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

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE STRUCTURE AND SYLLABUS

for

B. Tech. (Regular – Full Time)

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

and

B. Tech. (Lateral Entry Scheme)

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

ADITYA COLLEGE OF ENGINEERING :: MADANAPALLE
Punganur Road, Valasapalle (Post), Madanapalle, Annamayya (Dist.,) – 517325.
(An Autonomous Institution)
Department of Artificial Intelligence and Data Science

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 become a Centre of Excellence in the domain of Artificial Intelligence and Data Science for addressing local and global challenges.

Department Mission:

- To impart quality education in the areas of existing and evolving Al & DS techniques.
- To groom students to become technologically superior and ethically stronger.
- To equip students with interdisciplinary skills to solve real - world problems and make them life-long learners.

Programme Outcomes (POs):

On Successful completion, the graduate will be able to,

- **PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

- **PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10. Communication:** Communicate effectively on complex engineering activities with the engineering commUnity and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

On Successful completion, the graduate (Artificial Intelligence and Data Science) will be able to,

- Understand and apply the concepts of mathematics, basic sciences, basic computing, in analysing the real-world problems and solving them.
- Design and develop computer programs/computer - based systems in the areas related to Artificial Intelligence, Machine Learning, Web / Mobile Design, and Data Science using Software Engineering principles and practices.

Programme Educational Objectives (PEOs):

After few years of graduation, the graduates of Artificial Intelligence and Data Science are expected to

- Graduates of the program are adequately prepared to be employed in IT industries and Public Sector companies by forecasting a logical and practical approach to problem solving that would prepare them to function effectively as skilled computer engineers.
- To impart students with solid foundation in mathematics, computing and core engineering fundamentals so as to help them to excel in their professional career or higher education.
- To promote lifelong learning by encouraging research and an attitude to apply the basic theories learnt during their graduation, leading to the creativity and productivity in their respective fields.
- To inculcate students with leadership qualities, communication skills and ethical behaviour as IT professionals that can lead to positive impact of technology on society.

B.Tech. – Artificial Intelligence and Data Science
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	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.	HM	**Management Elective -I (HM – I)**		2	0	0	2
		24HMHS206T	Managerial Economics and Financial Analysis				
		24HMHS207T	Organizational Behaviour				
		24HMHS208T	Business Environment				
3.	PC	24PC05204T	Database Management Systems	2	1	0	3
4.	PC	24PC05202T	Advanced Data Structures and 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	**11**	**5**	**10**	**21**

B.Tech. – II Year II Semester

S. No.	Category	Course Code	Name of the Course	L	T	P	Credits
1.	BS	24BSHB211T	Statistical Methods for Data Science	2	1	0	3
2.	HM	24HMHS204L	Universal Human Values – Understanding Harmony and Ethical Human Conduct	2	1	0	3
3.	PC	24PC31201T	Artificial Intelligence	3	0	0	3
4.	PC	24PC30201T	Introduction to Data Science	3	0	0	3
5.	PC	24PC04204T	Digital Logic & Computer Organization	3	0	0	3
6.	PC	24PC31201P	Artificial Intelligence Lab	0	0	3	1.5
7.	PC	24PC30201P	Data Science using Python 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	**13+2**	**3**	**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	24PC30302T	Data Warehousing and Data Mining	2	1	0	3
2.	PC	24PC05307T	Introduction to Quantum Technologies and Applications	3	0	0	3
3.	PC	24PC31202T	Machine Learning	2	1	0	3
4.	PC	24PC30303T	Multi Agent Systems	3	0	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	24PC30302P	Data Warehousing and Data Mining Lab	0	0	3	1.5
8.	PC	24PC31302P	Machine Learning 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	**16**	**3**	**10**	**26**

Professional Elective – I (PE - I)

S. No.	Course Code	Name of the Professional Elective	L	T	P
1.	24PE30301T	Data Visualization	3	0	0
2.	24PE05302T	Soft Computing	3	0	0
3.	24PE30302T	Internet of Things for AI Applications	3	0	0
4.	24PE30303T	Exploratory Data Analysis with Python	3	0	0

Open Elective – I (OE - I)

S. No.	Course Code	Name of the Professional Elective	Offered by the Dept.	L	T	P
1.	24OE01301T	Green Buildings	Civil	2	1	0
2.	24OE01302T	Construction Technology and Management		2	1	0
3.	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	3	0	0
7.	24OEHB301T	Mathematics for Machine Learning & 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. 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	24PC30305T	Big Data Analytics	2	1	0	3
2.	PC	24PC31306T	Deep Learning	2	1	0	3
3.	PC	24PC31303T	Natural Language Processing	3	0	0	3
4.	PE	**Professional Elective – II (PE – II)**		3	0	0	3
5.	PE	**Professional Elective – III (PE – III)**		3	0	0	3
6.	OE	**Open Elective – II (OE – II)**		3	0	0	3
7.	PC	24PC31306P	Deep Learning Lab	0	0	3	1.5
8.	PC	24PC30305P	Big Data Analytics and Data Visualization Lab	0	0	3	1.5
9.	SE	24SEHS201S	Soft Skills	0	1	2	2
10.	MC	24MCHS309A	Mandatory Noncredit Course Technical Paper Writing &IPR	2	0	0	-
11.	WS	24IPWS302L	Workshop	0	0	0	0
			Total	**16+2**	**3**	**08**	**23**
Mandatory Industry Internship(24IPIN403L) of 6 to 8 weeks duration during Summer Vacation							

Professional Elective – II (PE - II)

S. No.	Course Code	Name of the Professional Elective	L	T	P
1.	24PE31302T	Reinforcement learning	3	0	0
2.	24PE30304T	Recommender Systems	3	0	0
3.	24PE30305T	Predictive Analytics	3	0	0
4.	24PE30306T	AI for Finance	3	0	0

Professional Elective – III (PE - III)

S. No.	Course Code	Name of the Professional Elective	L	T	P
1.	24PE05310T	Introduction to Quantum Computing	3	0	0
2.	24PE31306T	Computer Vision	3	0	0
3.	24PC31307T	Cloud Computing for AI	3	0	0
4.	24PE30307T	Social Network Analysis	3	0	0

Open Elective – II (OE - II)

S. No	Course Code	Name of the Professional Elective	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	24PC30406T	Generative AI	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 Noncredit Course Gender Sensitization	2	0	0	-
9.	IP	24IPIN403L	Evaluation of Industry Internship	-	-	-	2
		Total		**17+2**	**1**	**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 Professional Elective	L	T	P
1.	24PE30408T	Edge AI	3	0	0
2.	24PE30409T	Human Computer Interaction	3	0	0
3.	24PE30410T	Machine Learning Operations	3	0	0
4.	24PE30411T	No SQL Databases	3	0	0

Professional Elective – V (PE - V)

S. No.	Course Code	Name of the Professional Elective	L	T	P
1.	24PE30412T	Data Wrangling	3	0	0
2.	24PE30413T	Drone Technology	3	0	0
3.	24PE30414T	Robotics	3	0	0
4.	24PE30415T	Mining Massive Data Sets	3	0	0

Open Elective – III (OE - III)

S. No.	Course Code	Name of the Professional Elective	Offered by the Dept.	L	T	P
1.	24OE01405T	Building Materials and Services	CE	3	0	0
2.	24OE01406T	Environmental Impact Assessment	CE	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	Physics	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 Professional Elective	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 AI & DS

S. No.	Course Code	Name of the Course	L	T	P	Credits
1.	24HON3001T	Advanced Machine Learning & Statistical Modelling	2	1	0	3
2.	24HON3002T	Scalable AI & Big Data	2	1	0	3
3.	24HON3003T	Advanced Deep Learning for Data Science Applications	2	1	0	3
4.	24HON3004T	Data Engineering & Cloud-based AI Pipelines	2	1	0	3
5.	24HON3005T	Ethics, Bias & Explain ability in AI	2	1	0	3
6.	24HON3006P	Big Data & AI Analytics Lab	0	0	3	1.5
7.	24HON3007P	Data Science & Visualization Lab	0	0	3	1.5
		Total	**10**	**5**	**6**	**18**

MINOR DEGREE OFFERED BY AI & DS TO OTHERS
PROGRAMMING & COMPUTATIONAL INTELLIGENCE

S.No.	Course Code	Name of the Course	L	T	P	Credits
1.	24MCI3001T	Python for AI & Data Science	2	1	0	3
2.	24MCI3002T	Data Structures & Algorithms for AI	2	1	0	3
3.	24PE31302T	Reinforcement Learning	2	1	0	3
4.	24MCI3003T	Quantum Computing for AI	2	1	0	3
5.	24MCI3004T	Edge AI & IoT	3	0	0	3
6.	24MCI3005P	Python & DS Lab	0	0	3	1.5
7.	24MCI3006P	RL & Quantum AI Lab	0	0	3	1.5
		Total	**11**	**4**	**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,KhannaPublishers,2017, 44thEdition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley &Sons, 2018, 10thEdition.

Reference Books:

1. Thomas Calculus, George B.Thomas, MauriceD. WeirandJoelHass, Pearson Publishers,2018, 14th Edition.
2. Advanced Engineering Mathematics, R.K. Jainand, S.R.K. Iyengar, Alpha Science International Ltd., 2021, 5th Edition (9threprint).
3. Advanced Modern Engineering Mathematics, GlynJames, Pearson publishers, 2018, 5thEdition.
4. Advanced Engineering Mathematics, Micheael Greenberg, Pearson publishers, 9thedition.
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, 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 electro chemical 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, ampere metric 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 Thermo settings, 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, Dhanpat Rai, 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. Rama chandraiah, 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.

Online Resources:
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 to pics 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, Punctuations – 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 Tenny Son (Poem):

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

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

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

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

Grammar: Cohesive devices-linkers, use of articles and zero article; prepositions.

Vocabulary: Homonyms, Homophones, Homo graphs.

Unit III: Biography: Elon Musk:

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

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

Reading: Reading a text in detail by making basic inferences-recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Note-making, paraphrasing

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

Vocabulary: Compound words, Collocations

Unit IV: Inspiration: The Toys of Peace by Saki:

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

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

Reading: Studying the use of graphic elements in texts to convey 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 Intra Personal 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. Path finder: Communicative English for Under graduate 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, ShamJi &Co. English for Engineers, VikasPublishers,2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students.Routledge,2014.
3. Murphy, Raymond. English Grammar in use, Fourth Edition, Cambridge University Press.
4. Lewis, Norman. Word Power Made Easy the Complete Hand book for Building a Superior Vocabulary. Anchor ,2014

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:

- To Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- To Introduce the preliminary concepts of surveying
- To 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: Analyze 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. 2.Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
3. 3.Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

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

Part - B: Basic Mechanical Engineering

Pre-Requisites: Basic Knowledge in Physics & Chemistry.

Course Objectives:

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

Course Outcomes (COs):

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

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

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

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

Unit I: Introduction to Mechanical Engineering:

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

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

Unit II: Manufacturing Processes:

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

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

Unit III: Power Plants:

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

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

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

Text Books:

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

Reference Books:

1. Appuu Kuttan K.K, 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: Basics of Programming for writing and understanding code.

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 & 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 Micrometry
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 to be performed.

Reference Books:

1. Vogel’s Text book of Quantitative Chemical Analysis, Sixth Edition – Mendham Jetal, 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,2^{nd} 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 emphasis on LSRW skills. (L2)

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

CO3: Analyze the English speech sounds, stress, rhythm, intonation and syllabled vision for better Listening and speaking comprehension. (L4)

CO4: Evaluate and exhibit professional is min participating in debates and group discussions. (L5)

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: Basics of Engineering Practices for hands-on tools and practical skills.

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 work shop 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 woodworking and make following joints.

a) Half–Lap joint b)Mortise and Tenon joint c)Corner Dovetail joint or Bridle joint

3. Sheet Metal Working: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.

a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing

4. Fitting: Familiarity with different types of tools used in fitting and do the following fitting exercises.

a) V-fit b) Dovetail fit c) Semi-circular fit

d)Bicycle tire puncture and change of two-wheel retyre

5. Electrical Wiring: Familiarity with different types of basic electrical circuits and make the Following connections.

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

d)Tube light e)Three phase motor f)Sold erring of wires

6. Foundry Trade: Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds forgiven Patterns.

7. Welding Shop: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap Joint and Butt joint.

8. Plumbing: Demonstration and practice of Plumbing tools, Preparation of Pipe joints with Coupling for same diameter and with reducer for different diameters.

Text Books:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019.
2. Workshop Processes, Practices and Materials; Bruce J. Black, Rout ledge 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: Basics of Programming for practical coding skills.

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:

Tutorial 4: 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*Gb. A/B*C-B+A*D/3

c. A+++B---Ad. 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.

Week 14:

Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

Suggested Experiments/Activities:

Tutorial 14: File handling

Lab 14: File operations

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

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

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

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

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

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

Text Books:

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

Reference Books:

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

B.Tech. – I Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
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 imm Unity 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 comm Unity
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 to all branches of Engineering)	2	1	0	3

Pre- Requisites: Basic Knowledge of Mathematics.

Course Objectives:

- To enlighten the learners about the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into 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, cur land divergence. (L4)

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

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

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

Unit II: Linear Differential Equations of Higher Order (Constant 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) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

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

Unit III: Dielectric and Magnetic Materials:

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

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

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

Unit IV: Quantum Mechanics and Free Electron Theory:

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

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

Unit V: Semiconductors:

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

Text Books:

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

Reference Books:

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

Online Reference:

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

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

Unit I: DC & AC Circuits:

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

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

Unit II: Machines and Measuring Instruments:

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

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

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

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

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

Text Books:

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

Reference Books:

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

Online Resources:

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

Part-B: Basic Electronics Engineering

Pre-Requisites: Fundamentals of Physics and Boolean Algebra

Course Objectives:

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

Course Outcomes (COs):

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

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

CO2: Describe the operation of rectifiers, regulators, and amplifiers, and analyse the functional blocks of power supplies and electronic instrumentation systems for signal processing applications. (L4)

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

Unit I: Semiconductor Devices:

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

Unit II: Basic Electronic Circuits and Instrumentation:

Rectifiers and Power Supplies: Block diagram description of a DC power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator. **Amplifiers:** Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response.

Electronic Instrumentation: Block diagram of an electronic instrumentation system.

Unit III: Digital Electronics:

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

Text Books:

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

Reference Books:

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

Online Reference:

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 underset and the viewing perception of a solid objection Isometric and Perspective projections.

Course Outcomes (COs):

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

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

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

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

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

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

Unit I: Introduction:

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

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

Scales: Plain scales, diagonal scales and vernier scales.

Unit II: Orthographic Projections:

Reference plane, importance of reference lines or Plane, Projections of appoint situated in anyone 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 AutoCAD (Not for end examination).

Text Books:

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

Reference Books:

1. Engineering Drawing, K.L.Narayanaand P.Kannaiah,TataMcGrawHill,2013.
2. Engineering Drawing, M.B.Shahand B.C.Rana,PearsonEducationInc,2009.
3. Engineering Drawing with an Introduction to Auto CAD, Dhananjay Jolhe, TataMcGrawHill,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: Demonstrate Knowledge on measurement of various physical quantities using optical methods and fundamentals of magnetic fields. (L2)

CO2: Identify different physical properties of materials like bandgap, magnetic field intensity etc, for engineering and technological applications. (L4)

CO3: Provide valid conclusions on phenomena Interference and Diffraction. (L2)

CO4: Follow the ethical principles in implementing the programs. (L2)

CO5: Do experiments effectively as an individual and a state as a member in a group. (L3)

CO6: Communicate verbally and in written form, the understanding about the experiments. (L4)

List of Experiments

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

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

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

Reference Book:

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

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 by Kurt 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 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
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/V lookup

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, Students will be able to

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

CO2: Outline the needs and problems of the comm Unity. (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/Comm Unity 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.

iii) Conducting awareness programs on Health-related issues such as General Health,
iv) Mental health, Spiritual Health, HIV/AIDS,
v) Conducting consumer Awareness. Explaining various legal provisions etc.
vi) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population
vii) Education.
viii) 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.(L3)

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.

Text Books:

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 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
24HMHS206T	HM	**Managerial Economics and Financial Analysis** (Common to CE, EEE, ECE, CSE and AI&DS)	2	0	0	2

Pre- Requisites: Nil

Course Objectives:

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

Course Outcomes (COs):

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

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

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

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

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

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

Unit I: Managerial Economics:

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

Unit II: Production and Cost Analysis:

Introduction –Nature, meaning, significance, functions and advantages. Production Function–Least-cost combination–Short run and long run Production Function-Isoquants and Iso costs, Economies of Scale - Cost & Break-Even Analysis -Cost concepts and Cost Behavior-Break-Even Analysis (BEA) -Determination of Break-Even Point (Simple Problems).

Unit III: Business Organizations and Markets:

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

Unit IV: Capital Budgeting:

Introduction –Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting–

Features, Proposals, Methods and Evaluation. Projects –Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems).

Unit V: Financial Accounting and Analysis:

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

Text Books:

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

Reference Books:

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

Online Resources:

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

B.Tech. – II Year I Semester

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

Pre- Requisites: Nil

Course Objectives:

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

Course Outcomes (COs):

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

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

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

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

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

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

Unit I: Introduction to Organizational Behavior:

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

Unit II: Motivation and Leading:

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

Unit III: Organizational Culture:

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

Unit IV: Group Dynamics:

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

Unit V: Organizational Change and Development:

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

Text Books:

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

Reference Books:

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

Online Resources:

1. https://www.slideshare.net/Knight1040/organizational- culture9608857
2. https://www.slideshare.net/AbhayRajpoot3/motivation - 165556714
3. https://www.slideshare.net/harshrastogi1/group-dynamics-159412405
4. https://www.slideshare.net/vanyasingla1/organizational

B.Tech. – II Year I Semester

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

Pre- Requisites: Nil

Course Objectives:

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

Course Outcomes (COs):

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

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

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

CO3: Analyze India's Trade Policy (L4)

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

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

Unit I: Overview of Business Environment:

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

Unit II: Fiscal & Monetary Policy:

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

Unit III: India's Trade Policy:

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

Unit IV: World Trade Organization:

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

Unit V: Money Markets and Capital Markets:

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

Text Books:

1. Francis Cherunilam, International Business: Text and Cases, Prentice Hall of India.
2. K. Aswathappa, Essentials of Business Environment: Texts and Cases & Exercises 13th Revised Edition.HPH

Reference Books:

1. K. V. Sivayya, V. B. M Das, Indian Industrial Economy, Sultan Chand Publishers, New Delhi, India.
2. Sundaram, Black, International Business Environment Text and Cases, Prentice Hall of India, New Delhi, India.
3. Chari. S. N, International Business, Wiley India.
4. E. Bhattacharya, International Business, Excel Publications, New Delhi.

