develop problem-solving skills and algorithmic thinking, applying OOP concepts to design efficient solutions to various programming challenges. (L4)

CO5: Proficiently construct graphical user interface (GUI) applications using JavaFX. (L4)

List of Experiments:

Exercise – 1:

a) Write a JAVA program to display default value of all primitive data type of JAVA (page 30)

b) Write a java program that display the roots of a quadratic equation $ax^2+bx+c=0$. Calculate the discriminate D and basing on value of D, describe the nature of root.

Exercise - 2

c) Write a JAVA program to search for an element in a given list of elements using binary search mechanism.

d) Write a JAVA program to sort for an element in a given list of elements using bubble sort

e) Write a JAVA program using StringBuffer to delete, remove character.

Exercise - 3

a) Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.

b) Write a JAVA program implements method overloading.

c) Write a JAVA program to implement constructor.

d) Write a JAVA program to implement constructor overloading.

Exercise - 4

a) Write a JAVA program to implement Single Inheritance

b) Write a JAVA program to implement multi level Inheritance

c) Write a JAVA program for abstract class to find areas of different shapes

Exercise - 5

a) Write a JAVA program give example for “super” keyword.

b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?

c) Write a JAVA program that implements Runtime polymorphism

Exercise - 6

a) Write a JAVA program that describes exception handling mechanism

b) Write a JAVA program Illustrating Multiple catch clauses

Write a JAVA program for creation of Java Built-in Exceptions

Write a JAVA program for creation of User Defined Exception

Exercise - 7

a) Write a JAVA program that creates threads by extending Thread class. First thread display “Good Morning “every 1 sec, the second thread displays “Hello “every 2 seconds and the third display “Welcome” every 3 seconds, (Repeat the same by implementing Runnable)

b) Write a program illustrating **isAlive** and **join()**

c) Write a Program illustrating Daemon Threads.

d) Write a JAVA program Producer Consumer Problem

Exercise – 8

a) Write a JAVA program that import and use the user defined packages

b) Without writing any code, build a GUI that display text in label and image in an Image View (use JavaFX)

c) Build a Tip Calculator app using several JavaFX components and learn how to respond to user interactions with the GUI

Exercise – 9

a) Write a java program that connects to a database using JDBC

b) Write a java program to connect to a database using JDBC and insert values into it.

c) Write a java program to connect to a database using JDBC and delete values from it

References Books:

1. P. J. Deitel, H. M. Deitel, “Java for Programmers”, Pearson Education, PHI, 4th Edition, 2007.
2. P. Radha Krishna, “Object Oriented Programming through Java”, Universities Press, 2nd Edition, 2007
3. Bruce Eckel, “Thinking in Java”, Pearson Education, 4th Edition, 2006.
4. Sachin Malhotra, Saurabh Chaudhary, “Programming in Java”, Oxford University Press, 5th Edition, 2010.

Online Learning Resources:

1. https://java-iitd.vlabs.ac.in/
2. http://peterindia.net/JavaFiles.html

B. Tech. – II Year I Semester

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

Pre-Requisites: Logical and Analytical Thinking

Course Objective:

The main objectives of the course are to

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

Course Outcomes (COs):

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

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

CO2: Develop Python programs using user-defined functions with parameters and 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 I:

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

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

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

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.
   i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
5. Write a program to add and multiply complex numbers

6. Write a program to print multiplication table of a given number.

Unit II:

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

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

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

Sample Experiments:

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

Unit III:

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

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, 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
2. https://www.coursera.org/learn/python?specialization=python#syllabus

B. Tech. – II Year I Semester

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

Pre-Requisites: Nil

Course Objectives:

To 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.

Textbooks:

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://swayam.gov.in/nd1_noc19_mg60/preview
3. https://nptel.ac.in/courses/109/104/109104109/

B.Tech. – II Year
II Semester

B.Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS204L	HM	**Universal Human Values– Understanding Harmony and Ethical Human Conduct** (Common for 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 fulfillment of basic human aspirations. (L4)

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

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

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

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

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

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

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

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

Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

Unit II: Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

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

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

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

Practice Sessions for Unit II –Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body
Practice Sessions for Unit III –Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfill Human Goal
Practice Sessions for Unit IV –Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence
Practice Sessions for Unit V –Implications of the Holistic Understanding –a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

Readings:
Textbook and Teachers Manual

- The Textbook R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
- The Teacher’s Manual R R Gaur, R Asthana, G P Bagaria,Teachers’ Manual for A Foundation Course in Human Values and Professional Ethics,2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. JeevanVidya: E k Parichaya, 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://fdpsi.aicteindia.org/UHVII%20Class%20Notes%20&%20Handouts/UHV%20Handout%201- Introduction%20to%20Value%20Education.pdf
2. https://fdpsi.aicteindia.org/UHII%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdpsi.aicteindia.org/UHVII%20Class%20Notes%20&%20Handouts/UHV%20Handout%203Harmony%20in%20the%20Family.pdf
4. https://fdpsi.aicteindia.org/UHV%201%20Teaching%20Material/D3S2%20Respect%20July%2023.pdf
5. https://fdpsi.aicteindia.org/UHVII%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdpsi.aicteIndia.org/download/FDTeachingMaterial/3days%20FDPSI%20UHV%20Teaching
7. https://fdp-si.aicteindia.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5holisticunderstandingofharmonyonprofessionalethics/62490385https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB210T	BS	**Probability & Statistics** (Common to CSE, CSE-AI and CSE-AI&ML)	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: Apply statistical techniques such as measures of central tendency, variability, correlation, and regression to analyse data in computing tasks like performance evaluation, data mining, and machine learning. (L4)

CO2: Apply probability concepts, including conditional probability, Bayes' theorem, and random variables, to model uncertainties and analyse data in computing systems, algorithms, and communication networks. (L4)

CO3: Utilize binomial, Poisson, and normal distributions to model and approximate random events in computer algorithms, system performance, and reliability analysis. (L4)

CO4: Apply estimation techniques and hypothesis testing using large sample tests to evaluate algorithm performance, validate system behaviour, and support data-driven decision-making in computing applications. (L4)

CO5: Conduct small sample tests including t-tests, F-test, and chi-square tests to assess algorithm efficiency, system variability, and attribute independence in computing and data analysis. (L4)

Unit I: Descriptive Statistics:

Statistics Introduction, Population Vs Sample, Collection of data, primary and secondary data, Measures of Central tendency, Measures of Variability (spread or variance) Skewness, Kurtosis, correlation, correlation coefficient, rank correlation, regression coefficients, method of least squares, regression lines.

Unit II: Probability:

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.

Unit III: Probability Distributions:

Probability distributions: Binomial, Poisson and Normal-their properties (Chebyshevs inequality). Approximation of the binomial distribution to normal distribution.

Unit IV: Estimation and Testing of Hypothesis, Large Sample Tests:

Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

Unit V: Small Sample Tests:

Student-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Textbooks:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson,2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics,11/e, Sultan Chand & Sons Publications, 2012.

Reference Books:

1. S. Ross, a First Course in Probability, Pearson Education India, 2002.
2. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
3. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. https://onlinecourses.nptel.ac.in/noc22_mg31/preview

B. Tech. - II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31202T	PC	**Machine Learning** (Common to CSE, AI&DS, CSE-AI, and CSE-AI&ML)	2	1	0	3

Pre-Requisites: Basic knowledge of programming skills and Data Structures & Algorithms

Course Objectives:

- Define Machine Learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbors (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.

Course Outcomes (COs):

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

CO1: Apply fundamental machine learning paradigms and analyse each stage of the machine learning pipeline from data acquisition and feature engineering to model selection, evaluation, and prediction using suitable datasets. (L4)

CO2: Apply various proximity and distance-based techniques to solve classification and prediction tasks, and analyse the performance of these models using appropriate evaluation metrics. (L4)

CO3: Apply decision tree-based and Bayesian classification techniques to solve classification and regression problems, and analyse their performance using impurity measures, bias–variance trade-off, and probabilistic inference. (L4)

CO4: Apply linear and non-linear classification techniques—including Perceptron, Support Vector Machines, Logistic and Linear Regression and analyse multi-layer perceptron (MLPs) and the backpropagation algorithm for training complex models on real-world datasets. (L4)

CO5: Apply a variety of clustering algorithms to discover patterns in unlabelled data, and analyse the effectiveness of partitioning, hierarchical, and probabilistic approaches for different data distributions. (L4)

Unit I: Introduction to Machine Learning:

Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

Unit II: Nearest Neighbor-Based Models:

Nearest Neighbor-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures, K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

Unit III: Models Based on Decision Trees:

Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression.

The Bayes Classifier: Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

Unit IV: Linear Discriminants for Machine Learning:

Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

Unit V: Clustering:

Clustering: Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

1. "Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

1. "Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017
2. "Machine Learning in Action", Peter Harrington, DreamTech.
3. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

B. Tech. - II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05204T	**PC**	**Database Management Systems** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites: Basics of Data Structures and Algorithms

Course Objectives: The main objective of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQL as a universal Database language
- Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

Course Outcomes (COs):

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

CO1: Apply the foundational concepts and characteristics of database systems to distinguish them from traditional file systems and identify various types of database users and applications. (L3)

CO2: Analyze relational model concepts and integrity constraints to evaluate data consistency, and apply relational algebra, relational calculus, and basic SQL commands for data definition and manipulation in structured schemas. (L4)

CO3: Apply SQL constructs to retrieve and manipulate relational data, and analyze the use of constraints, views, and relational set operations for building consistent and relationally complete database applications. (L4)

CO4: Analyze database schemas to identify functional dependencies and apply normalization techniques to achieve lossless join and dependency preservation, ensuring minimal redundancy and data consistency. (L4)

CO5: Analyze the concepts of transaction management, including ACID properties, serializability, and concurrency control protocols, and apply recovery techniques and indexing methods to ensure data consistency, isolation, and efficient retrieval. (L4)

Unit I: Introduction:

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

Unit II: Relational Model:

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. **BASIC SQL:** Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

Unit III: SQL:

SQL: Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion). Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins,view(updatable and non-updatable), relational set operations.

Unit IV: Schema Refinement (Normalization):

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency, Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form (BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form (5NF).

Unit V: Transaction Concept:

Transaction Concept: Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

Introduction to Indexing Techniques: B+ Trees, operations on B+Trees, Hash Based Indexing:

Textbooks:

1. Database Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
2. Database System Concepts,5th edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

Reference Books:

1. Introduction to Database Systems, 8thedition, C J Date, Pearson.
2. Database Management System, 6th edition, RamezElmasri, Shamkant B. Navathe,Pearson
3. Database Principles Fundamentals of Design Implementation and Management,
4. Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105175/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04204T	PC	**Digital Logic and Computer Organization** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic Knowledge on digital logic, computer and memory concepts

Course Objectives:

- To provide students with a comprehensive understanding of digital logic design principles and computer organization fundamentals
- Describe memory hierarchy concepts
- Explain input/output (I/O) systems and their interaction with the CPU, memory, and peripheral devices

Course Outcomes (COs):

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

CO1: Represent data in various number systems, perform number base conversions, and design combinational logic circuits using logic gates and K-map simplification. (L3)

CO2: Design sequential logic circuits using flip-flops, counters, and registers, and explain the basic structure, functionality, and architecture of modern computer systems. (L4)

CO3: Perform computer arithmetic operations including fast addition, multiplication, and floating-point operations, and explain processor organization and control Unit design in instruction execution. (L4)

CO4: Explain the architecture and performance of memory systems including RAM, ROM, cache, and virtual memory, and analyse their role in computer performance and memory management. (L4)

CO5: Describe I/O organization techniques including interrupt handling, DMA, and standard interfaces, and analyse the role of buses and interface circuits in data transfer. (L4)

Unit I:

Data Representation: Binary Numbers, Fixed Point Representation. Floating Point Representation. Number base conversions, Octal and Hexadecimal Numbers, components, Signed binary numbers, Binary codes

Digital Logic Circuits - I: Basic Logic Functions, Logic gates, universal logic gates, Minimization of Logic expressions. K-Map Simplification, Combinational Circuits, Decoders, Multiplexers.

Unit II:

Digital Logic Circuits - II: Sequential Circuits, Flip-Flops, Binary counters, Registers, Shift Registers, Ripple counters

Basic Structure of Computers: Computer Types, Functional Units, Basic operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers, Computer Generations, Von- Neumann Architecture

Unit III:

Computer Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations

Processor Organization: Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control and Multi programmed Control.

Unit IV: The Memory Organization:

Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage.

Unit V: Input /Output Organization:

Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces

Text Books:

1. Computer Organization, Carl Hamacher, ZvonkoVranesic, SafwatZaky, 6th edition, McGraw Hill, 2023.
2. Digital Design, 6th Edition, M. Morris Mano, Pearson Education, 2018.
3. Computer Organization and Architecture, William Stallings, 11thEdition, Pearson, 2022.

Reference Books:

1. Computer Systems Architecture, M. Moris Mano, 3rdEdition, Pearson, 2017.
2. Computer Organization and Design, David A. Paterson, John L. Hennessy, Elsevier, 2004.
3. Fundamentals of Logic Design, Roth, 5thEdition, Thomson, 2003.

Online Learning Resources:

https://nptel.ac.in/courses/106/103/106103068/

B. Tech.II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31302P	PC	Machine Learning Lab (Common to CSE, AI&DS, CSE-AI&ML)	0	0	3	1.5

Pre-Requisites: Basics of libraries like NumPy, Pandas

Course Objectives:

- To learn about computing central tendency measures and Data pre- processing techniques
- To learn about classification and regression algorithms
- To apply different clustering algorithms for a problem.

Course Outcomes (COs):

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

CO1: Compute central tendency and dispersion measures (mean, median, mode, variance, SD) and apply pre-processing techniques such as attribute selection, missing value handling, discretization, and outlier elimination on given datasets.(L3)

CO2: Implement and demonstrate KNN, Decision Tree (classification & regression), Random Forest, Naïve Bayes, SVM, Linear Regression, Logistic Regression, and MLP algorithms on appropriate datasets. (L3)

CO3: Evaluate the performance of classification and regression models by performing parameter tuning and comparing results across algorithms. (L5)

CO4: Implement K-Means, Fuzzy C-Means, and EM-based clustering algorithms and analyze cluster quality using Euclidean distance metrics and parameter sensitivity (K). (L4)

Software Required: Python/R/Weka

1. Lab should cover the concepts studied in the course work, sample list of Experiments:
2. Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation.
3. Apply the following Pre-processing techniques for a given dataset.
4. Attribute selection
5. Handling Missing Values
6. Discretization
7. Elimination of Outliers
8. Apply KNN algorithm for classification and regression
9. Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results
10. Demonstrate decision tree algorithm for a regression problem
11. Apply Random Forest algorithm for classification and regression
12. Demonstrate Naïve Bayes Classification algorithm.
13. Apply Support Vector algorithm for classification
14. Demonstrate simple linear regression algorithm for a regression problem
15. Apply Logistic regression algorithm for a classification problem
16. Demonstrate Multi-layer Perceptron algorithm for a classification problem
17. Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K.
18. Demonstrate the use of Fuzzy C-Means Clustering
19. Demonstrate the use of Expectation Maximization based clustering algorithm

B. Tech. - II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05204P	PC	**Database Management Systems Lab** (Common to CSE, CSE-AI and CSE-AI&ML)	0	0	3	1.5

Pre-Requisites: Basic Programming and Logical Thinking

Course Objectives: This Course will enable students to

- To Populate and query a database using SQL DDL/DML Commands
- To Declare and enforce integrity constraints on a database
- To Writing Queries using advanced concepts of SQL
- To Programming PL/SQL including procedures, functions, cursors and triggers.

Course Outcomes (COs):

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

CO1: Utilizing Data Definition Language (DDL), Data Manipulation Language (DML), and Data Control Language (DCL) commands effectively within a database environment. (L3)

CO2: Constructing and execute queries to manipulate and retrieve data from databases. (L3)

CO3: Develop application programs using PL/SQL. (L3)

CO4: Analyse requirements and design custom Procedures, Functions, Cursors, and Functionality. (L4)

CO5: Establish database connectivity through JDBC (Java Database Connectivity) (L3)

Experiments covering the topics:

- DDL, DML, DCL commands
- Queries, nested queries, built-in functions,
- PL/SQL programming- control structures
- Procedures, Functions, Cursors, Triggers,
- Database connectivity- ODBC/JDBC

Sample Experiments:

1. Creation, altering and droping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS,UNION, INTERSET, Constraints. Example:- Select the roll number and name of the student who secured fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
4. Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between,least, greatest, trunc, round, to_char, to_date)
5.
   i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
   ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
6. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.

7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISEAPPLICATION ERROR.
8. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
9. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers
12. Create a table and perform the search operation on table using indexing and non indexing techniques.
13. Write a Java program that connects to a database using JDBC
14. Write a Java program to connect to a database using JDBC and insert values into it
15. Write a Java program to connect to a database using JDBC and delete values from it

B. Tech II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE05203S	SE	**Full Stack Development - I** (Common to CSE, AI&DS, CSE-AI & CSE-AI&ML)	0	1	2	2

Pre-Requisites: Basic Understanding of Web Concepts and Java

Course Objectives:

- The main objectives of the course are to Make use of HTML elements and their attributes for designing static web pages
- Build a web page by applying appropriate CSS styles to HTML elements
- Experiment with JavaScript to develop dynamic web pages and validate forms

Course Outcomes (COs):

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

CO1: Design and develop structured web pages using HTML elements including lists, tables, forms, frames, images, and hyperlinks; and demonstrate client-side functionalities such as image galleries and navigation using best practices in layout and formatting. (L4)

CO2: Apply HTML5 semantic tags and CSS styles using various selector forms and style types to design responsive and structured web pages. (L4)

CO3: Apply CSS properties for colour, background, font, text, and box model to enhance the layout.

CO4: Develop dynamic web pages using JavaScript for input/output handling, type conversion, and manipulation of predefined and user-defined objects. (L4)

CO5: Apply JavaScript control structures, functions, and event handling to build interactive web applications with input validation and dynamic behaviour. (L4)

Experiments:

1. Lists, Links and Images

a. Write a HTML program, to explain the working of lists.
   Note: It should have an ordered list, unordered list, nested lists and ordered list in an unordered list and definition lists.

b. Write a HTML program, to explain the working of hyperlinks using <a> tag and href, target Attributes.

c. Create a HTML document that has your image and your friend’s image with a specific height and width. Also when clicked on the images it should navigate to their respective profiles.

d. Write a HTML program, in such a way that, rather than placing large images on a page, the preferred technique is to use thumbnails by setting the height and width parameters to something like to 100*100 pixels. Each thumbnail image is also a link to a full sized version of the image. Create an image gallery using this technique

2. HTML Tables, Forms and Frames

a. Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>,<td> and attributes: aborder, rowspan, colspan)

b. Write a HTML program, to explain the working of tables by preparing a timetable. (Note: Use <caption> tag to set the caption to the table & also use cell spacing, cell padding, border, rowspan, colspan etc.).

c. Write a HTML program, to explain the working of forms by designing Registration form. (Note: Include text field, password field, number field, date of birth field, checkboxes, radio buttons, list boxes using <select>&<option> tags, <text area> and two buttons ie: submit and reset. Use tables to provide a better view).

d. Write a HTML program, to explain the working of

e. Frames, such that page is to be divided into 3 parts on either direction. (Note: first frame image, second frame paragraph, third frame □ hyperlink. And also make sure of using "no frame" attribute such that frames to be fixed).

3. HTML 5 and Cascading Style Sheets, Types of CSS

a. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, <div>, <span> tags.

b. Write a HTML program, to embed audio and video into HTML web page.

c. Write a program to apply different types (or levels of styles or style specification formats) - inline, internal, external styles to HTML elements. (identify selector, property and value).

4. Selector forms

a. Write a program to apply different types of selector forms
   - i. Simple selector (element, id, class, group, universal)
   - ii. Combinator selector (descendant, child, adjacent sibling, general sibling)
   - iii. Pseudo-class selector
   - iv. Pseudo-element selector
   - v. Attribute selector

5. CSS with Color, Background, Font, Text and CSS Box Model

a. Write a program to demonstrate the various ways you can reference a color in CSS.

b. Write a CSS rule that places a background image halfway down the page, tilting it horizontally. The image should remain in place when the user scrolls up or down.

c. Write a program using the following terms related to CSS font and text:
   i. Font-size ii. Font-weight iii. Font-style iv. Text-decoration
   v. Text-transformation vi. Text-alignment

d. Write a program, to explain the importance of CSS Box model using
   i. Content ii. Border iii. Margin iv. Padding

6. Applying JavaScript - internal and external, I/O, Type Conversion

a. Write a program to embed internal and external JavaScript in a web page.

b. Write a program to explain the different ways for displaying output.

c. Write a program to explain the different ways for taking input.

d. Create a webpage, which uses prompt dialogue box to ask a voter for his name and age. Display the information in table format along with either the voter can vote or not

7. JavaScript Pre-defined and User-defined Objects

a. Write a program using document object properties and methods.

b. Write a program using window object properties and methods.

c. Write a program using array object properties and methods.

d. Write a program using math object properties and methods

e. Write a program using string object properties and methods.

f. Write a program using regex object properties and methods.

g. Write a program using date object properties and methods.

h. Write a program to explain user-defined object by using properties, methods accessors, constructors and display.

8. JavaScript Conditional Statements and Loops

a. Write a program which asks the user to enter three integers, obtains the numbers from the user and outputs HTML text that displays the larger number followed by the words "LARGER NUMBER" in an information message dialog. If the numbers are equal, output HTML text as "EQUAL NUMBERS".

b. Write a program to display week days using switch case.

c. Write a program to print 1 to 10 numbers using for, while and do-while loops.
d. Write aprogram to print data in object using for-in, for-each and for-of loops
e. Develop a program to determine whether a given number is an 'ARMSTRONG NUMBER' or not. [Eg: 153 is an Armstrong number, since sum of the cube of the digits is equal to the number i.e.,13 + 53+ 33 = 153]
f. Write a program to display the denomination of the amount deposited in the bank in terms of 100's, 50's, 20's, 10's, 5's, 2's & 1's. (Eg: If deposited amount is Rs.163, the output should be 1-100's, 1-50's, 1- 10's, 1-2's & 1-1's)

9. Java script Functions and Events

a. Design a appropriate function should be called to display
   i. Factorial of that number
   ii. Fibonacci series up to that number
   iii. Prime numbers up to that number
   iv. Is it palindrome or not

b. Design a HTML having a text box and four buttons named Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate function should be called to display
   i. Factorial of that number
   ii. Fibonacci series up to that number
   iii. Prime numbers up to that number
   iv. Is it palindrome or not

c. Write a program to validate the following fields in a registration page
   i. Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 characters)
   ii. Mobile (only numbers and length 10 digits)
   iii. E-mail (should contain format like xxxxxxx@xxxxxx.xxx)

Textbooks:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
2. Web Programming with HTML5, CSS and JavaScript, John Dean, Jones Bartlett Learning, 2019 (Chapters 1-11).
3. 3.Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, A Press,

II B. Tech. II Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS205A	**HM**	**Environmental Science** (Common to 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.

Textbooks:

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

II B. Tech. II Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPIN301L	IP	**Community Service Intership** (Common to 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 INTERSHIP ……Experiential learning through commUnity engagement

Introduction

- CommUnity Service Project is an experiential learning strategy that integrates meaningful commUnity service with instruction, participation, learning and commUnity development.
- CommUnity Service Project involves students in commUnity development and service activities and applies the experience to personal and academic development.
- CommUnity Service Project 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 Project 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 Intership

- Every student should put in 6 weeks for the Community Service Intership 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 Project 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 Project is a twofold one –
- First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas.

A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.

- Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –
  - Agriculture
  - Health
  - Marketing and Cooperation
  - Animal Husbandry
  - Horticulture
  - Fisheries
  - Sericulture
  - Revenue and Survey
  - Natural Disaster Management
  - Irrigation
  - Law & Order
  - Excise and Prohibition
  - Mines and Geology
  - Energy
  - Internet
  - Free Electricity
  - Drinking Water

EXPECTED OUTCOMES:

BENEFITS OF COMMUNITY SERVICE INTERSHIP 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 INTERSHIP 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 INTERSHIP TO COLLEGES AND UNIVERSITIES

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

BENEFITS OF COMMUNITY SERVICE INTERSHIP 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 INTERSHIIP

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 intership the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programs

Programs for School Children

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

Programs for Women Empowerment

1. Government Guidelines and Policy Guidelines
2. Women's Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharath
7. AIDS awareness camp
8. Anti-Plastic Awareness

9. Programs on Environment
10. Health and Hygiene
11. Hand wash programmes
12. Commemoration and Celebration of important days

Programs for Youth Empowerment

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programs

1. Awareness on RTI
2. Health intervention programmes
3. Yoga
4. Tree plantation
5. Programs in consonance with the Govt. Departments like –
    i. Agriculture
    ii. Health
    iii. Marketing and Cooperation
    iv. Animal Husbandry
    v. Horticulture
    vi. Fisheries
    vii. Sericulture
    viii. Revenue and Survey
    ix. Natural Disaster Management
    x. Irrigation
    xi. Law & Order
    xii. Excise and Prohibition
    xiii. Mines and Geology
    xiv. Energy

Role of Students:

- Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
- As and when required the College faculty themselves act as Resource Persons.
- Students can work in close association with Non-Governmental Organizations like Lions 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 Intership 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 secretariats could be aligned for the survey.
2. **CommUnity Awareness Campaigns (One Week)**
   - Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.
3. **CommUnity Immersion Programme (Three Weeks)**
   Along with the CommUnity Awareness Programmes, the student batch can also work with any one of the below-listed governmental agencies and work in tandem with them. This commUnity involvement programme will involve the students in exposing themselves to experiential learning about the commUnity and its dynamics. Programs could be in consonance with the Govt. Departments.
4. **CommUnity Exit Report (One Week)**
   - During the last week of the CommUnity Service Project, a detailed report of the outcome of the 8 weeks' works to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University. Throughout the CommUnity Service Project, a daily logbook needs to be maintained by the 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
24PC31303T	PC	**Natural Language Processing** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	2	1	0	3

Pre-Requisites: Basic knowledge of Python programming, Data Structures, Probability & Statistics, Machine Learning, and text processing concepts.

Course Objectives

- Basics of NLP, Morphology, Tokenization, N-gram Models
- POS Tagging, Parsing, Treebanks, Ambiguity Handling
- Word Sense Disambiguation, Semantic Parsing, Sentiment Analysis
- Machine Translation, Transformers, BERT/GPT, Ethical NLP
- Speech Recognition, Feature Extraction, Discourse Analysis

Course Outcomes (COs):

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

CO1: Practice the architectural organization of Natural Language Understanding systems by analyzing linguistic backgrounds and different levels of language analysis. (L3)

CO2: Apply various parsing techniques, grammars (Top-Down, Bottom-Up, ATN), and information theory concepts like Entropy to resolve morphological and lexical structures. (L3)

CO3: Examine human preferences and movement phenomena in natural language using Shift-Reduce and Deterministic parsers. (L4)

CO4: Prepare semantic interpretations and language modeling techniques, including n-grams and multilingual adaptation, to resolve word sense ambiguity. (L5)

CO5: Analyze the frameworks for Machine Translation, Multilingual Information Retrieval, and Automatic Summarization to solve cross-lingual communication challenges. (L4)

Unit I: Introduction to NLP:

Introduction to NLP: Origins and Challenges, Language and Grammar in NLP, Regular Expressions and Finite-State Automata, Tokenization: Text Segmentation and Sentence Splitting, Morphological Parsing: Stemming and Lemmatization, Spelling Error Detection and Correction, Minimum Edit Distance and Applications, Statistical Language Models: Unigram, Bigram, and Trigram Models, Processing Indian Languages in NLP.

Unit II: Word-Level and Syntactic Analysis:

Introduction, Part-of-Speech (POS) Tagging: Rule-Based, Stochastic and Transformation-Based Approaches, Hidden Markov Models (HMM) and Maximum Entropy Models for POS Tagging, Context-Free Grammar (CFG) and Constituency Parsing, Treebanks and Normal Forms for Grammar, Top-Down and Bottom-Up Parsing Strategies, CYK Parsing Algorithm, Probabilistic Context-Free Grammars (PCFGs), Feature Structures and Unification.

Unit III: Text Classification and Information Retrieval:

Naïve Bayes Classifier for Text Classification, Training and Optimization for Sentiment Analysis, Information Retrieval: Basic Concepts and Design Features, Information Retrieval Models: Classical, Non-Classical, and Alternative Models, Cluster Model, Fuzzy Model, and LSTM-Based Information, Retrieval, Word Sense Disambiguation (WSD) Methods: Supervised and Dictionary-Based Approaches.

Unit IV: Machine Translation and Semantic Processing:

Introduction to Machine Translation (MT), Language Divergence and Typology in MT Encoder-Decoder Model for Machine Translation, Translating in Low-Resource Scenarios, MT Evaluation Metrics and Techniques, Bias and Ethical Issues in NLP and Machine Translation, Semantic Analysis and First-Order Logic in NLP, Thematic Roles and Selectional Restrictions in Semantics, Word Senses and Relations Between Senses

Unit V: Speech Processing and Advanced NLP Models:

Speech Fundamentals: Phonetics and Acoustic Phonetics, Digital Signal Processing in Speech Analysis, Feature Extraction in Speech: Short-Time Fourier Transform (STFT), Mel-Frequency Cepstral Coefficients (MFCC) and Perceptual Linear Prediction (PLP), Hidden Markov Models (HMMs) in Speech Recognition.

Textbooks (Core Learning Materials):

1. Daniel Jurafsky & James H. Martin – Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 2023.
2. Tanveer Siddiqui & U.S. Tiwary – Natural Language Processing and Information Retrieval, Oxford University Press.

Reference Books (Supplementary Learning):

1. T.V. Geetha – Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives, Pearson, 2024.
2. Akshay Kulkarni & Adarsha Shivananda – Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python, Apress, 2019.

Online Learning Resources:

1. https://www.youtube.com/watch?v=M7SWr5xObkA
2. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
3. https://archive.nptel.ac.in/courses/106/106/106106211/

B.Tech. - III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC05307T	PC	**Introduction to Quantumtechnologies and Applications** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites: Basics of Mathematics, basic physics and computer knowledge.

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 3: 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

Textbooks:

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*, Oneworld Publications, Revised Edition, 2005.
5. **Eleanor G. Rieffel, Wolfgang H. Polak**, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
6. **Leonard Susskind, Art Friedman**, *Quantum Mechanics: The Theoretical Minimum*, Basic Books, 2014.
7. **Bruce Rosenblum, Fred Kuttner**, *Quantum Enigma: Physics Encounters Consciousness*, Oxford University Press, 2nd Edition, 2011.
8. **GiulianoBenenti, GiulioCasati, GiulianoStrini**, *Principles of Quantum Computation and Information, Volume I: Basic Concepts*, World Scientific Publishing, 2004.
9. **K.B. Whaley et al.**, *Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document*, Quantum Flagship, European Commission, 2020.
10. **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
24PC31304T	PC	**Sytem Software Programming** (Common to CSE-AI & CSE-AI&ML)	`2	1	0	3

Pre-Requisites: Basic knowledge of Programming in C, Data Structures, Computer Organization, and Operating System concepts.

Course Objectives:

- To understand the architecture and design of system software including compilers, assemblers, linkers, loaders, and macro processors.
- To gain in-depth knowledge of programming tools, shell environments, and low-level system utilities.
- To apply principles of system programming in Unix/Linux environments.
- To explore process creation, inter-process communication, signal handling, and multi-threading using C/C++.
- To enable development of foundational tools like simple compilers, parsers, and loaders.

Course Outcomes (COs):

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

CO1: Analyze the phases of compilation and the design of single-pass and two-pass assemblers including symbol table management and relocation. (L4)

CO2: Design macro processors and various loading/linking schemes to facilitate efficient program expansion and memory allocation. (L5)

CO3: Apply lexical analysis, syntax parsing, and code optimization techniques to build the foundational front-end and back-end components of a compiler. (L3)

CO4: Inspect automated shell scripts and debugging workflows by utilizing symbol resolution, redirection, and Unix/Linux control statements. (L4)

CO5: Implement system-level applications in C using process creation, inter-process communication (IPC), and POSIX threads in a Unix environment. (L3)

Unit I: Language Processors and Assemblers:

Language processing system overview, Phases of compilation and data structures, Assemblers – features, single pass and two-pass assembler, Intermediate code generation, Literal and symbol tables, Relocation and linking concepts

Unit II: Macro Processors and Loaders:

Macro instruction and features, Nested macros and macro expansion, Macro processing in two-pass assemblers, Design of macro processors, Loaders: absolute, relocating, and linking, Dynamic loading and linking, bootstrap loader

Unit III: Scanning, Parsing, and Compilers:

Language grammars and ambiguity, Lexical analysis – regular expressions, token generation, Syntax analysis – parsing techniques (top-down, bottom-up), Semantic analysis and intermediate code generation, Code optimization techniques – constant folding, dead code elimination

Unit IV: Linkers, Debuggers, and Shell Programming:

Symbol resolution and relocation, linking (static vs dynamic), relocation records, Debugging techniques and breakpoints, Unix/Linux shell environment, Shell commands, variables, redirection, pipes, control statements, Shell script functions and script-based automation

Unit V: Unix/Linux System Programming:

Introduction to system-level programming in C, File I/O system calls (open, read, write, close), Process creation using fork(), exec(), wait(), Inter-process communication (pipes, FIFO), Signal handling and POSIX threads (pthread_create, pthread_join), Case studies: background processes, daemon creation, mini shell

Textbooks:

1. **Leland L. Beck, D. Manjula**, *System Software: An Introduction to Systems Programming*, 3rd Edition, Pearson.
2. **Silberschatz, Galvin, Gagne**, *Operating System Concepts*, 10th Edition, Wiley (selectively for system calls & programming).

Reference Books:

1. **D.M. Dhamdhere**, *System Programming and Operating Systems*, McGraw Hill.
2. **Neil Matthew, Richard Stones**, *Beginning Linux Programming*, Wrox.
3. **Andrew S. Tanenbaum**, *Modern Operating Systems*, Pearson Education.
4. **Yashwant Kanetkar**, *Unix Shell Programming*, BPB Publications.

B.Tech.- III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31305T	PC	**Computer Vision & Image Processing** (Common to CSE-AI & CSE-AI&ML)	2	1	0	3

Pre-Requisites: Basic knowledge of Python programming, Linear Algebra, Probability & Statistics, Digital Image Processing fundamentals, and Machine Learning concepts.

Course Objectives:

- Introduce fundamental concepts of image processing and computer vision.
- Develop proficiency in applying algorithms for image analysis and interpretation.
- Explore techniques for feature extraction, object recognition, and scene understanding.
- Understand the integration of machine learning methods in computer vision applications.

Course Outcomes (COs):

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

CO1: Apply image formation principles and frequency domain processing (DFT) to perform image enhancement and restoration tasks. (L3)

CO2: Analyze images using edge detection, region-based segmentation, and morphological processing to extract meaningful features and patterns. (L4)

CO3: Implement 3D reconstruction and motion analysis using stereo vision, optical flow, and camera calibration techniques. (L3)

CO4: Inspect object recognition models and deep learning architectures like CNNs and GANs for complex vision-based classification and detection. (L4)

CO5: Design specialized vision systems for face recognition and medical image analysis by integrating compression standards and morphological tools. (L5)

Unit I: Introduction to Computer Vision and Image Processing:

Overview of Computer Vision and Image Processing:Definitions and scope, Historical development and applications, Image Formation and Representation: Image acquisition methods, Sampling and quantization, Color spaces and models, Fundamentals of Image Processing:Point operations (brightness and contrast adjustments), Histogram processing, Spatial filtering techniques Fourier Transform and Frequency Domain Processing:Discrete Fourier Transform (DFT), Filtering in the frequency domain, Image restoration concept.

Unit II: Image Analysis Techniques:

Edge Detection and Feature Extraction:Gradient operators (Sobel, Prewitt), Canny edge detector, Corner and interest point detection, Image Segmentation:Thresholding methods, Region-based segmentation, Clustering techniques (K-means, Mean-Shift), Morphological Image Processing: Erosion and dilation, Opening and closing operations, Applications in shape analysis, Texture Analysis, Statistical methods (co-occurrence matrices), Transform-based methods (Gabor filters), Applications in pattern recognition

Unit III: 3D Vision and Motion Analysis:

Stereo Vision: Epipolar geometry, Disparity mapping, Depth estimation techniques, Structure from Motion (SfM): Feature tracking across frames, 3D reconstruction from motion, Applications in scene understanding, Optical Flow and Motion Analysis: Lucas-Kanade method, Horn-Schunck method, Motion segmentation, Camera Calibration and 3D Reconstruction: Intrinsic and extrinsic parameters, Calibration techniques, 3D point cloud generation

Unit IV: Object Recognition and Machine Learning in Vision:
Feature Descriptors and Matching: Scale-Invariant Feature Transform (SIFT), Speeded-Up Robust Features (SURF), Feature matching algorithms, Object Detection and Recognition: Template matching, Deformable part models, Convolutional Neural Networks (CNNs), Introduction to Machine Learning for Vision:Supervised and unsupervised learning, Support Vector Machines (SVMs), Decision trees and random forests, Deep Learning Architectures:Autoencoders, Recurrent Neural Networks (RNNs), Generative Adversarial Networks (GANs)

Unit V: Applications and Advanced Topics:
Image Compression: Lossy and lossless compression techniques, Standards (e.g., JPEG, PNG), Morphological Image Processing: Dilation, erosion, opening, and closing operations, Applications in shape analysis, Case Studies: Face recognition systems., Automated visual inspection, Medical image analysis.

Reference Books

1. Forsyth, D. A., & Ponce, J. (2002). Computer Vision: A Modern Approach. Prentice Hall.
2. Shapiro, L. G., & Stockman, G. C. (2001). Computer Vision. Prentice Hall.

Textbooks:

1. Gonzalez, R. C., & Woods, R. E. (2008). Digital Image Processing (3rd ed.). Pearson Prentice Hall.Stony Brook University
2. Szeliski, R. (2010). Computer Vision: Algorithms and Applications. Springer.

Online Learning Resources:

1. Coursera: Introduction to Computer Vision and Image Processing. LinkCoursera
2. Stanford University: CS231n: Deep Learning for Computer Vision. Linkcs231n.stanford.edu
3. MIT OpenCourseWare: Introduction to Computer Vision. Link

Professional Elective – I
(PE - I)

B.Tech.- III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30301T	PE	**Data Visualization** (Common to AI&DS, CSE-AI & CSE-AI&ML)	2	1	0	3

Pre-Requisites: Basic knowledge of Statistics, Data Analysis, Database Concepts, Spreadsheet Tools (Excel), and Python programming.

Course Objectives:

- To understand the principles, techniques, and tools of data visualization.
- To develop the ability to transform data into visual insights using different types of charts and plots.
- To introduce the cognitive and perceptual foundations of effective data visualization.
- To apply tools and programming environments (like Python, Tableau, or Power BI) for creating interactive and dynamic visualizations.
- To analyze real-world datasets and effectively communicate data-driven findings visually.

Course Outcomes (COs):

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

CO1: Apply the concepts of data visualization, data types, sources, and principles of visual perception including pre-attentive processing and Gestalt laws. (L3)

CO2: Apply design principles such as data-ink ratio, data density, lie factor, and visualization processes to create effective and meaningful visual representations. (L3)

CO3: Analyze and select appropriate visualization techniques for categorical, quantitative, multidimensional, temporal, and hierarchical data. (L4)

CO4: Develop static and interactive visualizations using tools such as Python (Matplotlib, Seaborn, Plotly), Tableau, Power BI, and dashboard frameworks like Dash and Streamlit. (L3)

CO5: Analyze data-driven storytelling dashboards to identify patterns, effectiveness, and issues related to bias, ethics, and misleading visualizations. (L4)

Unit I: Introduction to Data Visualization & Perception:

Introduction to Data Visualization, Importance and Scope of Data Visualization, Data Types and Sources, Visual Perception: Pre-attentive Processing, Gestalt Principles, Data-Ink Ratio, Data Density, Lie Factor, Visualization Process and Design Principles, Tools Overview: Tableau, Power BI, Python Libraries

Unit II: Visualization Techniques for Categorical & Quantitative Data:

Charts for Categorical Data: Bar Charts, Pie Charts, Column Charts, Charts for Quantitative Data: Histograms, Line Charts, Boxplots, Scatter Plots, Bubble Charts, Heatmaps, Choosing the Right Chart Type, Best Practices in Labeling, Coloring, and Scaling.

Unit III: Multidimensional, Temporal and Hierarchical Data Visualization:

Visualizing Multivariate Data: Parallel Coordinates, Radar Charts, Time-Series Visualization: Time Plots, Animation over Time, Geographic Data Visualization: Maps, Choropleths, Hierarchical Data: Treemaps, Sunburst Charts, Network and Graph Visualization.

Unit IV: Data Visualization Using Python and Dashboards:

Introduction to Matplotlib, Seaborn, and Plotly, Creating Static and Interactive Charts, Pandas Visualization Capabilities, Dashboards with Dash, Streamlit, Power BI, Case Studies: Real-world Dataset Visualization.

Unit V: Storytelling with Data and Ethical Visualization:

Storytelling and Narrative Techniques in Visualization, Dashboards and Reporting, Misleading Visualizations and Bias, Ethical Principles in Data Visualization, Final Project: Create a Storytelling Dashboard with Real Data.

Text Books:

1. Tamara Munzner, Visualization Analysis and Design, CRC Press, 2014.
2. Nathan Yau, Data Points: Visualization That Means Something, Wiley, 2013.

Reference Books:

1. Alberto Cairo, The Truthful Art: Data, Charts, and Maps for Communication, New Riders, 2016.
2. Cole Nussbaumer Knaflic, Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley, 2015.
3. Claus O. Wilke, Fundamentals of Data Visualization, O'Reilly, 2019.
4. Rohan Chopra, Hands-On Data Visualization with Bokeh, Packt Publishing, 2019.

Online Learning Resources*:*

1. NPTEL: Data Visualization - IIT Madras
2. Coursera: Data Visualization with Python by IBM

B.Tech. - III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE05302T	PE	**Soft Computing** (Common to CSE, AI&DS, CSE-AI, CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Mathematics, Probability & Statistics, Artificial Intelligence, Machine Learning fundamentals, and Programming concepts.

Course Objectives:

- To Understand the concepts of soft computing techniques and how they differ from traditional AI techniques.
- To Introduce the fundamentals of fuzzy logic and fuzzy systems.
- To Familiarize with artificial neural networks and their architectures.
- To Learn genetic algorithms and their role in optimization.
- To Explore hybrid systems integrating fuzzy logic, neural networks, and genetic algorithms.

Course Outcomes (COs):

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

CO1: Apply soft computing techniques to solve real-world problems. (L3)
CO2: Analyze and design fuzzy logic systems for decision-making. (L4)
CO3: Evaluate clustering and optimization techniques like neuro-fuzzy and PSO. (L4)
CO4: Apply genetic algorithms to optimization and search problems. (L3)
CO5: Evaluate rough set theory for knowledge discovery and data analysis. (L5)

Unit I: Introduction to Soft Computing and Fuzzy Logic:

Introduction to Soft Computing: Definition, Components, Differences with Hard Computing, Applications of Soft Computing, Fuzzy Logic: Crisp Sets vs Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems: Mamdani and Sugeno Models, Defuzzification Techniques.

Unit II: Artificial Neural Networks – I:

Introduction to Neural Networks: Biological Neurons vs Artificial Neurons, Architecture of Neural Networks: Feedforward, Feedback, Learning Rules: Hebbian, Delta, Perceptron Learning Rule, Single Layer Perceptron and its Limitations, Multi-Layer Perceptron: Backpropagation Algorithm, Applications of Neural Networks

Unit III: Artificial Neural Networks – II:

Hopfield Networks and Associative Memories, Radial Basis Function Networks, Self-Organizing Maps (SOM), Recurrent Neural Networks (RNNs) – Basic Concepts, Convolutional Neural Networks (CNNs) – Overview and Applications, Practical Use Cases in Image and Pattern Recognition,

Unit IV: Genetic Algorithms and Optimization:

Introduction to Genetic Algorithms, GA Operators: Selection, Crossover, Mutation, Fitness Function and Evaluation, Schema Theorem, Elitism, Applications in Function Optimization, Scheduling, and Robotics, Introduction to Particle Swarm Optimization (PSO).

Unit V: Hybrid Systems and Advanced Topics:

Hybrid Systems: Neuro-Fuzzy Systems, Fuzzy-GA, GA-ANN, ANFIS: Architecture and Learning, Case Studies on Hybrid Systems, Introduction to Deep Learning in Soft Computing, Real-World Applications: Forecasting, Control Systems, Medical Diagnosis, Image Processing.

Textbooks:

1. S. N. Sivanandam, S. N. Deepa, ―Principles of Soft Computing‖, Wiley India, 3rd Edition
2. Timothy J. Ross, ―Fuzzy Logic with Engineering Applications‖, Wiley, 4th Edition
3. S. Rajasekaran and G. A. Vijayalakshmi Pai, ―Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications‖, PHI

Reference Books:

1. Laurene Fausett, ―Fundamentals of Neural Networks: Architectures, Algorithms and Applications‖, Pearson
2. David E. Goldberg, ―Genetic Algorithms in Search, Optimization and Machine Learning‖, Pearson
3. Simon Haykin, ―Neural Networks and Learning Machines‖, Pearson, 3rd Edition
4. Bart Kosko, ―Neural Networks and Fuzzy Systems‖, Prentice Hall

Online Learning Resources:

1. NPTEL – Soft Computing by Prof. S. Sengupta (IIT Kharagpur)
2. Coursera – Neural Networks and Deep Learning (Andrew Ng)

B. Tech. III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30303T	PE	**Exploratory Data Analysis with Python** (Common to AI&DS, CSE-AI & CSE-AI&ML)	2	1	0	3

Pre-Requisites: Basic knowledge of Python programming, Statistics, Data Analysis concepts, and Spreadsheet/Data Handling techniques.

Course Objectives:

- To introduce the principles and practices of Exploratory Data Analysis (EDA) using Python.
- To teach techniques for data cleaning, preprocessing, transformation, and visualization.
- To apply statistical techniques and visual methods to discover patterns and relationships.
- To gain experience using popular Python libraries such as NumPy, Pandas, Matplotlib, and Seaborn.
- To prepare datasets for further machine learning and predictive modeling.

Course Outcomes (COs):

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

CO1: Apply Python-based tools and libraries such as NumPy and Pandas to perform basic data exploration and operations. (L3)

CO2: Apply data wrangling and preprocessing techniques to clean and transform datasets for analysis. (L3)

CO3: Analyze data using univariate and bivariate statistical methods and visualization techniques to identify patterns and relationships. (L4)

CO4: Analyze and create effective visualizations using Matplotlib, Seaborn, and interactive tools for data interpretation. (L4)

CO5: Analyze and develop end-to-end exploratory data analysis workflows on real-world datasets to prepare data for Machine Learning applications. (L4)

Unit I: Introduction to EDA and Python Environment:

Introduction to Data Science and EDA, Importance of EDA in Data Science Life Cycle, Setting up Python Environment: Jupyter, Anaconda, VS Code, Introduction to NumPy and Pandas: Arrays, Series, DataFrames, Data loading, viewing, basic operations (info, describe, shape)

Unit II: Data Wrangling and Preprocessing:

Handling Missing Data (mean, median, drop, interpolation), Dealing with Duplicates, Outliers, and Anomalies, Encoding Categorical Variables (Label, One-hot), Data Transformation: Scaling, Normalization, Binning, Data Types Conversion and Data Type Casting.

Unit III: Univariate and Bivariate Analysis:

Measures of Central Tendency and Dispersion, Distribution Plots: Histograms, Boxplots, KDE, Bar Charts, Count Plots, Pie Charts, Bivariate Analysis: Scatter Plots, Pair Plots, Heatmaps, Correlation and Covariance Analysis

Unit IV: Data Visualization Techniques:

Visualization with Matplotlib and Seaborn, Customizing Plots: Titles, Legends, Labels, Themes, Advanced Visuals: Violin Plots, Strip Plots, Swarm Plots, Multivariate Visualization and Subplots, Plotly and Interactive Visualizations (basic overview)

Unit V: EDA Case Studies and Real-Time Datasets:

Step-by-step EDA on Models

Textbooks:

1. **Jake VanderPlas**, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly, 2016.
2. **Wes McKinney**, Python for Data Analysis, 2nd Edition, O'Reilly, 2018.

Reference Books:

1. **Joel Grus**, Data Science from Scratch, O'Reilly, 2019.
2. **Aurelien Geron**, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, 2nd Edition, O'Reilly, 2019.
3. **Allen B. Downey**, Think Stats: Probability and Statistics for Programmers, O'Reilly, 2014.

Online Learning Resources:

1. NPTEL Course – Data Science for Engineers Coursera – Applied Data Science with Python Specialization (University of Michigan)

B.Tech. - III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31301T	PE	**Computational Intelligence** (Common to AI&DS CSE-AI and CSE-AI&ML)	2	1	0	3

Pre-Requisites:

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

Course Objectives:

- To Understand the concepts and foundations of computational intelligence.
- To Study neural networks, fuzzy logic systems, and evolutionary algorithms.
- To Explore hybrid systems and their applications.
- To Apply computational intelligence techniques to real-world problem-solving.
- To Analyze the effectiveness of various computational intelligence approaches.

Course Outcomes (COs):

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

CO1: Analyze the architectures of Artificial Neural Networks, including Multilayer Feedforward and Backpropagation algorithms, to solve pattern recognition and classification problems. (L4)

CO2: Apply fuzzy logic principles, membership functions, and inference systems to design fuzzy control and reasoning models. (L3)

CO3: Implement evolutionary computation techniques, such as Genetic Algorithms and Differential Evolution, to find optimal solutions based on fitness functions and selection operators. (L3)

CO4: Analyze swarm intelligence algorithms (ACO, PSO) and hybrid intelligent systems (Neuro-Fuzzy, ANN-GA) to evaluate collective intelligence and integration strategies. (L4)

CO5: Inspect intelligent agent-based decision-making systems for real-time applications in robotics, biomedical engineering, and finance. (L4)

Unit I: Introduction to Computational Intelligence and Artificial Neural Networks:

Definition and Scope of Computational Intelligence (CI), Components of CI: Neural Networks, Fuzzy Logic, Evolutionary Computation, Biological Neuron vs. Artificial Neuron, McCulloch-Pitts Model, Perceptron, Adaline and Madaline, Multilayer Feedforward Networks, Backpropagation Algorithm, Applications of ANN in Pattern Recognition and Classification.

Unit II: Fuzzy Logic and Fuzzy Systems:

Introduction to Fuzzy Logic and Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Rules and Inference Systems, Fuzzification and Defuzzification, Fuzzy Control Systems, Fuzzy Reasoning and Approximate Reasoning

Unit III: Evolutionary Computation Techniques:

Basics of Evolutionary Algorithms (EA), Genetic Algorithms (GA): Operators, Encoding, Fitness Function, Selection, Crossover and Mutation, Convergence Criteria, Genetic Programming (GP), Differential Evolution (DE), Applications of GA and GP

Unit IV: Swarm Intelligence and Hybrid Systems:

Swarm Intelligence: Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Behavior of Swarms and Collective Intelligence, Comparison of Evolutionary Algorithms and Swarm Techniques, Hybrid Systems: Neuro-Fuzzy, Fuzzy-GA, ANN-GA Systems, Case Studies in Hybrid Systems

Unit V: Applications of Computational Intelligence:

CI in Image and Signal Processing, CI for Optimization Problems and Robotics, CI in Biomedical Engineering and Finance, Intelligent Agents and Decision-Making Systems, Real-time Applications and Emerging Trends in CI.

Text Books:

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, PHI Learning.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India.

Reference Books:

1. S.N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley India.
2. Simon Haykin, Neural Networks and Learning Machines, Pearson.
3. James Kennedy and Russell C. Eberhart, Swarm Intelligence, Morgan Kaufmann.
4. Andries P. Engelbrecht, Computational Intelligence: An Introduction, Wiley.

Online Learning Resources:

1. NPTEL - Computational Intelligence
2. Coursera – Computational Intelligence
3. YouTube: IIT Lectures on Soft Computing and CI

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)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Building Construction and Environmental Concepts.
- Familiarity with Sustainable Development and Energy Efficiency Basics.

Course Objectives:

- To understand the fundamental concepts of green buildings, their necessity, and sustainable features.
- To analyze green building concepts, rating systems, and their benefits in India.
- To apply green building design principles, energy efficiency measures, and renewable energy sources.
- To evaluate air conditioning systems, HVAC designs, and energy modeling for sustainable buildings.
- To assess material conservation strategies, waste management, and indoor environmental quality in green buildings.

Course Outcomes (COs):

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

CO1: Apply concepts of sustainable building design to explain the significance of energy efficiency and green building rating systems. (L3)

CO2: Analyze indoor environmental quality requirements including thermal comfort, ventilation, lighting, and acoustic conditions for green buildings. (L4)

CO3: Evaluate the impact of climatic factors such as solar radiation, temperature, and wind on building energy performance. (L5)

CO4: Apply passive and active design strategies to optimize building energy performance and reduce environmental footprint. (L3)

CO5: Assess green building certification criteria and recommend appropriate design modifications for sustainable building construction. (L5)

Unit I: Introduction to Green Building:

Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing A Green Building, Important Sustainable Features for Green Buildings.

Unit II: Green Building Concepts and Practices:

Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building OpportUnities and Benefits: OpportUnities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, 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)	3	0	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, Student will be able to

CO1: Apply estimation techniques to prepare detailed cost estimates for various construction projects using standard methodologies. (L3)

CO2: Analyze abstract estimates and rate analysis for different civil engineering construction works and project components. (L4)

CO3: Apply project management tools including CPM, PERT, and resource planning for effective construction project control. (L3)

CO4: Develop specifications and tender documents for construction projects as per standard practices and government procedures. (L5)

CO5: Assess construction project performance using quality management, safety standards, and value engineering techniques. (L5)

Unit I: Introduction:

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

Reference Books:

1. Brien, J.O. andPlotnick, F.L., CPMin Construction Management, Mcgraw Hill, 2010.
2. Punmia, B.C., andKhandelwal, K.K., Project Planning and control with PERT and CPM, Laxmi Publications, 2002.
3. Construction Methods and Management: Pearson New International Edition 8 th Edition Stephens Nunnally.
4. Rhoden, M and Cato B, Construction Management andOrganisational Behaviour, Wiley-Blackwell, 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

24OE02301T	**OE**	**Electrical Safety Practices and Standards** (Common to CE, ECE, CSE, AI&DS, CSE-AI & CSE-AI&ML)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Electrical Fundamentals such as Current, Voltage, Resistance, and Power.
- Familiarity with Basic Electrical Components and Safe Handling Practices.

Course Objectives:

- To understand the fundamental principles of electrical safety, including electric shock effects, hazards, and causes of electrical failures.
- To gain knowledge of safety components such as conductors, insulators, overvoltage protection, and electrical safety equipment.
- To learn grounding and earthing practices, safe working distances, and methods to minimize electrical risks.
- To apply safety practices, standards, and regulations (such as NFPA 70E, OSHA, and IEEE) for ensuring safe operation and handling 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:

Fundamentals of Electrical safety - Electric Shock-physiological effects of electric current- Safety requirements–Hazards of electricity–Arc–Blast–Causes for electrical failure.

Unit II: Safety Components:

Introduction to conductors and insulators- voltage classification -safety against over voltages- safety against static electricity-Electrical safety equipment‘s-Fire extinguishers for electrical safety.

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Unit III: Grounding:

General requirements for grounding and bonding- Definitions- System grounding - Equipment grounding - The Earth-Earthing practices-Determining safe approach distance- Determining archazard category.

Unit IV: Safety Practices:

General first aid-Safety in handling handheld electrical appliances tools-Electrical safety in train stations-swimming pools, external lighting installations, medical locations - Case studies.

Unit V: Standards for Electrical Safety:

Electricity Acts- Rules & regulations- Electrical standards - NFPA 70 E-OSHA standards-IEEE standards-National Electrical Code 2005 – National Electric Safety code NESC-Statutory requirements from electrical inspectorate

Text Books:

1. Massimo A. G. Mitolo,― Electrical Safety of Low-Voltage Systems‖, Mc GrawHill, USA,2009.
2. Mohamed El-Sharkawi,―Electric Safety-Practice and Standards‖,CRC Press, USA,2014

Reference Books:

1. Kenneth G. Mastrullo, Ray A. Jones,–The Electrical Safety Program Book, Jones and Bartlett Publishers, London, 2nd Edition, 2011.
2. Palmer Hickman, ―Electrical Safety-Related Work Practices‖, Jones & Bartlett Publishers, London, 2009.
3. Fordham Cooper, W,―Electrical Safety Engineering‖, Butter worth and Company, London,1986.
4. JohnCadick, MaryCapelli -Schellpfeffer, Dennis K.Neitzel,―Electrical Safety Handbook, McGraw-Hill, NewYork,USA, 4th edition, 2012.

B.Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03301T	OE	**Sustainable Energy Technologies** (Common to All branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Energy Sources and Electrical Fundamentals.
- Familiarity with Environmental Science and Sustainability Concepts.

Course Objectives:

- To demonstrate the importance the impact of solar radiation, solar PVmodules
- To understand the principles of storage in PV systems
- To discuss solar energy storage systems and their applications.
- To get knowledge in wind energy and bio-mass
- To gain insights in geothermal energy, ocean energy and fuel cells.

Course Outcomes (COs):

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

CO1: Analyze solar radiation parameters, solar geometry, and photovoltaic module characteristics to estimate solar energy availability and design basic off-grid solar PV systems. (L4)

CO2: Apply the principles of battery operation, selection, installation, and maintenance for effective energy storage in solar photovoltaic systems. (L3)

CO3: Analyze the performance of solar energy collection and storage methods for suitable thermal energy applications such as heating, cooling, drying, and power generation. (L4)

CO4: Evaluate the operational characteristics and energy conversion potential of wind and biomass energy systems for practical renewable energy applications. (L5)

CO5: Analyze the working principles, performance, and applications of geothermal, ocean, and fuel cell technologies in sustainable energy generation. (L4)

Unit I: Solar Radiation:

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.

Solar Pv Modules and PV Systems: PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.

Unit II: Storage in PV Systems:

Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.

Unit III: Solar Energy Collection:

Flat Plate and Concentrating Collectors, Classification of Concentrating Collectors, Orientation.

Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

Unit IV: Wind Energy:

Sources And Potentials, Horizontal and Vertical Axis Windmills, Performance Characteristics, Betz Criteria, Types of Winds, Wind Data Measurement.

Bio-Mass: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

Unit-V: Geothermal Energy:
Origin, Applications, Types of Geothermal Resources, Relative Merits

Ocean Energy: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges

Fuel Cells: Introduction, Applications, Classification, Different Types of Fuel Cells 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

References:

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=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=-mwIa2X-SuSiNy13
3. https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=Apfjx6oDfz1Rb_N3
4. 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)	**3**	**0**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Semiconductor Devices and Electronic Components.

- Familiarity with Fundamental Circuit Analysis Concepts.

Course Objectives:

- To understand semiconductor diodes, their characteristics and applications.
- To explore the operation, configurations, and biasing of BJTs.
- To study the operation, analysis, and coupling techniques of BJT amplifiers.
- To learn the operation, applications and uses of feedback amplifiers and oscillators.
- To analyze the characteristics, configurations, and applications of operational amplifiers.

Course Outcomes (COs):

On successful completion of the course, 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: 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 Amplifiers:

Classification of Amplifiers - Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model.

Multistage Amplifiers: 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:

Concepts of feedback, Classification of feedback amplifiers, Effect of feedback on amplifier characteristics, Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations (Qualitative treatment only).

Oscillators: Classification of oscillators, Condition for oscillations, RC Phase shift Oscillators, Generalized analysis of LC Oscillators-Hartley and Colpitts Oscillators, Wien Bridge Oscillator.

Unit V: 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.

Applications of Op-Amp: Summing, scaling and averaging amplifiers, Integrator, Differentiator, phase shift oscillator and comparator.

Text Books:

1. Electronics Devices and Circuits, J.Millman and Christos. C. Halkias, 3rd edition, Tata McGraw Hill, 2006.
2. Electronics Devices and Circuits Theory, David A. Bell, 5th Edition, Oxford University press. 2008.

Reference Books:

1. Electronics Devices and Circuits Theory, R.L. Boylestad, 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
24OE05302T	**OE**	**Quantum Technologies and Applications** (Common for 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:

On successful completion of the course, Student 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: Analyze probabilistic models and statistical methods for AI applications. (L4)

CO3: Implement optimization techniques for machine learning algorithms. (L3)

CO4: Utilize vector calculus and transformations in AI-based models. (L3)

CO5: Develop graph-based AI models using mathematical representations. (L5)

Unit I: Linear Algebra for Machine Learning:

Review of Vector spaces, basis, linear independence, Vector and matrix norms, Matrix factorization techniques, Eigenvalues, eigenvectors, diagonalization, Singular Value Decomposition (SVD) and Principal Component Analysis (PCA).

Unit II: Probability and Statistics for AI:

Probability distributions: Gaussian, Binomial, Poisson. Bayes'Theorem, Maximum Likelihood Estimation (MLE), and Maximum a Posteriori (MAP).Entropy and Kullback-Leibler (KL) Divergence in AI, Cross entropy loss, Markov chains.

Unit III: Optimization Techniques for ML:

Multivariable calculus: Gradients, Hessians, Jacobians. Constrained optimization: Lagrange multipliers and KKT conditions. Gradient Descent and its variants (Momentum, Adam) Newton's method, BFGS method.

Unit IV: Vector Calculus & 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 Learningby 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.

Online Learning Ressources:

1. MIT– Mathematics for Machine Learning https://ocw.mit.edu
2. Stanford CS229 – Machine Learning Course https://cs229.stanford.edu

B.Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB302T	OE	**Materials Characterization Techniques** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Materials Science and Solid-State Physics.
- Familiarity with Waves, Optics, and Fundamental Spectroscopy Concepts.

Course Objectives:

- To provide exposure to different characterization techniques.
- To explain the basic principles and analysis of different spectroscopic techniques.
- To elucidate the working of Scanning electron microscope - Principle, limitations and applications.
- To illustrate the working of 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

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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 Banwelland 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 for all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Chemistry, Chemical Reactions, and Electrochemical Concepts.
- Familiarity with Energy Sources and Fundamental Thermodynamic Principles.

Course Objectives:

- To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
- To understand the basic concepts of processing and limitations of Fuel cells & their applications.
- To impart knowledge to the students about fundamental concepts of photo chemical cells, reactions and applications
- Necessarily of harnessing alternate energy resources such as solar energy and its basic concepts.
- To 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)
2. Hand book of solar energy and applications by ArvindTiwari and Shyam.
3. 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: Identify the basics of English grammar and its importance (L2)

CO2: Explain the use of grammatical structures in sentences (L2)

CO3: Demonstrate the ability to use various concepts in grammar and vocabulary and their applications in everyday use and in competitive exams (L3)

CO4: Analyze an unknown passage and reach conclusions about it. (L4)

CO5: Choose the appropriate form of verbs in framing sentences (L5)

CO6: Develop speed reading and comprehending ability thereby perform better in competitive exams

Unit I: Grammar - 1:

Nouns – classification – errors – Pronouns -types-errors-Adjectives-types-errors-Articles-definite - indefinite - Degrees of Comparison – Adverbs - types - errors-Conjunctions-usage –Prepositions - usage -Tag Questions, types-identifying errors- Practice

Unit II: Grammar - 2:

Verbs – tenses – structure – usages – negatives – positive s- 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 Vocubulary:

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 Learning 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- passive-voice
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 for 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 – 16 industries 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 .
2. Entrepreneurship, McGrawHill, 11th Edition.(2020)
3. Ries, E. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business,(2011).
4. Osterwalder, A., & Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons. (2010).

Reference Books:
1. Simon Sinek, Start with Why, Penguin Books limited. (2011)
2. Brown Tim, Change by Design Revised & Updated: 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
5. Saras D. Sarasvathy, (2008) Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd.

Online 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 I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC33301P	PC	Computer Vision & Machine Learning Lab	0	0	3	1.5

Pre-Requisites: Basic knowledge of Python programming, Machine Learning, Digital Image Processing, Natural Language Processing concepts, and data handling techniques.

Course Objectives:

- To impart practical knowledge of computer vision concepts using OpenCV and image processing libraries.
- To implement core machine learning algorithms and evaluate model performance.
- To work with real-world datasets for classification, regression, and image processing tasks.
- To train, test, and validate models using Python, TensorFlow, and Scikit-learn.
- To understand the integration of ML models in vision applications.

Course Outcomes (COs):

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

CO1: Apply image preprocessing and filtering techniques to solve real-time computer vision problems using OpenCV. (L3)

CO2: Analyze visual data through edge detection and feature extraction methods such as HOG, SIFT, and ORB. (L4)

CO3: Implement object and face detection systems using contour analysis and DNN-based pre-trained models. (L3)

CO4: Experiment and evaluate machine learning models (SVM, KNN, Logistic Regression) and dimensionality reduction techniques (PCA) for image classification. (L4)

CO5: Design end-to-end solutions by integrating CNN models and vision-based features for real-time tasks like emotion recognition. (L5)

List of Experiments (12 Total)

1. Image preprocessing techniques: resizing, filtering, thresholding using OpenCV
2. Edge detection using Sobel, Canny, and Laplacian operators
3. Object detection using contour detection and bounding boxes
4. Feature extraction using HOG, SIFT, and ORB
5. Implement face detection using Haar cascades or DNN models
6. Train a machine learning model (SVM / KNN) for image classification
7. Build and evaluate a decision tree classifier using scikit-learn
8. Implement a logistic regression model for binary classification on numerical dataset
9. Apply PCA for feature reduction and visualization
10. Design a simple neural network using TensorFlow/Keras for image classification
11. Train and evaluate a CNN model for digit recognition using MNIST dataset
12. Real-time emotion recognition using webcam input and pre-trained model integration

Text Books:

1. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O‘Reilly.
3. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer

B.Tech. - III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31304P	PC	**AI & System Programming Lab** (Common to CSE-AI & CSE-AI&ML)	0	0	3	1.5

Pre-Requisites: Basic knowledge of Programming in C/Python, Data Structures, Artificial Intelligence concepts, and Operating System fundamentals.

Course Objectives:

- To provide practical exposure to foundational AI algorithms and system programming.
- To develop skills to write intelligent systems and low-level programs.
- To integrate concepts of AI and system programming for automation and optimization.

Course Outcomes (COs):

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

CO1: Apply foundational AI search algorithms (DFS, BFS, A*) and logic programming using Prolog to build expert systems. (L3)

CO2: Implement competitive AI logic using the Minimax algorithm for game-playing applications. (L3)

CO3: Examine and develop core system software components, including two-pass assemblers and macro processors, in C. (L4)

CO4: Experiment system-level utilities like a Linux Shell and shell scripts for process management and inter-process communication (IPC). (L4)

CO5: Create an AI-powered system utility by integrating AI search or logic into shell scripts for automated task management. (L5)

List of Experiments:

1. Write simple programs in Prolog for facts, rules, and queries.
2. Develop a Prolog-based expert system for medical diagnosis or animal identification.
3. Implement Depth-First Search (DFS) and Breadth-First Search (BFS) in Python.
4. Implement A* Search Algorithm using heuristics in Python.
5. Implement the Minimax algorithm for a simple game (e.g., Tic Tac Toe).
6. Design and implement a two-pass assembler in C.
7. Implement a Macro Processor using C for assembly language programs.
8. Develop a simple Linux Shell (command interpreter) using C.
9. Write shell scripts for file operations, process creation, and monitoring.
10. Demonstrate inter-process communication using pipes and signals in Linux.
11. Integrate AI logic (search/expert system) into a shell script or system utility for task automation.
12. **Final Mini Project**: Develop an AI-powered system utility (e.g., Intelligent File Manager, AI Bot for CLI commands).