Online Resources:

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

B.Tech. – II Year I 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: Nil

Course Objectives: The main objective of the course is to

- To Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- To Introduce the concepts of basic SQL as a universal Database language
- To Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- To 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:

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:

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:

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):

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 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:

Text Books:

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, Ramez Elmasri, 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 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: Basics of Data Structures.

Course Objectives: The main objective of the course is to

- To Provide knowledge on advance data structures frequently used in Computer Science domain
- To Develop skills in algorithm design techniques popularly used
- To 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, NP Hard Graph Problems and NP Hard Scheduling Problems:

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, Sartaj Sahni, SanguthevarRajasekaran2ndEdition 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

B.Tech. – II Year 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: Basics of C- Programming.

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

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

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

Unit IV:

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java. lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java. time. Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java.

Unit V:

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

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.

Java Database Connectivity: Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result Set Interface

Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

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

B.Tech. – II Year 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 and CSE- AI&ML)	0	0	3	1.5

Pre- Requisites: Basics of Data Structures

Course Objectives:

- To Acquire practical skills in constructing and managing Data structures
- To 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:

1. Operations on AVL trees, B-Trees, Heap Trees
2. Graph Traversals
3. Sorting techniques
4. Minimum cost spanning trees
5. Shortest path algorithms
6. 0/1 Knapsack Problem
7. Travelling Salesperson problem
8. Optimal Binary Search Trees
9. N-Queens Problem
10. 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.

B.Tech. – II Year 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: Basics of C- Programming

Course Objectives: The aim of this course is to

- To Practice object-oriented programming in the Java programming language
- To Implement Classes, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- To Illustrate inheritance, Exception handling mechanism, JDBC connectivity
- To 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 ax2+bx+c=0. Calculate the discriminate D and basing on value of D, describe the nature of root.

Exercise - 2:

a) Write a JAVA program to search for an element in a given list of elements using binary search mechanism.
b) Write a JAVA program to sort for an element in a given list of elements using bubble sort
c) Write a JAVA program using String Buffer 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
c) c)Write a JAVA program for creation of Java Built-in Exceptions
d) d)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 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:

- To Introduce core programming concepts of Python programming language.
- To Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries.
- To 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 Resources:

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.
- To Equip students with design thinking skills and ignite the minds to create innovative ideas.
- To 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 start-up strategies. (L4)

Unit I: Introduction to Design Thinking:

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

Unit II: Design Thinking Process:

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development.

Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

Unit III: Innovation:

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

Unit IV: Product Design:

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

Unit V: Design Thinking in Business:

Processes Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Text Books:

1. Tim Brown, Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell,Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough.H, The Era of Open Innovation – 2013

Online Resources:

1. https://nptel.ac.in/courses/110/106/110106124/
2. https://nptel.ac.in/courses/109/104/109104109/
3. https://swayam.gov.in/nd1_noc19_mg60/preview

B. Tech. – II Year
II Semester

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24BSHB211T	BS	Statistical Methods for Data Science	2	1	0	3

Pre -Requisites: Basic Knowledge of Mathematics.

Course Objective:

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

Course Outcomes (COs):

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

COl: Analyze probability distributions and estimator properties to model uncertainty and improve predictive accuracy in AI and data science. (L4)

CO2: Analyse point estimation methods such as maximum likelihood, moments, least squares, and minimum chi-square to estimate model parameters and support statistical inference in AI and data science. (L4)

CO3: Construct and interpret confidence intervals for population parameters to assess model reliability and improve decision-making in machine learning and data science. (L4)

CO4: Analyze types of errors, test power, and hypothesis testing methods—including Neyman-Pearson lemma and likelihood ratio tests—to enhance model evaluation and hypothesis validation in machine learning and data science. (L4)

CO5: Apply t-tests, F-tests, and chi-square tests to evaluate hypotheses about population means, variances, and attribute independence, supporting model validation and feature analysis in AI and data science. (L4)

Unit I: Basic Concepts:

Random variables (discrete and continuous), probability density functions, properties, mathematical expectation. Probability distributions: Binomial, Poisson and Normal-their properties. Population, sample, parameter and statistic; characteristics of a good estimator; Consistency – Invariance property of Consistent estimator, Sufficient condition for consistency; Unbiasedness; Sufficiency.

Unit II: Point Estimation:

Point Estimation- Estimator, Estimate, Methods of point estimation – Maximum likelihood method (the asymptotic properties of ML estimators are not included), Large sample properties of ML estimator (without proof)- applications, Method of moments, method of least squares, method of minimum chi-square and modified minimum chi-square-Asymptotic Maximum Likelihood Estimation and applications.

Unit III: Interval Estimation:

Confidence limits and confidence coefficient; Duality between acceptance region of a test and a confidence interval; Construction of confidence intervals for population proportion (small and large samples) and between two population proportions (large samples); Confidence intervals for mean and variance of a normal population; Difference between the mean and ratio of two normal populations.

Unit IV: Testing of Hypotheses:

Types of errors, power of a test, most powerful tests; Ney man-Pearson Fundamental Lemma and its applications; Notion of Uniformly most powerful tests; Likelihood Ratio tests: Description and property of LR tests - Application to standard distributions.

Unit V: Small Sample Tests:

Student's t-test, test for a population mean, equality of two population means, paired t-test, F- test for equality of two population variances, Chi-square test for goodness of fit and test for independence of attributes, $\chi 2$ test for testing variance of a normal distribution.

Text Books:

1. Miller and Freunds, Probability and Statistics for Engineers, 7/e, Pearson,2008.
2. Manoj Kumar Srivastava and Namita Srivastava, Statistical Inference–Testing of Hypotheses, Prentice Hall of India, 2014

Reference Books:

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics,11/e, Sultan Chand & Sons Publications, 2012.
2. S.Ross, a First Coursein Probability, Pearson Education India, 2002.
3. W.Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
4. Robert V Hogg, Elliot A Tannis and Dale L. Zimmerman, Probability and Statistical Inference, 9th edition, Pearson publishers,2013.

Online 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
24HMHS204L	HM	**Universal Human Values– Understanding Harmony and Ethical Human Conduct** (Common to all branches of Engineering)	2	1	0	3

Pre- Requisites: Nil

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes (COs):

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

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

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

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

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

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

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

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

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

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

Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

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

Unit III: **Harmony in the Family and Society** (6 lectures and 3 tutorials for practice Sessions)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

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

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

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

Readings:

Textbook and Teachers Manual

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

b. The Teacher's Manual R 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. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth-by Mohandas Karamchand Gandhi
5. Small is Beautiful-E. F Schumacher.
6. Slow is Beautiful -Cecile Andrews
7. Economy of Permanence-J C Kumarappa
8. Bharat Mein Angreji Raj–PanditSunderlal
9. Rediscovering India -by Dharampal
10. Hind Swaraj or Indian Home Rule-by Mohandas K. Gandhi
11. India Wins Freedom-Maulana Abdul Kalam Azad
12. Vivekananda-Romain Rolland (English)
13. Gandhi -Romain Rolland (English)

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.
Tutorial hours are to be used for practice sessions.
While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements. In the discussions, particularly during practice sessions (tutorials), the

mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

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

Online Resources:

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

B. Tech. – II Year II 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: Advanced Data Structure, Python Programming.

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

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC30201T	PC	Introduction to Data Science	3	0	0	3

Pre -Requisites: Basics of Database Management Systems, Probability and Statistics

Course Objectives:

- Knowledge and expertise to become a data scientist.
- Essential concepts of statistics and machine learning that are vital for data science.
- Significance of Exploratory Data Analysis (EDA) in data science.
- Critically evaluate data visualizations presented on the dashboards.
- Suitability and limitations of tools and techniques related to data science process.

Course Outcomes (COs):

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

CO1: Apply the fundamental concepts and benefits of data science, including facets of data and the data science process, to solve basic real-world problems using an understanding of its applications within the big data ecosystem. (L3)

CO2: Apply appropriate machine learning techniques and Python tools in the data science modelling process and analyse challenges and solutions in handling large data through practical case studies such as malicious URL detection and recommender systems. (L4)

CO3: Apply NoSQL database solutions for big data applications, leveraging Hadoop framework and principles. (L3)

CO4: Apply graph database and text mining tools to solve complex data science problems. (L3)

CO5: Analyze data visualizations and dashboards to effectively communicate insights and solve real-world problems. (L4)

Unit I: Introduction to Data Science:

Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science.

Data Science Process: Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them

Unit II: Applications of Machine Learning in Data Science:

Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modelling process for feature engineering, model selection, validation and prediction, types of ML, semi-supervised learning.

Handling Large Data: Problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems

Unit III: No SQL Movement for Handling Big Data:

Distributing data storage and processing with Hadoop framework, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling .

Unit IV: Tools and Applications of Data Science:

Tools and Applications of Data Science: Introducing Neo4j for dealing with graph databases, graph query language Cypher, Applications graph databases, Python libraries like nltk and SQLite for handling Text mining and analytics, case study on classifying Reddit posts

Unit V: Data Visualization and Prototype Application Development:

Data Visualization and Prototype Application Development: Data Visualization options, Cross filter, the JavaScript Map Reduce library, Creating an interactive dashboard with dc.js, Dashboard development tools.

Applying the Data Science process for real-world problem-solving scenarios as a detailed case study.

Text Book:

1. Davy Cielen, Arno D.B.Meysman, and Mohamed Ali, "Introducing to Data Science using Python tools", Manning Publications Co, Dreamtech Press, 2016.
2. Prateek Gupta, "Data Science with Jupyter" , BPB Publishers, 2019.

Reference Books:

1. Joel Grus, "Data Science from Scratch", OReilly, 2019.
2. Cathy O'Neil and Rachel Schutt, "Doing Data Science: Straight Talk from The Frontline", 1st Edition, O'Reilly, 2013.

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.
- To Describe memory hierarchy concepts
- To 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, Zvonko Vranesic, Safwat Zaky, 6th edition, McGraw Hill, 2023.
2. Digital Design,6th Edition, M. Morris Mano, Pearson Education,2018.
3. Computer Organization and Architecture, William Stallings,11th Edition, Pearson, 2022.

Reference Books:

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

Online 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
24PC31201P	PC	**Artificial Intelligence Lab** (Common to CSE and AI&DS)	0	0	3	1.5

Pre- Requisites: Basics of Python Programming.

Course Objectives:

- The student should be made to study the concepts of Artificial Intelligence.
- The student should be made to learn the methods of solving problems using Artificial Intelligence.
- The student should be made to introduce the concepts of Expert Systems and machine learning.

Course Outcomes (COs):

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

CO1: Adapt the Mathematical and Statistical prospective of Machine Learning algorithms through Python Programming. (L3)

CO2: Diagnose the importance of visualization in the data analytics solution. (L4)

CO3: Examine the insights using Machine Learning algorithms. (L4)

CO4: Explore AI and ML algorithms. (L4)

List of Experiments:

1. Write a Program to Implement Breadth First Search using Python.
2. Write a program to implement Best First Searching Algorithm
3. Write a Program to Implement Depth First Search using Python.
4. Write a program to implement the Heuristic Search
5. Write a python program to implement A* and AO* algorithm. (Ex: find the shortest path)
6. Write a Program to Implement Water-Jug problem using Python.
7. Write a Program to Implement Alpha-Beta Pruning using Python.
8. Write a Program to implement 8-Queens Problem using Python.
9. Write a program to schedule a meeting among a 5 busy people using Default Reasoning the output should give the time, place and day of the meeting
10. Write a program to implement the Unification algorithm
11. Develop a knowledge base system consisting of facts and rules about some specialized knowledge domain
12. Write a program to implement 8 puzzle programs using different heuristics. Using it play the game Tic-Tac-Toe at the end the game the program should display the no. of nodes generated, cutoff values at each stage in the form of a table.
13. Write a Program for Wumpus world problem.

Text Books:

1. Prateek Joshi, Artificial Intelligence with Python, Packt Publishing, 2017.
2. Xiao, Perry. Artificial intelligence programming with Python: from zero to hero. John Wiley& Sons, 2022.

Reference Books:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach, Fourth Edition, Pearson, 2020.

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC30201P	PC	Data Science using Python Lab	0	0	3	1.5

Pre- Requisites: Python Programming.

Course Objective:

The main objective of the course is to inculcate the basic understanding of Data Science and its practical implementation using Python.

Course Outcomes (COs):

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

CO1: Apply principles and techniques for optimizing the performance of Python applications. (L3)

CO2: Explore Parallel computing applications using Python. (L4)

CO3: Analyze GPU accelerated Python applications. (L4)

List of Experiments

1. **Creating a NumPy Array**
   a) Basic ndarray
   b) Array of zeros
   c) Array of ones
   d) Random numbers in nd array
   e) An array of your choice
   f) I matrix in NumPy
   g) Evenly spaced nd array
2. **The Shape and Reshaping of NumPy Array**
   a) Dimensions of NumPy array
   b) Shape of NumPy array
   c) Size of NumPy array
   d) Reshaping a NumPy array
   e) Flattening a NumPy array
   f) Transpose of a NumPy
3. **Expanding and Squeezing a NumPy Array**
   a) Expanding a NumPy array
   b) Squeezing a NumPy array
   c) Sorting in NumPy Arrays
4. **Indexing and Slicing of NumPy Array**
   a) Slicing 1-D NumPy arrays
   b) Slicing 2-D NumPy arrays
   c) Slicing 3-D NumPy arrays
   d) Negative slicing of NumPy arrays
5. **Stacking and Concatenating NumPy Arrays**
   a) Stacking nd arrays
   b) Concatenating nd arrays
   c) Broadcasting in NumPy Arrays
6. **Perform Following Operations Using Pandas**
   a) Creating Data Frame
   b) concat()
   c) Setting conditions
   d) Adding a new column

7. Perform Following Operations Using Pandas

a) Filling NaN with string
b) Sorting based on column values
c) groupby()

8. **Read the Following File Formats Using Pandas**

a) Text files
b) CSV files
c) Excel files
d) JSON files

9. Read the Following File Formats

a) Pickle files
b) Image files using PIL
c) Multiple files using Glob
d) Importing data from database

10. Demonstrate Web Scraping Using Python

11. Perform Following Pre-Processing Techniques on Loan Prediction Dataset

a) Feature Scaling
b) Feature Standardization
c) Label Encoding
d) One Hot Encoding

12. Perform Following Visualizations Using Matplotlib

a) Bar Graph
b) Pie Chart
c) Box Plot
d) Histogram
e) Line Chart and Subplots
f) Scatter Plot

13. Getting Started with NLTK, Install NLTK Using PIP

14. Python Program to Implement with Python Scikit Learn & NLTK

15. Python Program to Implement with Python NLTK/Spicy/PyNLPI.

Online References:

1. https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/
2. https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/
3. https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/
4. https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/
5. https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-exploration-python/
6. https://www.nltk.org/book/ch01.html

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 and CSE- AI&ML)	0	1	2	2

Pre-Requisites: Basics **of** HTML and Java Programming.

Course Objectives:

- To Make use of HTML elements and their attributes for designing static web pages
- To Build a web page by applying appropriate CSS styles to HTML elements
- To 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.

b) Note: It should have an ordered list, unordered list, nested lists and ordered list in an unordered list and definition lists.

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

d) 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.

e) 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>,

b) <td> and attributes: border, rowspan, colspan)

c) 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.).

d) 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).

e) Write a HTML program, to explain the working of 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 webpage.

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:

Write a program to apply different types of selector forms

- Simple selector (element, id, class, group, universal)
- Combinator selector (descendant, child, adjacent sibling, general sibling)
- Pseudo-class selector
- Pseudo-element selector
- 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 a program 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 an appropriate function should be called to display
   - Factorial of that number
   - Fibonacci series up to that number
   - Prime numbers up to that number
   - 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
   - Factorial of that number
   - Fibonacci series up to that number
   - Prime numbers up to that number
   - Is it palindrome or not

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

Text Books:

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. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.

Online Resources:

- https://www.w3schools.com/html
- https://www.w3schools.com/css
- https://www.w3schools.com/js/
- https://www.w3schools.com/nodejs
- https://www.w3schools.com/typescript

B. Tech. – II Year 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.

Text Books:

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

Reference Books:

1. Deeksha Dave and E. Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications.
2. M. Anji Reddy, “Text book of Environmental Sciences and Technology”, BS Publication.

3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice Hall of India Private limited
5. G.R. Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House 6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice Hall of India Private limited.

Online Resources:

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

B. Tech. – II Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPIN301L	**IP**	**Community Service Internship** (Common to all branches of Engineering)	**0**	**0**	**0**	**2**

Pre-Requisites: Problem-Solving & Critical Thinking, Communication & Presentation Skills, Teamwork & Collaboration Skills, Foundations in Ethics and Social Responsibility.

Course Objectives:

- To develop social awareness and responsibility among engineering students by engaging with real-world community needs.
- To apply basic engineering knowledge and problem-solving skills in designing practical solutions for local societal challenges.
- To foster teamwork, leadership, and communication skills through collaborative, interdisciplinary project work.
- To cultivate ethical reasoning, empathy, and intercultural understanding by working with diverse communities and stakeholders.
- To enhance students' ability to plan, execute, and document projects through structured project management and reporting.
- To bridge academic learning with practical experience, strengthening the relevance of engineering education to societal development.

Course Outcomes (COs):

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

CO1: Apply engineering knowledge to identify and address community needs through structured service-based projects. (L3)

CO2: Work collaboratively in diverse teams to plan, execute, and evaluate community service initiatives. (L3)

CO3: Communicate project goals, processes, and outcomes effectively through written reports and oral presentations. (L3)

CO4: Assess the social, ethical, and environmental implications of engineering solutions implemented in community settings. (L4)

CO5: Evaluate personal and professional development achieved through community engagement, with emphasis on leadership, empathy, and social responsibility. (L4)

Community Service Internship ……Experiential learning through community engagement

Introduction:

- Community Service Internship is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development.
- Community Service Internship involves students in community development and service activities and applies the experience to personal and academic development.
- Community Service Internship is meant to link the community with the college for mutual benefit. The community will benefit with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and emerge as a socially responsible institution.