Lab Software Requirements:

- **Languages:** Python, Prolog, C
- **Tools:** GCC, SWI-Prolog, Linux (Ubuntu/WSL), Shell, Lex/Yacc (optional)
- **IDEs:** Code :: Blocks / VS Code / Geany / Terminal-based compilation

B.Tech. - III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE05304S	**SE**	**Full Stack Development - II** (Common to AI&DS, CSE-AI and CSE-AI&ML)	**0**	**1**	**2**	**2**

Pre-Requisites:

Course Objectives: The main objectives of the course are to

- Make use of Modern- day JavaScript with ES6 standards for designing Dynamic web pages
- Building robust & responsive User Interfaces using popular JavaScript library **_React.js**‘. Building robust backend APIs using **_Express. js**‘
- Establishing the connection between frontend (React) User interfaces and backend APIs (Express) with Data Bases. (My SQL)
- Familiarize students with GitHub for remote repository hosting and collaborative development.

Course Outcomes (COs):

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

CO1: Apply ES6 JavaScript features and DOM manipulations to build interactive and dynamic web pages. (L3)

CO2: Apply and analyze React.js concepts such as components, hooks, props, and forms to develop responsive user interfaces. (L4)

CO3: Develop and analyze backend APIs using Node.js and Express.js and integrate them with databases (MySQL). (L4)

CO4: Evaluate and justify the use of Git and GitHub for version control, remote repository hosting, and collaborative development in ensuring efficient software project management. (L5)

CO5: Evaluate full-stack web applications by integrating frontend, backend, and databases systems. (L5)

Experiments covering the Topics:

- Introduction to DOM (Document Object Model), Ecma Script (ES6) standards and features like Arrow functions, Spread operator, Rest operator, Type coercion, Type hoisting, String literals, Array and Object Destructuring.
- Basics of React. js like React Components, JSX, Conditional rendering Differences between Real DOM and Virtual DOM.
- Important React.js concepts like React hooks, Props, React forms, Fetch API, Iterative rendering using JavaScript map() function.
- JavaScript runtime environment node. js and its uses, Express. js and Routing, Micro-Services architecture and MVC architecture, database connectivity using (My SQL)
- Introduction to My SQL, setting up MySQL and configuring, Databases, My SQL queries, subqueries, creating My SQL driver for database connectivity to Express. js server.
- Introduction to Git and GitHub and upload project& team collaboration

Sample Experiments:

1. **Introduction to Modern JavaScript and DOM**
   - **a.** Write a JavaScript program to link JavaScript file with the HTML page
   - **b.** Write a JavaScript program to select the elements in HTML page using selectors
   - **c.** Write a JavaScript program to implement the event listeners
   - **d.** Write a JavaScript program to handle the click events for the HTML button elements
   - **e.** Write a JavaScript program to with three types of functions
   - **i.** Function declaration

ii. Function definition

iii. Arrow functions

2. **Basics of React. js**
   - **a.** Write a React program to implement a counter button using react class components
   - **b.** Write a React program to implement a counter button using react functional components
   - **c.** Write a React program to handle the button click events in functional component
   - **d.** Write a React program to conditionally render a component in the browser
   - **e.** Write a React program to display text using String literals
3. **Important concepts of React. js**
   - **a.** Write a React program to implement a counter button using React use State hook
   - **b.** Write a React program to fetch the data from an API using React use Effect hook
   - **c.** Write a React program with two react components sharing data using Props.
   - **d.** Write a React program to implement the forms in react
   - **e.** Write a React program to implement the iterative rendering using map() function

4. Introduction to Git and GitHub

a. **Setup**
   - Install Git on local machine.
   - Configure Git (user name, email).
   - Create GitHub account and generate a personal access token.

b. **Basic Git Workflow**
   - Create a local repository using git init
   - Create and add files → git add .
   - Commit files → git commit -m "Initial commit"
   - Connect to GitHub remote → git remote add origin <repo_url>
   - Push to GitHub → git push -u origin main

c. **Branching and Collaboration**
   - Create a branch → git checkout -b feature1
   - Merge branch to main → git merge feature1
   - Resolve merge conflicts (guided)

5. Upload React Project to GitHub
   - Create a new React app using npx create-react-app myapp
   - Initialize a git repo and push to GitHub
   - Use. gitignore to exclude node_modules
   - Create multiple branches: feature/navbar, feature/form
   - Practice merge and pull requests (can use GitHub GUI)

6. **Introduction to Node. js and Express. js**
   - Write a program to implement the _hello world ‘message in the route through the browser using Express
   - Write a program to develop a small website with multiple routes using Express. js
   - Write a program to print the _hello world ‘in the browser console using Express. js
   - Write a program to implement the CRUD operations using Express. js
   - Write a program to establish the connection between API and Database using Express – My SQL driver

7. **Introduction to My SQL**
    - Write a program to create a Database and table inside that database using My SQL Command line client
    - Write a My SQL queries to create table, and insert the data, update the data in the table
    - Write a My SQL queries to implement the subqueries in the My SQL command line client
    - Write a My SQL program to create the script files in the My SQL workbench
    - Write a My SQL program to create a database directory in Project and initialize a database. sql file to integrate the database into API
8. **Team Collaboration Using GitHub**
    - Form groups of 2–3 students
    - Create a shared GitHub repo
    - Assign tasks and work in branches
    - Use Issues, Pull Requests, and Code Reviews
    - Document code with README.md

Textbooks:

1. Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett Professional JavaScript for Web Developers Book by Nicholas C. Zakas
2. John Dean, Web Programming with HTML5, CSS and JavaScript, Jones & Bartlett Learning, 2019.
3. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.
4. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon
5. AZAT MARDAN, Full Stack Java Script: Learn Back bone. js, Node.jsand Mongo DB.2015

Reference Books:

1. Full-Stack JavaScript Development by Eric Bush.
2. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
3. Tomasz Dyl, Kamil Przeorski, MaciejCzarnecki, Mastering Full Stack React Web Development 2017

Online Learning Resources:

1. https://ict.iitk.ac.in/product/full-stack-developer-html5-css3-js-bootstrap-php-4/
2. https://www.w3schools.com/html
3. https://www.w3schools.com/css
4. https://www.w3schools.com/js/
5. https://www.w3schools.com/nodejs
6. https://www.w3schools.com/typescript
7. https://docs.github.com/https://education.github.com/git-cheat-sheet-education.pdf

B. Tech. - III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24ES04301P	ES	**Tinkering Lab** (Common for all branches of Engineering)	0	0	2	1

Pre-Requisites:

- Basic knowledge of science and engineering fundamentals
- Familiarity with basic electronics and programming
- Problem-solving and analytical skills
- Interest in hands-on learning and innovation

Course Objectives:

- Encourage Innovation and Creativity
- Provide Hands-on Learning and Impart Skill Development
- Foster Collaboration and Teamwork
- Enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship
- Impart Problem-Solving mind-set

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: Analyze the properties and functions of various materials, tools, and technologies to determine their suitability for specific tasks or projects(L4)

CO3: Collaborate effectively in teams to solve interdisciplinary engineering problems. (L4)

CO4: Utilize tools and techniques to develop solutions with potential for real-world applications and entrepreneurship. (L3)

CO5: Evaluate and improve prototype performance based on testing and feedback. (L4)

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

B.Tech. - III Year
II Semester

B. Tech - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31307T	PC	**Cloud Computing for AI** (Common to AI&DS, CSE-AI and CSE-AI&ML)	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 introduce the concepts, models, and services of cloud computing and its role in AI.
- To explore the architecture and deployment of AI applications on cloud platforms.
- To equip students with skills in using cloud-based tools and services for AI/ML workloads.
- To understand data storage, processing, and security in cloud for AI tasks.
- To apply cloud computing principles to real-world AI-based solutions.

Course Outcomes (COs):

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

CO1: Analyze cloud service models (IaaS, PaaS, SaaS) and deployment strategies to identify optimal environments for AI and NLP integration. (L4)

CO2: Apply distributed computing frameworks like Hadoop and Spark to manage large-scale data ingestion and storage in the cloud. (L3)

CO3: Practice machine learning workflows using cloud-specific services (SageMaker, Vertex AI) and specialized hardware like GPUs/TPUs. (L3)

CO4: Inspect cloud-native AI applications using Docker containers, Kubernetes, and serverless computing for scalable CI/CD pipelines. (L4)

CO5: Evaluate the security, ethics, and cost-management implications of deploying real-time AI solutions in cloud environments. (L5)

Unit I: Introduction to Cloud Computing and AI Integration:

Basics of Cloud Computing: Characteristics, Models, and Services, Cloud Service Models: IaaS, PaaS, SaaS, Deployment Models: Public, Private, Hybrid, CommUnity, AI and Cloud Convergence: Benefits and Challenges, Use Cases of AI in Cloud: NLP, Vision, Analytics, Overview of Cloud Providers for AI: AWS, Azure, GCP.

Unit II: Storage, Computing, and Data Processing in the Cloud:

Cloud Storage Services: S3, Blob, BigQuery, Virtualization and Elastic Computing, Distributed Computing with Hadoop and Spark, Data Ingestion and Processing Pipelines, Data Lakes and Warehousing in the Cloud, Cost Optimization for Storage and Compute Resources.

Unit III: Cloud-based Machine Learning and Deep Learning:

ML Services on AWS (SageMaker), Azure ML, GCP Vertex AI, Training and Deploying Models on Cloud, AutoML and Custom ML Model Workflows, GPUs/TPUs for Model Training, Experiment Tracking and Model Evaluation, Integration of Notebooks (Jupyter, Colab) with Cloud Storage.

Unit IV: Advanced Cloud Concepts for AI Applications:

Containers and Docker for AI Applications, Kubernetes and Cloud-native AI Workflows, Serverless Computing: AWS Lambda, Azure Functions, CI/CD Pipelines for AI Models in Cloud, Scaling AI Applications using Load Balancers and Auto-Scaling. Monitoring and Logging in Cloud for AI Workflows.

Unit V: Security, Ethics, and Case Studies in Cloud AI:

Security and Privacy in Cloud-based AI, Identity and Access Management (IAM) in Cloud, Cost Management and Billing for AI Services, Ethical Issues and Fairness in Cloud AI, Case Study: AI in Healthcare Cloud Solutions, Case Study: Real-Time Analytics in Financial Cloud Services.

Text Books:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, McGraw-Hill.
2. Judith Hurwitz et al., Cloud Computing for Dummies, Wiley.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31308T	PC	Big Data Analytics & AI Applications (Common to CSE-AI & CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Database Management Systems, Data Analytics, Python programming, Machine Learning concepts, and Statistics.

Course Objectives:

- To introduce the fundamentals of big data and its role in AI-driven applications.
- To explore big data tools and technologies such as Hadoop, Spark, and NoSQL databases.
- To enable students to build scalable AI pipelines for data analytics.
- To apply AI/ML algorithms for real-time and batch processing environments.
- To demonstrate use cases of big data in domains like healthcare, finance, and IoT using AI.

Course Outcomes (COs):

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

CO1: Analyze the Hadoop ecosystem and NoSQL database models to address the challenges of high-volume and high-velocity big data. (L4)

CO2: Apply Spark SQL, Streaming, and Kafka to implement real-time data ingestion and querying pipelines. (L3)

CO3: Analyze large-scale datasets using distributed MLlib and Scikit-learn techniques for supervised and unsupervised learning. (L4)

CO4: Design AI-powered big data solutions for domain-specific applications in healthcare, retail, and smart city IoT analysis. (L5)

CO5: Demonstrate advanced topics like Explainable AI (XAI) and edge computing to ensure ethical and low-latency performance in big data environments. (L3)

Unit I: Introduction to Big Data and Analytics Ecosystem:

Definition and Characteristics of Big Data – Volume, Velocity, Variety, Veracity, Value, Types of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive, Big Data Challenges and OpportUnities, Hadoop Ecosystem Overview: HDFS, MapReduce, YARN, NoSQL Databases: Key-Value, Columnar, Document, Graph Models, Data Lake vs. Data Warehouse.

Unit II: Big Data Tools and Frameworks:

Apache Spark Architecture and RDDs, Spark SQL, DataFrames, and Datasets, Spark Streaming for Real-Time Analytics, Kafka for Data Ingestion and Message Queues, Hive, Pig, and Impala for Big Data Querying, Comparative Analysis of Hadoop vs. Spark.

Unit III: Machine Learning on Big Data:

Introduction to MLlib and Scikit-learn, Data Preprocessing for Big Data ML Pipelines, Supervised Learning: Classification and Regression on Large Datasets, Unsupervised Learning: Clustering and Dimensionality Reduction, Model Evaluation and Validation Techniques, Distributed Training and Optimization Techniques.

Unit IV: AI Applications on Big Data:

Predictive Maintenance using Big Data & AI, Fraud Detection in Banking with Machine Learning, AI in Healthcare: Diagnosis, Genomics, Patient Monitoring, Retail and E-commerce Analytics, AI for Smart Cities and IoT Sensor Data Analysis, Evaluation of Real-Time AI Applications on Streaming Data.

Unit V: Advanced Topics and Case Studies:

Deep Learning on Big Data using TensorFlow on Spark, Explainable AI (XAI) in Big Data Environments, Ethical Issues and Data Governance in Big Data AI, Edge Computing and AI for Low Latency Applications, Case Study 1: AI-Powered Big Data in Healthcare, Case Study 2: Big Data AI Solution in Smart Manufacturing.

Text Books:

1. Big Data: Principles and Paradigms by Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi – Wiley
2. Learning Spark: Lightning-Fast Big Data Analysis by Jules S. Damji et al. – O'Reilly
3. Data Science and Big Data Analytics by EMC Education Services – Wiley

Reference Books:

1. Designing Data-Intensive Applications by Martin Kleppmann – O'Reilly
2. Machine Learning with Spark by Rajdeep Dua, Tathagata Das – Packt Publishing
3. Streaming Systems by Tyler Akidau – O‘Reilly Media
4. Artificial Intelligence for Big Data by Anand Deshpande – Packt

Online Learning Resources*:*

1. https://www.coursera.org/specializations/big-data – Coursera Big Data Specialization
2. https://spark.apache.org/docs/latest/ – Apache Spark Documentation

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31309T	**PC**	**Full Stack AI Development** (Common to CSE-AI and CSE-AI&ML)	**3**	**0**	**0**	**3**

Pre-Requisites: Basics on Programming

Course Objectives:

- To introduce the concepts of full stack development with integration of AI capabilities.
- To provide practical exposure to frontend and backend frameworks suitable for AI applications.
- To build intelligent web applications using ML/DL models.
- To explore RESTful APIs, microservices, and deployment strategies for AI solutions.
- To develop skills for scalable, end-to-end AI-powered application development.

Course Outcomes (COs):

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

CO1: Apply HTML5, CSS3, JavaScript, and Git to develop responsive web interfaces and manage version control. (L3)

CO2: Analyze server-side logic and database connectivity using Node.js, Express.js, and MongoDB for asynchronous data exchange. (L4)

CO3: Practice full-stack applications by integrating React components with Redux state management and backend APIs. (L3)

CO4: Examine secure API architectures featuring JWT authentication, role-based access control, and efficient file handling. (L4)

CO5: Develop and deploy complete full-stack projects by implementing advanced routing, state persistence, and cloud hosting strategies. (L5)

Unit I: Introduction to Full Stack AI Development:

Overview of Full Stack Development in AI Context, Components: Frontend, Backend, Database, AI Models, MVC, MVVM Architectures for AI Applications, Introduction to Web Technologies (HTML, CSS, JS, Bootstrap), Role of JavaScript Frameworks in AI Dashboards, Full Stack AI Development Life Cycle.

Unit II: Frontend Technologies for AI Applications:

React.js for Dynamic AI Interfaces, State Management in React (Hooks, Redux), Data Binding and Visualization with Chart.js, D3.js, Integration with AI Results (JSON APIs to UI), UI/UX Design for Intelligent Apps, Responsive Design and Accessibility.

Unit III: Backend and AI Model Integration:

Node.js and Express.js for Backend Services, Flask API Development for ML Models, REST API Creation and Consumption, Handling File Uploads, JSON Input, Streaming Output, Integration of Pre-trained Models (Sklearn, TensorFlow, PyTorch), Middleware, Error Handling, and Model Response Evaluation.

Unit IV: Databases, Authentication, and AI Workflows:

MongoDB and PostgreSQL for Storing AI Inputs/Outputs, User Authentication and Session Management (JWT, OAuth), CRUD Operations with AI Insights, Building AI Feedback Loops with Data Storage, Secure AI Application Workflows, Creating Intelligent Dashboards with Real-Time Data.

Unit V: Deployment, Scaling & Case Studies:

Containerization using Docker for AI Microservices, Deployment to Cloud (AWS, GCP, Azure), CI/CD Pipelines for AI Model Updates, Monitoring and Logging in AI Apps, Performance and Load Testing of AI APIs, Case Study: End-to-End Full Stack AI Project (Deployment + Demo).

Textbooks:

1. Full Stack Development with Flask and React by O. Olatunde – Packt Publishing
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron – O'Reilly
3. Flask Web Development by Miguel Grinberg – O'Reilly Media

Reference Books:

1. Node.js Design Patterns by Mario Casciaro – Packt
2. Building Machine Learning Powered Applications by Emmanuel Ameisen – O'Reilly
3. Mastering React by Adam Horton – Packt
4. MongoDB: The Definitive Guide by Kristina Chodorow – O'Reilly

Online Learning Resources:

1. https://fullstackopen.com/en/ – Full Stack Open
2. https://www.coursera.org/specializations/full-stack – Coursera Full Stack Development

Professional Elective - II (PE - II)

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31303T	PE	**Graph Neural Networks** (Common to CSE-AI & CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Linear Algebra, Probability & Statistics, Data Structures, Machine Learning, Deep Learning, and Graph Theory concepts.

Course Objectives:

- To introduce the fundamentals of graph theory and graph-structured data.
- To explore the concepts of neural networks extended to non-Euclidean domains.
- To understand architectures and algorithms behind various types of GNNs.
- To apply GNN models in real-world applications such as recommendation, social networks, and bioinformatics.
- To enable students to build and evaluate GNN models using frameworks like PyTorch Geometric and DGL.

Course Outcomes (COs):

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

CO1: Analyze graph-structured data and traversal algorithms to formulate node, edge, and graph-level prediction problems for machine learning. (L4)

CO2: Apply spectral and spatial convolution methods to identify the properties of graph Laplacians and filter responses in non-Euclidean domains. (L3)

CO3: Implement modern GNN architectures, including GCNs, GATs, and Message Passing Neural Networks, for inductive and transductive learning. (L3)

CO4: Analyze GNN applications in social network modeling, traffic forecasting, and bioinformatics to assess explainability and interpretability. (L4)

CO5: Demonstrate optimized GNN models using PyTorch Geometric or DGL through hyperparameter tuning and advanced research architectures. (L3)

Unit I: Fundamentals of Graph Theory and Machine Learning on Graphs:

Introduction to Graphs: Nodes, Edges, Adjacency Matrix, Types of Graphs: Directed, Undirected, Weighted, Bipartite, Graph Traversal Algorithms (BFS, DFS), Graph Representations for ML (Adjacency List, Matrix, Laplacian), Node, Edge, and Graph-level Prediction Problems, Motivation and Challenges for Learning on Graphs.

Unit II: Spectral and Spatial Methods for Graph Learning:

Spectral Graph Theory Basics, Graph Convolution via Spectral Methods, Chebyshev and First-order Approximations, Spatial Graph Convolutions, Comparison of Spectral vs Spatial GNNs, Graph Laplacian and Eigenvalue Properties.

Unit III: Graph Neural Network Architectures:

Graph Convolutional Networks (GCNs), Graph Attention Networks (GATs), GraphSAGE: Sampling and Aggregation, Graph Isomorphism Networks (GIN), Message Passing Neural Networks (MPNNs), Inductive vs Transductive GNN Learning.

Unit IV: Applications of GNNs:

Node Classification (e.g., Cora, Citeseer), Link Prediction (e.g., Recommender Systems), Graph Classification (e.g., Molecule Property Prediction), Traffic Forecasting and Social Network

Modeling, GNNs in Healthcare and Bioinformatics, Explainability and Interpretability in GNNs.

Unit V: Implementation, Optimization, and Recent Advances:
Overview of PyTorch Geometric and DGL, Data Loading and Preprocessing for Graph Datasets, Model Training, Loss Functions, and Evaluation Metrics, Hyperparameter Tuning in GNNs, Recent Research Trends and Architectures (e.g., Heterogeneous GNNs, Graph Transformers), Challenges and Future Directions in GNNs.

Text Books:

1. Zonghan Wu, Shirui Pan, Fengwen Chen, Guodong Long, Chengqi Zhang, Philip S. Yu, A Comprehensive Survey on Graph Neural Networks, IEEE Transactions on Neural Networks and Learning Systems, 2021.
2. Yao Ma, Jiliang Tang, Deep Learning on Graphs, Cambridge University Press, 2021.
3. William L. Hamilton, Graph Representation Learning, Morgan & Claypool Publishers, 2020.

Reference Books:

1. Barrett, Jure Leskovec, Mining of Massive Datasets, Cambridge University Press.
2. Thomas Kipf, GCN and related papers and tutorials (arXiv).
3. Petar Veličković, Graph Attention Networks (original paper and slides).
4. Michael Bronstein et al., Geometric Deep Learning: Grids, Groups, Graphs, Geodesics, and Gauges (arXiv preprint).

Online Learning Resources:

1. https://pytorch-geometric.readthedocs.io/ – PyTorch Geometric Docs
2. https://cs.stanford.edu/people/jure/ – Stanford GNN Projects
3. https://www.coursera.org/learn/graph-neural-networks – Coursera GNN Course by Stanford

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30304T	**PE**	**Recommender Systems** (Common to AI&DS, CSE-AI and CSE-AI&ML)	**3**	**0**	**0**	**3**

Pre-Requisites: Basic knowledge of Python programming, Linear Algebra, Probability & Statistics, Database Systems, Machine Learning, and Data Mining concepts.

Course Objectives:

- To provide students with basic concepts and its application in various domain
- To make the students understand different techniques that a data scientist needs to know for analysing big data
- To design and build a complete machine learning solution in many application domains.

Course Outcomes (COs):

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

CO1: Analyze recommender system techniques, including collaborative filtering, neighborhood-based methods, and rating prediction models, to address domain-specific challenges and applications. (L4)

CO2: Analyze and evaluate model-based and content-based recommender system techniques, including latent factor models and classification approaches, for effective recommendation generation. (L4)

CO3: Analyze and evaluate knowledge-based, ensemble, and hybrid recommender system techniques to develop effective and personalized recommendation solutions. (L4)

CO4: Analyze evaluation techniques and context-sensitive approaches in recommender systems to assess performance and improve recommendation accuracy. (L4)

CO5: Analyze time- and location-sensitive recommender system techniques, including temporal collaborative filtering and location-aware models, to enhance personalized recommendations. (L4)

Unit I: An Introduction to Recommender Systems, Neighborhood-Based Collaborative Filtering:

Introduction, Goals of Recommender Systems, Basic Models of Recommender Systems, Domain Specific Challenges in Recommender Systems. Advanced Topics and Applications. Introduction, Key Properties of Ratings Matrices, Predicting Ratings with Neighborhood- Neighborhood-Based Collaborative Filtering: Based Methods, Clustering and Neighborhood-Based Methods, Dimensionality Reduction and Neighborhood Methods, Graph Models for Neighborhood-Based Methods, A Regression Modelling View of Neighborhood Methods.

Unit II: Model-Based Collaborative Filtering, Content-Based Recommender Systems: Introduction, Decision and Regression Trees, Rule-Based Collaborative Filtering, Naive Bayes Collaborative Filtering, Using an Arbitrary Classification Model as a Black-Box, Latent Factor Models, Integrating Factorization and Neighborhood Models. Content-Based Recommender Systems: Introduction, Basic Components of Content-Based Systems, Preprocessing and Feature Extraction, Learning User Profiles and Filtering, Content-Based Versus Collaborative Recommendations, Using Content-Based Models for Collaborative Filtering, Summary.

Unit III: Knowledge-Based Recommender Systems, Ensemble Based and Hybrid Recommender Systems:

Introduction, Constraint-Based Recommender Systems, Case-Based Recommenders, Persistent Personalization in Knowledge-Based Systems, Summary. Introduction, Ensemble Methods from the Classification Perspective, Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Feature

Augmentation Hybrids, Meta-Level Hybrids, Feature Combination Hybrids, Summary.

Unit IV: Evaluating Recommender Systems, Context-Sensitive Recommender Systems
Introduction, Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender Evaluation, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures, Limitations of Evaluation Measures. Introduction, The Multidimensional Approach, Contextual Pre-filtering: A Reduction-Based Approach, Contextual Pre-filtering: A Reduction-Based Approach, Contextual Modelling.

Unit V: Time- and Location-Sensitive Recommender Systems
Introduction, Temporal Collaborative Filtering, Discrete Temporal Models, Location-Aware Recommender Systems, Location-Aware Recommender Systems Location-Aware Recommender Systems, Summary.

Textbooks:
1. Charu C. Aggarwal, ―Recommender Systems‖, Springer,2016.

Reference Books:
1. Francesco Ricci, LiorRokach, ―Recommender Systems Handbook‖, 2nd ed., Springer, 2015 Edition

Online Learning Resources:
1. Recommendation System -Understanding The Basic Concepts (analyticsvidhya.com)
2. Recommender Systems | Coursera

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30305T	PE	**Predictive Analytics** (Common to AI&DS, CSE-AI & CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Statistics, Probability, Data Analysis, Python programming, Machine Learning, and Database concepts.

Course Objectives:

- To introduce the fundamental concepts and techniques of predictive analytics.
- To apply statistical models and machine learning algorithms for prediction.
- To interpret model performance using evaluation metrics.
- To explore feature engineering, model tuning, and cross-validation.
- To implement predictive solutions for real-world business and research problems.

Course Outcomes (COs):

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

CO1: Apply the principles and importance of predictive analytics, including its role in decision-making and real-world applications. (L3)

CO2: Apply regression and classification models for predictive tasks using appropriate machine learning algorithms. (L3)

CO3: Perform data preprocessing, feature selection, and transformation techniques to prepare datasets for predictive modeling. (L3)

CO4: Analyze and evaluate models using standard performance metrics and validation techniques such as cross-validation. (L4)

CO5: Analyze and develop predictive solutions to address domain-specific business and research problems. (L4)

Unit I: Introduction to Predictive Analytics:

Introduction to Predictive Analytics and Business Intelligence, Types of Predictive Models: Classification, Regression, Time Series, Supervised vs Unsupervised Learning, Predictive Modeling Workflow, Applications in Marketing, Finance, Healthcare, Challenges in Predictive Analytics.

Unit II: Data Preparation and Feature Engineering:

Data Cleaning: Handling Missing, Noisy, and Inconsistent Data, Feature Selection and Dimensionality Reduction (PCA, LDA), Feature Scaling: Normalization, Standardization, Encoding Categorical Variables, Feature Extraction and Construction, Dealing with Imbalanced Datasets.

Unit III: Predictive Modeling with Regression and Classification:

Linear Regression and Polynomial Regression, Logistic Regression for Binary Classification, Decision Trees and Random Forest, k-Nearest Neighbors (k-NN) and Naïve Bayes, Support Vector Machines (SVM), Model Selection and Comparison.

Unit IV: Model Evaluation and Validation:

Training, Testing, and Validation Sets, Cross-Validation Techniques (k-Fold, Stratified, LOOCV), Evaluation Metrics: Accuracy, Precision, Recall, F1 Score, ROC-AUC, Confusion Matrix and Classification Report, Bias-Variance Trade-off and Overfitting, Hyperparameter Tuning: Grid Search, Random Search.

Unit V: Advanced Topics and Applications:

Ensemble Learning: Bagging, Boosting (AdaBoost, XGBoost), Predictive Analytics with Time Series (ARIMA, Prophet), Deep Learning for Predictive Modeling (ANNs, LSTM), Use of Predictive Analytics in IoT, Retail, and Healthcare, Ethics and Privacy in Predictive Analytics, Building and Deploying End-to-End Predictive Systems.

Textbooks:

1. **Dean Abbott**, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Wiley, 2014.
2. **John D. Kelleher, Brendan Tierney**, Data Science: Predictive Analytics and Data Mining, MIT Press, 2018.

Reference Books:

1. **Galit Shmueli et al.**, Data Mining for Business Analytics: Concepts, Techniques, and Applications in R, Wiley, 2017.
2. **Eric Siegel**, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Wiley, 2016.
3. **Trevor Hastie, Robert Tibshirani, Jerome Friedman**, The Elements of Statistical Learning, Springer, 2009.

Online Learning Resources:

1. https://www.coursera.org/specializations/predictive-analytics – Coursera Specialization
2. https://www.edx.org/course/data-science-and-machine-learning-capstone – edX Predictive Analytics Courses
3. https://www.kaggle.com/learn/intro-to-machine-learning – Kaggle Tutorials

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31304T	PE	**Blockchain for AI** (Common to CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Computer Networks, Cryptography fundamentals, Distributed Systems, Python programming, and Artificial Intelligence concepts.

Course Objectives:

- To understand the foundational concepts of blockchain technology and its architecture.
- To explore smart contracts, consensus algorithms, and distributed ledger technology.
- To investigate the integration of AI with blockchain for secure, decentralized applications.
- To develop blockchain-enabled AI solutions for real-world use cases.
- To understand the ethical, security, and scalability challenges in Blockchain-AI ecosystems.

Course Outcomes (COs):

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

CO1: Analyze blockchain architecture, including hashing, Merkle trees, and P2P networks, to evaluate different distributed ledger technologies. (L4)

CO2: Construct smart contracts using Solidity on Ethereum or Hyperledger Fabric platforms using various consensus algorithms. (L3)

CO3: Apply blockchain integration techniques to secure decentralized AI models and federated learning provenance. (L3)

CO4: Practice blockchain-based AI applications in healthcare, IoT, and supply chain logistics to ensure data integrity and trust. (L3)

CO5: Analyze security, privacy, and scalability challenges in Blockchain-AI ecosystems to implement zero-knowledge proofs and quantum-resistant solutions. (L4)

Unit I: Blockchain Fundamentals and Architecture:

Introduction to Blockchain Technology, Components: Blocks, Hashing, Merkle Trees, Types of Blockchains: Public, Private, Consortium, Distributed Ledger Technology (DLT) and P2P Networks, Blockchain Structure and Mining, Use Cases and Evolution of Blockchain.

Unit II: Smart Contracts and Consensus Mechanisms:

Smart Contracts: Definition, Features, Use Cases, Ethereum and Solidity Basics, Consensus Algorithms: PoW, PoS, DPoS, PBFT, Gas, Transactions, and Events in Ethereum, Hyperledger Fabric: Architecture and Chaincode, Deployment and Testing of Smart Contracts.

Unit III: Integration of Blockchain and AI:

Motivation for Integrating Blockchain with AI, Decentralized AI Models and Federated Learning, Secure Model Sharing and Provenance, Blockchain for Data Integrity in AI Systems, AI for Blockchain (e.g., optimizing consensus), Case Study: Decentralized AI Marketplace.

Unit IV: Applications of Blockchain in AI Systems:

Blockchain for Explainable and Trusted AI, Applications in Healthcare and Genomics, Blockchain for Autonomous Vehicles and IoT, Financial AI Systems with Smart Contracts, Supply Chain and Logistics Intelligence, NFT-based AI Applications (Digital Identity, IP).

Unit V: Security, Privacy and Challenges in Blockchain-AI:

Security Challenges: Sybil Attacks, 51% Attacks, Privacy Preservation and Zero Knowledge Proofs, Scalability and Energy Concerns in Blockchain-AI, Ethical and Legal Concerns in AI with Blockchain, Interoperability of Blockchain Platforms, Future Trends: Quantum-Resistant Blockchain-AI.

Text Books:

1. Imran Bashir, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, Packt, 2020.
2. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015.
3. Joseph Holbrook, Architecting AI Solutions on Blockchain, Packt Publishing, 2020.

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, Blockchain Applications: A Hands-On Approach, VPT, 2017.
2. Karamjit Singh, Blockchain for AI: Use Cases and Implementation, Springer, 2023.
3. Roger Wattenhofer, The Science of the Blockchain, 2016.

Online Learning Resources:

1. Coursera: Blockchain Specialization – University at Buffalo
2. edX: Blockchain Fundamentals – UC Berkeley
3. Coursera: AI and Blockchain – IBM

Professional Elective - III (PE - III)

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30306T	PE	**AI for Finance** (Common to AI&DS, CSE-AI & CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Finance and Economics, Statistics, Python programming, Data Analytics, Machine Learning, and Database concepts.

Course Objectives:

- To introduce the role of Artificial Intelligence (AI) in financial applications and decision-making.
- To understand financial data types, sources, and processing methods.
- To apply machine learning and deep learning models in various finance sectors.
- To analyze risk, fraud detection, credit scoring, and portfolio management using AI.
- To evaluate ethical and regulatory challenges in AI-enabled finance.

Course Outcomes (COs):

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

CO1: Apply financial markets, instruments, financial data types, and the role of AI techniques in various financial applications. (L3)

CO2: Apply machine learning techniques such as classification, clustering, and time series forecasting to financial problems including credit scoring, fraud detection, and forecasting. (L3)

CO3: Apply deep learning and natural language processing techniques for tasks such as stock prediction, sentiment analysis, and document classification in finance. (L3)

CO4: Analyze AI-based financial applications such as fraud detection, credit risk assessment, robo-advisors, and algorithmic trading systems. (L4)

CO5: Analyze ethical, regulatory, and privacy issues in AI-based financial systems, including bias, transparency, and responsible AI practices. (L4)

Unit I: Introduction to Finance and AI Applications:

Introduction to Financial Markets and Instruments, Overview of AI Techniques in Finance, Types of Financial Data: Market, Transactional, Customer, Financial Statements and Key Indicators, AI Use Cases in Banking, Insurance, and Investment, FinTech and the Rise of Robo-Advisors.

Unit II: Machine Learning in Finance:

Supervised Learning for Credit Scoring, Unsupervised Learning for Customer Segmentation, Feature Engineering for Financial Data, Handling Imbalanced Datasets in Fraud Detection, Time Series Forecasting with Regression and ARIMA, Model Validation and Backtesting in Finance.

Unit III: Deep Learning and NLP in Finance:

Introduction to Deep Learning for Finance, Stock Price Prediction using LSTM and RNNs, Sentiment Analysis from Financial News and Tweets, NLP for Document Classification: Earnings Reports, Chatbots and Virtual Assistants in Banking, Reinforcement Learning for Portfolio Optimization.

Unit IV: AI-Driven Financial Applications:

Fraud Detection Systems using ML and DL, Credit Risk and Loan Default Prediction, AI in Algorithmic and High-Frequency Trading, Robo-Advisors: Architecture and Optimization, Blockchain and AI Integration for Financial Security, Case Studies: AI in Wealth Management & Insurance.

Unit V: Ethics, Regulation, and Future of AI in Finance:

Regulatory Frameworks in AI-based Finance, Explainability and Interpretability of Financial Models, Ethical Issues: Bias, Fairness, Transparency, Data Privacy and GDPR in Financial AI, Responsible AI Practices in Finance, Emerging Trends: Quantum AI, Decentralized Finance (DeFi).

Textbooks:

1. Yves Hilpisch, Artificial Intelligence in Finance: A Python-Based Guide, O‘Reilly, 2020.
2. Yves Hilpisch, Python for Finance: Mastering Data-Driven Finance, O‘Reilly, 2018.
3. Markus Loecher, Machine Learning for Finance, Packt Publishing, 2021.

Reference Books:

1. A. W. Lo, The Evolution of Technical Analysis, Wiley Finance, 2010.
2. Tony Guida, Big Data and Machine Learning in Quantitative Investment, Wiley, 2019.
3. Tucker Balch, AI for Trading – Georgia Tech Specialization, Coursera.

Online Learning Resources:

1. Coursera: AI for Trading – by NYIF and Google Cloud
2. edX: Artificial Intelligence in Finance – NYIF
3. Udemy: Machine Learning and AI in Finance
4. DataCamp: Financial Trading with Python
5. YouTube: AI for Finance by Sentdex, Two Minute Papers, and DataProfessor

B. Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE05310T	PE	**Introduction to Quantum Computing** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites: Basic knowledge of Linear Algebra, Probability & Statistics, Discrete Mathematics, Computer Programming, and Fundamental Concepts of Physics.

Course Objectives:

- To introduce the principles and mathematical foundations of quantum computation.
- To understand quantum gates, circuits, and computation models.
- To explore quantum algorithms and their advantages over classical ones.
- To develop the ability to simulate and write basic quantum programs.
- To understand real-world applications and the future of quantum computing in AI, cryptography, and optimization.

Course Outcomes (COs):

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

CO1: Explain the fundamental concepts of quantum mechanics used in computing. (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.- III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30307T	PE	**Social Network Analysis** (Common to AI&DS, CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Graph Theory, Data Structures, Statistics, Database Systems, Python programming, and Data Analytics concepts.

Course Objectives:

- To introduce the fundamentals and key concepts of social network theory and graph theory.
- To analyze the structure and properties of large-scale social networks.
- To apply centrality, influence, and commUnity detection measures.
- To model information diffusion and network dynamics.
- To implement real-world social network analysis using tools and datasets.

Course Outcomes (COs):

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

CO1: Apply basic network models and social network structures. (L3)

CO2: Analyze key network properties such as centrality, clustering, and the small-world effect. (L4)

CO3: Apply community detection algorithms and influence maximization techniques. (L3)

CO4: Analyze diffusion models for viral marketing and information spread. (L4)

CO5: Apply tools such as Gephi, NetworkX, or SNAP for real-world social network analysis. (L3)

Unit I: Introduction to Social Networks and Graph Theory:

Basic Concepts: Graphs, Nodes, Edges, Directed/Undirected Graphs, Real-world Examples: Facebook, Twitter, LinkedIn, Adjacency Matrix and Graph Representation, Types of Social Networks: Ego, Bipartite, Multilayer, Degree Distribution, Path Length, and Connectivity, Random Graph Models: Erdős–Rényi and Watts-Strogatz.

Unit II: Structural Properties of Networks:

Network Centrality Measures: Degree, Closeness, Betweenness, Eigenvector Centrality and PageRank, Network Clustering and CommUnity Detection Basics, Triadic Closure and Clustering Coefficient, Small-world Phenomenon and Milgram‘s Experiment, Homophily, Influence, and Structural Balance.

Unit III: CommUnity Detection and Subgroup Analysis:

Girvan–Newman Algorithm and Modularity, Label Propagation and Louvain Method, Clique Detection and k-Core Decomposition, Overlapping CommUnities and Fuzzy Clustering, Cohesive Subgroups and Structural Equivalence, Evaluation Metrics: NMI, Modularity Score.

Unit IV: Information Diffusion and Influence in Networks:

Models of Diffusion: Linear Threshold and Independent Cascade, Influence Maximization and Viral Marketing, Contagion Models and Epidemic Spreading, Rumor Propagation and Cascade Models, Information Bottlenecks and Bridges, Measuring Influence and Reach.

Unit V: Tools, Applications, and Ethics in SNA:

SNA Tools: Gephi, Pajek, NetworkX, SNAP, Case Study: Twitter and Hashtag Analysis, LinkedIn Network Mining and Graph Features, Applications in Marketing, Security, and Epidemiology, Ethical Issues in Social Network Data Mining, Building and Visualizing Your Own Social Graph.

Textbooks:

1. Wasserman, S., & Faust, K., Social Network Analysis: Methods and Applications, Cambridge University Press, 1994.
2. Easley, D., & Kleinberg, J., Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press, 2010.
3. Newman, M., Networks: An Introduction, Oxford University Press, 2010.

Reference Books:

1. Borgatti, S. P., Everett, M. G., & Johnson, J. C., Analyzing Social Networks, SAGE Publications, 2018.
2. Barabási, A.-L., Linked: How Everything Is Connected to Everything Else, Basic Books, 2014.
3. Hansen, D., Shneiderman, B., & Smith, M. A., Analyzing Social Media Networks with NodeXL, Elsevier, 2020.

Online Learning Resources:

1. Coursera – Social Network Analysis (University of Michigan)
2. [YouTube – NetworkX and Gephi Tutorials (freeCodeCamp, TheNetNinja)]
3. edX – Networks: Friends, Money, and Bytes (University of California, Berkeley)
4. Khan Academy – Graph Theory

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31307T	PE	**Cybersecurity & AI-driven Threat Detection** (Common to CSE-AI & CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Computer Networks, Cybersecurity fundamentals, Python programming, Data Analysis, Machine Learning, and Artificial Intelligence concepts.

Course Objectives:

- To provide a foundational understanding of cybersecurity principles and threat landscapes.
- To explore the application of AI and machine learning techniques in detecting cyber threats.
- To analyze malware behavior, intrusion patterns, and anomaly detection using intelligent systems.
- To evaluate and build automated systems for real-time security analytics.
- To understand the ethical, legal, and societal implications of AI-driven security systems.

Course Outcomes (COs):

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

CO1: Analyze cybersecurity frameworks (NIST, OWASP) and vulnerability management protocols to assess organizational risk. (L4)

CO2: Apply machine learning classification and clustering models to identify intrusions and anomalous network traffic patterns. (L3)

CO3: Implement deep learning architectures (RNN, CNN, Autoencoders) to perform malware classification and sequence-based threat intelligence. (L3)

CO4: Demonstrate automated security analytics pipelines using SIEM tools (Splunk, ELK) and real-time packet inspection. (L4)

CO5: Examine the ethical, legal, and privacy implications of AI-driven security systems, including GDPR compliance and zero-trust trends. (L4)

Unit I: Fundamentals of Cybersecurity:

Introduction to Cybersecurity: CIA Triad, Threats & Vulnerabilities, Types of Attacks: Malware, Phishing, DDoS, Insider Threats, Security Policies and Access Controls, Risk Assessment and Vulnerability Management, Cryptography Basics: Symmetric, Asymmetric, Hash Functions, Cybersecurity Frameworks: NIST, ISO 27001, OWASP.

Unit II: Machine Learning for Cyber Threat Detection:

Supervised and Unsupervised Learning in Security Contexts, Feature Engineering for Security Data, Classification Models for Intrusion Detection (SVM, RF, KNN), Clustering Techniques for Anomaly Detection, Evaluation Metrics: Accuracy, Precision, ROC, F1 Score, Case Study: AI for Email Phishing Detection.

Unit III: Deep Learning in Threat Intelligence:

Deep Neural Networks for Cybersecurity, RNNs and LSTMs for Log and Sequence Data, Autoencoders for Anomaly Detection, CNNs for Malware Classification using Binary Analysis, Adversarial Attacks on AI-based Security Systems, Case Study: Threat Detection using Deep Learning.

Unit IV: Real-Time Threat Detection and SIEM Systems:

Security Information and Event Management (SIEM), Log Analysis and Real-Time Alerting, Threat Intelligence Platforms (TIPs), Integration of AI in SIEM Tools (Splunk, ELK Stack), Network Traffic and Packet Inspection using ML, SOC Operations and Automation using AI

Unit V: Ethical Hacking, Privacy, and Legal Aspects:

Penetration Testing & Ethical Hacking with AI Tools, Red Team vs. Blue Team Simulation, Data Privacy Regulations: GDPR, HIPAA, Cyber Laws, AI Bias and Fairness in Security Decision-Making, Case Study: Ethical Dilemmas in AI Security Systems, Future Trends: Zero Trust, AI SOC, Federated Threat Detection.

Textbooks:

1. Stallings, W., Network Security Essentials: Applications and Standards, Pearson Education.
2. Shon Harris & Fernando Maymi, CISSP All-in-One Exam Guide, McGraw Hill.
3. Emmanuel Tsukerman, Machine Learning for Cybersecurity Cookbook, Packt Publishing.
4. Clarence Chio & David Freeman, Machine Learning and Security, O'Reilly Media.

Reference Books:

1. John Paul Mueller, Luca Massaron, Machine Learning for Dummies, Wiley.
2. Mark Stamp, Information Security: Principles and Practice, Wiley.
3. Bruce Schneier, Secrets and Lies: Digital Security in a Networked World, Wiley.
4. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning, Cambridge University Press.

Online Learning Resources:

1. Coursera – AI for Cybersecurity (IBM)
2. edX – Cybersecurity Fundamentals by Rochester Institute of Technology
3. MIT OpenCourseWare – Computer and Network Security
4. [YouTube – Cybersecurity & AI Tutorials by Simplilearn, Great Learning]
5. Udemy – Machine Learning for Cybersecurity
6. Splunk Documentation – AI & Threat Detection

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 and CSE-AI&ML)	3	0	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 Disaster:

Brief Introduction to Different Types of Natural Disasters, Occurrence of Disasters in Different Climatic and Geographical Regions, Hazard Maps (Earthquake and Cyclone) of The World and India, Regulations for Disaster Risk Reduction,
Post-Disaster Recovery and Rehabilitation (Socioeconomic Consequences).

Unit II: Cyclones and their Impact:

Climate Change and Its Impact on Tropical Cyclones, Nature of Cyclonic Wind, Velocities and Pressure, Cyclone Effects, Storm Surges, Floods, and Landslides. Behavior of Structuresin 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, Epicenter, Energy Release, and Ground Motions. Earthquake Effects– On Ground, Soil Rupture, Liquefaction, Landslides. Performance of Ground and Buildings in Past Earthquakes– Behavior of Various Types of Buildings and Structures, Collapse Patterns; Behavior 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, andIlanKelman (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)	3	0	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, Students 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. - CO2 Contribution from Cement and Other Construction Materials.

Unit II: Materials Used in Sustainable Construction:

Construction Materials and Indoor Air Quality - No/Low Cement Concrete - Recycled and Manufactured Aggregate - Role of QC and Durability - Life Cycle and Sustainability.

Unit III: Energy Calculations:

Components of Embodied Energy - Calculation of Embodied Energy for Construction Materials - Energy Concept and Primary Energy - Embodied Energy 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 Neighboring Tropical Countries - OTTV Concepts and Calculations – Features of LEED and TERI – GRIHA Ratings - Role of Insulation and Thermal Properties of Construction Materials - Influence of Moisture Content and Modeling - Performance Ratings of Green Buildings - Zero Energy Building

Unit V: Environmental Effects:

Non-Renewable Sources of Energy and Environmental Impact– Energy Norm, Coal, Oil, Natural Gas - Nuclear Energy - Global Temperature, Green House Effects, Global Warming - Acid Rain: Causes, Effects and Control Methods - Regional Impacts of Temperature Change.

Text Books:

1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4^{th} Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell, UK, 2016.

Reference Books:

1. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
2. William P Spence, Construction Materials, Methods & Techniques (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
24OE02302T	OE	**Renewable Energy Sources** (Common to CE, ECE, CSE, AI&DS, CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Energy Concepts and Electrical Fundamentals.
- Familiarity with Conventional and Non-Conventional Energy Sources.

Course Objectives:

- To understand the principles, sources, and conversion methods of renewable energy systems such as solar, wind, geothermal, ocean, biomass, and fuel cells.
- To analyze the performance, design, and operating characteristics of solar PV systems, collectors, and wind energy conversion systems.
- To study various energy storage methods, site selection factors, and practical applications of renewable energy technologies.
- To develop awareness of sustainable energy solutions and their role in meeting future energy demands

Course Outcomes (COs):

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

CO1: Describe solar energy fundamentals including solar radiation geometry, solar collectors, and thermal energy storage systems. (L3)

CO2: Analyze photovoltaic energy systems including PV cell characteristics, module design, and standalone and grid-connected configurations. (L4)

CO3: Examine wind energy systems including wind turbine components, aerodynamic forces, energy estimation, and site selection criteria. (L4)

CO4: Evaluate geothermal energy resources, characteristics, applications, and prospects for sustainable energy generation. (L5)

CO5: Assess miscellaneous renewable energy technologies including tidal, wave, biomass, and fuel cell systems for energy production. (L5)

Unit I: Solar Energy:

Solar radiation - beam and diffuse radiation, solar constant, Sun at Zenith, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

Unit II: PV Energy Systems:

Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Solar PV modules from solar cells, mismatch in series and parallel connections design and structure of PV modules, Electrical characteristics of silicon PV cells and modules, Stand-alone PV system configuration, Grid connected PV systems.

Unit III: Wind Energy:

Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades; wind data and energy estimation and site selection considerations.

Unit IV: Geothermal Energy:
Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

Unit V: Miscellaneous Energy Technologies:
Ocean Energy: Tidal Energy-Principle of working, Operation methods, advantages and limitations. Wave Energy-Principle of working, energy and power from waves, wave energy conversion devices, advantages and limitations.
Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration
Fuel cell: Principle of working of various types of fuel cells and their working, performance and limitations.

Text Books:

1. G. D. Rai, ―Non-Conventional Energy Sources‖, 4th Edition, Khanna Publishers, 2000.
2. Chetan Singh Solanki ―Solar Photovoltaics fundamentals, technologies and applications‖ 2nd Edition PHI Learning Private Limited. 2012.

Reference Books:

1. Stephen Peake, ―Renewable Energy Power for a Sustainable Future‖, Oxford International Edition, 2018.
2. S. P. Sukhatme, ―Solar Energy‖,3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
3. B H Khan , ― Non-Conventional Energy Resources‖, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
4. S. Hasan Saeed and D.K.Sharma,―Non-Conventional Energy Resources‖,3rd Edition, S.K.Kataria& Sons, 2012.
5. G. N. Tiwari and M.K.Ghosal, ―Renewable Energy Resource: Basic Principles and Applications‖, Narosa Publishing House, 2004.

Online Learning Resources:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/108108078

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03302T	OE	**Automation and Robotics** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Electrical, Electronic, and Mechanical Fundamentals.
- Familiarity with Control Systems and Basic Programming Concepts.

Course Objectives:

- Fundamentals of industrial automation, production types, automation strategies, and hardware elements used in modern manufacturing processes.
- Understanding of automated manufacturing systems, and strategies for improving productivity and flexibility in industrial automation.
- Knowledge of industrial automation and robotics, sensors, and end-effector design for modern manufacturing environments.
- Explain industrial automation and robotics, and trajectory planning for intelligent and efficient manufacturing applications.
- Familiarity of industrial automation and robotics, and practical applications in manufacturing processes.

Course Outcomes (COs):

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

CO1: Understand and analyze the structure and functions of automated manufacturing systems, and evaluate hardware components for efficient production. (L3)

CO2: Analyze and design automated flow lines with or without buffer storage, perform quantitative evaluations, apply assembly line balancing techniques. (L4)

CO3: Classify robot configurations, select suitable actuators and sensors, analyze and apply automation and robotics principles to optimize production efficiency and flexibility. (L4)

CO4: Apply kinematic and dynamic modeling using D-H notation and select appropriate hardware and control strategies for real-world industrial scenario to analyze and design automated and robotic systems. (L3)

CO5: Design, program, and implement robotic systems, understand and apply robotics technology to manufacturing tasks. (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/ PearsonEdu.
2. Industrial Robotics -M. P. Groover, TMH.

Reference Books:

1. Robotics, FuKS, McGrawHill,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 RK & NagrathIJ, TMH.

Online Learning Resources:

1. https://www.youtube.com/watch?v=yxZm9WQJUA0&list=PLRLB5WCqU54UJG45UnazSYmnmhl- gt76o
2. https://www.youtube.com/watch?v=6f3bvIhSWyM&list=PLRLB5WCqU54X5Vy4DwjfSODT3Z JgwEjyE

B. Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE04302T	**OE**	**Digital Electronics** (Common to CE, EEE, CSE, AI&DS, CSE-AI and CSE-AI&ML)	**3**	**0**	**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 1:

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 2:

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
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 Analyze duality concepts and complementary slackness conditions in optimization techniques.
- To Understand unconstrained and constrained nonlinear programming methods for solving engineering optimization problems.
- To Apply feasible direction methods, search techniques, and sequential programming methods in nonlinear optimization.
- To Solve geometric programming problems using primal-dual approaches and arithmetic-geometric inequality methods.
- To Develop analytical and decision-making skills for optimization problems in engineering and management 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:

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.

Online Learning Resources:

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 QuantumTechnologies** (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: Understand vector spaces, inner products, and linear operators with applications to quantum systems. (L2)

CO2: Apply linear algebra concepts to function spaces and analyze the transition from finite to infinite dimensional systems. (L4)

CO3: Analyze 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. (L5)

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).

Online Learning Resources:

1. https://eclass.uoa.gr/modules/document/file.php/CHEM248/Griffiths%20 %20Introduction%20to%20Quantum%20Mechanics%203rd%20ed%202018.pdf
2. https://fisica.net/mecanica-quantica/Shankar%20 %20Principles%20of%20quantum%20mechanics.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)	3	0	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, Students will be able to

CO1: Analyze phase diagrams, crystal growth mechanisms, crystal defects, and thin film deposition techniques for the characterization of engineering materials. (L4)

CO2: Apply the principles of semiconductors to analyze charge carrier transport, carrier concentration, conductivity, mobility, and temperature-dependent semiconductor behavior. (L3)

CO3: Analyze the operating principles and characteristics of semiconductor devices such as PN junctions, heterojunctions, transistors, and MOSFETs. (L4)

CO4: Apply the principles of excitonic and luminescent processes to interpret light emission phenomena in solid-state materials and optoelectronic devices. (L3)

CO5: Analyze the working principles and applications of modern display technologies, including LCD, holographic displays, light-field displays, head-mounted displays, MOEMS, and MEMS displays. (L4)

Unit I: Fundamentals of Materials Science:

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. The basic idea of point, line, and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RF and glow discharge).

Unit II: Semiconductors:

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

Unit III: Physics of Semiconductor Devices:

Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Heterojunctions, Transistors, MOSFETs.

Unit IV: Excitons and Luminescence:

Luminescence: Different types of luminescence, basic definitions, Light emission in solids, Inter band luminescence, Direct and indirect gap materials.

Photoluminescence: General Principles 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 Engineering Chemistry, Chemical Bonding, Organic Chemistry, and Material Science concepts.

Course Objectives:

- To understand the basic principles of polymers
- To understand natural polymers and their applications.
- To impart knowledge to the students about synthetic polymers, their preparation and importance.
- To enumerate the applications of hydogel polymers
- To enumerate applications of conducting and degradable polymers in engineering.

Course Outcomes (COs):

On successful completion of the course, Students 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 co-ordination 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 Cellulosics:

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEA.

Unit III: Synthetic Polymers:

Addition and condensation polymerization processes– Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers 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

Reference Books:

1. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
2. 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 for 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 – 1 January 2010 Pearson Education; First edition (1 January 2010)
2. Pease, Allan & Barbara. The Definitive Book of Body LanguageRHUS Publishers, 2016

Reference Books:

1. Alice Savage, Masoud Shafiei Effective Academic Writing,2Ed.,2014
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-nonverbal aspects-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 - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31308P	PC	Big Data & Cloud Computing Lab (Common to CSE-AI and CSE-AI&ML)	0	0	3	1.5

Pre-Requisites: Basic knowledge of Database Management Systems, Programming (Python/Java), Operating Systems, Computer Networks, and Cloud Computing fundamentals.

Course Objectives:

- To provide hands-on experience in working with big data tools and cloud computing environments.
- To equip students with practical skills in data ingestion, transformation, analysis, and visualization using Hadoop and Spark ecosystems.
- To enable deployment and management of cloud services using AWS, Azure, or GCP.
- To expose students to cloud-native storage, computing, and container orchestration techniques.
- To integrate big data workflows with cloud infrastructure for scalable, distributed data processing.

Course Outcomes (COs):

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

CO1: Apply HDFS operations and MapReduce programming for distributed data processing in a hadoop cluster environment. (L3)

CO2: Analyze large-scale datasets using Hive and Pig querying and Spark RDD/DataFrame transformations. (L4)

CO3: Implement scalable machine learning pipelines using PySpark MLlib on distributed cloud infrastructure. (L3)

CO4: Design cloud-native architectures using AWS/Azure/GCP storage, compute services, and serverless functions. (L5)

CO5: Develop containerized applications using Docker and manage orchestration through Kubernetes for scalable data processing. (L5)

List of Lab Experiments:

1. Installation and Configuration of Hadoop Cluster (Single Node & Multi-node) Hadoop HDFS setup, NameNode & DataNode configuration
2. Working with HDFS: File Operations
   Upload, read, delete, and replicate files in HDFS
3. MapReduce Programming Basics
   Word count, sorting, and filtering examples in Java/Python
4. Apache Hive & Pig for Querying Large Datasets Creation of tables, data loading, and running queries
5. Apache Spark Basics: RDDs and DataFrames Implement Spark transformations and actions
6. Data Preprocessing and Machine Learning using PySpark MLlib Classification or regression using MLlib pipelines
7. Introduction to Cloud Computing and AWS/Azure/GCP Console Creating virtual machines, basic compute and storage services
8. Cloud Storage and Database Services
   Using S3 (AWS), Blob (Azure), or GCP buckets and Cloud SQL/NoSQL
9. Deploying Big Data Workloads on Cloud (EMR, HDInsight, Dataproc) Running Hadoop/Spark jobs in cloud-managed services
10. Cloud Function/Serverless Deployment

11. Building and deploying a serverless function (e.g., AWS Lambda) Containerization with Docker
12. Building, running, and managing Docker containers Orchestration with Kubernetes in the Cloud Deploy and manage a containerized application using GKE/EKS/AKS

Text Books:

1. Tom White, Hadoop: The Definitive Guide, O'Reilly Media.
2. Rajkumar Buyya et al., Mastering Cloud Computing, McGraw-Hill Education.
3. Holden Karau et al., Learning Spark: Lightning-Fast Big Data Analysis, O'Reilly Media.

Reference Books:

1. Vignesh Prajapati, Big Data Analytics with R and Hadoop, Packt Publishing.
2. Benjamin Bengfort, Data Analytics with Hadoop, O'Reilly.
3. Srinivasan & J. Shrinivasan, Cloud Computing – A Hands-on Approach, Wiley India.

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31309P	**PC**	**Full Stack AI Lab** (Common to CSE-AI and CSE-AI&ML)	**0**	**0**	**3**	**1.5**

Pre-Requisites: Basic knowledge of Python programming, Web Technologies (HTML, CSS, JavaScript), Database Management Systems, Artificial Intelligence, and Machine Learning concepts.

Course Objectives:

- To Enable students to build end-to-end AI-powered web applications.
- To Integrate frontend, backend, database, and AI models in real-time.
- To Provide hands-on experience with Flask, Express, MongoDB, React, and ML models.
- To Develop and deploy AI applications using industry-standard practices. Course Outcomes:
- To Design frontend interfaces using React/HTML/CSS.
- To Build backend logic using Flask or Node.js APIs.
- To Integrate and deploy ML models with web services.
- To Store and retrieve data using MongoDB/MySQL.
- To Test, debug, and deploy AI-based web applications.

Course Outcomes (COs):

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

CO1: Apply frontend technologies (React/HTML/CSS) and backend frameworks (Flask/Node.js) to develop web interfaces. (L3)

CO2: Implement machine learning models as APIs and integrate them into frontend applications using AJAX/Fetch. (L3)

CO3: Analyze user interaction and prediction history through dynamic data visualizations and database management (MongoDB/MySQL). (L4)

CO4: Design secure full-stack applications featuring JWT-based authentication and complex file upload functionalities. (L5)

CO5: Experiment end-to-end AI applications using CI/CD pipelines on platforms like Heroku, Render, or Vercel. (L4)

List of Lab Experiments:

Lab Experiments (12 Total)

1. Setup Flask or Node.js server with React/HTML frontend.
2. Create login/signup system with Express/Flask and MongoDB.
3. Train and save ML model (e.g., Naive Bayes, Logistic Regression).
4. Build API to serve ML model predictions via Flask.
5. Integrate ML predictions in frontend using fetch/AJAX.
6. Create dynamic dashboard using Chart.js/Plotly.
7. Implement JWT tokens or sessions for authentication.
8. Add file upload functionality (image/text for prediction).
9. Store interactions/predictions in database and visualize history.
10. Create CI/CD pipeline using GitHub Actions/Heroku.
11. Build mini-project: News Classifier / Spam Detector / Fake News Detector.
12. Final Demo & Deployment on Render/Heroku/Vercel/localhost.

Text Books:

1. **“Full Stack Deep Learning”** by Emmanuel Ameisen, O‘Reilly, 2020
2. **“Flask Web Development”** by Miguel Grinberg, O‘Reilly, 2018

3. **“Python Machine Learning”** by Sebastian Raschka, Packt Publishing Reference Books:
4. “Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow” by Aurélien
5. Géron
6. **“MongoDB: The Definitive Guide”** by Kristina Chodoro
7. **“Node.js Design Patterns”** by Mario Casciaro

Online Courses:

1. Full Stack Web Development with Flask and Python- Udemy

B.Tech. - III Year II Semester

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

Pre-Requisites: Basic communication skills, fundamental English language proficiency, and a willingness to participate in interpersonal and professional development activities.

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

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

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

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

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

Unit I : Soft Skills & 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:
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: 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, K I 2018 ,esuoH gnihsilbuP lanoitanretnI

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 Press, 2018
5. 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_j2PUy0pwjVUgj7Kl J
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc
7. https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

B.Tech. - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24MCHS309A	IP	**Technical Report Writing & IPR** (Common for all branches of Engineering)	2	0	0	0

Pre-Requisites:

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

Course Objectives: ·

- To enable 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, Students 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 andlogical 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:

Technical Research Paper Writing: Abstract- Objectives-Limitations-Review of Literature-Problemsand Framing Research Questions- Synopsis

Unit III: Process of Research:

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

Uniit IV: Intellectual property and Trade Marks:

Introduction to Intellectual Property: Introduction, types of intellectual property, International organizations, agencies and ties, importance of intellectual property rights

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and uating trade mark, trade mark registration processes.

Unit V: Copy Right and Patent Laws:

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.h tml
3. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.h tml
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

B.Tech. III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C

24IPWS302L	**WS**	**Workshop** (Common to all branches of Engineering)	**0**	**0**	**0**	**0**

Pre-Requisites: Basic knowledge of programming concepts using any programming language, fundamental understanding of mathematics, familiarity with core technical subjects, and basic problem-solving and logical thinking skills.

Course Objectives:

- To provide domain-specific knowledge and practical exposure in emerging areas relevant to various engineering disciplines.
- To enhance analytical thinking and problem-solving skills through hands-on sessions and real-world applications.
- To develop the ability to apply theoretical concepts learned in earlier semesters to practical engineering scenarios.
- To promote active learning and technical competency through participation in quizzes, assignments, and interactive activities.
- To prepare students for industry and research challenges by strengthening their technical skills and fostering a habit of continuous learning.

Course Outcomes (COs):

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

CO1: Explain the fundamental concepts and techniques covered in the workshop. (L2)

CO2: Apply domain-specific tools and techniques to solve basic problems (L3)

CO3: Analyze real-world problems and identify appropriate methodologies for solution development. (L4)

CO4: Develop practical solutions using learned concepts and hands-on experience. (L6)

CO5: Evaluate the effectiveness of implemented solutions and interpret the results. (L5)

B. Tech - III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C

24IPIN403L	**IP**	**Industrial Internship** (Common for 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)

B.Tech. - IV Year
I Semester

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC30406T	PC	Generative AI	2	1	0	3

Pre-Requisites: Basic knowledge of Artificial Intelligence, Machine Learning, Python programming, and Natural Language Processing concepts.

Course Objectives

- Introduce the fundamentals of Generative AI, including its principles, architecture, and evolution.
- Provide a deep understanding of Large Language Models (LLMs) and their application in natural language generation tasks.
- Develop practical knowledge of Prompt Engineering, including prompt tuning, prompt design, and performance evaluation.
- Explore applications of Generative AI across various domains including code generation, art synthesis, content generation, and interactive systems.
- Equip students with ethical, social, and safety considerations when designing and deploying generative AI applications.

Course Outcomes (COs):
On successful completion of the course, Student will be able to

CO1: Apply the architecture and functioning of Generative AI models, including transformers and large language models (LLMs). (L3)
CO2: Apply prompt engineering techniques to guide model behavior for desired outputs across various tasks. (L3)
CO3: Evaluate and fine-tune generative models for applications such as text generation, image creation, music synthesis, and conversational AI. (L5)
CO4: Analyze and evaluate the effectiveness of prompts and generated content using appropriate metrics and methodologies. (L4)
CO5: Analyzeethical principles for the responsible development and deployment of generative AI systems. (L4).

UNIT I – Introduction to Generative AI (Cognitive Level: Understand, Remember)

Overview of AI and types of AI, What is Generative AI? Definitions and Concepts, Historical evolution of generative models, Types of generative models – GANs, VAEs, Autoregressive Models, Introduction to Transformers and LLMs, Applications and use cases of Generative AI, Challenges in Generative AI development, Introduction to text-to-image and image-to-text models.

UNIT II – Fundamentals of Prompt Engineering

Definition and significance of Prompt Engineering, Types of prompts: Zero-shot, One-shot, Few-shot, Techniques for effective prompt design, Prompt templates and chaining, Prompt tuning and parameter-efficient tuning, Evaluating prompt performance, Use of APIs for testing prompts (OpenAI, Cohere, Anthropic), Best practices and prompt libraries.

UNIT III – Working with Large Language Models (LLMs)
Overview of pre-trained LLMs: GPT, BERT, LLaMA, Claude, PaLM, Architectures and tokenization strategies, Fine-tuning vs. in-context learning, LLM-powered tools (ChatGPT, GitHub Copilot, Bard, Claude), Role of attention mechanism and transformer layers, Tools for model experimentation (Hugging Face, LangChain), Performance metrics for LLMs, Case studies of model adaptation and deployment.

UNIT IV – Applications of Generative AI

Text generation and summarization, Image and art generation (DALL·E, Midjourney, Stable Diffusion), Code generation and completion tools (Codex, Copilot), Music and video generation, Generative chatbots and customer service, Story generation and dialogue systems, Domain-specific applications (Legal, Healthcare, Education), Comparative study of generative models by task.

UNIT V – Ethics, Security & Responsible AI

Bias and fairness in LLMs and generative systems, Explainability and transparency in generative AI, Copyright and originality issues, Adversarial use of generative models – deepfakes, misinformation, AI safety protocols and red-teaming, Regulatory and policy frameworks for generative AI, Responsible prompt crafting and moderation.

Text Books:

1. Deep Learning with Python by François Chollet, Manning Publications
2. Transformers for Natural Language Processing by Denis Rothman, Packt
3. Practical Generative AI by Amit Shukla, BPB Publications

Reference Books:

1. Generative Deep Learning by David Foster, O‘Reilly
2. Artificial Intelligence: A Guide for Thinking Humans by Melanie Mitchell
3. Machine Learning B. Techning by Andrew Ng (available online)

Online Courses:

1. Generative AI with Large Language Models – Coursera (AWS & DeepLearning.AI)
2. Prompt Engineering for ChatGPT – Coursera
3. Generative AI Fundamentals – Google Cloud Training
4. Hugging Face – Transformers Course
5. DeepLearning.AI Short Courses

MANAGEMENT ELECTIVE - II (HM – II)

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS410T	HM	**Business Ethics and Corporate Governance** (Common to all branches of Engineering)	2	0	0	2

Pre-Requisites:

- Basic Understanding of Business, Management, and Organizational Concepts.
- Familiarity with Social Responsibility, Ethics, and Legal Awareness.

Course Objectives:

- To make the student understand the principles of business ethics
- To enable them in knowing about the ethics in management
- To facilitate the student‘role in corporate culture
- To impart knowledge about the fair-trade practices
- To encourage the student in knowing about the corporate governance

Course Outcomes (COs):

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

CO1: Analyze ethical principles, value systems, business ethics, and CSR in organizational contexts. (L4)

CO2: Evaluate ethical theories (e.g., Utilitarianism, Distributive Justice) and apply them across functional areas. (L5)

CO3: Analyze corporate culture, leadership styles, and their impact on organizational effectiveness. (L4)

CO4: Evaluate legal and ethical compliance requirements related to corporate governance, environmental protection, and fair-trade practices. (L5)

CO5: Evaluate corporate governance practices, roles of boards, auditors, and committees (e.g., Cadbury Committee) in ensuring transparency and accountability. (L5)

Unit I: Ethics:

Introduction – Meaning – Nature, Scope, significance, Loyalty, and ethical behavior, Value systems - Business Ethics - Types, Characteristics, Factors, Contradictions and Ethical Practices in Management-Corporate Social Responsibility – Issues of Management – Crisis Management.

Unit II: Ethics in Management:

Introduction- Ethics in production, finance, Human resource management and Marketing Management - The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures - Culture and Individual Ethics – professional ethics and technical ethics.