Objective:

Community Service Internship should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships.

The Specific Objectives are:

- To sensitize the students to the living conditions of the people who are around them,
- To help students to realize the stark realities of society.
- To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
- To make students aware of their inner strength and help them to find new /out of box solutions to social problems.
- To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
- To help students to initiate developmental activities in the commUnity in coordination with public and government authorities.
- To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Internship:

- Every student should put in 6 weeks for the CommUnity Service Internship during the summer vacation.
- Each class/section should be assigned with a mentor.
- Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, housewives, etc
- A logbook must be maintained by each of the students, where the activities undertaken/ involved to be recorded.
- The logbook has to be countersigned by the concerned mentor/faculty in charge.
- An evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
- The final evaluation to be reflected in the grade memo of the student.
- The Community Service Internship should be different from the regular programs of NSS/ NCC/ Green Corps/ Red Ribbon Club, etc.
- Minor project reports should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training.

Procedure:

- A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, to enable them to commute from their residence and return back by evening or so.
- The Community Service Internship is a twofold one –
  - First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.
  - Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –

- Agriculture
- Health
- Marketing and Cooperation
- Animal Husbandry
- Horticulture
- Fisheries
- Sericulture
- Revenue and Survey
- Natural Disaster Management
- Irrigation
- Law & Order
- Excise and Prohibition
- Mines and Geology
- Energy
- Internet
- Free Electricity
- Drinking Water

Expected Outcomes:

Benefits of Community Service Internship to Students:

Learning Outcomes:

- Positive impact on students' academic learning
- Improves students' ability to apply what they have learned in "the real world"
- Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development.
- Improved ability to understand complexity and ambiguity

Personal Outcomes:

- Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
- Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills.

Social Outcomes:

- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in commUnity service after graduation

Career Development:

- Connections with professionals and commUnity members for learning and career opportunities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity. Relationship with the Institution
- Stronger relationships with faculty
- Greater satisfaction with college
- Improved graduation rates

Benefits of Community Service Internship to Faculty Members:

- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and commUnity
- Providing networking opportunities with engaged faculty in other disciplines or institutions

- A stronger commitment to one's research.

Benefits of Community Service Internship to Colleges and Universities:

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

Benefits of Community Service Internship to Community:

- Satisfaction with student participation
- Valuable human resources needed to achieve commUnity goals.
- New energy, enthusiasm and perspectives applied to commUnity work.
- Enhanced commUnity-university relations.

Suggestive List of Programmes under Community Service Internship:

The following the recommended list of projects for Engineering students. The lists are not exhaustive and open for additions, deletions, and modifications. Colleges are expected to focus on specific local issues for this kind of project. The students are expected to carry out these projects with involvement, commitment, responsibility, and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of project. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting should be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation

27. Floury culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species 3
3. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilisation of free electricity to farmers and related issues
40. Gender ration in schooling level- observation.

Complimenting the Community Service Internship, The Students May Be Involved to Take Up Some Awareness Campaigns on Social Issues/Special Groups. The Suggested List of Programs

Programs for School Children:

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

Programs for Women Empowerment:

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

General Camps:

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharath
7. AIDS awareness camp
8. Anti-Plastic Awareness
9. Programs on Environment
10. Health and Hygiene
11. Hand wash programmes
12. Commemoration and Celebration of important days

Programs for Youth Empowerment:

1. Leadership
2. Anti-alcoholism and Drug addiction

3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programs:

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

Role of Students:

- Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
- As and when required the College faculty themselves act as Resource Persons.
- Students can work in close association with Non-Governmental Organizations like Lions lub, Rotary Club, etc or with any NGO actively working in that habitation.
- And also, with the Governmental Departments. If the program is rolled out, the district Administration could be roped in for the successful deployment of the program.
- An in-house training and induction program could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Internship Activity

Duration: 8 weeks

1. Preliminary Survey (One Week)

• A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.

• A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.

• The Governmental agencies, like revenue administration, corporation and municipal authorities and village 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
24PC30302T	**PC**	**Data Warehousing and Data Mining**	**2**	**1**	**0**	**3**

Pre-Requisites: Basic Knowledge of DBMS.

Course Objectives:

- To introduce the fundamental concepts and architecture of data warehousing.
- To understand data pre-processing, transformation, and integration techniques.
- To explore data mining techniques such as classification, clustering, and association rules.
- To provide practical skills for applying data mining in real-world scenarios.
- To introduce tools and frameworks for data warehousing and mining, such as OLAP and WEKA.

Course Outcomes (COs):

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

CO1: Apply the concepts of data warehousing, architecture, and OLAP operations to design and analyze multidimensional data models for decision support applications. (L4)

CO2: Examine data Preprocessing and understanding techniques to assess their impact on improving data quality for analysis and mining tasks. (L4)

CO3: Examine association rule mining and classification techniques to determine their effectiveness in extracting meaningful patterns and building predictive models. (L4)

CO4: Assess clustering and outlier detection techniques to interpret data groupings and evaluate the quality of clustering results. (L4)

CO5: Evaluate data mining tools and techniques to determine their effectiveness in addressing real-world applications such as business intelligence, fraud detection, and e-commerce. (L4)

Unit I: Introduction to Data Warehousing and OLAP:

Introduction to Data Warehousing: Concepts and Applications, Data Warehouse Architecture: Components and 3-Tier Architecture, ETL Process: Extraction, Transformation, Loading, OLAP: Multidimensional Data Model, OLAP Operations, Star, Snowflake, and Fact Constellation Schemas, Data Cubes and Roll-Up/Drill-Down Analysis

Unit II: Data Preprocessing and Data Understanding:

Data Cleaning, Integration, and Transformation, Data Reduction Techniques and Feature Selection, Handling Missing, Noisy, and Inconsistent Data, Data Discretization and Normalization, Measures of Similarity and Dissimilarity, Exploratory Data Analysis and Visualization.

Unit III: Association Rule Mining and Classification:

Basics of Association Rule Mining: Support, Confidence, Lift, Apriori Algorithm and FP-Growth Algorithm, Applications of Association Rule Mining, Classification Techniques: Decision Trees (ID3, C4.5), Bayesian Classifiers and Naïve Bayes, Rule-Based and Model-Based Classification.

Unit IV: Clustering and Advanced Mining Methods:

Introduction to Clustering: Types and Applications, Partitioning Methods: K-Means, K-Medoids, Hierarchical Clustering: Agglomerative and Divisive, Density-Based Clustering: DBSCAN, OPTICS, Evaluation of Clustering Results, Outlier Detection and Handling.

Unit V: Data Mining Applications and Tools:

Web Mining, Text Mining, and Spatial Data Mining, Temporal and Sequence Data Mining, Introduction to Big Data and Scalable Mining, Data Mining Tools: WEKA, RapidMiner, Orange, Case Studies: Business Intelligence, Fraud Detection, E-commerce, Ethical and Privacy Issues in Data Mining.

Text Books:

1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques,3rd Edition, Elsevier.
2. Paulraj Ponniah, Data Warehousing Fundamentals for IT Professionals, Wiley.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson.

Reference Books:

1. Ralph Kimball, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley.
2. Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson.
3. Arun K. Pujari, Data Mining Techniques, Universities Press.

Online Resources:

1. Coursera - Data Mining Specialization (University of Illinois)
2. Data Warehousing for Business Intelligence – Coursera (Duke University)
3. WEKA Data Mining Tutorials – University of Waikato
4. Data Mining and Analysis – Stanford Online
5. Khan Academy: Introduction to Data Mining

B.Tech. – III Year I Semester

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

Pre-Requisites: Nil

Course Objectives:

- To Introduce fundamental quantum concepts like superposition and entanglement.
- To Understand theoretical structure of qubits and quantum information.
- To Explore conceptual challenges in building quantum computers.
- To Explain principles of quantum communication and computing.
- To Examine real-world applications and the future of quantum technologies.

Course Outcomes (COs):

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

CO1: Apply fundamental quantum principles such as superposition, entanglement, uncertainty, and wave-particle duality to explain the behaviour of basic quantum systems like electrons, photons, and atoms. (L3)

CO2: Demonstrate conceptual understanding of qubits using spin and polarization to differentiate classical and quantum information systems, and illustrate key phenomena such as coherence, entanglement, and decoherence in basic quantum systems. (L3)

CO3: Illustrate the conceptual requirements for building a quantum computer by explaining system fragility, error correction, scalability, and comparing quantum hardware platforms like superconducting circuits, trapped ions, and photonics. (L3)

CO4: Examine the principles of quantum communication and computing by comparing classical and quantum gates, evaluating the impact of entanglement on secure communication, and analyzing the feasibility of the quantum internet and its future applications. (L4)

CO5: Analyze the societal, ethical, and industrial implications of quantum technology adoption by evaluating real-world use cases, challenges related to cost and standardization, and India's strategic position in the global quantum research and career landscape. (L4)

Unit I: Introduction to Quantum Theory and Technologies:

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison, Quantum states and measurement: nature of observation, Overview of quantum systems: electrons, photons, atoms, The concept of quantization: discrete energy levels, Why quantum? Strategic, scientific, and technological significance, A snapshot of quantum technologies: Computing, Communication, and Sensing, National and global quantum missions: India‘s Quantum Mission, EU, USA, China

Unit II: Theoretical Structure of Quantum Information Systems:

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non- engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract, The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences, Philosophical implications: randomness, determinism, and observer role

Unit III: Building a Quantum Computer – Theoretical Challenges and Requirements:

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers: Why maintaining entanglement is difficult, Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual Comparision) Superconducting circuits, Trapped ions, Photonics, Vision vs reality: what‘s working and what remains elusive, The role of quantum software in managing theoretical complexities.

Unit IV: Quantum Communication and Computing:

Theoretical Perspective: Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD), Role of Entanglement in Communication, The Idea of the Quantum Internet – Secure Global Networking, Introduction to Quantum Computing, Quantum Parallelism (Many States at Once), Classical vs Quantum Gates, Challenges: Decoherence and Error Correction, Real- World Importance and Future Potential.

Unit V: Applications, Use Cases, and the Quantum Future:

Real-world application domains: Healthcare (drug discovery), Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, Psi Quantum, Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization, Emerging careers in quantum: roles, skillsets, and preparation pathways, Educational and research landscape – India's opportunity in the global quantum race.

Text Books:

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.
4. **Alastair I.M. Rae**, Quantum Physics: A Beginner's Guide, One world Publications, Revised Edition, 2005.
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 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
24PC31202T	PC	**Machine Learning** (Common to CSE, AI&DS, CSE- AI, and CSE- AI&ML)	2	1	0	3

Pre-Requisites: Basics of Python and Linear Algebra (Matrices & Vectors).

Course Objectives:

- To Define machine learning and its different types (Supervised and Unsupervised) and understand their applications.
- To Apply Supervised learning algorithms including decision trees and K-Nearest Neighbors (K-NN).
- To 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 un labelled data, and analyse the effectiveness of partitioning, hierarchical, and probabilistic approaches for different data distributions. (L4)

Unit I: Introduction to Machine Learning:

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

Uni II: Nearest Neighbor-Based Models:

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

Unit III: 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:

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

Unit V: Clustering:

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

Text Books:

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

Reference Books:

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

B.Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC30303T	PC	Multi Agent Systems	3	0	0	3

Pre-Requisites: Basic knowledge of Python, Understanding of intelligent agents.

Course Objectives:

- To introduce the foundational concepts and architectures of intelligent agents and multi-agent systems.
- To understand agent communication, coordination, and negotiation strategies.
- To explore cooperation, teamwork, and distributed problem-solving in agent-based systems.
- To study real-world applications and design methodologies of multi-agent systems.
- To impart knowledge on formal models and game theory-based interactions in multi-agent environments.

Course Outcomes (COs):

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

CO1: Analyze the architecture and functioning of intelligent agents. (L4)

CO2: Analyze communication, coordination, and negotiation among multiple agents. (L4)

CO3: Apply distributed problem-solving approaches to real-world multi-agent systems. (L3)

CO4: Analyze multi-agent system design methodologies for practical applications. (L4)

CO5: Analyze the performance and scalability aspects of multi-agent systems using game-theoretic concepts. (L4)

Unit I: Introduction to Intelligent Agents:

Definition and Characteristics of Agents, Types of Agents: Reactive, Deliberative, Hybrid, Learning, Agent Architectures: Subsumption, BDI, Layered, Environments: Deterministic/Stochastic, Episodic/Sequential, Rationality and Autonomy, Simple Agent Programming Models.

Unit II: Multi-Agent Systems Fundamentals:

Definition and Properties of Multi-Agent Systems (MAS), Agent Communication Languages: KQML, FIPA ACL, Interaction Protocols: Contract Net, Auctions, Coordination Techniques: Blackboard, Mediator, Broker, Distributed Problem Solving (DPS) Concepts, Roles and Teamwork in MAS.

Unit III: Cooperation, Negotiation, and Learning:

Cooperative and Non-Cooperative Agents, Negotiation Techniques: Bidding, Bargaining, Argumentation, Game Theory: Basics and Applications in MAS, Reinforcement Learning in Multi-Agent Settings, Case Studies: Multi-Robot Coordination, Resource Allocation, Conflict Resolution and Consensus Building.

Unit IV: Agent-Oriented Software Engineering:

Agent-Based System Design Methodologies: Gaia, Tropos, Agent UML: Notations and Modeling, MAS Design Patterns and Best Practices, Ontologies and Semantic Web Integration, Middleware and Frameworks for MAS (JADE, SPADE), Scalability, Fault-Tolerance, and Deployment Challenges.

Unit V: Advanced Topics and Applications:

Emergence and Self-Organization in MAS, Swarm Intelligence and Distributed Optimization, Trust, Privacy, and Ethics in MAS, Real-Time and Embedded MAS Applications, MAS in Smart Grid, IoT, and Traffic Systems, Case Studies: Amazon Robotics, Autonomous Trading Agents.

Text Books:

1. Michael Wooldridge, An Introduction to MultiAgent Systems, Wiley, 2nd Edition.
2. Gerhard Weiss, Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence, MIT Press.

Reference Books:

1. Yoav Shoham and Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game- Theoretic, and Logical Foundations, Cambridge University Press.
2. Nikos Vlassis, A Concise Introduction to Multiagent Systems and Distributed Artificial Intelligence, Morgan & Claypool.
3. Mehdi Dastani et al., Programming Multi-Agent Systems, Springer.

Online Resources:

1. NPTEL - Artificial Intelligence: Knowledge Representation and Reasoning
2. Coursera - Multi-Agent Systems by University of Washington
3. edX – Principles of AI Planning (covers agent-based modeling)
4. MIT OpenCourseWare – Multi-Agent Systems
5. YouTube – Multi-Agent Systems Lectures by Stanford, MIT

B.Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC30302P	**PC**	**Data Warehousing and Data Mining Lab**	**0**	**0**	**3**	**1.5**

Pre-Requisites: Basic knowledge of DBMS and SQL.

Course Objectives:

- To enable students to construct and query data warehouses using OLAP operations.
- To implement classification, clustering, and association rule mining algorithms.
- To explore real-world datasets for data pre-processing and pattern discovery.
- To develop hands-on experience with data mining tools and frameworks.
- To evaluate the performance and accuracy of various mining techniques.

Course Outcomes (COs):

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

CO1: Design and implement Star and Snowflake schemas and perform OLAP operations (Roll-up, Drill-down, Slice, Dice, Pivot) using SQL. (L3)

CO2: Preprocess and transform raw datasets using data cleaning, normalization, and handling of missing values for mining tasks. (L3)

CO3: Implement classification, clustering, and association algorithms (Apriori, FP-Growth, Naïve Bayes, Decision Tree, KNN, K-Means, Hierarchical) using WEKA/Python/R. (L4)

CO4: Evaluate and interpret model performance using accuracy, precision, recall, and visualize patterns and clusters from datasets. (L4)

CO5: Develop a mini-project applying classification, clustering, or association on real-world data and present insights through visualization tools. (L5)

List of Experiments:

1. Create a Star and Snowflake schema for a sample sales dataset using SQL
2. Perform OLAP operations (Roll-up, Drill-down, Slice, Dice, Pivot) using SQL
3. Import a CSV dataset and perform data cleaning, missing value handling, and normalization
4. Implement Apriori algorithm to find frequent item sets and generate association rules
5. Use FP-Growth algorithm for mining frequent patterns from a retail dataset
6. Implement Naïve Bayes classifier and evaluate it using accuracy, precision, and recall
7. Build a Decision Tree using ID3 or C4.5 algorithm and visualize the result
8. Perform classification using K-Nearest Neighbors (KNN) and analyze the results
9. Apply K-Means clustering on a dataset and visualize cluster separation
10. Use Hierarchical clustering and dendrogram visualization
11. Perform Principal Component Analysis (PCA) on a high-dimensional dataset
12. Mini-project: Apply classification/clustering/association on a real-world dataset and present findings

Tools/Technologies to be used:

1. Python (pandas, scikit-learn, matplotlib, seaborn)
2. R / RStudio
3. WEKA / Orange Data Mining Tool
4. SQL for OLAP operations
5. Jupyter Notebook / Google Colab

B.Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31302P	**PC**	**Machine Learning Lab** (Common to CSE, AI&DS, and 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. – III Year I Semester

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

Pre-Requisites: Basics of Web Development (from FSD-I).