Unit III: Corporate Culture:

Introduction - Meaning, definition, Nature, and significance – Key elements of corporate culture, shared values, beliefs and norms, rituals, symbols and language - Types of corporate culture, hierarchical culture, market driven culture – Organization leadership and corporate culture, leadership styles and their impact on culture, transformational leadership and culture change.

Unit IV: Legal Frame Work:

Law and Ethics -Agencies enforcing Ethical Business Behavior - Legal Impact – Environmental Protection, Fair Trade Practices, legal Compliances, Safeguarding Health and wellbeing of

Customers – Corporate law, Securities and financial regulations, corporate governance codes and principles.

Unit V: Corporate Governance:
Introduction - Meaning – Corporate governance code, transparency & disclosure -Role of auditors, board of directors and shareholders. Global issues, accounting and regulatory 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	2	0	0	2

Pre-Requisites:

- Basic Knowledge of Business and Internet Fundamentals.
- Familiarity with Computer Applications and Online Communication.

Course Objectives: The Objectives of this course are

- 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, Students 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

References:

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,* RaymondLeathamWiley India 2007
4. S. Jaiswal. *E-Commerce* GalgotiaPublication Pvt Ltd., 2003.

Online Resources:

1. https://www.slideshare.net/fatimahAlkreem/e-businessppt-67935771
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:

- Basic Understanding of Business, Management, and Organizational Concepts.
- Familiarity with Quantitative Reasoning and Problem-solving skills

Course Objectives:

- To provide fundamental knowledge on Management, Administration, Organization &its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection,Training & Development, job evaluation and Merit rating concepts
- To create awareness on identify Strategic Management areas & the PERT/CPM forbetter Project Management
- To make the students aware of the contemporary issues in modern management

Course Outcomes (COs):

On successful completion of the course, Students 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

References 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-and-organization-231308043/231308043
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
24PE31408T	**PE**	**Explainable AI & Model Interpretability** (Common to CSE-AI and CSE-AI&ML)	**3**	**0**	**0**	**3**

Course Objectives:

- To introduce the principles of interpretability and explainability in AI/ML models.
- To analyze the trade-offs between model accuracy and interpretability.
- To explore popular post-hoc and intrinsic explainability techniques.
- To examine fairness, accountability, and transparency in AI systems.
- To develop hands-on skills with interpretability tools and libraries.

Course Outcomes (COs):

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

CO1: Analyze the taxonomy of XAI techniques and regulatory implications (GDPR) to assess the need for transparency in black-box models. (L4)

CO2: Apply model-specific interpretability techniques, such as GAMs and visualization of decision trees, to explain transparent AI models. (L3)

CO3: Implement model-agnostic tools like LIME, SHAP, and PDPs to perform model debugging and feature importance analysis. (L3)

CO4: Analyze deep learning explainability through Grad-CAM, attention maps, and feature visualization for CNNs and Transformers. (L4)

CO5: Analyze fair and accountable AI pipelines using bias mitigation tools like AIF360 and What-If analysis. (L4)

Unit I: Foundations of Explainable AI:

Introduction to Explainability and Interpretability, Importance of XAI in Healthcare, Finance, and Law, White-box vs Black-box Models, Desiderata: Fairness, Accountability, Transparency, Human-Centered AI and Trust, Taxonomy of XAI Techniques (Global vs Local, Post-hoc vs Intrinsic), Regulatory and Ethical Implications (GDPR, AI Bill of Rights), Model Simplicity vs Predictive Power.

Unit II: Model-Specific Explainability Techniques:

Decision Trees and Rule-based Models, Linear Models and Feature Importance, Generalized Additive Models (GAMs), Visualization of Weights and Coefficients, Logistic Regression Coefficient Interpretation, Case Study: Credit Scoring using Transparent Models,Comparison of Interpretable ML Models, Use Cases and Trade-offs.

Unit III: Model-Agnostic Explainability Techniques:

Local Interpretable Model-agnostic Explanations (LIME), SHAP Values (SHapley AdditiveexPlanations), Partial Dependence Plots (PDPs), Individual Conditional Expectation (ICE) Plots, Anchors and Counterfactual Explanations, Feature Interaction and Permutation Importance, Comparative Analysis of SHAP, LIME, PDP, Model Debugging with XAI.

Unit IV: Deep Learning Explainability:

Visualizing CNNs: Filters, Feature Maps, Saliency Maps and Grad-CAM, Integrated Gradients, Explaining RNNs and LSTM Outputs, Concept Activation Vectors (TCAV), Attention-based Interpretability in Transformers, Explaining Language Models (BERT, GPT) Evaluation of Deep Model Explanations.

Unit V: Fairness, Bias & Tools for XAI:

Fairness Metrics: Demographic Parity, Equal OpportUnity, Sources of Bias in Data and Models, Discrimination Detection and Mitigation Strategies, Introduction to AIF360, What-If Tool, Fairlearn, Case Study: Bias in Hiring Algorithms, Explainability in ML Pipelines (MLFlow, Skater), XAI in Federated and Privacy-Preserving AI, Designing Interpretable AI Systems from Scratch.

Text Books:

1. Christoph Molnar, ―Interpretable Machine Learning‖, Leanpub.
2. Sameer Singh et al., ―Explainable AI: Interpreting, Explaining and Visualizing Deep Learning‖, Springer.
3. Dan Roth, Zachary Lipton, and Been Kim, ―Explainable AI: Foundations, Developments, Prospects‖, MIT Press (Online forthcoming).

Reference Books:

1. Marco Tulio Ribeiro et al., ―Why Should I Trust You?‖ (LIME) – Research Paper
2. Scott Lundberg et al., ―A Unified Approach to Interpreting Model Predictions‖ (SHAP) – NIPS
3. A. Barredo Arrieta et al., ―Explainable Artificial Intelligence (XAI): Concepts, Taxonomies, OpportUnities and Challenges‖, Information Fusion Journal.
4. Zachary C. Lipton, ―The Mythos of Model Interpretability‖ – Communications of the ACM

Online Learning Resources:

- Coursera – Explainable AI with Google Cloud
- Udacity – AI for Everyone by Andrew Ng
- HarvardX – Data Science: Machine Learning Interpretability

B. Tech - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31409T	PE	**AI for Robotics** (Common to CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Programming, Linear Algebra, Control Systems, Artificial Intelligence, and Robotics fundamentals.

Course Objectives:

- Introduce the fundamental principles of robotics and artificial intelligence integration.
- Understand robot perception, localization, mapping, motion planning, and control using AI algorithms.
- Apply machine learning and deep learning techniques in robotic environments.
- Explore the use of reinforcement learning, behavior-based AI, and neural networks in autonomous robots.
- Enable students to build intelligent robots that can perceive, learn, and adapt to dynamic environments.

Course Outcomes (COs):

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

CO1: Analyze autonomous robot architectures and programming frameworks (ROS) to integrate sensors and actuators with AI logic. (L4)

CO2: Apply computer vision and sensor fusion techniques (Kalman/Particle filters) to implement SLAM and 3D scene reconstruction. (L3)

CO3: Implement path planning (A*, RRT) and trajectory optimization for autonomous navigation in dynamic environments. (L3)

CO4: Analyze learning-based models, including reinforcement learning and imitation learning, to develop adaptive robotic behaviors. (L4)

CO5: Evaluate the ethical considerations and performance of AI-enabled humanoid or industrial robots in real-world human-robot interaction scenarios. (L5)

Unit I: Fundamentals of Robotics and AI:

Introduction to Robotics: Types and Components, Overview of Artificial Intelligence and Machine Learning, Relationship between Robotics and AI, Sensors and Actuators in Robotics, Embedded Systems and Microcontrollers in Robotics, Architecture of Autonomous Robots, Programming Tools: ROS (Robot Operating System), Python, C++, Applications of AI in Robotics – Overview

Unit II: Perception and Sensor Fusion:

Computer Vision for Robotics: Basics and Techniques, Depth Sensing, RGB-D Cameras, LIDAR, and Ultrasonic Sensors, Feature Extraction and Object Recognition, Kalman Filter and Extended Kalman Filter, Particle Filter and Sensor Fusion Techniques, SLAM (Simultaneous Localization and Mapping) – Concepts, Visual SLAM and LiDAR-based SLAM, 3D Mapping and Scene Reconstruction.

Unit III: Motion Planning and Navigation:

Path Planning Algorithms – Dijkstra, A*, RRT, Obstacle Detection and Avoidance, Robot Kinematics and Dynamics, Trajectory Generation and Optimization, Localization Techniques – GPS, Wi-Fi, Odometry, Autonomous Navigation in Indoor and Outdoor Environments, Multi-Robot Coordination and Swarm Intelligence, Integration of Perception and Planning Systems

Unit IV: AI Techniques in Robotics:

Supervised and Unsupervised Learning for Robotics, Neural Networks and Deep Learning Models for Robot Vision, Reinforcement Learning – Q-Learning and Deep Q Networks, Policy Gradient and Actor-Critic Methods, Behavior-Based Robotics and Finite State Machines, Imitation Learning and Learning from Demonstration, Transfer Learning for Robotic Tasks, Safety and Generalization in AI Models for Robots

Unit V: Advanced Applications and Ethical Considerations:

Humanoid and Service Robots with AI, AI in Industrial, Healthcare, and Assistive Robotics, Edge AI and Real-Time Inference in Robots, Human-Robot Interaction and Social Intelligence, Autonomous Vehicles and Delivery Drones, AI in Robotics Competitions (RoboCup, DARPA), Ethical Issues in AI-Enabled Robotics, Future Trends: Neuromorphic and Quantum Robotics

Text Books:

1. "Artificial Intelligence for Robotics" by Robin R. Murphy
2. "Probabilistic Robotics" by Sebastian Thrun, Wolfram Burgard, Dieter Fox
3. "Introduction to Autonomous Robots" by Nikolaus Correll, Bradley Hayes, et al.

Reference Books:

1. "Robot Operating System (ROS) for Absolute Beginners" by Lentin Joseph
2. "Modern Robotics: Mechanics, Planning, and Control" by Kevin M. Lynch and Frank C. Park
3. "Learning for Adaptive and Reactive Robot Control" by Aude Billard, Jean-Jacques Slotine
4. IEEE Transactions and Springer Journals on Robotics and Intelligent Systems

Online Courses:

1. AI for Robotics – Udacity (by Sebastian Thrun)
2. Modern Robotics: Mechanics, Planning, and Control – Coursera (Northwestern University)
3. Deep Learning for Robotics – edX

B. Tech - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31410T	PE	**AI in Cybersecurity** (Common to CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Computer Networks, Cybersecurity fundamentals, Python programming, Data Analysis, and Artificial Intelligence concepts.

Course Objectives:

- To introduce the fundamental concepts of AI and their applications in cybersecurity.
- To understand AI-driven techniques for threat detection, classification, and mitigation.
- To explore machine learning and deep learning methods used for malware and intrusion detection.
- To equip students with skills in building intelligent security systems.
- To examine ethical, legal, and privacy aspects in AI-driven cybersecurity.

Course Outcomes:

CO1: Demonstrate AI and cybersecurity fundamentals to understand intelligent threat detection systems. (L3)

CO2: Apply intrusion detection and anomaly detection models for securing network environments. (L3)

CO3: Analyze malware analysis and phishing detection techniques using AI models. (L4)

CO4: Examine adversarial attacks and robustness mechanisms in AI-based security systems. (L4)

CO5: Evaluate AI-powered cyber threat intelligence and automated incident response frameworks. (L5)

Unit I: Introduction to AI in Cybersecurity:

Role of AI in Modern Cybersecurity, Overview of Cyber Threats and Attack Vectors, Fundamentals of Machine Learning for Security, AI vs Traditional Security Techniques, AI-Based Cyber Defense Lifecycle, Threat Intelligence with AI, Cybersecurity Data Types and Challenges, Case Studies of AI-Driven Attacks and Defenses

Unit II: Machine Learning for Cyber Threat Detection:

Supervised Learning for Intrusion Detection, Unsupervised Learning for Anomaly Detection, Feature Engineering from Network Traffic, Classification Algorithms: SVM, Decision Trees, Random Forests, Clustering Techniques: K-Means, DBSCAN, Ensemble Models and Model Evaluation Metrics, Real-Time Threat Detection Pipelines, Data Imbalance and Adversarial Sampling

Unit III: Deep Learning in Cybersecurity:

Neural Networks for Threat Classification, CNNs for Malware Detection from Binary Files, RNNs/LSTMs for Sequential Log Analysis, Autoencoders for Anomaly Detection,GANs in Malware Evasion and Defense,Transfer Learning for Threat Signature Extraction, Deep Learning vs Traditional Models: A Comparative Study,Real-World Use Cases and Limitations

Unit IV: AI for Specific Security Domains:

AI for Phishing and Spam Detection, AI in Cloud Security and Edge Devices, Botnet and DDoS Attack Detection**,** AI-Driven Endpoint Security, Natural Language Processing for Threat Intelligence, Behavioral Biometrics and Fraud Detection, AI in Social Engineering Attack Prevention, Security Information and Event Management (SIEM) with AI

Unit V: Challenges, Ethics & Future of AI in Cybersecurity:

Explainable AI (XAI) in Cybersecurity, Adversarial Attacks and Defenses in AI Systems, Data Privacy and Federated Learning, Legal and Ethical Issues in AI Security Solutions, AI Model Bias and Fairness in Security Decisions, Securing AI Models Against Manipulation, Building Scalable AI-Powered SOCs, Future Trends: Autonomous Security, AI-Augmented Threat Hunting

Textbooks:

1. Clarence Chio & David Freeman, ―Machine Learning and Security‖, O‘Reilly Media.
2. Xiaofeng Chen et al., ―Artificial Intelligence and Big Data Analytics for Cybersecurity‖, Springer.
3. Mark Stamp, ―Information Security: Principles and Practice‖, Wiley.

Reference Books:

1. Sumeet Dua & Xian Du, ―Data Mining and Machine Learning in Cybersecurity‖, CRC Press.
2. Shai Shalev-Shwartz & Shai Ben-David, ―Understanding Machine Learning‖, Cambridge University Press.
3. Zhiwei Lin & Yang Xiang, ―Cyber Security Intelligence and Analytics‖, Springer.
4. Bhavani Thuraisingham, ―Data Mining for Malware Detection‖, CRC Press.

Online Learning Resources:

1. Coursera – ―AI for Cybersecurity‖ by University of Colorado
2. Udemy – ―Machine Learning for Cybersecurity‖
3. edX – ―Cybersecurity MicroMasters‖ by RIT

B. Tech - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31411T	PE	**AI-driven Software Engineering & DevOps** (Common to CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Software Engineering, Programming, Database Management Systems, Operating Systems, and DevOps fundamentals.

Course Objectives:

- To introduce the principles and practices of AI-driven software engineering and DevOps.
- To explore how AI techniques can automate and optimize software development workflows.
- To study intelligent tools for code generation, testing, monitoring, and deployment.
- To equip students with skills in AI-powered CI/CD pipelines and operations.
- To foster an understanding of ethical implications and reliability in intelligent software systems.

Course Outcomes (COs):

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

CO1: Analyze the opportunities for AI in the software lifecycle, including learning from code representations and knowledge graphs. (L4)

CO2: Apply large language models and prompt engineering to automate code generation, refactoring, and bug detection. (L3)

CO3: Demonstrate intelligent QA frameworks using AI-based test case generation and reinforcement learning for test prioritization. (L3)

CO4: Analyze AI-powered CI/CD pipelines to implement predictive build failure analysis and infrastructure orchestration. (L4)

CO5: Examine AI solutions for AIOps, including root cause analysis and predictive maintenance, in modern software operations. (L4)

Unit I: Foundations of AI in Software Engineering:

Overview of Traditional vs AI-driven Software Development, AI OpportUnities in Software Lifecycle Phases, Introduction to ML/DL Models in Engineering Tasks, Code Representation and Learning from Code, NLP for Source Code Understanding, Software Knowledge Graphs and Reasoning, Datasets and Benchmarks for Software Engineering AI, Case Studies of AI-Enhanced Development Tools

Unit II: AI in Code Generation and Refactoring:

Program Synthesis and Code Completion Models, Large Language Models (e.g., Codex, CodeBERT) in IDEs, Code Clone Detection and Automated Refactoring, Learning-Based Bug Detection and Code Smell Identification, AI in Software Architecture Recommendations, Embedding Techniques for Source Code, Prompt Engineering for Software Tasks, Reliability and Safety in Generated Code

Unit III: Intelligent Testing, QA, and Debugging:

Test Case Generation Using AI, Automated Unit Testing, Regression Testing with ML, Learning Bug Patterns from Repositories, AI-Based Static and Dynamic Code Analysis, Fault Localization and Automated Debugging, Quality Assurance Metrics Enhanced by AI, Reinforcement Learning for Test Prioritization, Ethics and Bias in AI-Driven Testing – (E)

Unit IV: AI in DevOps Automation and CI/CD:

DevOps Fundamentals and Integration with AI, Intelligent CI/CD Pipeline Design, Predictive Build Failure and Log Analysis, AI in Infrastructure-as-Code and Deployment Orchestration, Self-Healing

Systems and AIOps Concepts, Log Analytics and Anomaly Detection in Production, AI in Monitoring, Tracing, and Feedback Loops, DevSecOps and AI for Security Automation

Unit V: Advanced Topics and Ethical Considerations:
Explainability and Transparency in AI-Driven Tools, Ethical and Legal Aspects in Automated Engineering, Human-AI Collaboration in Software Teams, Risk Management in Autonomous Code Deployment, AI for Technical Debt Prediction and Management, AI for Developer Productivity Analytics, Research Trends and Challenges in AI for SE, Capstone: Building a Smart DevOps Workflow

Text Books:

1. Tim Menzies, Diomidis Spinellis, and Thomas Zimmermann, ―Perspectives on Data Science for Software Engineering‖, Morgan Kaufmann.
2. André van der Hoek, Reid Holmes, ―Software Engineering for Machine Learning‖, Springer.
3. Len Bass, Ingo Weber, Liming Zhu, ―DevOps: A Software Architect's Perspective‖, Addison-Wesley.

Reference Books:

1. Carlos Eduardo Parnin et al., ―AI for Software Engineering: Foundations, Advances, and Trends‖, Springer.
2. Luciano Baresi et al., ―Machine Learning Techniques for Software Quality Evaluation‖, Springer.
3. Gene Kim, Jez Humble, and Nicole Forsgren, ―Accelerate: The Science of Lean Software and DevOps‖, IT Revolution.

Online Learning Resources:

- Coursera – ―AI for Software Engineering‖ by DeepLearning.AI
- edX – ―DevOps for Developers‖ by Microsoft
- GitHub Copilot and OpenAI Codex documentation
- PapersWithCode – AI for Software Engineering benchmarks
- MIT OCW – ―Software Systems‖ and ―DevOps and CI/CD‖
- Udemy – ―AI-Powered DevOps Pipelines and Automation‖
- Google Cloud – AIOps and MLOps tutorials

Professional Elective – V
(PE - V)

B. Tech - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31412T	PE	**AI for Smart Cities & IoT Systems** (Common to CSE-AI & CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of IoT concepts, Computer Networks, Sensors and Embedded Systems, Data Analytics, and Artificial Intelligence fundamentals.

Course Objective:

- To understand the foundational concepts of smart cities and IoT architectures integrated with AI technologies.
- To explore AI-driven solutions for urban mobility, transportation, and traffic management systems.
- To apply AI and IoT techniques for efficient energy, waste, and water management in smart urban environments.
- To examine AI applications in smart healthcare, surveillance, and public safety systems.
- To design, deploy, and evaluate AIoT systems with an understanding of real-time processing, governance, and future challenges.

Course Outcomes (COs):

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

CO1: Analyze the architecture and components of smart cities and explain how AI and IoT integrate to optimize urban planning and services. (L4)

CO2: Apply AI models in transportation systems to improve traffic flow, public mobility, and autonomous vehicle operations. (L3)

CO3: Examine AI and IoT solutions for sustainable energy, waste, and water management in smart city ecosystems. (L4)

CO4: Analyze AI-based healthcare, surveillance, and emergency response applications, considering privacy and ethical aspects. (L4)

CO5: Design and deploy AIoT systems using edge/cloud platforms and evaluate them using appropriate governance and performance metrics. (L5)

Unit I: Introduction to AI in Smart Cities and IoT Systems:

Smart City Concepts: Components, Infrastructure, and Urban Needs, Overview of IoT and AI Integration, Smart City Frameworks (India, Singapore, EU, etc.), IoT Architecture: Sensing, Network, Processing, and Application Layers, Role of AI in Urban Planning and Resource Optimization, Case Studies on AI in Smart Cities, Edge, Fog, and Cloud Computing Concepts for Smart Systems

Unit II: AI Applications in Smart Transportation and Mobility:

Traffic Monitoring and Congestion Prediction using AI, Intelligent Traffic Signal Control using Reinforcement Learning, Autonomous Vehicles and AI Algorithms, Vehicle Detection and License Plate Recognition using CV, Public Transport Optimization using Predictive Analytics, Smart Parking and Navigation Systems, Use of Drones and AI for Traffic Surveillance

Unit III: AI and IoT for Smart Energy, Waste, and Water Management:

AI for Smart Grids and Energy Consumption Prediction, Load Balancing and Demand Forecasting using ML, Waste Segregation and Collection Automation using CV, Water Quality Monitoring Systems using IoT Sensors, Leak Detection and Anomaly Detection Models, Smart Metering and Energy Theft Detection, Sustainability and Carbon Monitoring AI Models

Unit IV: Smart Healthcare, Surveillance, and Public Safety:

IoT-based Health Monitoring and Alert Systems, Predictive Healthcare and Disease Outbreak Detection, AI for CCTV Surveillance, Crowd Monitoring, and Violence Detection, NLP for Emergency Response and Chatbot Assistance, Smart Ambulance Routing and Response Optimization, COVID-19 Contact Tracing and Monitoring via AI & IoT, Data Privacy, Security & Ethical Issues in Surveillance Systems

Unit V: AIoT System Design, Deployment, and Governance:

AI Model Deployment on Edge Devices (Raspberry Pi, Jetson Nano), Smart City Dashboards and Data Visualization, Real-time Streaming and Analytics Platforms (Apache Kafka, Spark), Cloud Integration: AWS IoT, Google Cloud AI, Azure IoT Suite, Governance Frameworks, Data Privacy, and Policy Standards, Evaluation Metrics for Smart City Projects, Future Trends in AIoT and Smart Urban Living

Text Books:

1. Pethuru Raj & Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.
2. Janaka Ekanayake, Smart Grid: Technology and Applications, Wiley.
3. Rajkumar Buyya, Fog and Edge Computing: Principles and Paradigms, Wiley.
4. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley.

Reference Books:

1. Mahalik N. P., Sensor Networks and Applications, McGraw Hill.
2. Kim F. Taylor, Urban Artificial Intelligence and Governance, Springer.
3. Dastbaz, J. & Pattinson, C., Smart Cities: Innovation and Sustainability, Springer.
4. Research papers from IEEE Smart Cities, AIoT Journal, and Springer Urban Tech.

Online Courses:

1. Coursera – Smart Cities: Management of Smart Urban Infrastructures (EPFL)
2. edX – Internet of Things (IoT) Program – Curtin University

B. Tech - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31413T	PE	**MLOps& AI Model Deployment** (Common to CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Python programming, Machine Learning, Software Engineering, Cloud Computing, and DevOps fundamentals.

Course Objective:

- To understand the principles and best practices of operationalizing machine learning models in production environments.
- To explore the life cycle of AI model development, deployment, monitoring, and maintenance using modern MLOps frameworks.
- To develop skills in CI/CD for ML, reproducibility, model versioning, and containerization using Docker and Kubernetes.
- To deploy machine learning models using cloud-native services and track their performance using real-time metrics.
- To address scalability, reliability, and ethical considerations in ML model deployment.

Course Outcomes (COs):

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

CO1: Illustrate the lifecycle and pipeline components of MLOps and implement basic version control and orchestration for ML workflows. (L3)

CO2: Combine ML models using appropriate tools and deploy them using Docker and Kubernetes environments with effective resource management. (L5)

CO3: Examine and deploy machine learning models as APIs using FastAPI/Flask and configure for real-time or batch inference scenarios. (L3)

CO4: Demonstrate and log ML systems using modern tools and detect data/model drift with strategies for continuous evaluation and feedback. (L3)

CO5: Experiment end-to-end MLOps solutions using cloud platforms and CI/CD tools, and analyze deployment challenges in real-world use cases. (L4)

Unit I: Introduction to MLOps and Deployment Pipelines:

Definition and need of MLOps, ML system lifecycle and pipeline components, DevOps vs. MLOps: key differences, CI/CD for ML projects, Data versioning and model lineage, Introduction to DVC, Git, and MLFlow, Workflow orchestration using Apache Airflow, Automated testing in ML pipelines,

Unit II: Model Packaging and Environment Management:

Packaging ML models using Pickle, Joblib, ONNX, Python virtual environments, Conda, Pipenv, Introduction to Docker for ML workloads, Building Dockerfiles for ML apps, Using Kubernetes for orchestration, Security, logging, and resource management, Docker Compose and Helm charts for deployment, Hands-on: Containerize and deploy a scikit-learn model

Unit III: Model Serving and APIs:

RESTful API design for ML models, Model deployment using FastAPI and Flask, TensorFlow Serving, TorchServe basics, Introduction to gRPC for ML deployment, Asynchronous inference and batch vs real-time serving, Load testing and benchmarking, Authentication and authorization in model APIs, Deploying models on edge devices

Unit IV: Monitoring, Logging, and Continuous Evaluation:

Importance of monitoring and alerting in MLOps, Data drift and model drift detection, Logging prediction results and metadata, Prometheus, Grafana, and ELK Stack, A/B testing and canary deployments, Shadow deployments and rollback strategies, Feedback loops for continuous learning, Integration with external monitoring tools

Unit V: Cloud-native MLOps and Case Studies:

ML deployment on AWS SageMaker, Azure ML, Google AI Platform, CI/CD using GitHub Actions, Jenkins, and GitLab CI, AutoML and model registry, Real-world case study: End-to-end MLOps pipeline, Challenges and limitations in enterprise ML deployment, Responsible AI in production systems, Future trends in MLOps, Capstone Project Planning

Text Books:

1. Introducing MLOps: How to Scale Machine Learning Projects with DevOps Tools – Mark Treveil, Alok Shukla, O'Reilly Media.
2. Machine Learning Engineering – Andriy Burkov, TrueShelf Publishing.
3. Designing Machine Learning Systems – Chip Huyen, O‘Reilly Media.

Reference Books:

1. Practical MLOps – Noah Gift, O‘Reilly Media
2. Kubeflow for Machine Learning – Trevor Grant et al., O'Reilly
3. Hands-On MLOps: Implement Machine Learning in Production – Munn, Meza, Vohra, Packt Publishing
4. Research papers from arXiv, MLSys Conference, and ICML Industry Track

Online Courses:

1. Coursera – MLOps Specialization by DeepLearning.AI
2. Google Cloud – MLOps: Continuous Delivery and Automation Pipelines
3. Udemy – MLOps: ML Pipelines, CI/CD, and Model Deployment

B. Tech - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30412T	PE	**Data Wrangling** (Common to AI&DS, CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Python programming, Data Analysis, Statistics, Database Management Systems, and Spreadsheet/Data Handling techniques.

Course Objectives:

- To introduce the fundamental techniques for acquiring, cleaning, transforming, and manipulating data.
- To enable students to handle real-world messy data for analysis and machine learning.
- To teach efficient use of libraries like Pandas, NumPy, and SQL for data wrangling.
- To promote understanding of handling missing values, outliers, and inconsistent formats.
- To expose students to automation, reproducibility, and workflow design in data preprocessing.

Course Outcomes (COs):

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

CO1: Explain and apply core data wrangling techniques. (L3)
CO2: Apply data cleaning, transformation, and reshaping techniques using Python and SQL. (L3)
CO3: Analyze and handle missing values, data inconsistencies, and outliers in datasets. (L4)
CO4: Analyze techniques to merge and join multiple datasets from diverse sources. (L3)
CO5: Analyze data pipelines and preprocessing workflows for analytics and machine learning. (L4)

Unit I: Introduction to Data Wrangling and Data Acquisition:

Introduction to Data Wrangling: Importance and Use Cases, Types of Data: Structured, Semi-Structured, Unstructured, Data Acquisition Techniques: APIs, Web Scraping, Reading Data from CSV, Excel, JSON, XML, Using Python libraries: pandas, requests, BeautifulSoup, Working with Databases using SQLAlchemy and pandas, Loading Large Datasets and Chunking, Exploratory Analysis Before Cleaning.

Unit II: Handling Missing, Noisy, and Inconsistent Data:

Identifying and Understanding Missing Data, Techniques for Imputing Missing Values, Handling Inconsistent Data: Dates, Texts, Units, Removing Duplicates and Irrelevant Data, Detecting and Treating Outliers, Normalization and Standardization Techniques, Regular Expressions for Text Cleaning, Visualizing Missing/Outlier Data.

Unit III: Data Transformation and Feature Engineering:

Data Type Conversion and Parsing, Feature Extraction from Text, Dates, and Strings, One-Hot Encoding, Label Encoding, Binning and Discretization, Data Aggregation and Grouping, Pivoting, Melting, and Reshaping Data, Handling Imbalanced Data, Creating Derived Features and Feature Selection.

Unit IV: Data Integration, Joining, and Workflows:

Merging and Joining Datasets (Inner, Outer, Left, Right), Concatenation and Appending DataFrames, Data Consistency and Referential Integrity, Resolving Schema Mismatches, Designing Reusable Data Wrangling Functions, Automating Workflows with Functions and Pipelines, Data Lineage and Documentation, Case Study: End-to-End Data Wrangling Pipeline.

Unit V: Tools, Libraries, and Case Studies in Data Wrangling:

Pandas and NumPy Advanced Techniques, Pyjanitor, Dask, and Polars for Efficient Wrangling, Using OpenRefine for Data Cleaning, SQL vs NoSQL in Data Wrangling, Real-world Wrangling Case Studies (Finance, Healthcare, Retail), Best Practices and Common Pitfalls in Data Wrangling, Reproducibility and Versioning in Data Pipelines, Final Capstone: Build and Evaluate a Clean Dataset for ML/

Textbooks:

1. M. Heydt – Data Wrangling with pandas, O‘Reilly Media.
2. Hadley Wickham – R for Data Science (Data Wrangling Chapters), O‘Reilly.
3. J. VanderPlas – Python Data Science Handbook, O‘Reilly Media.

Reference Books:

1. Wes McKinney – Python for Data Analysis, O‘Reilly.
2. Cathy O'Neil and Rachel Schutt – Doing Data Science, O‘Reilly.
3. David Mertz – Cleaning Data for Effective Data Science, Packt.

Online Resources:

1. Data Wrangling with pandas (Datacamp): https://www.datacamp.com/courses/data-manipulation-with-pandas
2. Coursera: Data Wrangling, Analysis and AB Testing with SQL – *https://www.coursera.org/learn/data-wrangling-analysis-abtesting*
3. edX: Data Wrangling with R – https://online.rice.edu/courses/data-wrangling-r

B. Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31414T	PE	**Healthcare AI** (Common to CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of Artificial Intelligence, Machine Learning, Data Analytics, Statistics, and healthcare data concepts.

Course Objectives:

- To provide a foundational understanding of AI applications in healthcare.
- To familiarize students with medical data types, preprocessing, and ethical considerations.
- To explore ML and DL algorithms tailored for diagnosis, prognosis, and treatment recommendations.
- To expose students to real-world healthcare systems and AI solutions like predictive modeling, EHRs, and medical imaging.
- To enable students to design, evaluate, and deploy AI-driven healthcare applications.

Course Outcomes (COs):

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

CO1: Apply AI concepts in healthcare systems for diagnosis, prognosis, and monitoring applications. (L3)

CO2: Apply biomedical data preprocessing and feature engineering techniques for clinical analytics. (L3)

CO3: Analyze ML/DL model performance in healthcare using appropriate metrics and interpretability methods. (L4)

CO4: Experiment AI applications in disease diagnosis, medical imaging, and personalized medicine. (L4)

CO5: Evaluate ethical, legal, and regulatory issues in responsible healthcare AI deployment. (L5)

Unit I: Introduction to AI in Healthcare:

Overview of Healthcare Systems and Data Ecosystem , AI in Clinical Decision Support Systems (CDSS), Types of Medical Data: EHRs, Imaging, Genomic, Sensor Data, Applications of AI in Diagnosis, Prognosis, and Monitoring, Use Cases: Radiology, Pathology, Oncology, Cardiology, Limitations and Challenges of AI in Healthcare, AI for Telemedicine and Remote Patient Monitoring.

Unit II: Medical Data Preprocessing and Feature Engineering:

Data Cleaning, Imputation, and Normalization for Clinical Data, Handling Missing Values, Outliers, and Bias, Feature Engineering from EHRs and Time-Series Data, Text Mining for Medical Notes using NLP, Encoding Diagnosis and Procedure Codes (ICD, CPT), Temporal Pattern Extraction from Clinical Sequences, Data Privacy, Anonymization, and HIPAA Compliance.

Unit III: Machine Learning & Deep Learning in Healthcare:

Supervised Learning for Risk Prediction and Classification, Unsupervised Learning for Patient Segmentation, Deep Learning for Medical Imaging: CNNs, Transfer Learning, Recurrent Neural Networks for Time-series Clinical Data, Survival Analysis and Time-to-Event Prediction, Model Evaluation Metrics: Sensitivity, Specificity, AUC, Handling Imbalanced Datasets in Healthcare, Interpretability in Medical ML Models (LIME, SHAP)

Unit IV: Specialized Healthcare AI Applications:

AI for Disease Diagnosis: Diabetes, Cancer, Heart Disease, AI in Medical Imaging: X-ray, MRI, CT Scan Analysis, Predictive Modeling for ICU Admission & Mortality Risk, AI in Genomics andPersonalized Medicine, Drug Discovery and Repurposing with AI, Chatbots and Virtual Health Assistants, Remote Monitoring using IoT & Wearables + AI.

Unit V: Ethics, Regulation, and Future Directions in Healthcare AI:

Ethical AI in Healthcare: Bias, Fairness, and Accountability, Regulatory Landscape: FDA Approval, CE Marking, Explainable AI and Clinical Trust, Federated Learning for Privacy-Preserving AI, Clinical Trials and AI Decision-Support Tools, Case Studies: Google DeepMind, IBM Watson Health, PathAI, Responsible Deployment of AI in Healthcare Settings.

Textbooks:

1. Jiang, Fei et al. – Artificial Intelligence in Healthcare: Past, Present and Future.
2. Kevin Frick – Introduction to Healthcare AI.
3. Eric Topol – Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again.

Reference Books:

1. Mathias Goyen – AI in Medical Imaging.
2. Bertalan Meskó – The Guide to the Future of Medicine: Technology and The Human Touch.
3. Peter Szolovits – Artificial Intelligence in Medicine (Morgan Kaufmann).

Online Learning Resources:

1. Coursera: AI for Medicine Specialization (offered by DeepLearning.AI)
https://www.coursera.org/specializations/ai-for-medicine
2. HarvardX: Data Science in Healthcare (edX)
https://online-learning.harvard.edu/course/data-science-healthcare

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 ECE, EEE, CSE, AI&DS, CSE-AI & CSE-AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Construction Materials and Building Components.
- Familiarity with Building Systems and Service Requirements.

Course Objectives:

- Understand properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
- Analyze the composition, manufacturing process, and properties of cement and admixtures.
- Apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
- Evaluate masonry, mortars, finishing techniques, and formwork systems.
- Assess various building services including plumbing, ventilation, air conditioning, acoustics, and fire protection.

Course Outcomes (COs):

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

CO1: Apply knowledge of conventional and modern building materials to explain their properties, specifications, and construction applications. (L3)

CO2: Analyze the performance characteristics of building materials under various environmental and structural loading conditions. (L4)

CO3: Evaluate building services systems including water supply, drainage, electrical, fire protection, and HVAC for efficient building operation. (L5)

CO4: Apply appropriate material selection criteria and service system design principles for safe and sustainable building construction. (L3)

CO5: Assess the integration of smart building technologies and energy management systems for optimized building performance. (L5)

Unit I: Stones, Bricks, Tiles, Timber, Aluminum, Glass, Paints and Plastics:

Stones and Bricks, Tiles: Building Stones – Classifications and Quarrying – Properties – Structural Requirements – Dressing. Bricks – Composition of Brick Earth – Manufacture and Structural Requirements, Fly Ash, Ceramics. Timber, Aluminum, Glass, Paints and Plastics: Wood – Structure – Types and Properties – Seasoning – Defects; Alternate Materials for Timber – GI/Fibre – Reinforced Glass Bricks, Steel & Aluminum, Plastics.

Unit II: Cement & Admixtures:

Types of Cement – Ingredients of Cement – Manufacture – Chemical Composition – Hydration – Field & Lab Tests – Fineness – Consistency – Initial & Final Setting – Soundness. Admixtures – Mineral & Chemical Admixtures – Uses.

Unit III: Building Components:

Lintels, Arches, Walls, Vaults – Stair Cases – Types of Floors – Types of Roofs: Flat, Curved, Trussed; Foundations – Types; Damp Proof Course; Joinery – Doors – Windows – Materials – Types.

Unit IV: Mortars, Masonry and Finishings:

Lime and Cement Mortars. Brick Masonry – Types – Bonds; Stone Masonry – Types; Composite Masonry – Brick-Stone Composite; Concrete, Reinforced Brick. Finishes: Plastering, Pointing, Painting, Claddings – Types – Tiles – ACP. Formwork: Types – Requirements – Standards – Scaffolding – Design; Shoring, Underpinning.

Unit V: Building Services:

Plumbing Services: Water Distribution, Sanitary Lines & Fittings; Ventilation: Functional Requirements, Systems of Ventilation. Air-Conditioning – Essentials and Types; Acoustics – Characteristics – Absorption – Acoustic Design; Fire Protection – Fire Hazards – Classification of Fire Resistant Materials and Constructions.

Text Books:

1. Building Materials and Construction – Arora & Bindra, Dhanpat Roy Publications.
2. Building Materials and Construction by G C Sahu, Joygopal Jena, McGraw Hill Pvt Ltd, 2015.

Reference Books:

1. Building Construction by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications (P) Ltd., New Delhi.
2. P. C. Varghese, Building Materials, Prentice Hall of India, 2015.
3. N. Subramanian, Building Materials Testing and Sustainability, Oxford Higher Education, 2019.
4. R. Chudley, Construction Technology, Longman Publishing Group, 1973.
5. S. K. Duggal, Building Materials, Oxford & IBH Publishing Co. Ltd., New Delhi, 2019.

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01406T	OE	**Environmental Impact Assessment** (Common to ECE, EEE, 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, Students 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 EIA Impact Evaluation and Analysis, Preparation of Environmental Base Map, Classification of Environmental Parameters, Criteria for the Selection of EIA Methodology, EIA Methods: Ad-Hoc Methods, Matrix Methods, Network Method, Environmental Media Quality Index Method, Overlay Methods and Cost/Benefit Analysis.

Unit II: Impact of Developmental Activities and Land Use:

Introduction and Methodology for the Assessment of Soil and Ground Water, Delineation of Study Area, Identification of Activities. Procurement of Relevant Soil Quality, Impact Prediction, Assessment of Impact Significance, Identification and Incorporation of Mitigation Measures. EIA in Surface Water, Air and Biological Environment: Methodology for the Assessment of Impacts on Surface Water Environment, Air Pollution Sources, Generalized Approach for Assessment of Air Pollution Impact.

Unit III: Assessment of Impact on Vegetation, Wild life and Risk Assessment:

Introduction – Assessment of Impact of Development Activities on Vegetation and Wildlife; Environmental Impact of Deforestation – Causes and Effects; Risk Assessment and Treatment of Uncertainty – Key Stages in Performing an Environmental Risk Assessment – Advantages of Environmental Risk Assessment.

Unit IV: Environmental Audit:

Introduction – Environmental Audit & Environmental Legislation – Objectives of Environmental Audit, Types of Environmental Audit, Audit Protocol, Stages of Environmental Audit, Onsite Activities, Evaluation of Audit Data and Preparation of Audit Report.

Unit V: Environmental Acts and Notifications:

The Environmental Protection Act, The Water Preservation Act, The Air (Prevention & Control of Pollution) Act, Wild Life Act – Provisions in the EIA Notification, Procedure for Environmental Clearance, Procedure for Conducting Environmental Impact Assessment Report – Evaluation of EIA Report. Concept of ISO and ISO 14000.

Text Books:

1. Environmental Impact Assessment Methodologies by Y. Anjaneyulu, B.S. Publication, Hyderabad, 2nd Edition, 2011.
2. Environmental Impact Assessment by Canter Larry W., McGraw-Hill Education Edi, 1996.

Reference Books:

1. Environmental Engineering by Peavy H.S., Rowe D.R., Tchobanoglous G., McGraw-Hill International Editions, New York, 1985.
2. Environmental Science and Engineering by Suresh K. Dhaneja, S.K. Katania & Sons Publication, New Delhi.
3. Environmental Science and Engineering by J. Glynn and Gary W. Hein Ke, Prentice Hall Publishers.
4. Environmental Pollution and Control by H.S. Bhatia, Galgotia Publication (P) Ltd, Delhi.

B. Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE02403T	OE	**Smart Grid Technologies** (Common to CE, ECE, CSE, AI&DS, CSE-AI and CSE-AI&ML)	3	0	0	3

Pre-Requisites:
- Basic Knowledge of Electrical Power Systems and Power System Components.
- Familiarity with Fundamental Communication Concepts and Electrical Measurements.

Course Objectives:
- To provide an understanding of the evolution of the electric power system and the need for Smart Grid technologies.
- To familiarize students with the architecture, components, and enabling technologies of Smart Grids.
- To develop knowledge of Wide Area Monitoring Systems (WAMS), including synchrophasor technology, PMUs, and PDCs.
- To introduce the concepts and applications of smart metering, AMR, and Advanced Metering Infrastructure (AMI).
- To impart understanding of communication technologies and protocols used in Smart Grid systems.

Course Outcomes (COs):

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

CO1: Describe the evolution, architecture, and enabling technologies of Smart Grid systems along with national and international deployment initiatives. (L3)

CO2: Analyze Wide Area Monitoring Systems using synchrophasor technology, PMU, and PDC for grid monitoring and blackout analysis. (L4)

CO3: Examine smart metering systems including AMR, AMI, smart meter functionalities, and demand-side management applications. (L4)

CO4: Analyze communication technologies and protocols used in Smart Grid systems including RF, PLC, optical fiber, and mobile communication. (L4)

CO5: Evaluate Smart Grid applications and cybersecurity aspects including renewable integration, energy storage systems, EVs, and security risk assessment. (L5)

Unit I: Introduction to Smart Grid:

Evolution of Electric Grid – Need for Smart Grid – Difference between Conventional & Smart Grid – Overview of Enabling Technologies – International Experience in Smart Grid Deployment – Smart Grid Road Map for India – Smart Grid Architecture.

Unit II: Wide Area Monitoring System:

Fundamentals of Synchrophasor Technology – Concept and Benefits of Wide Area Monitoring System – Structure and Functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC) – Road Map for Synchrophasor Applications (NAPSI) – Operational Experience and Blackout Analysis using PMU.

Unit III: Smart Meters:

Features and Functions of Smart Meters – Functional Specification – Category of Smart Meters – Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) Drivers and Benefits – AMI Protocol – Demand Side Integration: Peak Load, Outage and Power Quality Management.

Unit IV: Information and Communication Technology:

Overview of Smart Grid Communication System – Modulation and Demodulation Techniques: Radio Communication – Mobile Communication – Power Line Communication – Optical Fibre Communication – Communication Protocol for Smart Grid.

Unit V: Smart Grid Applications and Cyber Security:

Applications: Overview and Concept of Renewable Integration – Introduction to Distributed Generation – Role of Protective Relaying in Smart Grid – House Area Network – Advanced Energy Storage Technology: Flow Battery, Fuel Cell, SMES, Super Capacitors, Plug-in Hybrid Electric Vehicles. Cyber Security: Security Issues in DG, Distribution Automation, AMI, Electric Vehicle Management Systems – Approach to Assessment of Smart Grid Cyber Security Risks – Methodologies, Cyber Security Requirements – Smart Grid Information Model.

Text Books:

1. James Momoh, Smart Grid: Fundamentals of Design and Analysis, John Wiley and Sons, New York, 2012.
2. Janaka Ekanayake et al., Smart Grid: Technology and Applications, John Wiley & Sons, New Jersey, 2012.

Reference Books:

1. Power Grid Corporation of India Limited, Smart Grid Primer, 1st Edition, Bangalore, India, 2013.
2. Fereidoon P. Sioshansi, Smart Grid – Integrating Renewable, Distributed and Efficient Energy, Academic Press, USA, 2011.
3. Stuart Borlase, Smart Grids: Infrastructure, Technology and Solutions, CRC Press, England, 2013.
4. Phadke A G, Thorp J S, Synchronized Phasor Measurements and Their Applications, Springer, New York, 2012.

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03403T	OE	**3D Printing Technologies** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Engineering Materials and Manufacturing Processes.
- Familiarity with Technical Drawing and Design Fundamentals.

Course Objectives:

- Understand the fundamental concepts of prototyping and distinguish between traditional and rapid prototyping methods.
- Demonstrate the working principles, materials, and applications of solid-, liquid-, and powder-based RP systems.
- Define the processes and classifications of rapid tooling and reverse engineering techniques.
- Identify common errors in 3D printing and evaluate pre-processing, processing, and post-processing issues.
- Familiarize RP-related software and its role in applications such as design, manufacturing, and medical fields.

Course Outcomes (COs):

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

CO1: Apply the fundamentals of rapid prototyping technologies, including classification, processes, comparison with traditional manufacturing methods, and their role in product development. (L3)

CO2: Analyze working principles, materials, advantages, limitations, and applications of solid and liquid based rapid prototyping systems such as FDM, LOM, SLA, DLP, and SGC. (L4)

CO3: Analyze powder-based and other rapid prototyping systems including SLS, DMLS, LENS, EBM, 3DP, BPM, and SDM for suitable engineering and manufacturing applications. (L4)

CO4: Apply reverse engineering and rapid tooling concepts including scanning methods, data processing, and tool development for product design and manufacturing. (L3)

CO5: Evaluate errors in 3D printing processes, related software tools, data formats, and applications of rapid prototyping in engineering, medical, and industrial domains. (L5)

Unit I: Introduction to 3D Printing:

Introduction to Prototyping, Traditional Prototyping vs. Rapid Prototyping (RP), Need for Time Compression in Product Development, Usage of RP Parts, Generic RP Process, Distinction between RP and CNC, Classification of RP.

Unit II: Solid and Liquid Based RP Systems:

Working Principle, Materials, Advantages, Limitations and Applications of: Fusion Deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Stereolithography (SLA), Direct Light Projection System (DLP) and Solid Ground Curing (SGC).

Unit III: Powder Based & Other RP Systems:

Powder Based RP Systems: Working Principle, Materials, Advantages, Limitations and Applications of Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS) and Electron Beam Melting (EBM). Other RP Systems: Three-Dimensional Printing (3DP), Ballistic Particle Manufacturing (BPM), Shape Deposition Manufacturing (SDM).

Unit IV: Rapid Tooling & Reverse Engineering:

Rapid Tooling: Conventional Tooling vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling Methods. Reverse Engineering (RE): Meaning, Use, RE Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model Development.

Unit V: Errors in 3D Printing and Applications:

Pre-processing, processing and post-processing errors. Part building errors in SLA, SLS, etc. Software: MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, SolidView, 3DView, etc. Preparation of CAD models, Problems with STL files, STL file manipulation. RP Data Formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP. Applications: Design, Engineering Analysis and Planning, Rapid Tooling, Reverse Engineering, Medical Applications.

Text Books:

1. Chee Kai Chua and Kah Fai Leong, 3D Printing and Additive Manufacturing Principles and Applications, 5/e, World Scientific Publications, 2017.
2. Ian Gibson, David W Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Springer, 2/e, 2010.

Reference Books:

1. Frank W. Liou, Rapid Prototyping & Engineering Applications, CRC Press, Taylor & Francis Group, 2011.
2. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04312T	**OE**	**Microprocessors and Microcontrollers** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites: Basics of Digital Electronics and Programming

Course Objectives:

- To comprehend the architecture, operation, and configurations of the 8086 microprocessors.
- To get familiar with 8086 programming concepts, instruction set, and assembly language development tools.
- To study the interfacing of 8086 with memory, peripherals, and controllers for various applications.
- To learn the architecture, instruction set, and programming of the 8051 microcontrollers.
- To understand microcontroller interfacing techniques, peripheral programming, and processor comparisons.

Course Outcomes (COs):

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

CO1: Learn the fundamental architectural concepts of microprocessors. Apply knowledge of 8086 architecture to identify the roles of Bus Interface Unit (BIU) and Execution Unit (EU) in instruction execution. (L3)

CO2: Analyse the 8086-instruction set and addressing modes to develop assembly language programs for arithmetic and logical operations (L4)

CO3: Examine and Interfacing of Peripheral devices with the 8086 microprocessors. (L4)

CO4: Analyse the fundamentals of 8051 and the function of SFRs and I/O ports in executing control operations. (L4)

CO5: Evaluate the interfacing of peripheral devices with the 8086 microprocessors for efficient system performance(L5)

Unit I: 8086 Architecture:

Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing Unit, execution Unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

Unit II: 8086 Programming:

Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

Unit III: 8086 Interfacing:

Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDs, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237A DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

Unit IV: Microcontroller – 8051 Architecture:

Architecture of 8051 – Special Function Registers (SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming.

Unit V: 8051 Interfacing:

Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation. Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

Text Books:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V. Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition, 1994.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd Edition, McGraw Hill Education, 2017.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd Edition, Pearson, 2012.

Reference Books:

1. Ramesh S. Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th Edition, Penram International Publishing, 2013.
2. Kenneth J. Ayala, The 8051 Microcontroller, 3rd Edition, Cengage Learning, 2004.

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB408T	**OE**	**Wavelet transforms and its Applications** (Common to All Branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Calculus, Linear Algebra, and Transforms.
- Familiarity With Signals And Mathematical Analysis.

Course Objectives:

- To introduce the fundamental concepts of wavelets, wavelet expansion, and wavelet transform.
- To develop understanding of multiresolution analysis (MRA) and its role in signal representation.
- To explain the implementation of the Discrete Wavelet Transform (DWT) using filter banks and related structures.
- To provide knowledge of time-frequency analysis and compare wavelet transform with Fourier-based methods.

Course Outcomes (COs):

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

CO1: Understand wavelets and wavelet basis and characterize continuous and discrete wavelet transforms. (L3)

CO2: Illustrate 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 Wavelet Transforms, Prentice Hall, 1997.
2. James S. Walker, A Primer on Wavelets and their Scientific Applications, CRC Press, 1999.

Reference Books:

1. Raghuveer Rao, Wavelet Transforms, Pearson Education, Asia.
2. C.S. Burrus, Ramosh and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc.

B.Tech. - IV Year – I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB409T	OE	**Smart Materials and Devices** (Common to All Branches of Engineering)	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 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, Students will be able to

CO1: Describe the classification, characteristics, and applications of smart materials, including shape memory, chromoactive, magnetorheological, photoactive materials, and polymer composites. (L3)

CO2: Apply the optical, electrical, dielectric, piezoelectric, ferroelectric, pyroelectric, and magnetic properties of smart materials to explain their functional behavior. (L3)

CO3: Discuss the synthesis methods of smart materials using chemical routes, mechanical alloying, and thin film deposition techniques. (L3)

CO4: Analyze the role of characterization techniques such as X-ray diffraction, Raman spectroscopy, UV-Visible spectroscopy, SEM, TEM, and AFM in determining the structural and morphological properties of smart materials. (L4)

CO5: Evaluate the working principles and applications of smart material-based devices such as robotic hands, piezoelectric devices, MEMS, and intelligent systems. (L5)

Unit I: Introduction to Smart Materials:

Historical account of the discovery and development of smart materials, Shape memory materials, chromoactive materials, magnetorheological materials, photoactive materials, Polymers and polymer composites (Basics).

Unit II: Properties of Smart Materials:

Optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials.

Unit III: Synthesis of Smart Materials:

Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Mechanical alloying. Thin film deposition techniques: Chemical etching, Spray pyrolysis.

Unit IV: Characterization Techniques:

Powder X-ray diffraction, Raman spectroscopy (RS), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM).

Unit V: Smart Materials Based Devices:

Devices based on smart materials: Shape memory alloys in robotic hands, piezoelectric based devices, MEMS and intelligent devices.

Text Books:

1. Yaser Dahman, Nanotechnology and Functional Materials for Engineers, Elsevier, 2017.
2. E. Zschech, C. Whelan, T. Mikolajick, Materials for Information Technology: Devices, Interconnects and Packaging, Springer-Verlag London Limited, 2005.

Reference Books:

1. Gauenzi P., Smart Structures, Wiley, 2009.
2. Mahmood Aliofkhazraei, Handbook of Functional Nanomaterials, Vol (1 & 2), Nova Publishers, 2014.
3. Handbook of Smart Materials, Technologies, and Devices, Chaudhery Mustansar Hussain, Paolo Di Sia, Springer, 2022.
4. Fundamentals of Smart Materials, Mohsen Shahinpoor, Royal Society of Chemistry, 2020.

B. Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB410T	OE	**Introduction to Quantum Mechanics** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:
- Basic Knowledge of Calculus, Linear Algebra, and Differential Equations.
- Familiarity with Classical Mechanics, Waves, and Elementary Physics Concepts.

Course Objectives:
- Understand the fundamental differences between classical and quantum mechanics.
- Study wave-particle duality, uncertainty principle, and their implications.
- Learn and apply Schrödinger equations to basic quantum systems.
- Use operator formalism and mathematical tools in quantum mechanics.
- Explore angular momentum, spin and their quantum mechanical representations.

Course Outcomes (COs):

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

CO1: Describe the fundamental principles of quantum mechanics, including wave-particle duality, uncertainty principle, and Schrödinger wave equations for describing microscopic systems. (L3)

CO2: Apply quantum mechanical principles to analyze one-dimensional systems such as potential step, potential well, potential barrier, periodic potential, and harmonic oscillator. (L4)

CO3: Discuss the operator formalism of quantum mechanics, including operator algebra, eigenvalues, eigenvectors, and matrix representation of wave functions and operators. (L3)

CO4: Analyze the mathematical tools of quantum mechanics, including matrix algebra, Hermitian operators, Dirac notation, expectation values, and ladder operators. (L4)

CO5: Evaluate angular momentum and spin systems using angular momentum operators, Pauli spin matrices, Clebsch–Gordon coefficients, and rigid rotator models. (L5)

Unit I: Principles of Quantum Mechanics:

Limitations of Classical Mechanics, Difficulties with Classical Theories of Black Body Radiation and Origin of Quantum Theory of Radiation. Wave-Particle Duality: de Broglie wavelength, Heisenberg Uncertainty Principle. Schrödinger time independent and time dependent wave equations, Solution of the time dependent Schrödinger equation, Concept of stationary states, Physical significance of wave function (ψ), Orthogonal, Normalized and Orthonormal functions.

Unit II: One Dimensional Problems and Solutions:

Potential Step – Reflection and Transmission at the interface. Potential Well: Square well potential with rigid walls, Square well potential with finite walls. Potential Barrier: Penetration of a potential barrier (tunneling effect). Periodic Potential and Harmonic Oscillator, Energy Eigen functions and Eigen values.

Unit III: Operator Formalism:

Operators, Operator Algebra, Eigen values and Eigen vectors, Postulates of Quantum Mechanics, Matrix representation of wave functions and linear operators.

Unit IV: Mathematical Tools for Quantum Mechanics:

The concept of row and column matrices, Matrix algebra, Hermitian operators. Dirac's bra and ket notation, Expectation values, Heisenberg (operator) representation of harmonic oscillator, Ladder operators and their significance.

Unit V: Angular Momentum and Spin:

Angular Momentum Operators: Definition. Eigen functions and Eigen values of angular momentum operators. Matrix representation of angular momentum operators, System with spin half (1/2), Spin Angular Momentum, Pauli's Spin Matrices. Clebsch-Gordon Coefficients. Rigid Rotator: Eigen functions and Eigen values.

Text Books:

1. Quantum Mechanics, Vol 1, A. Messaia, North-Holland Pub. Co., Amsterdam, 1961.
2. A Text Book of Quantum Mechanics, P.M. Mathews and K. Venkatesan, Tata McGraw Hill, New Delhi, 1976.
3. Introduction to Quantum Mechanics, R.H. Dicke and J.P. Witke, Addison-Wesley Pub. Co. Inc., London, 1960.

Reference Books:

1. Quantum Mechanics, L.I. Schiff, McGraw Hill Book Co., Tokyo, 1968.
2. Introduction to Quantum Mechanics, Richard L. Liboff, Pearson Education Ltd., 4th Edition, 2003.

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB411T	OE	**Green Chemistry and Catalysis for Sustainable Environment** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Chemistry, Chemical Reactions, and Catalysis.
- Familiarity With Environmental Science and Sustainable Development Concepts.

Course Objectives:

- To Understand Principles and Concepts of Green Chemistry.
- To Understand the Types of Catalysis and Industrial Applications.
- To Apply Green Solvents in Chemical Synthesis.
- To Enumerate different sources of Green Energy.
- To Apply Alternative Greener Methods for Chemical Reactions.

Course Outcomes (COs):

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

CO1: Apply the Green chemistry Principles for day-to-day life as well as synthesis, describe the sustainable development and green chemistry, explain economic and un-economic reactions, demonstrate Polymer recycling. (L3)

CO2: Explain Heterogeneous catalyst and its applications in Chemical and Pharmaceutical Industries, Differentiate Homogeneous and Heterogeneous catalysis, Identify the importance of Bio and Photo Catalysis, Discuss Transition metal and Phase transfer Catalysis(L3)

CO3: Demonstrate Green solvents and importance, Discuss Supercritical carbon dioxide, Explain Supercritical water, recycling of green solvents. (L3)

CO4: Describe importance of Biomass and Solar Power, Illustrate Sonochemistry, Apply Green Chemistry for Sustainable Development; discuss the importance of Renewable resources, mechanochemical synthesis. (L4)

CO5: Discuss Alternative green methods like Photo redox catalysis, single electron transfer reactions (SET), Photochemical Reactions, Microwave-assisted Reactions and Sono chemical reactions, examples and applications. (L3)

Unit I: Principles and Concepts of Green Chemistry:

Introduction, Green Chemistry Principles, Sustainable Development and Green Chemistry, E Factor, Atom Economy. Atom Economic Reactions: Rearrangement and Addition Reactions. Atom Un-economic Reactions: Substitution, Elimination and Wittig Reactions. Reducing Toxicity. Waste – Problems and Prevention: Design for Degradation, Polymer Recycling.

Unit II: Catalysis and Green Chemistry:

Introduction, Types of Catalysis, Heterogeneous Catalysis: Basics, Zeolite and the Bulk Chemical Industry, Heterogeneous Catalysis in Fine Chemical and Pharmaceutical Industries, Catalytic Converters. Homogeneous Catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, and Phase Transfer Catalysis. Bio-catalysis and Photo-catalysis with examples.

Unit III: Green Solvents in Chemical Synthesis:

Green Solvents: Concept, Tools and Techniques for Solvent Selection. Supercritical Fluids: Supercritical CO2, Supercritical Water. Polyethylene Glycol (PEG), Ionic Liquids, Recycling of Green Solvents.

Unit IV: Emerging Greener Technologies:

Biomass as Renewable Resource, Energy from Biomass, Solar Power, Chemicals from Renewable Feedstocks, Chemicals from Fatty Acids, Polymers from Renewable Resources. Alternative Economies: The Syngas Economy, The Biorefinery, Design for Energy Efficiency, Mechanochemical Synthesis.

Unit V: Alternative Greener Methods:

Photochemical Reactions – Examples, Advantages and Challenges. Photoredox Catalysis, Single Electron Transfer Reactions (SET). Microwave-assisted Reactions and Sonochemical Reactions – Examples and Applications.

Text Books:

1. M. Lancaster, Green Chemistry: An Introductory Text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry: Theory and Practice, 4th Edition, Oxford University Press, USA.

Reference Books:

1. Green Chemistry for Environmental Sustainability, 1st Edition, Sanjay K. Sharma and Ackmez Mudhoo, CRC Press, 2010.
2. Edited by Alvise Perosa and Maurizio Selva, Handbook of Green Chemistry Volume 8: Green Nanoscience, Wiley-VCH, 2013.

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHS404T	**OE**	**Employability Skills** (Common to all branches of Engineering.)	**3**	**0**	**0**	**3**

Pre -Requisites:

- Basic Knowledge of Communication and Writing Skills.
- Familiarity with Presentation, Teamwork, and Interpersonal Skills.

Course Objectives:

- Encourage all round development of the students by focusing on productive skills.
- Make the students aware of Goal Setting and Writing Skills.
- Enable them to know the importance of Presentation Skills in achieving desired goals.
- Help them develop Organizational Skills through group activities.
- Function effectively with heterogeneous teams.

Course Outcomes (COs):

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

CO1: Apply goal-setting and self-management techniques, including SMART goals, motivation strategies, and SWOT analysis, for personal and professional development. (L3)

CO2: Develop professional written communication such as resumes, CVs, cover letters, emails, and statements of purpose by applying appropriate writing conventions and etiquette. (L3)

CO3: Demonstrate effective technical presentation skills through planning, preparation, stage management, and delivery of PPT and poster presentations in academic and professional contexts. (L3)

CO4: Analyze group behaviour, team dynamics, leadership qualities, and corporate etiquette to participate effectively in group discussions, debates, and collaborative tasks. (L4)

CO5: Evaluate interview situations and employ appropriate job-cracking strategies, including interview preparation, answering techniques, and mock interview performance, to enhance employability. (L5)

Unit I: Goal Setting and Self-Management:

Definition, importance, types of Goal Setting – SMART Goal Setting – Advantages – Motivation – Intrinsic and Extrinsic Motivation – Self-Management – Knowing about Self – SWOC Analysis.

Unit II: Writing Skills:

Definition, significance, types of Writing Skills – Resume Writing vs CV Writing – E-Mail Writing, Cover Letters – E-Mail Etiquette – SoP (Statement of Purpose).

Unit III: Technical Presentation Skills:

Nature, meaning & significance of Presentation Skills – Planning, Preparation, Presentation, Stage Dynamics – Anxiety in Public Speaking (Glossophobia) – PPT & Poster Presentation.

Unit IV: Group Presentation Skills:

Body Language – Group Behaviour – Team Dynamics – Leadership Skills – Personality Manifestation – Group Discussion – Debate – Corporate Etiquette.

Unit V: Job Cracking Skills:

Nature, characteristics, importance & types of Interviews – Job Interviews – Skills for Success – Job Searching Skills – STAR Method – FAQs – Answering Strategies – Mock Interviews.

Text Books:

1. Sabina Pillai, Agna Fernandez, Soft Skills & Employability Skills, Cambridge Publisher, 2014.
2. Alka Wadkar, Life Skills for Success, Sage Publications, 2016.

Reference Books:

1. Gangadhar Joshi, Campus to Corporate, Sage Publications, 2015.
2. Sherfield Montogomery Moody, Cornerstone: Developing Soft Skills, Pearson Publications, 4th Ed., 2008.
3. Shikha Kapoor, Personality Development and Soft Skills, Wiley, 2017.
4. M. Sen Gupta, Skills for Employability, Innovative Publication, 2019.

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 ECE, EEE, CSE, AI&DS, CSE-AI & CSE-AI&ML)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Maps, Measurements, and Geometry.
- Familiarity with Computer Applications and Spatial Data Basics.

Course Objectives:

- Understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
- Analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
- Apply network analysis techniques for geo coding, shortest path analysis, and location-allocation problems.
- Evaluate surface and geo statistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
- Assess GIS customization, Web GIS, and mobile mapping techniques for real-world applications.

Course Outcomes (COs):

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

CO1: Apply concepts of remote sensing, GIS, and GPS to explain their principles, components, and applications in civil engineering. (L3)

CO2: Analyze satellite imagery and geospatial data for mapping, land use classification, and change detection applications. (L4)

CO3: Evaluate GIS-based spatial analysis techniques for infrastructure planning, transportation, and environmental management. (L5)

CO4: Apply digital terrain modeling and photogrammetry principles for topographic mapping and engineering survey applications. (L3)

CO5: Assess geospatial technology applications in disaster management, urban planning, and resource mapping decision-making. (L5).

Unit I: Raster Analysis:

Raster Data Exploration: Query Analysis – Local Operations: Map Algebra, Reclassification, Logical and Arithmetic Overlay Operations – Neighborhood Operations: Aggregation, Filtering – Extended Neighborhood Operations – Zonal Operations – Statistical Analysis – Cost-Distance Analysis – Least Cost Path.

Unit II: Vector Analysis:

Non-Topological Analysis: Attribute Database Query, Structured Query Language, Co-Ordinate Transformation, Summary Statistics, Calculation of Area, Perimeter and Distance. Topological Analysis: Reclassification, Aggregation, Overlay Analysis: Point-In-Polygon, Line-In-Polygon, Polygon-On-Polygon: Clip, Erase, Identity, Union, Intersection – Proximity Analysis: Buffering.

Unit III: Network Analysis:

Network – Introduction – Network Data Model – Elements of Network – Building a Network Database – Geocoding – Address Matching – Shortest Path in a Network – Time and Distance

Based Shortest Path Analysis – Driving Directions – Closest Facility Analysis – Catchment/Service Area Analysis – Location-Allocation Analysis.

Unit IV: Surface and Geostatistical Analysis:

Surface Data – Sources of X, Y, Z Data – DEM, TIN – Terrain Analysis – Slope, Aspect, Viewshed. Watershed Analysis: Watershed Boundary, Flow Direction, Flow Accumulation, Drainage Network. Spatial Interpolation: IDW, Spline, Kriging, Variogram.

Unit V: Customization, Web GIS, Mobile Mapping:

Customization of GIS: Need, Uses, Scripting Languages – Embedded Scripts – Use of Python Script. Web GIS: Web GIS Architecture, Advantages of Web GIS, Web Applications. Location Based Services: Emergency and Business Solutions – Big Data Analytics.

Text Books:

1. Kang-Tsung Chang, Introduction to Geographical Information System, 4th Ed., Tata McGraw Hill Edition, 2008.
2. Lo C.P. and Yeung Albert K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall, 2002.

Reference Books:

1. Michael N. Demers, Fundamentals of Geographic Information Systems, Wiley, 2009.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasaraju, An Introduction to Geographical Information Systems, Pearson Education, 2nd Edition, 2007.
3. John Peter Wilson, The Handbook of Geographic Information Science, Blackwell Pub., 2008.

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C

Course Code	Category	Name of the Course	L	T	P	C
24OE01408T	OE	**Solid Waste Management** (Common To ECE, EEE, CSE, AI&DS, CSE-AI & CSE-AI&ML)	2	1	0	3

Pre-Requisites

- Basic Understanding of Environmental Science and Pollution Control.
- Familiarity with Waste Generation and Resource Management Concepts.

Course Objectives:

- Understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
- Analyze engineering systems for solid waste collection, storage, and transportation.
- Apply resource and energy recovery techniques for sustainable solid waste management.
- Evaluate landfill design, construction, and environmental impact mitigation strategies.
- Assess hazardous waste management techniques, including biomedical and e-waste disposal.

Course Outcomes (COs):

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

CO1: Apply knowledge of solid waste characterization to explain sources, classification, and health impacts of municipal solid waste. (L3)

CO2: Analyze collection, transportation, and storage systems for solid waste management in urban and rural settings. (L4)

CO3: Evaluate thermo-chemical and bio-chemical waste treatment methods for energy recovery and waste minimization. (L5)

CO4: Apply design principles for engineered sanitary landfills including site selection, leachate management, and closure plans. (L3)

CO5: Assess integrated solid waste management strategies, recycling policies, and regulatory frameworks for sustainable waste handling. (L5)

Unit I: Solid Waste Fundamentals:

Definitions, Types of Solid Wastes, Sources of Solid Wastes, Characteristics, and Perspectives; Properties of Solid Wastes, Sampling of Solid Wastes, Elements of Solid Waste Management – Integrated Solid Waste Management, Solid Waste Management Rules 2016.