Course Objectives:

- To Make use of Modern- day JavaScript with ES6 standards for designing Dynamic web pages
- To Building robust & responsive User Interfaces using popular JavaScript library 'React.js'. Building robust backend APIs using 'Express. Js'
- To Establish the connection between frontend (React) User interfaces and backend APIs (Express) with Data Bases (My SQL)
- To Familiarize students with GitHub forb 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:

1. 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.
2. Basics of React. js like React Components, JSX, Conditional rendering Differences between Real DOM and Virtual DOM.
3. Important React.js concepts like React hooks, Props, React forms, Fetch API, Iterative rendering using JavaScript map() function.
4. JavaScript runtime environment node. js and its uses, Express. js and Routing, Micro-Services architecture and MVC architecture, database connectivity using (My SQL)
5. 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.
6. 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:

a) Write a program to implement the ‗hello world‘ message in the route through the
b) browser using Express
c) Write a program to develop a small website with multiple routes using Express. js
d) Write a program to print the ‗hello world‘ in the browser console using Express. js
e) Write a program to implement the CRUD operations using Express. js

f) Write a program to establish the connection between API and Database using Express

g) My SQL driver

h) Introduction to My SQL

i) Write a program to create a Database and table inside that database using My SQL Command line client

j) Write a My SQL queries to create table, and insert the data, update the data in the table

k) Write a My SQL queries to implement the subqueries in the My SQL command line client

l) 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

7. 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

Text Books:

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 ,KamilPrzeorski , MaciejCzarnecki, Mastering Full Stack React Web Development 2017

Online 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/
8. 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	SE	**Tinkering Lab** (Common to all branches of Engineering)	0	0	2	1

Pre-Requisites: Understanding of basic science concepts (Physics, Electronics)

Course Objectives:

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

Course objectives: The objectives of the course are to	
1.	Encourage Innovation and Creativity
2.	Provide Hands-on Learning and Impart Skill Development
3.	Foster Collaboration and Teamwork
4.	Enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship
5.	Impart Problem-Solving mind-set

These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

Course Outcomes (COs):

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

CO1: Apply fundamental engineering concepts to design and build working prototypes. (L3)

CO2: Analyse the properties and functions of various materials, tools, and technologies to determine them suitability for specific tasks or projects. (L4)

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

CO4: Evaluate tools and techniques to develop solutions with potential for real-world applications and entrepreneurship. (L5)

CO5: Evaluate and improve prototype performance based on testing and feedback. (L5)

List of Experiments:

1. Make your own parallel and series circuits using breadboard for any application of your choice.
2. Design and 3D print a Walking Robot
3. Design and 3D Print a Rocket.
4. Temperature & Humidity Monitoring System (DHT11 + LCD)
5. Water Level Detection and Alert System
6. Automatic Plant Watering System
7. Bluetooth-Based Door Lock System
8. Smart Dustbin Using Ultrasonic Sensor
9. Fire Detection and Alarm System
10. RFID-Based Attendance System
11. Voice-Controlled Devices via Google Assistant
12. Heart Rate Monitoring Using Pulse Sensor

13. Soil Moisture-Based Irrigation
14. Smart Helmet for Accident Detection
15. Milk Adulteration Detection System
16. Water Purification via Activated Carbon
17. Solar Dehydrator for Food Drying
18. Temperature-Controlled Chemical Reactor
19. Ethanol Mini-Plant Using Biomass
20. Smart Fluid Flow Control (Solenoid + pH Sensor)
21. Portable Water Quality Tester
22. AI Crop Disease Detection
23. AI-based Smart Irrigation
24. ECG Signal Acquisition and Plotting
25. AI-Powered Traffic Flow Prediction
26. Smart Grid Simulation with Load Monitoring
27. Smart Campus Indoor Navigator
28. Weather Station Prototype
29. Firefighting Robot with Sensor Guidance
30. Facial Recognition Dustbin
31. Barcode-Based Lab Inventory System
32. Growth Chamber for Plants
33. Biomedical Waste Alert System
34. Soil Classification with AI
35. Smart Railway Gate
36. Smart Bin Locator via GPS and Load Sensors
37. Algae-Based Water Purifier
38. Contactless Attendance via Face Recognition

Note: The students can also design and implement their own ideas, apart from the list of experiments mentioned above.
Note: A minimum of 8 to 10 experiments must be completed by the students.

Professional Elective - I (PE - I)

B.Tech. – III Year I Semester

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

Pre-Requisites: Basic knowledge of statistics, data analysis, and programming concepts.

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 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, and CSE-AI & ML)	3	0	0	3

Pre-Requisites: Basic knowledge of mathematics, programming, and AI 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.

Text Books:

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

Online 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
24PE30302T	PE	Internet of Things for AI Applications	3	0	0	3

Pre-Requisites: Basic knowledge of IoT, programming, and AI fundamentals.

Course Objectives:

- To Understand the basics of Internet of Things and protocols.
- To Discuss the requirement of IoT technology
- To Introduce some of the application areas where IoT can be applied.
- To Understand the vision of IoT from a global perspective, understand its applications, determine its market perspective using gateways, devices and data management.

Course Outcomes (COs):

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

CO1: Apply general concepts of Internet of Things. (L3)
CO2: Apply design concept to IoT solutions. (L3)
CO3: Analyze various M2M and IoT architectures. (L4)
CO4: Evaluate design issues in IoT applications. (L5)
CO5: Analyze IoT solutions using sensors, actuators and Devices. (L4)

Unit I: Introduction to IoT:

Definition and Characteristics of IoT, physical design of IoT, IoT protocols, IoT communication models, IoT Communication APIs, Communication protocols, Embedded Systems, IoT Levels and Templates.

Unit II: Prototyping IoT Objects using Microprocessor/Microcontroller:

Working principles of sensors and actuators, setting up the board – Programming for IoT, Reading from Sensors, Communication: communication through Bluetooth, Wi-Fi.

Unit III: IoT Architecture and Protocols:

Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, Protocols- 6LowPAN, RPL, CoAP, MQTT, IoT frameworks- Thing Speak.

Unit IV: Device Discovery and Cloud Services for IoT:

Device discovery capabilities- Registering a device, Deregister a device, Introduction to Cloud Storage models and communication APIs Web-Server, Web server for IoT.

Unit V: UAV IoT:

Introduction to Unmanned Aerial Vehicles/Drones, Drone Types, Applications: Defence, Civil, Environmental Monitoring; UAV elements and sensors- Arms, motors, Electronic Speed Controller (ESC), GPS, IMU, Ultra sonic sensors; UAV Software –Arudpilot, Mission Planner, Internet of Drones (IoD)- Case study FlytBase.

Text Books:

1. Vijay Madisetti and ArshdeepBahga, ― Internet of Things (A Hands-on-Approach)‖, 1st Edition, VPT, 2014.
2. Handbook of unmanned aerial vehicles, *K Valavanis;George J Vachtsevanos,* New York, Springer, Boston, Massachusetts : Credo Reference, 2014. 2016.

Reference Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, ― From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence‖, 1st Edition, Academic Press, 2014.
2. ArshdeepBahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014.
3. The Internet of Things, enabling technologies and use cases – Pethuru Raj, Anupama C. Raman, CRC Press.
4. Francis daCosta, ―Rethinking the Internet of Things: A Scalable Approach to Connecting Everything‖, 1st Edition, Apress Publications, 2013
5. Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 9781-4493- 9357-1
6. DGCA RPAS Guidance Manual, Revision 3 – 2020
7. Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, John Baichtal

Online Resources:

1. https://www.arduino.cc/
2. https://www.raspberrypi.org/
3. https://nptel.ac.in/courses/106105166/5
4. https://nptel.ac.in/courses/108108098/

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, and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basics of Python programming, statistics, and 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 Sample Datasets (Titanic, Iris, Sales, etc.), Outlier Detection Techniques, Feature Engineering Techniques in EDA, EDA Report Generation using Python Notebooks, Preparing Data for Machine Learning Models.

Text Books:

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

Reference Books:

1. **JoelGrus**, Data Science from Scratch, O'Reilly, 2019.
2. **AurelienGeron**, Hands-On Machine Learning with Scikit-Learn, Keras &TensorFlow, 2nd Edition, O'Reilly, 2019.
3. **AllenB.Downey**, ThinkStats: Probability and Statistics for Programmers,O'Reilly, 2014.

Online Resources:

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

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, and CSE-AI&ML)	2	1	0	3

Pre-Requisites:

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

Course Objectives:

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

Course Outcomes (COs):

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

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

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

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

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

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

Unit I: Introduction to Green Building:

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

Unit II: Green Building Concepts and Practices:

Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, 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 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, and CSE-AI&ML)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Construction Materials and Building Methods.
- Familiarity with Planning, Estimation, and Project Management Basics.

Course Objectives:

- To understand project management fundamentals, organizational structures, and leadership principles in construction.
- To analyze manpower planning, equipment management, and cost estimation in civil engineering projects.
- To apply planning, scheduling, and project management techniques such as CPM and PERT.
- To evaluate various contract types, contract formation, and legal aspectsin 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 for Labour, Material, Design, Construction – Drafting of Contract Documents Based On IBRD/ MORTH Standard Bidding

Documents – Construction Contracts – Contract Problems – Arbitration and Legal Requirements Computer Applications in Construction Management: Software for Project Planning, Scheduling and Control.

Unit V: Safety Management:
Implementation and Application of QMS in Safety Programs, ISO 9000 Series, Accident Theories, Cost of Accidents, Problem Areas in Construction Safety, Fall Protection, Incentives, Zero Accident Concepts, Planning for Safety, Occupational Health and Ergonomics.

Text Books:

1. Construction Project Management, SK. Sears, GA. Sears, RH. Clough, John Wiley and Sons, 6th Edition, 2016.
2. Construction Project Scheduling and Control by Saleh Mubarak, 4th Edition, 2019 Pandey,
3. I.M (2021) Financial Management 12th edition. Pearson India Education Services Pvt. Ltd.

Reference Books:

1. Brien, J.O. and Plotnick, F.L., CPMin Construction Management, Mcgraw Hill, 2010.
2. Punmia, B.C., and Khandelwal, K.K., Project Planning and control with PERT and CPM, Laxmi Publications, 2002.
3. Construction Methods and Management: Pearson New International Edition 8 th Edition Stephens Nunnally.
4. Rhoden, M and Cato B, Construction Management and Organisational Behaviour, Wiley- Blackwell, 2016.

Online 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, and 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 fundamentals of electrical safety and associated hazards.
- To identify risks involved in electrical systems and equipment.
- To learn safety standards, rules, and regulations in electrical installations.
- To develop skills in applying protective measures and safety practices.
- To create awareness about accident prevention and emergency handling.

Course Outcomes (COs):

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

CO1: Describe the fundamentals of electrical safety, including electric shock effects, hazards, arc blast, and causes of electrical failures. (L3)

CO2: Analyze safety components such as conductors, insulators, overvoltage protection, static electricity control, and electrical safety equipment. (L4)

CO3: Analyze grounding and bonding concepts, including system and equipment grounding, earthing practices, and safety distance determination. (L4)

CO4: Analyze safety practices in electrical installations and usage environments including first aid procedures and case studies of electrical accidents. (L4)

CO5: Evaluate electrical safety standards, codes, and regulations including NFPA, OSHA, IEEE, NESC, and statutory requirements. (L5)

Unit I: Introduction to Electrical Safety:

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

Unit II: Safety Components:

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

Unit III: Grounding:

General requirements for grounding and bonding- Definitions- System grounding - Equipment grounding - The Earth-Earthing Practices-Determining safe approach distance- Determining 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, RayA. Jones,—The Electrical Safety Program Book‖, Jones
2. and Bartlett Publishers, London, 2nd Edition, 2011.
3. Palmer Hickman, —Electrical Safety-Related Work Practices‖, Jones & Bartlett Publishers, London, 2009.
4. Fordham Cooper,W.,—Electrical Safety Engineering‖, Butter worth and Company, London,1986.
5. JohnCadick, Mary Capelli -Schellpfeffer, Dennis K.Neitzel,—Electrical Safety Handbook, McGraw- Hill, New York, 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 PV modules
- To understand the principles of storage in PV systems
- To discuss solar energy storage systems and their applications.
- To get knowledge in wind energy and bio-mass
- To gain insights in geothermal energy, ocean energy and fuel cells.

Course Outcomes (COs):

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

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

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

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

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

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

Unit I: Solar Radiation:

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

Reference Books:

1. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth& John F Kreider / Taylor &Francis
2. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
3. Renewable Energy Technologies -Ramesh & Kumar /Narosa
4. Non-conventional Energy Source- G.D Roy/Standard Publishers

Online 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)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Semiconductor Devices and Electronic Components.
- Familiarity with Fundamental Circuit Analysis Concepts.

Course Objectives:

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

Course Outcomes (COs):

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

CO1: Apply the concepts of semiconductor diodes and their applications in rectifiers, clipping, and clamping circuits. (L3)

CO2: Apply the operating principles of BJT and biasing techniques to analyze transistor circuits as amplifiers and switches. (L3)

CO3: Analyze the performance of single-stage and multistage amplifiers using different configurations and coupling schemes. (L4)

CO4: Analyze feedback amplifiers and oscillator circuits based on their characteristics and configurations(L4)

CO5: Evaluate the performance of operational amplifiers and their applications in analog circuit design. (L5)

Unit I: Semiconductor Diode and Applications:

Introduction, PN junction diode – structure, operation and VI characteristics, Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Positive and Negative Clipping and Clamping circuits (Qualitative treatment only).

Special Diodes: Zener and Avalanche Breakdowns, VI Characteristics of Zener diode, Zener diode as voltage regulator, Construction, operation and VI characteristics of Tunnel Diode, LED, Varactor Diode, Photo Diode.

Unit II: Bipolar Junction Transistor (BJT):

Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch and Amplifier, Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Self-Bias, Bias Stability, Bias Compensation using Diodes.

Unit III: Single Stage 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 to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Physics and Mathematical Fundamentals.
- Familiarity with Waves, Energy, and Fundamental Computing Concepts.

Course Objectives:

- To introduce the fundamentals of quantum mechanics relevant to quantum technologies.
- To explain key quantum phenomena and their role in enabling novel technologies.
- To explore applications in quantum computing, communication, and sensing.
- To encourage understanding of emerging quantum-based technologies and innovations.

Course Outcomes (COs):

On successful completion of the course, 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 analyzing 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: 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 References:

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.

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

Online Resources:

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

B.Tech. – III Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB303T	OE	**Chemistry of Energy Systems** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

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

Course Objectives:

- 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: Apply grammatical concepts such as nouns, pronouns, adjectives, articles, degrees of comparison, adverbs, conjunctions, prepositions, and tag questions to identify and correct errors in sentences. (L3)

CO2: Apply knowledge of tenses, voice, reported speech, subject–verb agreement, modals, and conditional clauses to analyze and rectify grammatical errors in competitive examination contexts. (L4)

CO3: Analyze verbal ability questions involving sentence completion, analogies, word groups, critical reasoning, verbal deduction, para-jumbles, and reading comprehension to select appropriate responses. (L4)

CO4: Apply vocabulary-building strategies and reading techniques to interpret passages, infer meanings, and solve questions related to vocabulary, comprehension, and contextual usage effectively. (L3)

CO5: Evaluate and employ appropriate writing skills such as paragraph development, note-making, summarizing, précis writing, paraphrasing, essay writing, and punctuation for competitive examination requirements. (L5)

Unit I: Grammar-1:

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

Unit II: Grammar-2:

Verbs – tenses – structure – usages – negatives – 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 Vocabulary:

Competitive Vocabulary: Word Building – Memory Techniques-Synonyms, Antonyms, Affixes-Prefix &Suffix-One-word substitutes-Compound Words-Phrasal Verbs-Idioms and Phrases-Homophones- Linking Words-Modifiers-Intensifiers - Mastering Competitive Vocabulary- Cracking the unknowing passage-speed reading techniques- Skimming & Scanning-types of answering–Elimination methods.

Unit V: Writing for Competitive Examinations:

Punctuation- Spelling rules- Word Order-Sub Skills of Writing- Paragraph meaning-salient features-types - Note-making, Note-taking, summarizing-precise writing- Paraphrasing-Expansion of proverbs- Essay writing-types.

Text Books:

1. Wren & Martin, English for Competitive Examinations, S.Chand & Co, 2021
2. Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.

Reference Books:

1. Hari Mohan Prasad, Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.
2. Philip Sunil Solomon, English for Success in Competitive Exams, Oxford 2016
3. Shalini Verma , Word Power Made Handy, S Chand Publications
4. Neira, Anjana Dev & Co. Creative Writing: A Beginner's Manual. Pearson Education India, 2008.
5. Abhishek Jain, Vocabulary Learning Techniques Vol.I & II, RR Global Publishers 2013.
6. Michel Swan, Practical English Usage,Oxford,2006.

Online Resources:

1. https://www.grammar.cl/english/parts-of-speech.htm
2. https://academicguides.waldenu.edu/writingcenter/grammar/partsofspeech
3. https://learnenglish.britishcouncil.org/grammar/english-grammar-reference/active- 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 to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Understanding of Business, Markets, and Economic Concepts.
- Familiarity with Communication, Problem-solving, and Creative thinking skills.

Course Objectives:

- To foster an entrepreneurial mind-set for venture creation and intrapreneurial leadership.
- To encourage creativity and innovation
- To enable them to learn pitching and presentation skills
- To make the students understand MVP development and validation techniques to determine Product-Market fit and Initiate Solution design, Prototype for Proof of Concept.
- To enhance the ability of analyzing Customer and Market segmentation, estimate Market size, develop and validate Customer Person

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 analyzing 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 Deadiness:

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, McGraw Hill, 11th Edition. (2020)
3. Ries, E. The Lean Start-up: 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:

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

B.Tech. – III Year
II Semester

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC30305T	PC	Big Data Analytics	2	1	0	3

Pre-Requisites: Introduction to Data Science.

Course Objectives:

- To introduce the fundamental concepts and characteristics of Big Data.
- To equip students with knowledge of Hadoop, Spark, and distributed computing systems.
- To develop the ability to process, store, and analyze Big Data using modern tools.
- To implement various big data analytics techniques on real-world data.
- To apply big data tools and frameworks in domains such as finance, health, and e-commerce.