Unit II: Engineering Systems for Solid Waste Management:

Solid Waste Generation; On-Site Handling, Storage and Processing; Collection of Solid Wastes; Stationary Container System and Hauled Container Systems – Route Planning – Transfer and Transport; Processing Techniques.

Unit III: Engineering Systems for Resource and Energy Recovery:

Processing Techniques; Materials Recovery Systems; Recovery of Biological Conversion Products – Composting, Pre and Post Processing, Types of Composting, Critical Parameters, Problems with Composting; Recovery of Thermal Conversion Products: Pyrolysis, Gasification, RDF; Recovery of Energy from Conversion Products; Materials and Energy Recovery Systems.

Unit IV: Landfills:

Evolution of Landfills – Types and Construction of Landfills – Design Considerations – Life of Landfills – Landfill Problems – Lining of Landfills – Types of Liners – Leachate Pollution and Control – Monitoring Landfills – Landfills Reclamation.

Unit V: Hazardous Waste Management:

Sources and Characteristics, Effects on Environment, Risk Assessment – Disposal of Hazardous Wastes – Secured Landfills, Incineration – Monitoring – Biomedical Waste Disposal, E-Waste Management, Nuclear Wastes, Industrial Waste Management.

Text Books:

1. Tchobanoglous G., Theisen H. and Vigil S.A., Integrated Solid Waste Management, Engineering Principles and Management Issues, McGraw-Hill, 1993.
2. Vesilind P.A., Worrell W. and Reinhart D., Solid Waste Engineering, Brooks/Cole Thomson Learning Inc., 2002.

Reference Books:

1. Peavy H.S., Rowe D.R., and G. Tchobanoglous, Environmental Engineering, McGraw Hill Inc., New York, 1985.
2. Qian X., Koerner R.M. and Gray D.H., Geotechnical Aspects of Landfill Design and Construction, Prentice Hall, 2002.

B.Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C

Course Code	Category	Name of the Course	L	T	P	C
24OE02404T	OE	**Electric Vehicles** (Common to CE, ECE, CSE, AI&DS, CSE-AI & CSE-AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Electrical and Electronic Fundamentals.
- Familiarity with Energy Storage Systems and Electric Machines.

Course Objectives:

- Remember and understand the differences between conventional vehicles and electric vehicles, electro mobility and environmental issues of EVs.
- Analyze various EV configurations, parameters of EV systems and electric vehicle dynamics.
- Analyze the basic construction, operation and characteristics of fuel cells and battery charging techniques in HEV systems.
- Design and analyze the various control structures for electric vehicles.

Course Outcomes (COs):

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

CO1: Describe the evolution, configuration, and system architecture of electric vehicles along with environmental impacts and comparison of EV technologies. (L3)

CO2: Analyze electric vehicle propulsion systems including motor configurations, transmission types, and vehicle dynamics for performance evaluation. (L4)

CO3: Examine fuel cell systems and hybrid electric vehicle technologies including modeling, performance characteristics, and system comparison. (L4)

CO4: Analyze battery charging systems and control strategies including charger architecture, wireless charging, and feedback controller design for EV applications. (L4)

CO5: Evaluate energy storage technologies and energy management systems in electric vehicles, including batteries, supercapacitors, SMES, and smart grid integration. (L5)

Unit I: Introduction to EV Systems and Energy Sources:

Past, Present and Future of EV – EV Concept – EV Technology – State-of-the-Art of EVs – EV Configuration – EV System – Fixed and Variable Gearing – Single and Multiple Motor Drive – In-wheel Drives – EV Parameters: Weight, Size, Force and Energy, Performance Parameters. Electro Mobility and the Environment – History of Electric Power Trains – Carbon Emissions from Fuels – Green Houses and Pollutants – Comparison of Conventional, Battery, Hybrid and Fuel Cell Electric Systems.

Unit II: EV Propulsion and Dynamics:

Choice of Electric Propulsion System – Block Diagram – Concept of EV Motors – Single and Multi-Motor Configurations – Fixed and Variable Geared Transmission – In-Wheel Motor Configuration – Classification – Electric Motors Used in Current Vehicle Applications – Recent EV Motors – Vehicle Load Factors – Vehicle Acceleration.

Unit III: Fuel Cells:

Introduction of Fuel Cells – Basic Operation – Model – Voltage, Power and Efficiency – Power Plant System – Characteristics – Sizing – Example of Fuel Cell Electric Vehicle – Introduction to HEV – Brake Specific Fuel Consumption – Comparison of Series-Parallel Hybrid Systems.

Unit IV: Battery Charging and Control:

Battery Charging: Basic Requirements – Charger Architecture – Charger Functions – Wireless Charging – Power Factor Correction. Control: Introduction – Modelling of Electro Mechanical System – Feedback Controller Design Approach – PI Controller's Designing – Torque-Loop, Speed Control Loop Compensation – Acceleration of Battery Electric Vehicle.

Unit V: Energy Storage Technologies:

Role of Energy Storage Systems – Thermal – Mechanical – Chemical – Electrochemical – Electrical – Efficiency of Energy Storage Systems – Super Capacitors – Superconducting Magnetic Energy Storage (SMES) – SOC – SoH – Fuel Cells – G2V – V2G – Energy Storage in Micro-grid and Smart Grid – Energy Management with Storage Systems – Battery SCADA.

Text Books:

1. C.C. Chan, K.T. Chau, Modern Electric Vehicle Technology, Oxford University Press Inc., New York, 2001, 1st Edition.
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2017, 1st Edition.

Reference Books:

1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press, 2021, 3rd Edition.
2. Francisco Díaz-González et al., Energy Storage in Power Systems, Wiley Publication, 2016.
3. A.G. Ter-Gazarian, Energy Storage for Power Systems, The Institution of Engineering and Technology (IET), 2nd Edition, 2011.
4. Mehrdad Ehsani, Yimi Gao et al., Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

B.Tech. IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03404T	**OE**	**Total Quality Management** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Understanding of Management and Organizational Concepts.
- Familiarity with Problem-Solving and Process Improvement Basics.

Course Objectives:

- Familiarize the basic concepts of Total Quality Management.
- Expose with various quality issues in Inspection.
- Gain knowledge on quality control and its applications to real time.
- Understand the extent of customer satisfaction by the application of various quality concepts.
- Demonstrate the importance of Quality Standards in Production.

Course Outcomes (COs):

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

CO1: Apply the fundamental concepts of Total Quality Management, including quality dimensions, quality planning, and quality cost analysis for improving organizational quality performance. (L3)

CO2: Analyze the historical evolution of TQM, contributions of quality gurus, strategic planning concepts, and barriers in implementing Total Quality Management practices. (L4)

CO3: Analyze customer satisfaction, employee involvement, continuous process improvement, and supplier partnership concepts to enhance organizational quality systems. (L4)

CO4: Apply quality improvement tools such as benchmarking, QFD, Taguchi method, TPM, FMEA, Six Sigma, and other quality management tools for process enhancement. (L3)

CO5: Evaluate quality management systems including ISO 9000, ISO 14000, and QS 9000 standards, along with their implementation, documentation, and auditing processes. (L5)

Unit I: Introduction:

Definition of Quality, Dimensions of Quality, Definition of Total Quality Management, Quality Planning, Quality Costs – Analysis, Techniques for Quality Costs, Basic Concepts of Total Quality Management.

Unit II: Historical Review:

Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of Successful Quality Leader, Contributions of Gurus of TQM, Case Studies.

Unit III: TQM Principles:

Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention. Employee Involvement – Motivation, Empowerment Teams. Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen. Supplier Partnership – Partnering, Sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case Studies.

Unit IV: TQM Tools:

Benchmarking – Reasons to Benchmark, Benchmarking Process. Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits. Taguchi Quality Loss Function. Total Productive Maintenance (TPM) – Concept, Improvement Needs. FMEA – Stages of FMEA. The Seven Tools of Quality, Process Capability, Concept of Six Sigma, New Seven Management Tools, Case Studies.

Unit V: Quality Systems:

Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

Text Books:

1. Dale H. Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata McGraw Hill Publishing Company Ltd., 2005.
3. Joel E. Ross, Total Quality Management, Third Edition, CRC Press, 2017.

Reference Books:

1. Narayana V. and Sreenivasan N.S., Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L. Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd., 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata McGraw Hill, 2015.

B. Tech. IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
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. Nakra B.C and Chaudhary K. 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
24PE05310T	OE	**Introduction to Quantum Computing** (Common for all branches of Engineering)	3	0	0	3

Pre -Requisites: Basics of Mathematics and Physics

Course Objectives:

- To Introduce the principles and mathematical foundations of quantum computation.
- To Understand quantum gates, circuits, and computation models.
- To Explore quantum algorithms and their advantages over classical ones.
- To Develop the ability to simulate and write basic quantum programs.
- To Understand real-world applications and the future of quantum computing in AI, cryptography, and optimization.

Course Outcomes (COs):

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

CO1: Explain the fundamental concepts of quantum mechanics used in computing. (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 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 for 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 Lookbacks. Monte Carlo Methods for Derivative Pricing, Black-Scholes-Merton Model: Derivation and Applications.

Text Books:

1. Ales Cerny, Mathematical Techniques in Finance: Tools for Incomplete Markets, Princeton University Press.
2. S.R. Pliska, Introduction to Mathematical Finance: Discrete-Time Models, Cambridge University Press.

Reference Books:

1. Ioannis Karatzas & Steven E. Shreve, Methods of Mathematical Finance, Springer, New York.
2. John C. Hull, Options, Futures, and Other Derivatives, Pearson.

Online 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 for 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. Deposition: Chemical Vapor Deposition. Pattern: Photolithography. Etching: Dry and Wet Etching. Actuators: Functional Diagram of Actuators, Types of Actuators and Their Basic Principle: Pneumatic, Electromagnetic, Piezo-electric and Piezo-resistive Actuators, Applications of Actuators.

Unit II: Temperature and Mechanical Sensors:

Temperature Sensors: Types and Their Basic Principle of Working: Thermo-resistive Sensors: Thermistors, Thermo-electric Sensors: Thermocouples, PN Junction Temperature Sensors. Mechanical Sensors: Types and Their Basic Principle: Force Sensors: Strain Gauges, Tactile Sensors, Pressure Sensors: Piezoresistive, Variable Reluctance Sensor (VRP).

Unit III: Optical and Acoustic Sensors:

Optical Sensors: Basic Principle and Working of Photodiodes, Phototransistors and Photo Resistors Based Sensors, Photomultipliers, Infrared Sensors: Thermal, Passive Infra-Red, Fiber Based Sensors and Thermopiles. Acoustic Sensors: Principle and Working of Ultrasonic Sensors, Piezo-electric Resonators, Microphones.

Unit IV: Magnetic and Electromagnetic Sensors:

Motors as Actuators (linear, rotational, stepping motors), Magnetic Valves, Inductive Sensors (LVDT, RVDT, and Proximity), Hall Effect Sensors, Magneto-resistive Sensors, Magneto strictive Sensors and Actuators.

Unit V: Chemical and Radiation Sensors:

Chemical Sensors: Principle and Working of Electrochemical, Thermochemical, Gas, pH, Humidity and Moisture Sensors. Radiation Sensors: Principle and Working of Ionization Detectors, Scintillation Detectors, Semiconductor Radiation Detectors and Microwave Sensors (resonant, reflection, transmission).

Text Books:

1. Sensors and Actuators – Clarence W. de Silva, CRC Press, 2nd Edition, 2015.
2. Sensors and Actuators, D.A. Hall and C.E. Millar, CRC Press, 1999.

Reference Books:

1. Sensors and Transducers – D. Patranabhis, Prentice Hall of India (Pvt) Ltd., 2003.
2. Measurement, Instrumentation, and Sensors Handbook – John G. Webster, CRC Press, 1999.
3. Sensors – A Comprehensive Survey – Henry Bolte, John Wiley.
4. Handbook of Modern Sensors, Stefan Johann Rupitsch, Springer.

B. Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB414T	OE	Chemistry of Nanomaterials and Applications	3	0	0	3

		(Common for all branches of Engineering)				

Pre -Requisites:

- Basic Knowledge of Chemistry, Materials Science, and Atomic Structure.
- Familiarity with Chemical Bonding and Basic Characterization Concepts.

Course Objectives:

- Understand basics and characterization of nanomaterials.
- Understand synthetic methods of nanomaterials.
- Apply various techniques for characterization of nanomaterials.
- Understand studies of nano-structured materials.
- Enumerate the applications of advanced nanomaterials in engineering.

Course Outcomes (COs):

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

CO1: Classify the nanostructure materials; describe scope of nanoscience and importance technology. (L3)

CO2: Describe the top-down approach, explain aerosol synthesis and plasma arc technique, differentiate chemical vapor deposition method and electrode position method, Discuss about high energy ball milling. (L4)

CO3: Discuss different technique for characterization of nanomaterial, explain electron microscopy techniques for characterization of nanomaterial, Describe BET method for surface area analysis. (L4)

CO4: Explain synthesis and properties and applications of nanomaterials, discuss about fullerenes and carbon nanotubes, Differentiate nanomagnetic materials and thermoelectric materials, nonlinear optical materials. (L4)

CO5: Illustrate advance engineering applications of Water treatment, sensors, electronic devices, medical domain, civil engineering, chemical engineering, metallurgy and mechanical engineering, food science, agriculture, pollutants degradation. (L3)

Unit -I: Basics and Characterization of Nanomaterials:

Introduction, Scope of Nanoscience and Nanotechnology, Nanoscience in Nature, Classification of Nanostructured Materials, Importance of Nanomaterials.

Unit- II: Synthesis of Nanomaterials:

Top-Down Approach: Inert Gas Condensation, Arc Discharge Method, Aerosol Synthesis, Plasma Arc Technique, Ion Sputtering, Laser Ablation, Laser Pyrolysis, Chemical Vapour Deposition Method, Electrodeposition Method, High Energy Ball Milling Method. Bottom-Up Approach: Sol-Gel Synthesis, Microemulsions or Reverse Micelles, Co-precipitation Method, Solvothermal Synthesis, Hydrothermal Synthesis, Microwave Heating Synthesis, Sonochemical Synthesis.

Unit -III: Techniques for Characterization:

Diffraction Technique, Spectroscopy Techniques, Electron Microscopy Techniques for the Characterization of Nanomaterials, BET Method for Surface Area Analysis, Dynamic Light Scattering for Particle Size Determination.

Unit -IV: Studies of Nano-Structured Materials:

Synthesis, Properties and Applications of: Fullerenes, Carbon Nanotubes, 2D-Nanomaterial (Graphene), Core-Shell, Magnetic Nanoparticles, Thermoelectric Materials, Non-Linear Optical Materials.

Unit -V: Advanced Engineering Applications of Nanomaterials:
Applications of Nanoparticles, Nanorods, Nanowires in: Water Treatment, Sensors, Electronic Devices, Medical Domain, Civil Engineering, Chemical Engineering, Metallurgy and Mechanical Engineering, Food Science, Agriculture, Pollutants Degradation.

Text Books:

1. Nano: The Essentials, T. Pradeep, MaGraw-Hill, 2007.
2. Textbook of Nanoscience and Nanotechnology, B.S. Murty et al., University Press, 2012.

Reference Books:

1. Concepts of Nano chemistry, Ludovico Cademartiri and Geoffrey A. Ozin, Wiley-VCH, 2011.
2. Nanostructures & Nanomaterials; Synthesis, Properties & Applications, Guozhong Cao, Imperial College Press, 2007.

B. Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C

24OEHS405T	**OE**	**Literary Vibes** (Common for 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. Common for all branches of Engineering

CO4: Evaluate the ideas, style, and autobiographical elements in the prescribed prose essays and autobiographical writings to relate literary texts to personal and social contexts. (L5)

CO5: Analyze the plot, themes, characterization, and literary features of Hard Times to interpret the social concerns and artistic vision of the novelist. (L4)

Unit- I: Poetry:

- Ulysses – Alfred Lord Tennyson
- Ain't I a Woman? – Sojourner Truth
- The Second Coming – W.B. Yeats
- Where the Mind is Without Fear – Rabindranath Tagore

Unit - II: Drama – Twelfth Night (William Shakespeare):

- Shakespeare – Life and Works
- Plot & Sub-plot and Historical Background of the Play
- Themes and Criticism
- Style and Literary Elements
- Characters and Characterization

Unit - III: Short Story:

- The Luncheon – Somerset Maugham
- The Happy Prince – Oscar Wilde
- Three Questions – Leo Tolstoy
- Grief – Anton Chekhov

Unit- IV: Prose – Essay and Autobiography:

- My Struggle for an Education – Booker T. Washington
- The Essentials of Education – Richard Livingston
- The Story of My Life – Helen Keller

- Student Mobs – J.B. Priestley

Unit - V: Novel – Hard Times (Charles Dickens):

- Charles Dickens – Life and Works
- Plot and Historical Background of the Novel
- Themes and Criticism
- Style and Literary Elements
- Characters and Characterization

Text Books:

1. Charles Dickens, Hard Times, (Sangam Abridged Texts), Vantage Press, 1983.
2. DENT J.C., William Shakespeare, Twelfth Night, Oxford University Press, 2016.

Reference Books:

1. W.J. Long, History of English Literature, Rupa Publications India, 2015.
2. R.K. Kaushik and S.C. Bhatia, Essays, Short Stories and One Act Plays, Oxford University Press, 2018.
3. Dhanvel S.P., English and Soft Skills, Orient Blackswan, 2017.
4. New Horizon, Pearson Publications, New Delhi, 2014.

Online Resources:

1. https://www.litcharts.com/poetry/alfred-lord-tennyson/ulysses
2. https://www.litcharts.com/lit/ain-t-i-a-woman/summary-and-analysis
3. https://englishliterature.education/articles/poetry-analysis/the-second-coming-by-w-b-yeats critical-analysis-summary-and-line-by-line-explanation/#google_vignette
4. https://sirjitutorials.com/where-the-mind-is-without-fear-poem-notes-explanation/
5. https://www.litcharts.com/lit/twelfth-night/themes
6. https://smartenglishnotes.com/2021/11/28/the-luncheon-summary-characters-themes-and-irony

B. Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24SE05405S	SE	**Prompt Engineering** (Common to CSE, AI&DS, CSE-AI and CSE-AI&ML)	0	1	2	2

Pre-Requisites: Basic knowledge of Artificial Intelligence, Natural Language Processing, and effective communication and problem-solving skills.

Course Objective:

This course delves into prompt engineering principles, strategies, and best practices, a crucial aspect in shaping AI models' behaviour and performance. Understanding Prompt Engineering is a comprehensive course designed to equip learners with the knowledge and skills to effectively generate and utilize prompts in natural language processing (NLP) and machine learning (ML) applications. This course delves into prompt engineering principles, strategies, and best practices, a crucial aspect in shaping AI models' behaviour and performance.

Course Outcomes (COs):

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

CO1: Apply prompt engineering techniques to design effective prompts for various NLP and ML tasks. (L3)

CO2: Analyze different types of prompts (closed-ended, open-ended, probing, adversarial) and their impact on AI model responses. (L4)

CO3: Apply strategies for optimizing and fine-tuning prompts to enhance model performance and reliability. (L3)

CO4: Evaluate prompt effectiveness using appropriate metrics and interpret results for improving AI outputs. (L5)

CO5: Analyze ethical issues and biases in prompt engineering and propose suitable mitigation strategies for fair and inclusive AI systems. (L4)

Unit I: Introduction to Prompt Engineering:

Lesson 1: Foundations of Prompt Engineering

- Overview of prompt engineering and its significance in NLP and ML.
- Historical context and evolution of prompt-based approaches.

Unit II: Types of Prompts and Their Applications:

Lesson 2: Closed-Ended Prompts

- Under standing and creating prompts for specific answers.
- Applications in question- answering systems.

Lesson 3: Open-Ended Prompts

- Crafting prompts for creative responses.
- Applications in language generation models.

Unit III: Strategies for Effective Prompting:

Lesson 4: Probing Prompts

- Designing prompts to reveal model biases.
- Ethical considerations in using probing prompts.

Lesson 5: Adversarial Prompts

- Creating prompts to stress-test models.
- Enhancing robustness through adversarial prompting.

Unit IV: Fine-Tuning and Optimizing with Prompts:

Lesson 6: Fine-Tuning Models with Prompts

- Techniques for incorporating prompts during model training.
- Balancing prompt influence and generalization.

Lesson 7: Optimizing Prompt Selection

- Methods for selecting optimal prompts for specific tasks.
- Customizing prompts based on model behavior.

Unit V: Evaluation and Bias Mitigation:

Lesson 8: Evaluating Prompt Performance

- Metrics and methodologies for assessing model performance with prompts.
- Interpreting and analyzing results.

Lesson 9: Bias Mitigation in Prompt Engineering

- Strategies to identify and address biases introduced by prompts.
- Ensuring fairness and inclusivity in prompt-based models.

Unit VI: Real-World Applications and Case Studies:

Lesson 10: Case Studies in Prompt Engineering

Exploration of successful implementations and challenges in real-world scenarios.

Guest lectures from industry experts sharing their experiences.

Text books:

1. "Prompt Engineering in Action" – Danny D. Sullivan
2. "The Art of Prompt Engineering with Chat GPT: A Hands-On Guide" – Nathan Hunter.

Reference Books:

1. "Prompt Engineering in Practice" – Michael F. Lewis
2. "Mastering AI Prompt Engineering: The Ultimate Guide for Chat GPT Users" – Adriano Damiao
3. "Writing AI Prompts For Dummies" – Stephanie Diamond and Jeffrey Allan
4. "Prompt Engineering Guide" (Online Resource) – promptingguide.ai

Online Resources :

1. https://www.udemy.com/course/understanding-prompt-engineering/?couponCode=NVDINCTA35TRT

B. Tech. - IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24MCHS413A	**MC**	**Gender Sensitization** (Common for all branches of Engineering)	**2**	**0**	**0**	**-**

Pre-Requisites:

- Basic Understanding of Society, Culture, and Human Relationships.
- Familiarity with Social Issues and Communication Skills

Course Objectives:

- To enable students to understand the gender related issues, vulnerability of women and men
- To familiarize them about constitutional safeguard for gender equality
- To expose the students to debates on the politics and economics of work
- To help students reflect critically on gender violence
- To make them understand that gender identities and gender relations are part of culture as they shape the way daily life is lived in the family as well as wider commUnity and the workplace

Course Outcomes (COs):

On successful completion of the course, Students 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 ork.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 Empowerment, London: Lynne Rienner Publishers, 2002
3. Brush, Lisa D., Gender and Governance, New Delhi, Rawat Publication, 2007
4. Singh, Direeti, Women and Politics World Wide, New Delhi, Axis Publications, 2010
5. Raj Pal Singh, Anupama Sihag, Gender Sensitization: Issues and Challenges (English, Hardcover), Raj Publications, 2019
6. A. Revathy& Murali, Nandini, A Life in Trans Activism (Lakshmi Narayan Tripathi). The University of Chicago Press, 2016

Online Resources:

1. **UnderstandingGender** chrome- extension://kdpelmjpfafjppnhbloffcjpeomlnpah/
   https://www.arvindguptatoys.com/arvindgupt a/kamla-gender1.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-gender-roles-and-stereotypes
   https://www.verywellmind.com/understanding-gender-roles-and-their-effect-on-our-relationships-7499408
   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-can-it-be-redressed
   https://onlinecourses.nptel.ac.in/noc23_mg67/preview

4. **Gender-Based Violence**

   https://eige.europa.eu/gender-based-violence/what-is-gender-based-violence?language_content_entity=en
   https://www.worldbank.org/en/topic/socialsustainability/brief/violence-against-women-and-girlshttps://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/
   https://archive.nptel.ac.in/courses/109/106/109106136/
   AbdulaliSohaila.―I Fought ForMy Life…and Won.‖Available online (at:
   http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

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 for all branches of Engineering)	0	0	0	4

Pre-Requisites:

- Fundamental knowledge of core engineering concepts, laboratory practices, tools, and relevant software for applying technical skills in practical environments.
- Ability to work collaboratively in teams with basic proficiency in technical communication, including report writing and presentations.
- Awareness of professional ethics, safety practices, organizational processes, and readiness to learn and adapt in workplace settings.

Course Objectives:

- To provide practical exposure to professional environments for applying engineering knowledge and technical skills to real-world problems.
- To develop the ability to work effectively in multidisciplinary teams and understand organizational structure and processes.
- To enhance communication skills for preparing technical reports, delivering presentations, and engaging in professional interactions.
- To build analytical skills for studying practices, workflows, and technologies to identify inefficiencies and suggest improvements.
- To cultivate critical thinking and professional ethics for evaluating solutions, project outcomes, and personal growth in a societal and environmental context.

Course Outcomes (COs):

On successful completion of the Internship, the student will be able to:

CO1: Apply engineering knowledge and technical skills to perform assigned tasks and solve real-world problems in professional environments. (L3)

CO2: Collaborate with multidisciplinary teams to understand organizational processes and effectively contribute to project execution. (L3)

CO3: Communicate technical information effectively through reports, presentations, and professional interactions with supervisors and team members. (L3)

CO4: Analyse practices, workflows, and technologies to identify inefficiencies and propose appropriate improvements. (L4)

CO5: Evaluate processes, project outcomes, and personal professional development based on technical, economic, environmental, ethical, and societal considerations. (L5)

B. Tech. - IV Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPPR401L	IP	**Project** (Common for all branches of Engineering)	0	0	0	8

Pre-Requisites:

- Fundamental knowledge of core engineering concepts, tools, and relevant software, along with awareness of sustainability principles and environmental considerations in engineering practice.
- Ability to work collaboratively in teams with basic skills in problem-solving and technical communication, including report writing and presentations.

Course Objectives

- To provide opportunities for applying engineering knowledge and technical skills in developing sustainable solutions to real-world problems.
- To develop the ability to analyze project requirements, team dynamics, and organizational processes with a focus on sustainability and effective project execution.
- To enhance skills in analyzing and communicating technical information through reports, presentations, and professional interactions, incorporating sustainability perspectives.
- To build competency in evaluating engineering designs, methodologies, and technologies based on sustainability, ethical, environmental, and societal considerations.
- To foster creativity and innovation in designing and developing sustainable engineering solutions aligned with global sustainable development goals.

Course Outcomes (COs):

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

CO1: Apply engineering knowledge and technical skills to develop sustainable solutions for real-world problems considering resource efficiency and environmental impact. (L3)

CO2: Analyze team dynamics, organizational processes, and sustainability aspects to plan, manage, and execute project activities effectively in multidisciplinary environments. (L4)

CO3: Analyze and communicate technical information effectively through project reports, presentations, and professional interactions, incorporating sustainability considerations. (L4)

CO4: Evaluate design approaches, methodologies, and technologies to identify problems and justify appropriate engineering solutions based on sustainability, ethical, environmental, and societal Considerations. (L5)

CO5: Design and develop innovative and sustainable engineering solutions or prototypes for real-World problems by integrating appropriate tools and techniques aligned with sustainable development goals. (L6)

HONOURS DEGREE OFFERED IN C. S. E. - A. I. &M.L.

Course Code	Name of the Course	L	T	P	C
24HON3101T	Advanced Machine Learning & AI Systems	3	0	0	3

Pre-Requisites: Fundamentals of Machine Learning and AI.

Course Objectives:

- To deepen understanding of advanced machine learning concepts including ensemble learning, probabilistic models, and deep neural architectures.
- To explore scalable machine learning algorithms and their applications in real-world AI systems.
- To equip students with knowledge of interpretability, fairness, and trust in AI.
- To understand deployment, monitoring, and life-cycle management of AI systems.
- To apply machine learning in advanced domains such as natural language processing, vision, and multi-agent systems.

Course Outcomes (COs):

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

CO1: Apply advanced supervised and unsupervised learning algorithms including ensemble methods, SVMs, probabilistic models, and clustering for complex problem solving.(L3)

CO2: Illustrate deep learning architectures such as CNNs, RNNs, autoencoders, and transformers for vision and sequence modeling tasks.(L3)

CO3: Analyze interpretability, fairness, robustness, and trustworthiness techniques for ethical AI system design.(L4)

CO4: Analyze scalable machine learning pipelines, deployment frameworks, and production monitoring systems.(L4)

CO5: Design advanced AI applications including NLP, computer vision, reinforcement learning, and multi-agent systems.(L5)

Unit I: Advanced Supervised and Unsupervised Learning:

Ensemble Learning: Bagging, Boosting, Random Forests, Support Vector Machines: Kernels and Multi-Class SVMs, Probabilistic Graphical Models: Bayesian Networks, HMMs, Expectation-Maximization and Variational Inference, Clustering: Hierarchical, DBSCAN, Gaussian Mixture Models.

Unit II: Deep Learning Architectures:

Deep Neural Networks and Optimization Challenges, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), LSTMs, GRUs, Autoencoders, Variational Autoencoders, Attention Mechanisms and Transformer Architectures.

Unit III: Interpretability, Fairness, and Trust in AI:

Explainable AI: LIME, SHAP, Saliency Maps, Adversarial Examples and Robustness Techniques, Fairness Metrics and Bias Mitigation. Trustworthy AI Design and Ethical Considerations, Model Compression and Distillation.

Unit IV: Scalable and Production ML Systems:

ML Pipelines, Feature Stores, and Model Versioning, Distributed Training with TensorFlow and PyTorch, Hyperparameter Tuning at Scale (Ray Tune, Optuna),Model Deployment with Docker, FastAPI, Flask, Monitoring, Drift Detection, and Model Retraining

Unit V: Advanced Applications and Multi-Agent AI:

Natural Language Understanding with Transformers (BERT, GPT), Vision-based AI Systems (YOLO, Mask R-CNN), Reinforcement Learning and Policy Gradients, AI in Robotics and Autonomous Agents, Multi-Agent Systems and Decentralized Learning

Text Books:

1. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, O'Reilly
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville – Deep Learning, MIT Press.

Reference Books:

1. Kevin P. Murphy – Machine Learning: A Probabilistic Perspective, MIT Press
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman – The Elements of Statistical Learning, Springer
3. Chris Bishop – Pattern Recognition and Machine Learning, Springer
4. Ethem Alpaydin – Introduction to Machine Learning, MIT Press

Online Resources:

1. CS229 – Machine Learning by Stanford (Andrew Ng)
2. DeepLearning.AI – Advanced Deep Learning Specialization (Coursera)

Honours Degree

Course Code	Name of the Course	L	T	P	C

24HON3102T	Deep Learning & Neural Networks Architectures	3	0	0	3

Pre-Requisites: Python Programming, Linear Algebra, Calculus, Probability & Statistics, Data Structures, and Machine Learning Fundamentals.

Course Objectives:

- To introduce the fundamental concepts and mathematical foundations of deep learning.
- To explore different neural network architectures including CNNs, RNNs, LSTMs, and Transformers.
- To enable students to implement, train, and optimize deep neural networks.
- To analyze the performance and limitations of various architectures in different AI tasks.
- To develop the ability to apply deep learning models to real-world applications such as image recognition, language modeling, and autonomous systems.

Course Outcomes (COs):

On successful completion of this course, the student will be able to:

CO1: Apply neural network foundations including perceptrons, activation functions, backpropagation, and regularization methods. (L3)

CO2: Apply convolutional neural networks and transfer learning techniques for image analysis applications. (L3)

CO3: Analyze recurrent neural networks, LSTMs, and GRUs for sequential and time-series data tasks. (L4)

CO4: Analyze advanced architectures such as GANs, VAEs, and optimization techniques for improving model performance. (L4)

CO5: Inspect transformer models, attention mechanisms, and large language model applications in NLP tasks. (L4)

Unit I: Foundations of Neural Networks:

Introduction to Artificial Neural Networks, Biological Neuron vs. Artificial Neuron, Perceptron, Multilayer Perceptron (MLP), Activation Functions: ReLU, Sigmoid, Tanh, Softmax, Backpropagation and Gradient Descent, Loss Functions: MSE, Cross Entropy, Overfitting, Regularization (L1/L2), Dropout

Unit II: Convolutional Neural Networks (CNNs):

Convolution Operation and Feature Maps, Pooling Layers: Max and Average Pooling, CNN Architectures: LeNet, AlexNet, VGG, ResNet, Transfer Learning and Fine-tuning, Image Classification, Object Detection Basics, Implementation with TensorFlow/PyTorch

Unit III: Recurrent Neural Networks (RNNs) and Variants:

Sequential Data and Time Series, RNN Basics and Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, LSTM and GRU Architectures, Applications in Text, Speech, and Music, Sequence-to-Sequence Models

Unit IV: Advanced Architectures & Optimization:

Autoencoders and Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), Deep Reinforcement Learning Overview, Batch Normalization, Early Stopping, Hyperparameter Tuning and Optimization, Performance Metrics and Evaluation.

Unit V: Transformer Models & Applications:

Attention Mechanism and Self-Attention, Transformers and BERT Architecture, Positional Encoding, Multi-head Attention, Pre-trained Language Models and Fine-Tuning, Applications in NLP: Text Classification, Translation, Large Language Models and Transfer Learning

Text Books:

1. Deep Learning – Ian Goodfellow, Yoshua Bengio, and Aaron Courville (MIT Press)
2. Neural Networks and Deep Learning – Michael Nielsen (Online Book)
3. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow – Aurélien Géron (O'Reilly)

Reference Books:

1. Pattern Recognition and Machine Learning – Christopher M. Bishop
2. Deep Learning for Computer Vision – Rajalingappaa Shanmugamani
3. Natural Language Processing with Transformers – Lewis Tunstall, Leandro von Werra, Thomas Wolf
4. Reinforcement Learning: An Introduction – Richard S. Sutton and Andrew G. Barto

Online References:

1. Deep Learning Specialization – Andrew Ng (Coursera)
2. CS231n: Convolutional Neural Networks for Visual Recognition (Stanford)
3. Fast.ai – Practical Deep Learning for Coders
4. Deep Learning with PyTorch (Udacity)
5. Transformers by Hugging Face (free course)

Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON3103T	Reinforcement Learning & Decision Making	3	0	0	3

Pre-Requisites: Basic knowledge of Python programming, Probability & Statistics, Linear Algebra, Machine Learning, and Optimization concepts.

Course Objectives:

- To introduce the fundamentals of reinforcement learning (RL) and its mathematical foundation.
- To understand the Markov Decision Process (MDP) framework for decision making under uncertainty.
- To explore various RL algorithms including value-based, policy-based, and model-based approaches.
- To analyze deep reinforcement learning techniques for real-world applications.
- To study the integration of reinforcement learning with planning, exploration, and control strategies.

Course Outcomes (COs):

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

CO1: Apply reinforcement learning fundamentals and Markov Decision Processes for decision-making problems. (L3)

CO2: Apply dynamic programming and Monte Carlo methods for policy evaluation and control tasks. (L3)

CO3: Analyze temporal-difference learning and function approximation techniques for reinforcement learning systems. (L4)

CO4: Analyze policy gradient and actor-critic algorithms for continuous control optimization. (L4)

CO5: Compose deep reinforcement learning algorithms and exploration strategies for robotics, gaming, and autonomous systems. (L5)

Unit I: Introduction to Reinforcement Learning & MDPs:

Foundations of RL: Agent-Environment Interaction, Types of RL: Model-based vs. Model-free, Reward Signals, Return, and Discounting, Markov Decision Processes (MDPs), Bellman Equations and Optimality

Unit II: Dynamic Programming & Monte Carlo Methods:

Policy Evaluation and Policy Improvement, Value Iteration and Policy Iteration, Monte Carlo Prediction and Control, First-visit and Every-visit Methods, Limitations of DP and MC Approaches

Unit III: Temporal-Difference Learning & Function Approximation:

TD(0), Sarsa, and Q-Learning Algorithms, Eligibility Traces: TD(λ), Sarsa(λ), Off-policy vs. On- policy Learning, Linear Function Approximation, Generalization in RL

Unit IV: Policy Gradient Methods and Actor-Critic Algorithms

Policy Gradient Theorem, REINFORCE Algorithm, Baselines and Variance Reduction,Actor-Critic Architectures, Trust Region and Proximal Policy Optimization (PPO)

Unit V: Deep Reinforcement Learning and Applications:

Deep Q-Networks (DQN) and Experience Replay, DDPG, A3C, and SAC Algorithms, Exploration Techniques: ε-greedy, UCB, Intrinsic Rewards, RL in Robotics, Game AI, and Autonomous Systems, Safety, Ethics, and Fairness in Decision Making

Text Books:

1. Richard S. Sutton and Andrew G. Barto – Reinforcement Learning: An Introduction, 2nd

Edition, MIT Press

2. Ian Goodfellow, Yoshua Bengio, Aaron Courville – Deep Learning, MIT Press

Reference Books:

1. David Silver's RL Course Slides & Lectures – DeepMind, University College London
2. Marco Wiering & Martijn van Otterlo (Eds.) – Reinforcement Learning: State of the Art, Springer
3. Csaba Szepesvári – Algorithms for Reinforcement Learning, Morgan & Claypool
4. Yuxi Li – Deep Reinforcement Learning: An Overview, arXiv survey

Online Courses & Resources:

1. DeepMind x UCL Reinforcement Learning Lectures by David Silver
2. Coursera: Reinforcement Learning Specialization – University of Alberta
3. DeepLearning.AI – Deep Reinforcement Learning with TensorFlow

Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON3104T	AI for Robotics & Automation	3	0	0	3

Pre-Requisites: Python Programming, Data Structures, Artificial Intelligence Fundamentals, Sensors & Actuators, Control Systems, and Basic Electronics.

Course Objectives:

- To introduce the fundamental concepts of robotics and its integration with artificial intelligence (AI).
- To understand perception, motion planning, and control strategies using AI for autonomous robots.
- To explore machine learning and deep learning approaches in robotic automation.
- To develop intelligent systems capable of navigation, manipulation, and decision-making.
- To understand real-time robotic applications in industry and research.

Course Outcomes (COs):

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

CO1: Apply AI and robotics fundamentals to intelligent robotic system architectures and components. (L3)

CO2: Apply robotic perception, computer vision, and sensor fusion techniques for navigation and obstacle avoidance. (L3)

CO3: Analyze motion planning and control algorithms for robotic navigation and manipulation tasks. (L4)

CO4: Analyze machine learning and reinforcement learning models for autonomous robotic behavior and adaptation. (L4)

CO5: Evaluate AI-powered robotic applications in industrial automation, agriculture, healthcare, and logistics domains. (L5)

Unit I: Introduction to AI and Robotics:

Fundamentals of Robotics and Components, AI Techniques for Robotics, Types of Robots: Mobile, Industrial, Collaborative, Humanoids, Architectures for Intelligent Robots, Sensors and Actuators in Robotics

Unit II: Robotic Perception and Computer Vision:

Perception Pipeline in Robots, Image Processing & Object Detection, Depth Estimation, 3D Mapping (SLAM), Sensor Fusion (Camera, LiDAR, IMU), Vision-based Navigation and Obstacle Avoidance

Unit III: Motion Planning and Control:

Path Planning: Dijkstra, A*, RRT, PRM, Control Strategies: PID, Feedback Linearization. Trajectory Generation. Kinematics & Dynamics for Robot Manipulators. Motion Planning in Dynamic Environments

Unit IV: Machine Learning in Robotics:

Reinforcement Learning for Control, Supervised Learning for Object Recognition, Unsupervised Learning for Clustering and Mapping, Behavior Cloning and Imitation Learning, Online and Adaptive Learning in Robots

Unit V: Applications and Trends in Robotic Automation:
AI in Industrial Automation and Smart Factories, AI for Service Robots and Human-Robot Interaction (HRI), Robots in Agriculture, Healthcare, and Delivery, Ethical and Social Implications of AI in Robotics, Case Studies: Boston Dynamics, Tesla Bots, Warehouse Automation

Text Books:

1. Robin R. Murphy – Introduction to AI Robotics, MIT Press
2. Peter Corke – Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer
3. Oussama Khatib and Bruno Siciliano (Eds.) – Springer Handbook of Robotics, Springer

Reference Books:

1. Kevin M. Lynch & Frank C. Park – Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press
2. Siegwart, Nourbakhsh, Scaramuzza – Introduction to Autonomous Mobile Robots, MIT Press
3. Stuart Russell & Peter Norvig – Artificial Intelligence: A Modern Approach, Pearson

Online References:

1. Coursera – Robotics Specialization (University of Pennsylvania)
2. edX – AI for Robotics (Columbia University)
3. Udacity – AI for Robotics by Sebastian Thrun

Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON3105T	AI Ethics, Fairness & Explainability	3	0	0	3

Pre-Requisites: Basic knowledge of Artificial Intelligence, Machine Learning, Data Analytics, and ethical considerations in technology.

Course Objectives:

- To understand the ethical challenges and responsibilities involved in building and deploying AI systems.
- To identify and mitigate bias in AI data, algorithms, and models.
- To explore techniques for interpretability and explainability in machine learning.
- To critically evaluate AI systems from a legal, social, and philosophical perspective.
- To analyze real-world case studies involving ethical dilemmas in AI deployment.

Course Outcomes (COs):

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

CO1: Apply ethical principles, responsible AI concepts, and sustainability considerations in AI system development.(L3)

CO2: Analyze different types of bias, fairness metrics, and bias mitigation techniques in AI datasets and models.(L4)

CO3: Apply explainable AI techniques such as LIME, SHAP, Anchors, and interpretability methods for transparent AI systems.(L3)

CO4: Analyze legal, regulatory, and societal aspects influencing responsible AI deployment.(L4)

CO5: Evaluate responsible AI frameworks, governance mechanisms, and industry practices for ethical AI system development.(L5)

Unit I: Foundations of AI Ethics:

Introduction to AI Ethics and Responsible AI, Ethical Theories: Utilitarianism, Deontology, Virtue Ethics, Key Ethical Principles: Fairness, Accountability, Transparency, Privacy (FATP), Human-in-the-loop and Ethical Decision Making, AI and the SDGs (Sustainable Development Goals)

Unit II: Bias in Data and Algorithms:

Types of Bias: Historical, Representation, Measurement, Aggregation, Sources of Bias in AI: Data Collection, Annotation, Model Training, Metrics for Fairness: Demographic Parity, Equal Opportunity, Predictive Parity, Bias Mitigation Techniques: Pre-processing, In-processing, Post-processing, Case Studies: COMPAS, Hiring Algorithms, Face Recognition Bias

Unit III: Explainable AI (XAI) Techniques:

Need for Explainability and Transparency, Global vs Local Explanations, Methods: LIME, SHAP, Anchors, Integrated Gradients, Model-specific vs Model-agnostic Explanations, Visual Explanations and Human-Centric Interpretability

Unit IV: Legal, Regulatory & Societal Aspects:

Data Protection Laws: GDPR, CCPA, Indian Digital Personal Data Protection Act, Ethical Guidelines: IEEE, UNESCO, OECD AI Principles, Algorithmic Accountability and Auditing, Intellectual Property and Liability in AI, Ethical Considerations in Surveillance, Military, and Social Scoring

Unit V: Building Responsible AI Systems:

Designing Ethical AI Systems: Frameworks and Toolkits, Human-Centered AI and Value Alignment, Responsible AI Lifecycle and Documentation (Model Cards, Data Sheets), AI for Good and Ethical

Innovation, Industry Case Studies: Google, Microsoft, IBM‘s AI Governance

Text Books:

1. Virginia Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer, 2019.
2. Cathryn Carson and John Zerilli, Ethics and Data Science, O'Reilly Media, 2021.
3. Patrick Lin, Keith Abney, Ryan Jenkins, Robot Ethics 2.0: From Autonomous Cars to Artificial Intelligence, Oxford University Press, 2017.

Reference Books:

1. Shalini Sharma, B. Ravindran, Responsible AI: An Indian Perspective, Springer, 2023.
2. Christopher Kuner et al., The GDPR: General Data Protection Regulation (EU) Regulation 2016/679, Oxford University Press.

Course Code	Name of the Course	L	T	P	C
24HON3106P	**AI & Machine Learning Lab**	**0**	**0**	**3**	**1.5**

Pre-Requisites: Basic knowledge of Python programming, Statistics, Data Analysis, Machine Learning concepts, and problem-solving techniques.

Course Objectives:

- To provide hands-on experience in implementing AI and machine learning algorithms.
- To develop and evaluate models using real-world datasets.
- To introduce optimization and hyperparameter tuning techniques.
- To build intelligent systems for classification, prediction, and clustering.

Course Outcomes (COs):

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

CO1: Implement key machine learning algorithms from scratch and using libraries. (L3)

CO2: Preprocess data and select suitable features for modeling. (L3)

CO3: Train, test, and evaluate models for accuracy and performance. (L5)

CO4: Apply AI techniques to solve classification, regression, and decision-making problems. (L3)

CO5: Develop simple AI agents and use neural networks for predictive tasks. (L5)

Tools Required

- Python (NumPy, Pandas, Scikit-learn, TensorFlow/Keras, OpenCV)
- Jupyter Notebook / Google Colab
- Datasets from UCI, Kaggle, Scikit-learn
- Anaconda / VS Code

List of 12 Experiments

1. **Data Preprocessing** – Cleaning, normalization, encoding, and splitting data.
2. **Linear Regression** – Implement simple and multiple linear regression.
3. **Logistic Regression** – Binary classification on datasets like breast cancer or Titanic.
4. **K-Nearest Neighbors (KNN)** – Classification task with evaluation metrics.
5. **Decision Trees and Random Forests** – Tree-based classification and visualization.
6. **Support Vector Machines (SVM)** – Margin classification with kernel trick.
7. **Naive Bayes** – Text classification with spam dataset.
8. **K-Means Clustering** – Unsupervised clustering with customer segmentation.
9. **Principal Component Analysis (PCA)** – Dimensionality reduction and visualization.
10. **Artificial Neural Networks (ANNs)** – Implement basic neural network using Keras.
11. **Model Evaluation & Tuning** – Use cross-validation, GridSearchCV, and confusion matrices.
12. **AI Agent Search Algorithms** – Implement A*, DFS, BFS for pathfinding problems.

Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON3107P	Robotics & Autonomous Systems Lab	0	0	3	1.5

Pre-Requisites: Basic knowledge of Programming, Sensors and Actuators, Control Systems, Robotics fundamentals, and Artificial Intelligence concepts.

Course Objectives:

- To introduce students to the fundamental concepts of robotics, control, and autonomous navigation.
- To provide hands-on experience with robotic simulation tools and real-time robot programming.
- To explore sensor integration, motion planning, and autonomous decision-making.
- To familiarize students with ROS (Robot Operating System) and robotic hardware platforms.
- To apply AI and machine learning concepts in robotics for perception and autonomy.

Course Outcomes (COs):

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

CO1: Constructd the fundamentals of robotic systems, ROS environment, and robotic simulation platforms.(L3)

CO2: Apply ROS programming concepts for robot communication, control, and simulation tasks.(L3)

CO3: Apply kinematics, control strategies, and sensor integration techniques for robotic movement and perception.(L3)

CO4: Analyze SLAM, path planning, obstacle avoidance, and autonomous navigation algorithms in robotic systems.(L4)

CO5: Evaluate vision-based robotic applications and complete autonomous navigation workflows in mapped environments.(L5)

List of 12 Lab Experiments:

1. Experiment 1: Introduction to Robot Operating System (ROS) and workspace setup.
2. Experiment 2: Build a basic ROS publisher and subscriber for robot control.
3. Experiment 3: Simulate a differential drive robot in Gazebo or Webots.
4. Experiment 4: Implement forward and inverse kinematics for a 2-link robotic arm.
5. Experiment 5: Control robot movement using PID control in simulation.
6. Experiment 6: Interface and process data from ultrasonic/IR sensors.
7. Experiment 7: Integrate and visualize LIDAR data for environment sensing.
8. Experiment 8: Implement SLAM (Simultaneous Localization and Mapping) using Gmapping or Cartographer.
9. Experiment 9: Develop a path planning algorithm using A* or Dijkstra.
10. Experiment 10: Obstacle avoidance using sensor data and reactive behavior.
11. Experiment 11: Vision-based object detection and tracking using OpenCV.
12. Experiment 12: Mini project – Build a complete pipeline for autonomous navigation in a mapped environment.

Text Books:

1. Roland Siegwart, Illah Nourbakhsh, and Davide Scaramuzza, Introduction to Autonomous Mobile Robots, MIT Press.
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson.

MINOR DEGREE OFFERED BY THE C.S.E - A. I. &M.L. TO OTHERS

Minor Degree - Artificial Intelligence & Machine Learning

Course Code	Name of the Course	L	T	P	C
24MAM3301T	Introduction to Artificial Intelligence	3	0	0	3

Pre-Requisites: Basic Programming Concepts, Computer Fundamentals, Logical Reasoning, and Mathematics Fundamentals.

Course Objectives:

- Understand the fundamental concepts and historical evolution of Artificial Intelligence.
- Learn various problem-solving approaches using AI algorithms.
- Gain insights into knowledge representation, reasoning, and planning techniques.
- Explore basic machine learning and neural network models.
- Familiarize with real-world AI applications and ethical implications.

Course Outcomes (COs):

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

CO1: Apply fundamental AI concepts, intelligent agents, and AI techniques to identify suitable AI approaches for problem-solving environments. (L3)

CO2: Apply search strategies and constraint satisfaction techniques to solve AI-based computational problems. (L3)

CO3: Analyze knowledge representation models, logical reasoning methods, and uncertainty handling techniques in AI systems. (L4)

CO4: Analyze machine learning models and neural network fundamentals for data-driven decision-making tasks. (L4)

CO5: Inspect AI applications and ethical implications in real-world domains considering fairness, explainability, and societal impact. (L4)

Unit I: Introduction to Artificial Intelligence:

Definition and applications of AI, History and evolution of AI, Intelligent agents – types and environments, AI techniques: Symbolic AI, Sub-symbolic AI

Unit II: Problem Solving and Search Strategies:

Problem formulation, Uninformed search: BFS, DFS, Uniform Cost, Informed search: Greedy, A* search, Local search: Hill climbing, Simulated annealing, Constraint satisfaction problems

Unit III: Knowledge Representation and Reasoning:

Propositional and First-Order Logic, Forward and backward chaining, Rule-based systems and ontologies, Semantic networks, frames, Uncertainty: Bayesian reasoning, fuzzy logic

Unit IV: Machine Learning Basics:

Overview of supervised, unsupervised, reinforcement learning, Decision Trees, k-NN, Naïve Bayes, Basic concepts of neural networks and perceptron, Training and testing datasets, Evaluation metrics: Accuracy, precision, recall, F1-score

Unit V: Applications of AI and Ethical Issues:

AI in Robotics, NLP, Vision, Healthcare, Finance, Chatbots and virtual assistants, AI biases, fairness, explainability, Social and legal implications of AI, Future trends: AGI, ethical AI

Text Books:

1. **Stuart Russell & Peter Norvig**, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson
2. **Elaine Rich, Kevin Knight**, Artificial Intelligence, 3rd Edition, McGraw-Hill
3. **Dan W. Patterson**, Introduction to Artificial Intelligence and Expert Systems, PHI

Reference Books:

1. **Kevin Murphy**, Machine Learning: A Probabilistic Perspective, MIT Press
2. **Nils J. Nilsson**, The Quest for Artificial Intelligence, Cambridge
3. **Tom Mitchell**, Machine Learning, McGraw-Hill

Online Courses

1. **CourseraAI For Everyone – Andrew Ng**

Minor Degree - Artificial Intelligence & Machine Learning

Course Code	Name of the Course	L	T	P	C
24MAM3302T	Machine Learning Fundamentals	2	1	0	3

Pre requisites: Python Programming, Probability & Statistics, Linear Algebra, Calculus, and Basic Data Analysis.

Course Objectives

- Understand core concepts of supervised, unsupervised, and reinforcement learning.
- Learn foundational algorithms for classification, regression, and clustering.
- Analyze model performance using evaluation metrics and tuning methods.
- Gain practical knowledge in implementing ML models using datasets.
- Understand the mathematical and probabilistic foundations of ML algorithms.

Course Outcomes (COs):

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

CO1: Apply foundational machine learning concepts, workflows, and Python libraries for data-driven problem solving. (L3)

CO2: Apply supervised learning algorithms for regression and classification tasks using real-world datasets. (L3)

CO3: Analyze clustering and dimensionality reduction techniques for extracting patterns from unlabelled datasets. (L4)

CO4: Analyze model evaluation metrics and hyperparameter tuning strategies to improve learning performance. (L4)

CO5: Examine advanced ML applications and ethical considerations in practical machine learning deployments. (L4)

Unit I: Introduction to Machine Learning:

Definition and Scope of ML, Types of Learning: Supervised, Unsupervised, Reinforcement, Basic Terminology: Instance, Feature, Label, Training and Testing Sets, Applications and Challenges, Python Libraries: scikit-learn, pandas, numpy

Unit II: Supervised Learning – Regression & Classification:

Linear Regression, Polynomial Regression, Logistic Regression, k-Nearest Neighbors (k-NN), Decision Trees and Random Forests, Naïve Bayes Classifier

Unit III: Unsupervised Learning & Dimensionality Reduction:

k-Means Clustering, Hierarchical Clustering, Principal Component Analysis (PCA), t-SNE, Autoencoders (Intro Only). Association Rule Mining,

Unit IV: Model Evaluation and Tuning:

Confusion Matrix, Precision, Recall, F1-Score, ROC-AUC, Bias-Variance Tradeoff, Cross-Validation, Hyperparameter Tuning: Grid Search & Random Search, Overfitting & Underfitting

Unit V: Advanced Topics & Real-time Applications:

Introduction to Neural Networks (Perceptron), Introduction to SVMs, Feature Engineering & Selection, Real-world Use Cases: Spam Detection, Credit Scoring, Medical Diagnosis, Ethical AI and Model Explainability (XAI – Intro Only)

Textbooks:

1. **Tom M. Mitchell**, *Machine Learning*, McGraw-Hill, 1997.

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Course Code	Name of the Course	L	T	P	C
24MAM3303T	Deep Learning & Neural Networks	2	1	0	3

Pre-Requisites: Python Programming, Linear Algebra, Calculus, Probability & Statistics, and Machine Learning Fundamentals.

Course Objectives:

- To introduce the fundamental concepts and mathematical foundations of deep learning.
- To explore different neural network architectures including CNNs, RNNs, LSTMs, and Transformers.
- To enable students to implement, train, and optimize deep neural networks.
- To analyze the performance and limitations of various architectures in different AI tasks.
- To develop the ability to apply deep learning models to real-world applications such as image recognition, language modeling, and autonomous systems.

Course Outcomes (COs):

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

CO1: Apply neural network fundamentals, activation functions, and backpropagation techniques in deep learning models. (L3)

CO2: Apply optimization and regularization methods to improve deep neural network training efficiency. (L3)

CO3: Analyze convolutional neural network architectures for image-based applications. (L4)

CO4: Analyze recurrent neural networks and LSTM architectures for sequential data modeling. (L4)

CO5: Experiment generative models and transfer learning approaches for advanced deep learning applications. (L4)

Unit I: Foundations of Neural Networks:

Introduction to Artificial Neural Networks, Biological Neuron vs. Artificial Neuron, Perceptron, Multilayer Perceptron (MLP), Activation Functions: ReLU, Sigmoid, Tanh, Softmax, Backpropagation and Gradient Descent, Loss Functions: MSE, Cross Entropy, Overfitting, Regularization (L1/L2), Dropout

Unit II: Convolutional Neural Networks (CNNs):

Convolution Operation and Feature Maps, Pooling Layers: Max and Average Pooling, CNN Architectures: LeNet, AlexNet, VGG, ResNet, Transfer Learning and Fine-tuning, Image Classification, Object Detection Basics, Implementation with TensorFlow/PyTorch

Unit III: Recurrent Neural Networks (RNNs) and Variants:

Sequential Data and Time Series, RNN Basics and Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, LSTM and GRU Architectures, Applications in Text, Speech, and Music, Sequence-to-Sequence Models

Unit IV: Advanced Architectures & Optimization:

Autoencoders and Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), Deep Reinforcement Learning Overview, Batch Normalization, Early Stopping, Hyperparameter Tuning and Optimization, Performance Metrics and Evaluation

Unit V: Transformer Models & Applications:

Attention Mechanism and Self-Attention, Transformers and BERT Architecture, Positional Encoding, Multi-head Attention, Pre-trained Language Models and Fine-Tuning, Applications in NLP: Text Classification, Translation, Large Language Models and Transfer Learning

Text Books:

1. Deep Learning – Ian Goodfellow, Yoshua Bengio, and Aaron Courville (MIT Press)
2. Neural Networks and Deep Learning – Michael Nielsen (Online Book)
3. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow – Aurélien Géron (O'Reilly)

Reference Books:

1. Pattern Recognition and Machine Learning – Christopher M. Bishop
2. Deep Learning for Computer Vision – Rajalingappaa Shanmugamani
3. Natural Language Processing with Transformers – Lewis Tunstall, Leandro von Werra, Thomas Wolf
4. Reinforcement Learning: An Introduction – Richard S. Sutton and Andrew G. Barto

Recommended Online Courses:

1. Deep Learning Specialization – Andrew Ng (Coursera)
2. CS231n: Convolutional Neural Networks for Visual Recognition (Stanford)
3. Fast.ai – Practical Deep Learning for Coders
4. Deep Learning with PyTorch (Udacity)
5. Transformers by Hugging Face (free course)

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Course Code	Name of the Course	L	T	P	C
24PC31303T	Natural Language Processing	2	1	0	3

Pre-Requisites: Python Programming, Data Structures, Probability & Statistics, Machine Learning Fundamentals, and Basic Linguistics Concepts.

Course Objectives

- Basics of NLP, Morphology, Tokenization, N-gram Models
- POS Tagging, Parsing, Treebanks, Ambiguity Handling
- Word Sense Disambiguation, Semantic Parsing, Sentiment Analysis
- Machine Translation, Transformers, BERT/GPT, Ethical NLP
- Speech Recognition, Feature Extraction, Discourse Analysis

Course Outcomes (COs):

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

CO1: Practice the architectural organization of Natural Language Understanding systems by analyzing linguistic backgrounds and different levels of language analysis. (L3)

CO2: Apply various parsing techniques, grammars (Top-Down, Bottom-Up, ATN), and information theory concepts like Entropy to resolve morphological and lexical structures.(L3)

CO3: Examine human preferences and movement phenomena in natural language using Shift-Reduce and Deterministic parsers. (L4)

CO4: Prepare semantic interpretations and language modeling techniques, including n-grams and multilingual adaptation, to resolve word sense ambiguity. (L5)

CO5: Analyze the frameworks for Machine Translation, Multilingual Information Retrieval, and Automatic Summarization to solve cross-lingual communication challenges. (L4)

Unit I: Introduction to NLP:

Introduction to NLP: Origins and Challenges, Language and Grammar in NLP, Regular Expressions and Finite-State Automata, Tokenization: Text Segmentation and Sentence Splitting, Morphological Parsing: Stemming and Lemmatization, Spelling Error Detection and Correction, Minimum Edit Distance and Applications, Statistical Language Models: Unigram, Bigram, and Trigram Models, Processing Indian Languages in NLP.

Unit II: Word-Level and Syntactic Analysis:

Introduction, Part-of-Speech (POS) Tagging: Rule-Based, Stochastic and Transformation-Based Approaches, Hidden Markov Models (HMM) and Maximum Entropy Models for POS Tagging, Context-Free Grammar (CFG) and Constituency Parsing, Treebanks and Normal Forms for Grammar, Top-Down and Bottom-Up Parsing Strategies, CYK Parsing Algorithm, Probabilistic Context-Free Grammars (PCFGs), Feature Structures and Unification.

Unit III: Text Classification and Information Retrieval:

Naïve Bayes Classifier for Text Classification, Training and Optimization for Sentiment Analysis, Information Retrieval: Basic Concepts and Design Features, Information Retrieval Models: Classical, Non-Classical, and Alternative Models, Cluster Model, Fuzzy Model, and LSTM-Based Information, Retrieval, Word Sense Disambiguation (WSD) Methods: Supervised and Dictionary-Based Approaches.

Unit IV: Machine Translation and Semantic Processing:

Introduction to Machine Translation (MT), Language Divergence and Typology in MT Encoder-Decoder Model for Machine Translation, Translating in Low-Resource Scenarios, MT Evaluation Metrics and Techniques, Bias and Ethical Issues in NLP and Machine Translation, Semantic Analysis and First-Order Logic in NLP, Thematic Roles and Selectional Restrictions in Semantics, Word Senses and Relations Between Senses

Unit V: Speech Processing and Advanced NLP Models:

Speech Fundamentals: Phonetics and Acoustic Phonetics, Digital Signal Processing in Speech Analysis, Feature Extraction in Speech: Short-Time Fourier Transform (STFT), Mel-Frequency Cepstral Coefficients (MFCC) and Perceptual Linear Prediction (PLP), Hidden Markov Models (HMMs) in Speech Recognition.

Textbooks (Core Learning Materials):

1. Daniel Jurafsky & James H. Martin – Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 2023.
2. Tanveer Siddiqui & U.S. Tiwary – Natural Language Processing and Information Retrieval, Oxford University Press.

Reference Books (Supplementary Learning):

1. T.V. Geetha – Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives, Pearson, 2024.
2. Akshay Kulkarni & Adarsha Shivananda – Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python, Apress, 2019.

Online Resources :

1. https://www.youtube.com/watch?v=M7SWr5xObkA
2. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
3. https://archive.nptel.ac.in/courses/106/106/106106211/

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Course Code	Name of the Course	L	T	P	C
24PE31306T	Computer Vision	2	1	0	3

Pre-Requisites: Python Programming, Linear Algebra, Probability & Statistics, Digital Image Processing, and Machine Learning Fundamentals.

Course Objectives:

- To introduce the mathematical foundations of image formation, linear filtering, convolution, and multi-scale image representation used in computer vision.
- To equip students with techniques for noise modelling, derivative-based edge detection, and feature extraction including corners and orientations.
- To enable students to analyse and synthesise image texture using filter banks, pyramid representations, and statistical models of filter outputs.
- To impart knowledge of image segmentation methods-clustering, graph-theoretic approaches, and the Hough transform-for detecting geometric structures.
- To develop the ability to build recognition systems using template relations, probabilistic search, and Hidden Markov Models for real-world vision applications.

Course Outcomes (COs):

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

CO1: Apply image filtering, convolution, and frequency-domain techniques for image processing tasks.(L3)

CO2: Demonstrate edge detection and feature extraction methods for noisy image analysis. (L3)

CO3: Analyze texture representation and synthesis techniques using filter banks and pyramids. (L4)

CO4: Examine segmentation and geometric detection methods for image partitioning tasks. (L4)

CO5: Design recognition systems based on probabilistic models and Hidden Markov Models for vision applications. (L5)

Unit I : Linear Filters:

Introduction to Computer Vision, Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing Filters as Templates, Technique: Normalized Correlation and Finding Patterns, Technique: Scale and Image Pyramids.

Unit II : Edge Detection:

Noise- Additive Stationary Gaussian Noise, Why Finite Differences Respond to Noise, Estimating Derivatives - Derivative of Gaussian Filters, Why Smoothing Helps, Choosing a Smoothing Filter, Why Smooth with a Gaussian? Detecting Edges-Using the Laplacian to Detect Edges, Gradient-Based Edge Detectors, Technique: Orientation Representations and Corners.

Unit III: Texture:

Representing Texture –Extracting Image Structure with Filter Banks, Representing Texture using the Statistics of Filter Outputs, Analysis (and Synthesis) Using Oriented Pyramids –The Laplacian Pyramid, Filters in the Spatial Frequency Domain, Oriented Pyramids, Application: Synthesizing Textures for Rendering, Homogeneity, Synthesis by Sampling Local Models, Shape from Texture, Shape from Texture for Planes.

Unit IV :Segmentation By Clustering:

What is Segmentation, Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction. Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering. The Hough Transform, Fitting Lines, Fitting Curves

Unit V :Recognization By Relations Between Templates:

Finding Objects by Voting on Relations between Templates, Relational Reasoning Using Probabilistic Models and Search, Using Classifiers to Prune Search, Hidden Markov Models, Application: HMM and Sign Language Understanding, Finding People with HMM.

Text books:

1. David A. Forsyth, Jean Ponce, Computer Vision – A modern Approach, PHI, 2003.

Reference Books:

1. Geometric Computing with Clifford Algebras: Theoretical Foundations and Applicationsin Computer Vision and Robotics, Springer;1 edition,2001by Sommer.
2. Digital Image Processing and Computer Vision,1/e, by Sonka.
3. Computer Vision and Applications: Concise Edition (With CD) by Jack Academy Press, 2000.

Online Learning Resources:

https://nptel.ac.in/courses/106105216https://nptel.ac.in/courses/108103174

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Course Code	Name of the Course	L	T	P	C
24MAM3303P	AI & ML Lab	0	0	3	1.5

Pre-Requisites: Python Programming, Machine Learning Fundamentals, Data Preprocessing, and Basic Statistics.

Course Objectives:

- To understand the core concepts of supervised and unsupervised machine learning through hands-on Python-based experiments.
- To implement classical ML algorithms such as Linear Regression, Decision Trees, Naïve Bayes, SVM, and K-Means Clustering using scikit-learn.
- To apply data preprocessing techniques including feature scaling, encoding, and handling missing values on real-world datasets.
- To evaluate model performance using metrics like accuracy, precision, recall, F1-score, and ROC-AUC curves.
- To develop practical skills in model saving, loading, hyperparameter tuning, and basic deployment using Flask API.

Course Outcomes (COs):

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

CO1: Analyze the usage of Python libraries such as NumPy, Pandas, and scikit-learn for implementing AI and ML experiments. (L4)

CO2: Apply supervised learning algorithms such as Linear Regression, Decision Trees, Naïve Bayes, and SVM for solving classification and prediction problems. (L3)

CO3: Apply unsupervised learning techniques including K-Means clustering and data preprocessing methods on real-world datasets. (L3)

CO4: Analyze model tuning, model persistence, and deployment workflows for machine learning applications using Flask and pickle. (L4)

CO5: Evaluate machine learning model performance using accuracy, precision, recall, F1-score, ROC-AUC, and confusion matrix metrics. (L5)

Experiments:

1. Introduction to AI/ML libraries: NumPy, Pandas
2. Supervised vs Unsupervised Learning demo
3. Linear Regression implementation
4. Decision Tree Classifier
5. Naive Bayes Classifier
6. K-Means Clustering
7. SVM classifier
8. Hyperparameter tuning
9. Model evaluation techniques
10. Deployment with Flask API (demo)
11. Model saving and loading using pickle

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Course Code	Name of the Course	L	T	P	C
24MAM3304P	NLP & Computer Vision Lab	0	0	3	1.5

Pre-Requisites: Python Programming, Digital Image Processing, Natural Language Processing Fundamentals, Machine Learning, and Deep Learning Basics.

Course Objectives:

- To implement fundamental NLP preprocessing tasks including tokenization, stemming, lemmatization, and stopword removal on text corpora.
- To build text representation models such as Bag of Words, TF-IDF, and apply them for text classification tasks.
- To perform image reading, manipulation, filtering, and geometric transformation using the OpenCV library.
- To implement face detection using Haar cascades and develop CNN-based image classification models using TensorFlow/Keras.
- To integrate NLP and Computer Vision pipelines for applications such as Named Entity Recognition (NER), Sentiment Analysis, and image captioning

Course Outcomes (COs):

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

CO1: Apply NLP preprocessing concepts such as tokenization, stemming, lemmatization, and stopword removal for text analytics. (L3)

CO2: Apply text representation and classification techniques including Bag of Words, TF-IDF, Logistic Regression, and sentiment analysis. (L3)

CO3: Apply image processing operations such as filtering, transformations, and face detection using OpenCV. (L3)

CO4: Analyze CNN architectures and pre-trained models for image classification and visual recognition tasks. (L4)

CO5: Evaluate integrated NLP and Computer Vision applications such as NER, image captioning, and text-to-image systems. (L5)

Experiments:

1. Text preprocessing (tokenization, stemming, etc.)
2. Bag of Words and TF-IDF models
3. Text classification using Logistic Regression
4. Named Entity Recognition (NER)
5. Sentiment Analysis
6. Image reading and manipulation using OpenCV
7. Image filtering and transformations
8. Face detection using Haar cascades
9. CNN model using TensorFlow/Keras
10. Image classification with pre-trained models
11. Text-to-Image and Image Captioning (intro)