Course Outcomes (COs):

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

CO1: Analyze Big Data characteristics and compare traditional systems with Hadoop architecture, HDFS, YARN, MapReduce, and ecosystem components for large-scale data processing. (L4)

CO2: Examine the MapReduce programming model and advanced concepts, and evaluate the use of Hive, Pig, Sqoop, and Flume for efficient Big Data processing, querying, and data integration. (L4)

CO3: Compare NoSQL database models with RDBMS, and evaluate HBase architecture, data model, operations, and its integration with Hadoop for large-scale data storage applications. (L4)

CO4: Evaluate Apache Spark components including RDDs, Spark SQL, Streaming, MLlib, and GraphX, and apply performance optimization techniques for real-time Big Data analytics applications. Integrate big data platforms with machine learning and business intelligence solutions. (L5)

CO5: Design and justify Big Data solutions for healthcare, finance, e-commerce, smart cities, and cloud platforms, while addressing data privacy, security, and ethical considerations through case studies and a mini project. (L5)

Unit I: Introduction to Big Data and Hadoop Ecosystem:

Definition, Characteristics of Big Data (Volume, Variety, Velocity, Veracity, Value), Types of Data: Structured, Semi-Structured, and Unstructured, Traditional vs Big Data Systems, Big Data Challenges and Benefits, Introduction to Hadoop: Architecture and Components, Hadoop Distributed File System (HDFS): Features, Design, Blocks, YARN and MapReduce Overview, Hadoop Ecosystem Components: Pig, Hive, HBase, Sqoop, Flume.

Unit II: MapReduce Programming and Hadoop Tools:

MapReduce Programming Model: Mapper, Reducer, Partitioner, InputSplit and RecordReader, Combiner, Writing MapReduce Programs in Java, Advanced MapReduce Concepts: Counters, Joins, Secondary Sort, Hive: Data Warehousing Concepts, HiveQL, Partitions, Buckets, Pig: Data Flow, Pig Latin Scripts, Data Import & Export with Sqoop, Real-Time Data Collection using Flume.

Unit III: NoSQL Databases and HBase:

Introduction to NoSQL Databases, Types of NoSQL: Key-Value, Document, Column, Graph, Differences between RDBMS and NoSQL, HBase Data Model: Column Families, Regions, Tables, HBase Architecture and Internals, HBase CRUD Operations using Java, Integration of HBase with Hadoop, Case Study: Big Data Storage in Social Media.

Unit IV: Apache Spark and Big Data Analytics:

Apache Spark: RDDs and DAG Execution Model, Spark Core and Spark SQL, DataFrames and Datasets in Spark, Spark Streaming: Architecture and DStreams, Spark MLlib: Machine Learning on Big Data, GraphX: Graph Processing in Spark, Performance Tuning and Optimization in Spark, Case Study: Building a Spark Application for Real-Time Analytics.

Unit V: Applications and Case Studies in Big Data:

Big Data in Healthcare: Predictive Analysis, Genomics, Big Data in Finance: Fraud Detection, Risk Analytics, Big Data in E-Commerce: Customer Behavior, Personalization, Sentiment Analysis using Big Data, Big Data for Smart Cities and IoT, Big Data and Cloud Computing Integration (AWS, GCP, Azure), Data Privacy, Security, and Ethical Issues – (E), Mini-Project: Design and Development of a Big Data Solution.

Text Books:

1. Tom White, Hadoop: The Definitive Guide, O'Reilly Media.
2. V. Srinivasa Subramanian, Big Data Analytics, Wiley India.
3. Anand Rajaraman and Jeffrey D. Ullman, Mining of Massive Datasets, Cambridge University Press.

Reference Books:

2. Chuck Lam, Hadoop in Action, Manning Publications.
3. Bill Franks, Taming the Big Data Tidal Wave, Wiley.
4. Alex Holmes, Hadoop in Practice, Manning Publications.
5. Michael Minelli, Big Data, Big Analytics: Emerging Business Intelligence, Wiley.

Online Resources:

1. Coursera – Big Data Specialization by UC San Diego
2. edX – Big Data Analysis with Apache Spark
3. (UC Berkeley)Udacity – Data Engineering Nanodegree

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31306T	PC	**Deep Learning** (Common to CSE & AI&DS)	2	1	0	3

Pre-Requisites: Basic knowledge of machine learning, mathematics, and programming.

Course Objectives:

- To Demonstrate the major technology trends driving Deep Learning.
- To Build, train, and apply fully connected deep neural networks.
- To Implement efficient (vector zed) neural networks.
- To Analyse the key parameters and hyper parameters in a neural network's architecture

Course Outcomes (COs):

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

CO1: Apply concepts of Linear Algebra, Probability, and Gradient-Based Optimization to establish the mathematical foundations for neural network computation. (L3)

CO2: Analyze the design of Deep Feedforward Networks and the Back-Propagation algorithm to overcome challenges in supervised and unsupervised learning. (L4)

CO3: Practice various regularization and optimization strategies, such as Dropout and Adaptive Learning Rates, to enhance the training performance of deep models. (L3)

CO4: Build Convolutional Neural Networks (CNNs) by integrating convolution operations and pooling layers for structured data processing. (L5)

CO5: Analyze sequence modeling architectures, including RNNs, LSTMs, and Autoencoders, for generative and time-series applications. (L4).

Unit I: Linear Algebra:

Scalars, Vectors, Matrices and Tensors, Matrix operations, types of matrices, Norms, Eigen decomposition, Singular Value Decomposition, Principal Components Analysis. Probability and Information Theory: Random Variables, Probability Distributions, Marginal Probability, Conditional Probability, Expectation, Variance and Covariance, Bays' Rule, Information Theory. Numerical Computation: Overflow and Underflow, Gradient-Based Optimization, Constrained Optimization, Linear Least Squares.

Unit-II: Machine Learning:

Basics and Under fitting, Hyper parameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood, Bayesian Statistics, Supervised and Unsupervised Learning, Stochastic Gradient Descent, Challenges Motivating Deep Learning. Deep Feed forward Networks: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and other Differentiation Algorithms.

Unit III: Regularization for Deep Learning:

Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier. Optimization for Training Deep Models: Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms.

Unit IV: Convolution Networks:

The Convolution Operation, Pooling, Convolution, Basic Convolution Functions, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, Basis for Convolution Networks.

Unit V: Sequence Modelling:

Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, LSTM, Gated RNNs, Optimization for Long-Term Dependencies, Auto encoders, Deep Generative Models.

Text Books:

1. Ian Good fellow, Joshua Bagnio, Aaron Carville, ―Deep Learning‖, MIT Press,2016.
2. Josh Patterson and Adam Gibson, ―Deep learning: A practitioner's approach‖, O'Reilly
3. Media, First Edition,2017.

Reference Books:

1. Fundamentals of Deep Learning, Designing next-generation machine intelligence
2. algorithms, Nikhil Baume, O'Reilly, Sheriff Publishers,2019.
3. Deep learning Cook Book, Practical recipes to get started Quickly, Douse Using,
4. O'Reilly, Sheriff Publishers, 2019

Online Resources:

1. https://keras.io/datasets/
2. http://deeplearning.net/tutorial/deeplearning.pdf
3. https://arxiv.org/pdf/1404.7828v4.pdf
4. https://www.cse.iitm.ac.in/~miteshk/CS7015.html
5. https://www.deeplearningbook.org
6. https://nptel.ac.in/courses/106105215

B.Tech. – III Year II 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)	3	0	0	3

Pre-Requisites: Basic knowledge of programming, machine learning, and linguistics concepts

Course Objectives:

- To Explain and apply fundamental algorithms and techniques in the area of natural language processing (NLP)
- To Discuss approaches to syntax and semantics in NLP.
- To Examine current methods for statistical approaches to machine translation.
- To Teach machine learning techniques used in NLP.

Course Out comes (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 Natural Language:

The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Back ground: An outline of English Syntax.

Unit II : Grammars and Parsing :

Grammars and Parsing – Top – Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphologica l Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks, Bayees Rule, Shannongame, Entropy and Cross Entropy.

Unit III : Grammars for Natural Language :

Grammars for Natural Language, Movement Phenomenonin Language, Gap Threading, Human Preferences in Parsing, Shift Reduce Parsers, Deterministic Parsers.

Unit IV: Semantic Interpretation:

Semantic &Logical form, Word senses & ambiguity, the basic logical form language, encoding ambiguity in the logical Form, Verbs &States in logical form, the maticroles, Speech acts & embedded sentences, Defining semantics structure model theory.

Language Modelling: Introduction, n-Gram Models, Language model Evaluation, Parameter Estimation, Language Model Adaption, Types of Language Models, Language-Specific Modelling Problems, Multilingual and Cross lingual Language Modelling.

Unit V: Machine Translation Survey:

Introduction, Problems of Machine Translation, IsMachine Translation Possible, Brief History, Possible Approaches, Current Status. Anusaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem, Structure of Anusaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusarsaka Output, Language Bridges.

Multilingual Information Retrieval: Introduction, Document Pre-processing, Monolingual Information Retrieval, CLIR, MLIR, Evaluation in Information Retrieval, Tools, Software and Resources.

Multilingual Automatic Summarization: Introduction, Approaches to Summarization, Evaluation, How to Build a Summarizer, Competitions and Datasets.

Text Books:

1. James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education.
2. Multilingual Natural Language Processing Applications: From Theory to Practice- Daniel M.Bikel and ImedZitouni, Pearson Publications.
3. Natural Language Processing, A paninian perspective, Akshar Bharathi, Vineet chaitanya, Prentice –Hall of India.

Reference Books:

1. Charniack, Eugene, Statistical Language Learning, MITPress,1993.
2. Jurafsky, Dan and Martin, James, Speech and Language Processing, 2nd Edition, Prentice Hall,2008.
3. Manning, Christopher and Hen rich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press,1999.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105158/http://www.nptelvideos.in/2012/11/natural-language- processing.html

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31306P	PC	Deep Learning Lab	0	0	3	1.5

Pre-Requisites: Basic knowledge of Python, machine learning, and deep learning concepts.

Course Objectives:

To provide hands-on experience in building, training, and evaluating deep learning models using popular frameworks such as TensorFlow and PyTorch. Students will implement neural networks, understand hyperparameter tuning, and explore deep learning architectures for real-world applications.

Course Out comes (COs):

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

CO1: Apply basic Perceptron and Multilayer Perceptron (MLP) models to classify binary and image data using various activation functions. (L3)

CO2: Analyze the performance of deep learning optimizers like SGD, Adam, and RMSprop on model convergence. (L4)

CO3: Build and train Convolutional Neural Networks (CNNs) for image classification using data augmentation and transfer learning (ResNet, VGG). (L5)

CO4: Examine sequence modeling and generative architectures using RNNs, LSTMs for sentiment analysis, and GANs for image synthesis. (L4)

CO5: Experiment and deploy end-to-end deep learning solutions for real-world case studies using Flask or Streamlit. (L4)

List of Experiments:

1. Implement a basic Perceptron using Python and classify binary data.
2. Build and train a Multilayer Perceptron (MLP) using TensorFlow/Keras on the MNIST dataset.
3. Experiment with different activation functions (ReLU, sigmoid, tanh) and observe effects on learning.
4. Compare optimizers (SGD, Adam, RMS prop) on convergence and performance.
5. Implement Convolutional Neural Networks (CNN) for image classification on CIFAR-10 dataset.
6. Perform data augmentation techniques and evaluate improvements in model accuracy.
7. Implement Recurrent Neural Networks (RNN) and LSTMs for sentiment analysis on IMDB dataset.
8. Train a GAN (Generative Adversarial Network) to generate handwritten digits.
9. Use Transfer Learning (e.g., ResNet, VGG) for fine – tuning on a custom dataset.
10. Evaluate model using metrics such as precision, recall, F1-score, ROC curves.
11. Deploy a trained deep learning model using Flask or Streamlit for web - based inference.
12. Case Study: Develop an end-to-end solution (e.g., face mask detector, plant disease detection).

Text Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
2. François Chollet, Deep Learning with Python, Manning Publications, 2nd Edition, 2021.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow,
4. O‘Reilly, 3rd Edition, 2022.

Reference Books:

1. Nikhil Buduma, Fundamentals of Deep Learning, O'Reilly Media, 2017.
2. Josh Patterson and Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly, 2017.
3. Michael Nielsen, Neural Networks and Deep Learning (Online Book).

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC30305P	PC	Big Data Analytics and Data Visualization Lab	0	0	3	1.5

Pre-Requisites: Basic knowledge of data analysis, statistics, and programming.

Course Objectives:

- To introduce foundational tools and platforms in big data analytics.
- To apply programming skills in Hadoop and Spark for processing big datasets.
- To build visualization pipelines using Python libraries and BI tools.
- To analyze and interpret data insights visually and statistically.
- To implement predictive modeling and visual communication of outcomes.

Course Outcomes (COs):

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

CO1: Apply big data ecosystems and tools. (L3)
CO2: Execute data analysis tasks using Hadoop and Spark. (L3)
CO3: Perform data visualization using Python and BI platforms. (L3)
CO4: Analyze patterns, trends, and correlations in large datasets. (L4)
CO5: Create dashboards and interactive visual insights. (L4)

List of Experiments:

1. Installation of Hadoop ecosystem and execution of basic HDFS commands
2. Word Count and File Processing using Hadoop MapReduce
3. Working with Hive: Table creation, loading data, and performing analytical queries
4. Data cleaning and transformation using PySpark DataFrames
5. Implementing MLlib algorithms (e.g., Classification/Clustering) on Spark
6. Connecting Spark with MongoDB/Cassandra for NoSQL-based Big Data processing
7. Visualizing data using Matplotlib and Seaborn for univariate and bivariate analysis
8. Creating interactive plots using Plotly and Dash
9. Exploratory Data Analysis (EDA) and feature analysis with Pandas and Seaborn
10. Real-time data ingestion (Twitter API or sensor data) and live visualization with Kafka + Spark Streaming
11. Developing a dashboard using Tableau/Power BI for insights from processed Big Data
12. Mini Project: End-to-end pipeline integrating Big Data processing and visualization using any real dataset

Tools/Software Required:

1. Hadoop, Hive, Spark (PySpark)
2. Python (Pandas, NumPy, Seaborn, Matplotlib, Plotly, Dash)
3. NoSQL: MongoDB / Cassandra
4. Tableau, Power BI, or Google Data Studio
5. Jupyter Notebooks, Anaconda
6. Kafka / Twitter API (for streaming)

B.Tech. – III Year II Semester

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

Pre-Requisites: Basic communication and interpersonal skills.

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: List out various elements of soft skills (L2)

CO2: Describe methods for building professional image (L3)

CO3: Apply critical thinking skills in problem solving(L4)

CO4: Analyse the needs of an individual and team for well-being(L3)

CO5: Assess the situation and take necessary decisions(L4)

CO6 : Create a productive work place atmosphere using social and work-life skills ensuring personal and emotional well-being(L3)

Unit I: Soft Skills & Communication Skills:

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

Activities:

Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self-expression – articulating with felicity (The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)

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

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

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

Unit II:Critical Thinking:

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

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

Unit III: Problem Solving & Decision Making:

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

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

Unit IV: Emotional Intelligence & Stress Management:

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

Activities: Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations. Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

Unit V: Corporate Etiquette:

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

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

NOTE:

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

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc
7. https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
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	MC	**Technical Report Writing & IPR** (Common to all branches of Engineering)	2	0	0	-

Pre-Requisites: Basic knowledge of English communication and technical writing skills.

Course Objectives:

- To enable the students to practice the basic skills of research paper writing
- To make the students understand the importance of IP and to educate them on the basic concepts of Intellectual Property Rights.
- To practice the basic skills of performing quality literature review
- To help them in knowing the significance of real-life practice and procedure of Patents.
- To enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks

Course Outcomes (COs):

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

CO1: Apply clarity, precision, and coherence to produce effective and plagiarism-free technical writing. (L4)

CO2: Analyze key components of a research paper to develop a well-structured synopsis. (L4)

CO3: Evaluate publication processes and citation practices to prepare accurate and ethical manuscripts. (L4)

CO4: Analyze intellectual property types, treaties, and trademark processes to assess protection mechanisms. (L4)

CO5: Examine copyright and patent laws to determine ownership and registration procedures. (L4)

Unit I: Principles of Technical Writing:

styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language -highlighting your findings- discussing your limitations - hedging and criticizing -plagiarism and paraphrasing

Unit II : Technical Research Paper Writing:

Abstract- Objectives-Limitations-Review of Literature- Problems and Framing Research Questions- Synopsis

Unit III: Process of Research: Publication Mechanism:

Types of journals- indexing-seminars-conferences- proof reading –plagiarism style; seminar & conference paper writing; Methodology-discussion-results- citation rules.

Unit IV: Introduction to Intellectual property:

Introduction, types of intellectual property, International organizations, agencies and treaties, importance of intellectual property rights

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Unit V: Law of Copy Rights:

Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer. Patent law, intellectual property audits.

Text Books:

1. Deborah. E. Bouchoux, Intellectual Property Rights, Cengage Learning India, 2013
2. Meenakshi Raman, Sangeeta Sharma. Technical Communication: Principles and practices. Oxford.

Reference Books :

1. R.Myneni, Law of Intellectual Property, 9th Ed, Asia law House, 2019.
2. Prabuddha Ganguli, Intellectual Property Rights Tata Mcgraw Hill, 2001
3. P.Naryan,Intellectual Property Law, 3rd Ed ,Eastern Law House, 2007.
4. Adrian Wallwork. English for Writing Research Papers Second Edition. Springer Cham Heidelberg New York ,2016
5. Dan Jones, Sam Dragga, Technical Writing Style

Online Resources:

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

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. (BL4)

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)

Professional Elective – II (PE - II)

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31302T	PE	Reinforcement learning	3	0	0	3

Pre-Requisites: Basics of Machine Learning, Probability, Linear Algebra, and Python Programming.

Course Objectives:

- To understand the foundational concepts of Reinforcement Learning (RL) and its mathematical formulations.
- To explore dynamic programming, Monte Carlo methods, and temporal-difference learning.
- To study the advanced function approximation methods using neural networks.
- To apply RL algorithms to real-world decision-making problems.
- To introduce policy gradient methods and deep reinforcement learning techniques.

Course Out comes (COs):

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

CO1: Analyze the agent-environment interface and Markov Decision Processes (MDP) to formulate goals, rewards, and value functions for reinforcement learning tasks. (L4)

CO2: Apply dynamic programming and Monte Carlo methods to perform policy evaluation, iteration, and control in episodic and continuing tasks. (L3)

CO3: Implement Temporal-Difference learning (SARSA, Q-Learning) and eligibility traces to enable multi-step prediction and control. (L3)

CO4: Analyze deep reinforcement learning architectures, such as DQN and its variants, to resolve challenges in non-linear function approximation and experience replay. (L4)

CO5: Demonstrate autonomous systems using policy gradient theorems and Actor-Critic architectures for complex applications in robotics and gaming. (L3)

Unit I: Introduction to Reinforcement Learning:

Introduction to Machine Learning and RL, Agent-environment interface, Goals and rewards, Returns: episodic and continuing tasks, Markov Decision Processes (MDP), Value functions: state-value and action-value functions.

Unit II: Dynamic Programming and Monte Carlo Methods:

Policy evaluation and improvement, Policy iteration and value iteration, Generalized policy iteration, Monte Carlo prediction and control, On-policy and off-policy MC methods.

Unit III: Temporal-Difference Learning and Eligibility Traces:

TD Prediction (TD(0)), SARSA and Q-Learning, Expected SARSA, n-step returns, Eligibility traces, TD(λ) methods.

Unit IV: Function Approximation and Deep RL:

Linear and non-linear function approximation, Feature construction, Deep Q Networks (DQN), Experience replay and fixed Q-targets, Double DQN and Duelling DQN, Challenges in deep RL.

Unit V: Policy Gradient and Actor-Critic Methods:

Policy gradient theorem, REINFORCE algorithm, Variance reduction techniques, Actor-Critic architecture, Proximal Policy Optimization (PPO), Applications in Robotics and Games.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2nd Edition, MIT Press, 2018. (Free online at http://incompleteideas.net/book/the-book- 2nd.html)

Reference Books:

1. Csaba Szepesvári, "Algorithms for Reinforcement Learning", Morgan & Claypool, 2010.
2. Marco Wiering and Martijn van Otterlo, "Reinforcement Learning: State-of-the-Art", Springer, 2012.
3. David Silver, Reinforcement Learning Lecture Series, University College London (UCL).
4. François-Lavet et al., "An Introduction to Deep Reinforcement Learning", Foundations and Trends® in Machine Learning, 2018.

Online Resources:

1. NPTEL Online Course:https://nptel.ac.in/courses/106106143 – Reinforcement Learning by Prof. Balaraman Ravindran, IIT Madras
2. DeepMind & UCL Lectures (David Silver): https://www.davidsilver.uk/teaching/

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 machine learning, data analysis, and programming.

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 analyzing 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.

Text Books:

1. Charu C. Aggarwal, Recommender Systems‖, Springer,2016.

Reference Books:

1. Francesco Ricci, Lior Rokach, Recommender Systems Handbook‖, 2nd ed., Springer, 2015 Edition

Online 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, and CSE - AI &ML)	3	0	0	3

Pre-Requisites: Basic knowledge of statistics, machine learning, and data analysis.

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, Student 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.

Text Books:

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 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

Course Code	Category	Name of the Course	L	T	P	C
24PE30306T	PE	**AI for Finance** (Common to AI&DS, CSE-AI , and CSE-AI&ML)	3	0	0	3

Pre-Requisites: Basic knowledge of finance, statistics, and programming.

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, Student 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 Back testing 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, Explain ability 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).

Text Books:

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 Resources:

Coursera: AI for Trading – by NYIF and Google Cloud
edX: Artificial Intelligence in Finance – NYIF
Udemy: Machine Learning and AI in Finance
DataCamp: Financial Trading with Python
YouTube: AI for Finance by Sentdex, Two Minute Papers, and Data Professor

Professional Elective – III (PE - III)

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 mathematics, physics, and programming.

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

CO 1: Apply the fundamental concepts of quantum mechanics, including superposition, entanglement, and quantum states, in quantum computing applications. (L3)

CO 2: Construct and analyze quantum circuits using standard gates. .(L4)

CO 3: Apply quantum algorithms like Deutsch-Jozsa, Grover's, and Shor's. (L3)

CO 4: Develop simple quantum programs using Qiskit or similar platforms. (L5)

CO 5: 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. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE31306T	PE	Computer Vision	3	0	0	3

Pre-Requisites: Basics of Linear Algebra

Course Objectives:

The objective of this course is to understand the basic issues in computer vision and major approaches to address the methods to learn the Linear Filters, segmentation by clustering, Edge detection, Texture. **Course Outcomes (COs):**

On successful completion of the course, Student 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 Applications in 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 Resources:

https://nptel.ac.in/courses/106105216https://nptel.ac.in/courses/108103174

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC31307T	PE	**Cloud Computing for AI** (Common to AI&DS, CSE- AI , and CSE- AI&ML)	3	0	0	3

Pre-Requisites: Basics of Cloud Computing

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: Apply basic Perceptron and Multilayer Perceptron (MLP) models to classify binary and image data using various activation functions. (L3)

CO2: Analyze the performance of deep learning optimizers like SGD, Adam, and RMSprop on model convergence. (L4)

CO3: Build and train Convolutional Neural Networks (CNNs) for image classification using data augmentation and transfer learning (ResNet, VGG). (L5)

CO4: Examine sequence modeling and generative architectures using RNNs, LSTMs for sentiment analysis, and GANs for image synthesis. (L4)

CO5: Experiment and deploy end-to-end deep learning solutions for real-world case studies using Flask or Streamlit. (L4)

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, Big Query, 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.

Reference Books:
1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, Distributed and Cloud Computing Kaufmann.
2. Tomasz Kajdanowicz et al., Practical Cloud AI , Springer.
3. Mark Wilkins, AI and Machine Learning for Coders in Cloud

Online Resources:
1. AWS Cloud Practitioner & Machine Learning Path – AWS Training
2. Google Cloud AI and ML Specialization – Coursera
3. Microsoft Azure AI Engineer Associate – Learn Portal

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: Basics of Graph Theory for analyzing relationships and networks.

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, Student 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.

Text Books:

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., & **Analyzing Social Media Networks with NodeXL** Smith, M. A., , Elsevier, 2020.

Online 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

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)	2	1	0	3

Pre-Requisites:

- Basic Understanding of Environmental and Societal Issues.
- Familiarity with Risk, Safety, and Emergency Response Concepts

Course Objectives:

- To understand the fundamental concepts of natural disasters, their occurrence, and disaster risk reduction strategies.
- To analyze the impact of cyclones on structures and explore retrofitting techniques for adaptive reconstruction.
- To apply wind engineering principles and computational techniques in designing wind-resistant structures.
- To evaluate earthquake effects on buildings and develop strategies for seismic retrofitting.
- To assess seismic safety planning, design considerations, and innovative construction materials for disaster-resistant structures.

Course Outcomes (COs):

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

CO1: Apply knowledge of natural and man-made hazards to explain disaster types, risk assessment frameworks, and vulnerability analysis. (L3)

CO2: Analyze disaster preparedness, mitigation, and early warning systems for effective community-level risk reduction. (L4)

CO3: Evaluate disaster response and recovery strategies including emergency relief operations and post-disaster rehabilitation. (L5)

CO4: Apply disaster risk reduction policies, legal frameworks, and international guidelines for disaster management planning. (L3)

CO5: Assess the role of technology, remote sensing, and GIS in disaster monitoring, mapping, and management decision-making. (L5)

Unit I: Introduction to Natural Disasters:

Brief Introduction to Different Types of Natural Disasters, Occurrence of Disasters in Different Climatic and Geographical Regions, Hazard Maps (Earthquake and Cyclone) of The World and India, Regulations for Disaster Risk Reduction, Post-Disaster Recovery and Rehabilitation (Socioeconomic Consequences).

Unit II: Cyclones and Their Impact:

Climate Change and Its Impact on Tropical Cyclones, Nature of Cyclonic Wind, Velocities and Pressure, Cyclone Effects, Storm Surges, Floods, and Landslides. Behavior of Structures in Past Cyclones and Windstorms, Case Studies. Cyclonic Retrofitting, Strengthening of Structures, and Adaptive Sustainable Reconstruction. Life-Line Structures Such as Temporary Cyclone Shelters.

Unit III: Wind Engineering and Structural Response:

Basic Wind Engineering, Aerodynamics of Bluff Bodies, Vortex Shedding, and Associated Unsteadiness Along and Across Wind forces. Wind Tunnel Testing and Its Salient Features. Introduction to Computational Fluid Dynamics (CFD). General Planning and Design Considerations Under Windstorms and Cyclones. Wind Effects on Buildings, Towers, Glass Panels. Codal

Provisions, Design Wind Speed, Pressure Coefficients. Coastal Zoning Regulations for Construction. Innovative Construction Materials and Techniques.

Unit IV: Seismology and Earthquake Effects:
Causes of Earthquakes, Plate Tectonics, Faults, Seismic Waves; Magnitude, Intensity, Epicenter, Energy Release, and Ground Motions. Earthquake Effects: On Ground, Soil Rupture, Liquefaction, Landslides. Performance of Ground and Buildings in Past Earthquakes – Behavior of Various Types of Buildings, Collapse Patterns; Behavior of Non-Structural Elements – Case Studies. Seismic Retrofitting: Weakness in Existing Buildings, Aging, Concepts in Repair, Restoration, and Seismic Strengthening.

Unit V: Planning and Design for Seismic Safety:
General Planning and Design Considerations; Building forms, Horizontal and Vertical Eccentricities, Mass and Stiffness Distribution, Soft Storey Effects; Seismic Effects Related to Building Configuration. Plan and Vertical Irregularities, Redundancy, and Setbacks. Construction Details: Various Types of Foundations, Soil Stabilization, Retaining Walls, Walls, Openings, Roofs, Parapets, Underground and Overhead Tanks, Staircases, and Isolation of Structures. Innovative Construction Materials and Techniques. Local Practices – Traditional Regional Responses. Computational Investigation Techniques.

Text Books:

1. David Alexander, "Natural Disasters", 1st Edition, CRC Press, 2017.
2. Edward A. Keller and Duane E. DeVecchio, "Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes", 5th Edition, Routledge, 2019.

Reference Books:

1. Ben Wisner, J.C. Gaillard, and Ilan Kelman (Editors), "Handbook of Hazards and Disaster Risk Reduction and Management", 2nd Edition, Routledge, 2012.
2. Damon P. Coppola, "Introduction to International Disaster Management", 4th Edition, Butterworth-Heinemann, 2020.

Online Resources:

- https://nptel.ac.in/courses/124107010
- https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01304T	OE	**Sustainability in Engineering Practices** (Common to EEE, ECE, CSE, AI&DS, CSE-AI and CSE-AI&ML)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Engineering Principles and Environmental Concepts.
- Familiarity with Sustainable Development and Resource Conservation Basics.

Course Objectives:

- To understand the fundamentals of sustainability, the carbon cycle, and the environmental impact of construction materials.
- To analyze sustainable construction materials, their durability, and life cycle assessment.
- To apply energy calculations in construction materials and assess their embodied energy.
- To evaluate green building standards, energy codes, and performance ratings.
- To assess the environmental effects of energy use, climate change, and global warming.

Course Outcomes (COs):

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

CO1: Apply sustainability principles to explain their integration in engineering design, construction, and project lifecycle management. (L3)

CO2: Analyze sustainable material selection, energy efficiency strategies, and life cycle assessment methods in engineering practice. (L4)

CO3: Evaluate environmental, social, and economic impacts of engineering projects using sustainability assessment tools and metrics. (L5)

CO4: Apply green engineering principles and clean technology approaches to develop sustainable infrastructure solutions. (L3)

CO5: Assess sustainable development goals and their alignment with engineering decision-making and professional responsibilities. (L5)

Unit I: Introduction to Sustainability:

Introduction and Definition of Sustainability – Carbon Cycle – Role of Construction Material: Concrete and Steel, etc. – CO2 Contribution from Cement and Other Construction Materials.

Unit II: Materials Used in Sustainable Construction:

Construction Materials and Indoor Air Quality – No/Low Cement Concrete – Recycled and Manufactured Aggregate – Role of QC and Durability – Life Cycle and Sustainability.

Unit III: Energy Calculations:

Components of Embodied Energy – Calculation of Embodied Energy for Construction Materials – Energy Concept and Primary Energy – Embodied Energy Vis-à-Vis Operational Energy in Conditioned Building – Life Cycle Energy Use.

Unit IV: Green Buildings:

Control of Energy Use in Building – ECBC Code, Codes in Neigh boring Tropical Countries – OTTV Concepts and Calculations – Features of LEED and TERI – GRIHA Ratings – Role of Insulation and Thermal Properties of Construction Materials – Influence of Moisture Content and Modeling – Performance Ratings of Green Buildings – Zero Energy Building.

Unit V: Environmental Effects:

Non-Renewable Sources of Energy and Environmental Impact – Energy Norm, Coal, Oil, Natural Gas – Nuclear Energy – Global Temperature, Green House Effects, Global Warming – Acid Rain: Causes, Effects and Control Methods – Regional Impacts of Temperature Change.

Text Books:

1. Charles J. Kibert, "Sustainable Construction: Green Building Design & Delivery", 4th Edition, Wiley Publishers, 2016.
2. Steve Goodhew, "Sustainable Construction Process", Wiley Blackwell, UK, 2016.

Reference Books:

1. Craig A. Langston & Grace K.C. Ding, "Sustainable Practices in the Built Environment", Butterworth Heinemann Publishers, 2011.
2. William P. Spence, "Construction Materials, Methods & Techniques", 3rd Edition, Yesdee Publication Pvt. Ltd., 2012.

Online Resources:

- https://archive.nptel.ac.in/courses/105/105/105105157/

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE02302T	OE	**Renewable Energy Sources** (Common to CE, ECE, CSE, AI&DS, CSE-AI & CSE-AI&ML)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Energy Concepts and Electrical Fundamentals.
- Familiarity with Conventional and Non-Conventional Energy Sources.

Course Objectives:

- To understand the fundamental principles of various renewable energy sources such as solar, wind, geothermal, ocean, and biomass energy.
- To analyze solar radiation parameters, solar thermal systems, and photovoltaic technologies for effective energy conversion.
- To study the working principles, design considerations, and performance analysis of wind energy conversion systems.
- To explore geothermal and ocean energy resources, their extraction methods, applications, and feasibility, particularly in the Indian context.

Course Outcomes (COs):

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

CO1: Describe solar energy fundamentals including solar radiation geometry, solar collectors, and thermal energy storage systems. (L3)

CO2: Analyze photovoltaic energy systems including PV cell characteristics, module design, and standalone and grid-connected configurations. (L4)

CO3: Examine wind energy systems including wind turbine components, aerodynamic forces, energy estimation, and site selection criteria. (L4)

CO4: Evaluate geothermal energy resources, characteristics, applications, and prospects for sustainable energy generation. (L5)

CO5: Assess miscellaneous renewable energy technologies including tidal, wave, biomass, and fuel cell systems for energy production. (L5)

Unit I: Solar Energy:

Solar radiation – beam and diffuse radiation, solar constant, Sun at Zenith, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. Flat plate collectors, concentrating collectors, storage of solar energy – thermal storage.

Unit II: PV Energy Systems:

Introduction, The PV effect in crystalline silicon – basic principles, the film PV, Other PV technologies, Solar PV modules from solar cells, mismatch in series and parallel connections, design and structure of PV modules, Electrical characteristics of silicon PV cells and modules, Stand-alone PV system configuration, Grid connected PV systems.

Unit III: Wind Energy:

Principle of wind energy conversion; Basic components of wind energy conversion systems; windmill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines; analysis of aerodynamic forces acting on windmill blades; wind data and energy estimation and site selection considerations.

Unit IV: Geothermal Energy:

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

Unit V: Miscellaneous Energy Technologies:

Ocean Energy: Tidal Energy – Principle of working, Operation methods, advantages and limitations. Wave Energy – Principle of working, energy and power from waves, wave energy conversion devices. Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration. Fuel Cell: Principle of working of various types of fuel cells, performance and limitations.

Text Books:

1. G.D. Rai, "Non-Conventional Energy Sources", 4th Edition, Khanna Publishers, 2000.
2. Chetan Singh Solanki, "Solar Photovoltaics Fundamentals, Technologies and Applications", 2nd Edition, PHI Learning Pvt. Ltd., 2012.

Reference Books:

1. Stephen Peake, "Renewable Energy Power for a Sustainable Future", Oxford International Edition, 2018.
2. S.P. Sukhatme, "Solar Energy", 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., 2008.
3. B.H. Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw Hill, 2011.

Online Learning Resources:

- https://nptel.ac.in/courses/103103206
- https://nptel.ac.in/courses/108108078

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03302T	OE	**Automation and Robotics** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Electrical, Electronic, and Mechanical Fundamentals.
- Familiarity with Control Systems and Basic Programming Concepts.

Course Objectives:

- Fundamentals of industrial automation, production types, automation strategies, and hardware elements used in modern manufacturing processes.
- Understanding of automated manufacturing systems, and strategies for improving productivity and flexibility in industrial automation.
- Knowledge of industrial automation and robotics, sensors, and end-effector design for modern manufacturing environments.
- Explain industrial automation and robotics, and trajectory planning for intelligent and efficient manufacturing applications.
- Familiarity of industrial automation and robotics, and practical applications in manufacturing processes.

Course Outcomes (COs):

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

CO1: Apply the concepts of automation, manufacturing systems, production types, automation strategies, and hardware components to identify and implement suitable automation solutions in manufacturing environments. (L3)

CO2: Analyze automated flow lines and assembly line balancing techniques to improve production efficiency in manufacturing systems. (L4)

CO3: Analyze the configuration, components, actuators, and sensor systems of industrial robots for effective selection and application in automation tasks. (L4)

CO4: Apply manipulator kinematics, dynamics, and trajectory planning techniques for robot motion control and path optimization. (L3)

CO5: Apply robot programming methods and evaluate robotic applications in manufacturing processes such as material handling, welding, painting, assembly, and inspection. (L3)

Unit I: Introduction to Automation:

Introduction to Automation, Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation, Hardware components for automation and process control, mechanical feeders, hoppers, orienteers, high speed automatic insertion devices.

Unit II: Automated Flow Lines:

Automated flow lines, Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines. Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Unit III: Introduction to Industrial Robotics:

Introduction to Industrial Robotics, Classification of Robot Configurations, functional line diagram, degrees of freedom. Components – common types of arms, joints, grippers, factors to be considered in the design of grippers. Robot actuators and Feedback components: Actuators – Pneumatic, Hydraulic actuators, Electric & Stepper motors. Position sensors – potentiometers, resolvers, encoders – velocity sensors, Tactile sensors, Proximity sensors.

Unit IV: Manipulator Kinematics and Dynamics:

Manipulator Kinematics: Homogenous transformations as applicable to rotation and transition – D-H notation, Forward and inverse kinematics. Manipulator Dynamics: Differential transformations, Jacobians, Lagrange-Euler and Newton-Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles, path planning, skew motion, joint integrated motion, straight line motion.

Unit V: Robot Programming and Applications:

Robot Programming: Methods of programming – requirements and features of programming languages, software packages. Problems with programming languages. Robot Application in Manufacturing: Material Transfer – Material handling, loading and unloading – Process – spot and continuous arc welding & spray painting – Assembly and Inspection.

Text Books:

1. Automation, Production Systems and CIM, M.P. Groover, Pearson Edu.
2. Industrial Robotics, M.P. Groover, TMH.

Reference Books:

1. Robotics, Fu K.S., McGraw Hill, 4th edition, 2010.
2. An Introduction to Robot Technology, P. Coiffet and M. Chirouze, Kogan Page Ltd., 1983.
3. Robotics Engineering, Richard D. Klafter, Prentice Hall.
4. Robotics, Fundamental Concepts and Analysis, Ashitave Ghosal, Oxford Press, 1/e, 2006.

III B.Tech. – 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)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Binary Number Systems and Boolean Algebra.
- Familiarity with Logic Gates and Basic Electronic Circuits.

Course Objectives:

- To Learn Boolean algebra, logic simplification techniques, and combinational circuit design.
- To analyze combinational circuits like adders, subtractors, and code converters.
- To explore combinational logic circuits and their applications in digital design.
- To understand sequential logic circuits, including latches, flip-flops, counters, and shift registers.
- To gain knowledge about programmable logic devices and digital IC‘s.

Course Outcomes (COs):

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

CO1: Apply Boolean algebra, logic simplification techniques, and combinational circuit design to solve digital logic problems. (L3)

CO2: Analyse combinational circuits such as adders, subtractors, and code converters for efficient digital system design. (L4)

CO3: Analyse various combinational logic circuits and their applications in digital systems. (L4)

CO4: Analyse sequential logic circuits including latches, flip-flops, counters, and shift registers. (L4)

CO5: Evaluate programmable logic devices and digital ICs for designing reliable digital systems.(L5)

Unit I: Logic Simplification and Combinational Logic Design:

Review of Boolean Algebra and De Morgan‘s Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex NOR operations, Minimization of Switching Functions: Karnaugh map method, Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.

Unit II: Introduction to Combinational Design 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 understand the formulation and solution of linear programming problems, including graphical and simplex-based approaches.
- To analyze advanced linear programming concepts such as duality, transportation, and assignment problems for efficient resource allocation.
- To develop knowledge of unconstrained optimization techniques, including direct search and gradient-based methods for solving real-world problems.
- To apply constrained optimization methods such as feasible direction methods and sequential linear programming to engineering problems.

Course Outcomes (COs):

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

CO1: Understand the meaning, purpose, tools of Operations Research and linear programming in solving practical problems in industry. (L3)

CO2: Analyse and Interpret solutions are transportation models to address real -world problems. (L3)

CO3: Develop mathematical skills to analyse and solve nonlinear programming models arising from a wide range of applications. (L3)

CO4: Apply the concept of non-linear programming for solving the problems involving non-linear constraints and objectives. (L3)

CO5: Apply the concept of unconstrained geometric programming for solving the problems involving non-linear constraints and objectives. (L5)

Unit I: Linear Programming I:

Introduction, Applications of Linear Programming, Standard form of a Linear Programming Problem, Geometry of Linear Programming Problems, Basic Definitions in Linear Programming. Simplex Method, Simplex Algorithm and Two-phase Simplex Method, Big-M method.

Unit II: Linear Programming II – Duality:

Symmetric Primal-Dual Relations, General Primal-Dual Relations, Duality Theorem, Dual Simplex Method, Transportation Problem and assignment problem, Complementary slackness Theorem.

Unit III: Non-linear Programming – Unconstrained Optimization:

Introduction: Classification of Unconstrained minimization methods. Direct Search Methods: Random Search Methods, Descent Method and Fletcher-Powell Method, Grid Search Method.

Unit IV: Non-linear Programming – Constrained Optimization:

Introduction, Characteristics of a constrained problem, Random Search Methods, complex method, Sequential linear programming, Basic approach in methods of Feasible directions, Zoutendijk's method of feasible directions: direction finding problem, determination of step length, Termination criteria.

Unit V: Geometric Programming:

Unconstrained Minimization Problems: solution of unconstrained geometric programming using differential calculus and arithmetic-geometric inequality. Constrained Minimization Problems: Solution of a constrained geometric programming problem, primal-dual programming in case of less-than inequalities, geometric programming with mixed inequality constraints.

Text Books:

1. Singiresu S. Rao., "Engineering Optimization: Theory and Practices", New Age Int. (P) Ltd. Publishers, New Delhi.
2. J.C. Pant, "Introduction to Optimization Techniques", 7th edition, Jain Brothers, New Delhi.

Reference Books:

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

Online References:

- https://onlinecourses.nptel.ac.in/noc24_ee122/preview
- https://archive.nptel.ac.in/courses/111/105/111105039/

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB305T	OE	**Mathematical Foundation of Quantum Technologies** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites:

- Basic Knowledge of Matrices, Vectors, and Complex Numbers.
- Familiarity with Calculus, Probability, and Elementary Physics Concepts.

Course Objectives:

- To provide students with essential linear algebra foundations including vector spaces, inner products, and operators for quantum mechanical applications.
- To develop understanding of the transition from finite-dimensional systems to infinite- dimensional function spaces and Hilbert space concepts.
- To establish quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution principles.
- To enable students to apply quantum mechanical principles to solve problems in simple quantum systems.
- To introduce advanced concepts in composite systems, measurement processes, and modern perspectives in quantum mechanics.

Course Outcomes (COs):

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

CO1: Apply the principles of Vector spaces to solve mathematical problems. (L3)

CO2: Apply linear algebra concepts to function spaces and analyse the transition from finite to infinite dimensional systems. (L4)

CO3: Analyse quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution. (L4)

CO4: Apply quantum mechanical principles to solve problems in simple quantum systems and evaluate statistical interpretations. (L5)

CO5: Evaluate advanced concepts in composite systems and synthesize understanding of measurement processes and modern quantum theory. (L6)

Unit I: Linear Algebra Foundation for Quantum Mechanics:

Vector spaces definition and examples (R^2, R^3, function spaces), Inner products (dot product, orthogonality, normalization), Linear operators (matrices, eigenvalues, eigenvectors), Finite-dimensional examples (2×2 matrices, spin-1/2 systems), Dirac notation introduction ($|\psi\rangle$, $\langle\varphi|$, $\langle\varphi|\psi\rangle$), Change of basis (transformations, Unitary matrices).

Unit II: From Finite to Infinite Dimensions:

Function spaces (L^2 space, square-integrable functions), Inner products for functions ($\int\psi^*\varphi\, dx$), Orthogonal function sets (Fourier series, basis functions), Introduction to Hilbert space concept (complete inner product spaces), Position and momentum representations (wave functions), Operators on functions (d/dx, multiplication by x).

Unit III: Quantum Mechanical Formalism:

Mathematical formulation (states as vectors, observables as operators), Measurement theory (Born rule, expectation values, probabilities), Uncertainty relations (mathematical derivation from commutators), Time evolution (Schrödinger equation, Unitary evolution).

Unit IV: Applications and Statistical Interpretation:

Simple applications (infinite square well, harmonic oscillator), Statistical interpretation (ensembles, pure vs mixed states), Measurement process (von Neumann measurement scheme).

Unit V: Advanced Topics:

Composite systems (tensor products basic introduction), Reversibility and irreversibility (Unitary evolution vs measurement), Thermodynamic connections (equilibrium states, entropy), Modern perspectives (decoherence, measurement problem conceptual).

Text Books:

1. David J. Griffiths, Darrell F. Schroeter, "Introduction to Quantum Mechanics", 3rd Edition, Cambridge University Press, 2018.
2. R. Shankar, "Principles of Quantum Mechanics", 2nd Edition, Kluwer Academy/Plenum Publishers, 1994.

Reference Books:

1. George F. Simmons, "Introduction to Topology and Modern Analysis", MedTech Science Press.
2. Gilbert Strang, "Linear Algebra and Its Applications", 4th Edition, Cengage Learning, 2006.

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB306T	**OE**	**Physics of Electronic Materials and Devices** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites:

- Basic Knowledge of Semiconductor Physics and Electronic Fundamentals.
- Familiarity with Crystal Structures, Materials Properties, and Basic Device Concepts.

Course Objectives:

- To make the students understand the concept of crystal growth, defects in crystals and thin films.
- To provide insight into various semiconducting materials and their properties.
- To develop a strong foundation in semiconductor physics and device engineering.
- To elucidate excitonic and luminescent processes in solid-state materials.
- To understand the principles, technologies, and applications of modern display systems.

Course Outcomes (COs):

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

CO1: Analyze phase diagrams, crystal growth mechanisms, crystal defects, and thin film deposition techniques for the characterization of engineering materials. (L4)

CO2: Apply the principles of semiconductors to analyze charge carrier transport, carrier concentration, conductivity, mobility, and temperature-dependent semiconductor behavior. (L3)

CO3: Analyze the operating principles and characteristics of semiconductor devices such as PN junctions, heterojunctions, transistors, and MOSFETs. (L4)

CO4: Apply the principles of excitonic and luminescent processes to interpret light emission phenomena in solid-state materials and optoelectronic devices. (L3)

CO5: Analyze the working principles and applications of modern display technologies, including LCD, holographic displays, light-field displays, head-mounted displays, MOEMS, and MEMS displays. (L4)

Unit I: Fundamentals of Materials Science:

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. The basic idea of point, line, and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RF and glow discharge).

Unit II: Semiconductors:

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, change of electron-hole concentration (Qualitative analysis), Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

Unit III: Physics of Semiconductor Devices:

Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Heterojunctions, Transistors, MOSFETs.

Unit IV: Excitons and Luminescence:

Luminescence: Different types of luminescence, basic definitions, Light emission in solids, Inter-band luminescence, Direct and indirect gap materials. Photoluminescence: General Principles, Excitation and relaxation, OLED, Quantum-dot. Electroluminescence: General Principles, light emitting diode, diode laser.

Unit V: Display Devices:

LCD, three-dimensional display: Holographic display, light-field displays: Head-mounted display, MOEMS (Micro-Opto-Electro-Mechanical Systems) and MEMS displays.

Text Books:

1. Principles of Electronic Materials and Devices, S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd., 4th edition, 2021.
2. Semiconductor Physics & Devices: Basic Principles, 4th Edition, McGraw-Hill, 2012.

Reference Books:

1. Solid State Electronic Devices, B.G. Streetman and S. Banerjee, PHI Learning, 6th edition.
2. Electronic Materials Science, Eugene A. Irene, Wiley, 2005.
3. Electronic Components and Materials, Grover and Jamwal, Dhanpat Rai and Co., New Delhi, 2012.

Online Resources:

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

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB307T	OE	**Chemistry of Polymers and Applications** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Chemistry, Chemical Bonding, and Organic Compounds.
- Familiarity with Basic Material Properties and Chemical Reactions.

Course Objectives:

- To understand the basic principles of polymers.
- To understand natural polymers and their applications.
- To impart knowledge about synthetic polymers, their preparation and importance.
- To enumerate the applications of hydrogel polymers.
- To enumerate applications of conducting and degradable polymers in engineering.

Course Outcomes (COs):

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

CO1: Classify the polymers, explain polymerization mechanism, differentiate addition and condensation polymerizations, Describe measurement of molecular weight of polymer. (L2)

CO2: Describe the physical and chemical properties of natural polymers and Modified cellulosic. (L2)

CO3: Differentiate Bulk, solution, Suspension and emulsion polymerization; Describe fibers and elastomers; Identify the thermosetting and thermoplastic polymers. (L4)

CO4: Identify types of polymer networks; Describe methods involved in hydrogel preparation; Explain applications of hydrogels in drug delivery. (L3)

CO5: Explain classification and mechanism of conducting and degradable polymers. (L2)

Unit I: Polymers – Basics and Characterization:

Basic concepts: monomers, repeating Units, degree of polymerization, linear, branched and network polymers, classification of polymers. Polymerization: addition, condensation, copolymerization and coordination polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

Unit II: Natural Polymers and Modified Cellulosic:

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins. Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics – PES, PAES, PEEK, PEA.

Unit III: Synthetic Polymers:

Addition and condensation polymerization processes – Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers: Olefin polymers (PE, PVC), Butadiene polymers (BUNA-S, BUNA-N), nylons, Urea-formaldehyde, phenol-formaldehyde, Melamine, Epoxy and Ion exchange resins.

Unit IV: Hydrogels of Polymer Networks:

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

Unit V: Conducting and Degradable Polymers:

Conducting polymers: Introduction, Classification, Mechanism of conduction in Poly Acetylene, Poly Aniline, Poly Thiophene, Doping, Applications. Degradable polymers: Introduction, Classifications, Examples, Mechanism of degradation, poly lactic acid, Nylon-6, Polyesters, applications.

Text Books:

1. A Text book of Polymer Science, Billmayer.
2. Polymer Chemistry, G.S. Mishra.
3. Polymer Chemistry, Gowarikar.

Reference Books:

1. Organic Polymer Chemistry, K.J. Saunders, Chapman and Hall.
2. Advanced Organic Chemistry, B. Miller, Prentice Hall.
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

B.Tech. – III Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHS303T	OE	**Academic Writing and Public Speaking** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of English Grammar, Vocabulary, and Writing Skills.
- Familiarity with Oral Communication and Presentation Basics.

Course Objectives:

- To encourage all round development of the students by focusing on writing skills.
- To make the students aware of non-verbal skills.
- To develop analytical skills.
- To deliver effective public speeches.

Course Outcomes (COs):

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

CO1: Apply the principles and features of academic writing to compose clear, coherent, concise, and well-structured descriptive, analytical, persuasive, and critical texts. (L3)

CO2: Develop academic and professional documents such as abstracts, project proposals, internship applications, technical papers, and journal articles by applying appropriate writing, editing, proofreading, and ethical citation practices. (L3)

CO3: Analyze and construct different forms of academic writing such as argumentative essays, exploratory essays, book reviews, film reviews, summaries, and statements of purpose. (L4)

CO4: Demonstrate effective public speaking skills by applying presentation strategies, stage dynamics, audience engagement techniques, and response strategies in academic contexts. (L3)

CO5: Evaluate and employ verbal and non-verbal communication elements such as body language, facial expressions, kinesics, oculesics, proxemics, haptics, chronemics, and paralanguage to enhance the effectiveness of public speaking. (L5)

Unit I: Introduction to Academic Writing:

Introduction to Academic Writing – Essential Features of Academic Writing – Courtesy – Clarity – Conciseness – Correctness – Coherence – Completeness – Types: Descriptive, Analytical, Persuasive, Critical writing.

Unit II: Academic Journal Article:

Art of condensation – summarizing and paraphrasing – Abstract Writing, writing Project Proposal, writing application for internship, Technical/Research/Journal Paper Writing – Conference Paper writing – Editing, Proof Reading – Plagiarism.

Unit III: Essay and Writing Reviews:

Compare and Contrast – Argumentative Essay – Exploratory Essay – Features and Analysis of Sample Essays – Writing Book Report, Summarizing, Book/film Review – Statement of Purpose (SoP).

Unit IV: Public Speaking:

Introduction, Nature, characteristics, significance of Public Speaking – Presentation – 4 Ps of Presentation – Stage Dynamics – Answering Strategies – Analysis of Impactful Speeches – Speeches for Academic events.

Unit V: Public Speaking and Non-Verbal Delivery:

Body Language – Facial Expressions – Kinesics – Oculesics – Proxemics – Haptics – Chronomics – Paralanguage – Signs.

Text Books:

1. Critical Thinking, Academic Writing and Presentation Skills: MG University Edition, Pearson Education, 2010.
2. Pease, Allan & Barbara, "The Definitive Book of Body Language", RHUS Publishers, 2016.

Reference Books:

1. Alice Savage, Masoud Shafiei, "Effective Academic Writing", 2nd Ed., 2014, Oxford University Press.
2. Shalini Verma, "Body Language", S. Chand Publications, 2011.
3. Sanjay Kumar and Pushpalata, "Communication Skills", 2nd Ed., 2015, Oxford.

Online Resources:

- https://onlinecourses.nptel.ac.in/noc21_hs76/preview
- https://archive.nptel.ac.in/courses/109/107/109107172/

B. Tech. – IV Year
I Semester

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC30406T	PC	**Generative AI** (Common to AI&DS and CSE- AI&ML)	2	1	0	3

Pre-Requisites: Understanding of Neural Networks (basics of Deep Learning)

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: Analyze ethical 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, laude), 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, Explain ability and transparency in generative AI, Copyright and originality issues, Adversarial use of generative models – deep fakes, 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.Teching 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

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: Understanding of Neural Networks (basics of Deep Learning)

Course Objectives:

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, Student 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)

Module 1: 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.

Module 2: Types of Prompts and Their Applications:

- Lesson 2: Closed-Ended Prompts
    - Understanding 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.

Module 3: 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.

Module 4: 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.

Module 5: 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.

Module 6: 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 :

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 to all branches of Engineering)	2	0	0	-

Pre-Requisites: Basics of Human Values, Ethics, Communication Skills, and Social Awareness.

Course Objectives:

- To enable students to understand the gender related issues, vulnerability of women and men
- To familiarize them about constitutional safeguard for gender equality
- To expose the students to debates on the politics and economics of work
- To help students reflect critically on gender violence
- To make them understand that gender identities and gender relations are part of culture as they
- shape the way daily life is lived in the family as well as wider community and the workplace.

Course Outcomes (COs):

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

CO1: Apply fundamental concepts and terminology related to gender to examine attitudes, socialization processes, and the construction of gender roles in society. (L3)

CO2: Analyze gender roles, relationships, discrimination, and demographic issues to interpret their impact on individuals and society. (L4)

CO3: Analyze issues related to gender and labour, including unpaid work, unrecognized labour, work distribution, and gender mainstreaming in the context of sustainable development and human rights. (L4)

CO4: Evaluate the causes, forms, and consequences of gender-based violence from human rights and social perspectives. (L5)

CO5: Analyze the representation of gender in films, electronic media, advertisements, popular literature, and cultural practices to promote gender-sensitive perspectives and just relationships. (L4)

Unit I: Understanding Gender:

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male. First lessons in Caste.

Unit II : Gender Roles and Relations:

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and its Consequences-Declining Sex Ratio- Demographic Consequences-Gender Spectrum.

Unit III: Gender and Labour :

Division and Valuation of Labour-Housework: The Invisible Labour "My Mother doesn't Work". "Share the Load " Work: Its Politics and Economics -Fact and Fiction- Unrecognized and Unaccounted work -Gender Development Issues-Gender, Governance and Sustainable Development Gender and Human Rights-Gender and Mainstreaming.

Unit IV: Gender-Based Violence:

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment - Domestic Violence - Different forms of violence against women - Causes of violence, impact of violence against women - Consequences of gender-based violence.

Unit V: Gender and Culture:

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues- Gender Sensitive Language- Just Relationships

Text Books:

1. A.Suneetha, Uma Bhrugubanda, et al. Towards a World of Equals: A Bilingual Textbook on Gender, Telugu Akademi, Telangana, 2015.
2. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity. UK Paperback Edn. March 1990

Reference Books :

1. Wtatt, Robin and Massood, Nazia, Broken Mirrors: The dowry Problems in India, London :Sage Publications, 2011
2. Datt, R. and Kornberg, J.(eds), Women in Developing Countries, Assessing Strategies for 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. Understanding Gender
   Chrome extension://kdpelmjpfafjppnhbloffcjpeomlnpah/https://www.arvindguptatoys.com/arvindgupta/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-girls
   https://onlinecourses.swayam2.ac.in/nou25_ge38/preview

5. Gender and Culture
   https://gender.study/psychology-of-gender/culture-impact-gender-roles-identities/
   https://sociology.iresearchnet.com/sociology-of-culture/gender-and-culture/
   https://archive.nptel.ac.in/courses/109/106/109106136/

Management Elective - II (HM - II)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24HMHS410T	PC	**Business Ethics and Corporate Governance** (Common to all branches of Engineering)	2	0	0	2

Pre-Requisites: Basic understanding of management principles and organizational behavior.

Course Objectives:

- To understand the fundamental principles of business ethics.
- To gain knowledge of ethical practices in management.
- To understand the role of individuals in corporate culture.
- To learn about fair-trade practices and ethical standards.
- To understand the concepts and importance of 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	PC	**E-Business** (Common to all branches of Engineering)	2	0	0	2

Pre-Requisites: Fundamental Requirements for E-Business Implementation.

Course Objectives:

- To provide knowledge on emerging concept on E-Business related aspect.
- To understand various electronic markets & business models.
- To impart the information about electronic payment systems & banking.
- To create awareness on security risks and challenges in E-commerce.
- To the students aware on different e-marketing channels & strategies.

Course Outcomes (COs):

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

CO1: Apply concepts of e-business, e-commerce functions, internet services, and online shopping to identify business opportunities and advantages. (L3)

CO2: Analyze and evaluate electronic market types, business models (B2B, B2C, B2G), portals, and auction systems for strategic business decisions. (L5)

CO3: Apply various electronic payment methods (cards, UPI, wallets, crypto) and evaluate infrastructure and regulatory requirements for business transactions. (L4)

CO4: Analyze and evaluate e-commerce security risks, cyber threats, and protection mechanisms including firewalls, SSL/TLS, and digital signatures. (L4)

CO5: Evaluate online marketing strategies, digital advertising, social media, eCRM, and e-supply chain management to improve business performance. (L5)

Unit I: Electronic Business:

Introduction – Nature, meaning, significance, functions and advantages - Definition of Electronic Business - Functions of Electronic Commerce (EC)-Advantages & Disadvantages of E-Commerce – E-Commerce and E-Business, Internet Services, Online Shopping- E-Commerce Opportunities for Industries.

Unit II: Electronic Markets and Business Models:

Introduction –E-Shops-E-Malls E-Groceries - Portals - Vertical Portals-Horizontal Portals - Advantages of Portals -Business Models- Business to Business (B2B)-Business to Customers(B2C) - Business to Government(B2G)-Auctions-B2B Portals in India.

Unit III: Electronic Payment Systems:

Introduction to electronic payment systems (EPS) -Types of electronic payments - Credit/debit cards, e-wallets, UPI, and crypto currencies -Smart cards and digital wallets: Features and usage -Electronic Fund Transfer (EFT): Role in business transactions -Infrastructure requirements and regulatory aspects of e-payments.

Unit IV: E-Security:

Security risks and challenges in electronic commerce - Cyber threats - Phishing, hacking, identity theft, and malware - Digital Signatures & Certificates - Security protocols over public networks (HTTP, SSL, TLS) -Firewalls in securing e-business platforms.

Unit V: E-Marketing:

Introduction – Online Marketing – Advantages of Online Marketing – Internet Advertisement – Advertisement Methods – Conducting Online Market Research– – E-marketing planning: Online branding, social media marketing, role of AI&ML in e-Marketing and email marketing - E-business strategies: Digital advertising, content marketing, and analytics – E-Customer Relationship Management (eCRM) E-supply chain management (e-SCM).

Text Books:

1. Arati Oturkar&Sunil Khilari. E-Business. Everest Publishing House, 2022
2. P.T.S Joseph. E-Commerce, Fourth Edition, Prentice Hall of India, 2011

Reference Books:

1. Debjani, Kamalesh K Bajaj. E-Commerce, Second Edition Tata McGraw-Hill‘s, 2005
2. Dave Chaffey.E-Commerce E-Management, Second Edition, Pearson, 2012.
3. Henry Chan. E-Commerce Fundamentals and Application, Raymond Leatham Wiley India 2007
4. S. Jaiswal. E-Commerce Galgotia Publication Pvt Ltd., 2003.

Online Resources:

1. https://www.slideshare.net/fatimahAlkreem/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	**PC**	**Management Science** (Common to all branches of Engineering)	**2**	**0**	**0**	**2**

Pre-Requisites: Fundamentals of Management Science

Course Objectives:

- To provide fundamental knowledge on Management, Administration, Organization & its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts
- To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
- To make the students aware of the contemporary issues in modern management

Course Outcomes (COs):

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

CO1: Analyze management principles, classical theories, and organizational structures to interpret their role in organizational effectiveness. (L4)

CO2: Apply production methods, inventory techniques (EOQ, ABC), and marketing strategies in solving operational and business problems. (L3)

CO3: Analyze HRM functions such as recruitment, training, and performance appraisal to improve workforce effectiveness. (L4)

CO4: Evaluate strategic alternatives and project management techniques (PERT, CPM) for effective decision-making and project execution. (L5)

CO5: Evaluate modern management tools like MIS, ERP, CRM, and SCM in enhancing organizational performance and competitiveness. (L5)

Unit I: Introduction to Management:

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor‘s Scientific Theory-Henry Fayol‘s principles - Elton Mayo‘s Human relations - Organizational Designs - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

Unit II: Operations Management:

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control- Material Management - Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Marketing Management - Concept - Meaning - Nature-Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

Unit III: Human Resources Management (HRM):

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process - Employee Training and Development - methods - Performance Appraisal

Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

Unit IV: Strategic & Project Management:

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

Unit V: Contemporary issues in Management:

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

Text Books:

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

Reference Books:

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

Online Resources:

1. https://www.slideshare.net/slideshow/introduction-to-management-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
24PE30408T	PE	Edge AI	3	0	0	3

Pre-Requisites: Basics of Artificial Intelligence & Machine Learning.

Course Objectives:

- To introduce fundamental concepts and mathematical foundations of machine learning algorithms.
- To analyze and implement supervised, unsupervised, and reinforcement learning techniques.
- To explore real-time applications in healthcare, finance, security, and recommendation systems.
- To evaluate the performance of models using suitable metrics and tools.
- To familiarize students with practical use of machine learning libraries and frameworks.

Course Outcomes (COs):

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

CO1: Apply and differentiate various Machine Learning paradigms. (L3)

CO2: Apply core machine learning algorithms to solve classification, regression, and clustering problems. (L3)

CO3: Analyze and improve model performance using statistical and algorithmic metrics. (L4)

CO4: Evaluate real-time Machine Learning solutions using Python and relevant libraries. (L5)

CO5: Analyze and implement machine learning solutions in applications such as NLP, healthcare, and recommendation systems. (L4)

Unit I: Introduction to Machine Learning & Data Preprocessing:

Definition and types of Machine Learning (Supervised, Unsupervised, Reinforcement) – (R),Key Elements of ML: Features, Labels, Training and Testing – (U), Data Preprocessing: Cleaning, Normalization, Feature Scaling – (U), Handling Missing Data and Outliers – (U), Feature Engineering and Dimensionality Reduction (PCA, LDA) – (U), ML Pipeline and Workflow in Real-World Projects

Unit II: Supervised Learning Algorithms:

Linear Regression: Simple & Multiple – (A), Logistic Regression: Binary & Multiclass Classification – (A), Decision Trees and Random Forests – (A), Support Vector Machines (SVM) – (A), k-Nearest Neighbors (k-NN) – (A), Model Evaluation Metrics: Accuracy, Precision, Recall, F1 Score – (U)

Unit III: Unsupervised and Semi-Supervised Learning:

Clustering: k-Means, Hierarchical, DBSCAN – (A), Association Rule Learning: Apriori and FP Growth – (A), Gaussian Mixture Models and EM Algorithm – (A), Dimensionality Reduction Techniques: t-SNE, PCA – (AN), Semi-Supervised Learning: Self-Training, Co-Training – (AN), Anomaly and Outlier Detection – (AN)

Unit IV: Advanced Machine Learning & Optimization

Ensemble Learning: Bagging, Boosting, stacking – (A), Gradient Boosting, AdaBoost, XGBoost, Light GBM – (A), Model Selection and Hyperparameter Tuning (Grid/Random Search, Cross validation) – (E), Bias-Variance Trade-off and Regularization (L1, L2) – (AN), Bayesian Learning and Naive Bayes Classifier – (A), Handling Imbalanced Data and Sampling Techniques – (E)

Unit V: Applications of Machine Learning:

Machine Learning in Healthcare (Disease Prediction, Diagnostics) – (A), Financial Fraud Detection and Credit Scoring – (A), Recommender Systems (Collaborative & Content-Based Filtering) – (AN), Natural Language Processing (Text Classification, Sentiment Analysis) – (AN), Image Classification and Object Detection – (A), Building and Deploying ML Models using Flask/Streamlit – (C)

Text Books:

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

Reference Books:

1. Peter Flach, Machine Learning: The Art and Science of Algorithms, Cambridge University Press.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.
3. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning, Cambridge University Press.
4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer

Online Resources:

1. Coursera – Machine Learning by Andrew Ng (Stanford)
2. edX – Machine Learning with Python by IBM
3. Google AI – Machine Learning Crash Course
4. Kaggle – Learn Machine Learning

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30409T	PE	Human Computer Interaction	3	0	0	3

Pre -Requisites: Basics of Computer Fundamentals, User Interface Design, Psychology, and Communication Skills.

Course Objectives:

- To understand the fundamentals of Human-Computer Interaction.
- To design user-centric interfaces and systems with usability and accessibility in mind.
- To explore cognitive models and interaction design processes.
- To develop knowledge in evaluation techniques and prototyping.
- To introduce the latest advancements in HCI including AR/VR, gesture, and voice-based interfaces.

Course Outcomes (COs):

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

CO1: Apply the principles of Human-Computer Interaction, human perception, cognition, memory, interaction styles, and design principles for effective interface development.(L3)

CO2: Apply user-Centered design techniques including requirement gathering, task analysis, personas, and prototyping to design user-friendly interfaces. (L3)

CO3: Analyze usability and user experience using evaluation techniques such as heuristic evaluation, cognitive walkthroughs, and usability metrics. (L4)

CO4: Develop interactive user interfaces and prototypes using modern tools and technologies such as Figma, Adobe XD, and web technologies. (L3)

CO5: Analyze advanced interaction paradigms and inclusive, ethical, and intelligent interfaces with respect to accessibility, privacy, and emerging trends. (L4)

Unit I: Introduction to HCI & Human Factors:

Introduction to HCI: History, Importance, and Applications – (U), Human Factors: Perception, Cognition, and Memory – (U), Models of Human Behavior: Norman‘s Model, Fitts‘ Law – (U), Ergonomics and Accessibility in Design – (U), Visual, Auditory, and Haptic Modalities – (U), Interaction Styles: Command-line, WIMP, Direct Manipulation – (R), Principles of Good Design: Consistency, Feedback, Affordance – (U), Case Study: Bad vs Good Interface Design – (U).

Unit II: Design Process and User-Centered Design:

Design Thinking and User-Centered Design – (U), Requirement Gathering: Task Analysis, Personas, Scenarios – (A), Information Architecture: Navigation and Flow – (A), Interface Design Guidelines (Shneiderman, Nielsen) – (U), Storyboarding and Wireframing – (A), Low-Fidelity vs High-Fidelity Prototyping – (A), Interaction Design Patterns – (A), Case Study: Designing an ATM Interface (AN).

Unit III: Evaluation Techniques and Usability Testing:

Types of Evaluation: Formative vs Summative – (U), Usability Metrics: Learnability, Efficiency, Memorability – (A), Cognitive Walkthrough and Heuristic Evaluation – (A), A/B Testing and Controlled Experiments – (A), Eye Tracking and Think-Aloud Protocols – (A), User Feedback: Surveys and Interviews – (A), Quantitative and Qualitative Data Analysis – (AN), Case Study: Usability Analysis of a Mobile App – (E).

Unit IV: Interface Technologies and Prototyping Tools:

Graphical User Interfaces (GUI) and Web Interfaces – (U), Mobile and Touch Interfaces – (U), Voice Based Interfaces (VUI) and Chatbots – (A), Gesture-Based Interaction and Wearables – (U), Augmented and Virtual Reality Interfaces – (A), Rapid Prototyping Tools: Figma, Adobe XD, Axure – (A), HTML/CSS/JS for UI Prototyping – (A), Case Study: Building a Prototype for a Fitness App.

Unit V: Advanced Topics in HCI and Future Trends:

Brain-Computer Interfaces (BCI) – (U), Multimodal Interaction: Combining Voice, Gesture, Gaze – (U), Intelligent Interfaces using AI – (U), Emotion Recognition and Affective Computing – (U), Ethics in HCI: Privacy, Bias, and Design for Inclusion – (E), Accessibility Standards: WCAG, ADA – (A), Gamification and Persuasive Design – (AN), Capstone Project: Designing an Inclusive Learning App – (C).

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, ―Human-Computer Interaction‖, Pearson Education, 4th Edition.
2. Ben Shneiderman et al., ―Designing the User Interface: Strategies for Effective Human Computer Interaction‖, Pearson.
3. Donald A. Norman, ―The Design of Everyday Things‖, Basic Books.

Reference Books:

1. Jenny Preece, Yvonne Rogers, Helen Sharp, ―Interaction Design: Beyond Human-Computer Interaction‖, Wiley.
2. Jeff Johnson, ―Designing with the Mind in Mind‖, Morgan Kaufmann.
3. Steven Krug, ―Don‘t Make Me Think‖, New Riders.

Online Resources:

- Coursera: Human-Centered Design by UC San Diego (https://www.coursera.org/learn/human computer-interaction)
- edX: HCI by Georgia Tech (https://www.edx.org/course/human-computer-interaction)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30410T	PE	Machine Learning Operations	3	0	0	3

Pre -Requisites: Basics of Machine Learning, Python Programming, Cloud Computing, and Software Development Practices.

Course Objectives:

- To introduce MLOps practices for streamlining the ML lifecycle.
- To understand versioning, reproducibility, automation, and deployment in ML.
- To provide knowledge of CI/CD pipelines in machine learning workflows.
- To integrate monitoring, governance, and retraining mechanisms in production ML systems.
- To explore MLOps platforms and tools like MLflow, Kubeflow, and TFX.

Course Outcomes (COs):

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

CO1: Analyze end-to-end Machine Learning lifecycle from experimentation to deployment. (L4)
CO2: Apply DevOps practices in the design and implementation of ML systems. (L3)
CO3: Utilize tools for tracking, testing, and automating ML workflows. (L3)
CO4: Evaluate and monitor scalable ML systems in cloud or hybrid environments. (L5)
CO5: Evaluate and implement robust and reproducible MLOps pipelines using industry-standard tools. (L5)

Unit I: Introduction to MLOps and ML Lifecycle:

Introduction to MLOps: Principles and Need , Differences between DevOps and MLOps , ML Lifecycle: Data, Model, Code, Deployment , Roles and Responsibilities in MLOps Teams – (R), Experiment Tracking and Management , Data and Model Versioning , Reproducibility and Reusability , Case Study: MLOps in a Real-World Project

Unit II: Data Engineering for MLOps:

Data Ingestion Pipelines and Orchestration ,Data Validation and Profiling ,Feature Engineering and Feature Stores ,Handling Data Drift and Concept Drift ,Batch vs Streaming Data Processing ,DataOps for MLOps: Tools and Techniques ,Tools: Apache Airflow, TFX Data Validation ,Case Study: Building a Scalable Data Pipeline.

Unit III: Model Training, Tracking, and Versioning :

Automated ML Training Pipelines , Model Tracking with MLflow, Weights & Biases , Model Version Control and Registry , Hyperparameter Tuning Automation , Training on Cloud Platforms (GCP, AWS, Azure ML) , Performance Metrics and Evaluation , Reproducibility Using Docker & Conda Environments , Case Study: Hyperparameter Tuning Pipeline.

Unit IV: CI/CD in Machine Learning :

CI/CD Concepts and Pipelines for ML , Infrastructure as Code: Terraform, YAML , ML Testing: Data, Model, Pipeline, Integration , Model Validation and Bias Testing , Continuous Training and Automated Retraining , Tools: Jenkins, GitHub Actions, Kubeflow Pipelines , Containerization with Docker and Orchestration with Kubernetes , Case Study: Implementing End-to-End CI/CD for ML.

Unit V: Model Deployment, Monitoring, and Governance:

Deployment Strategies: A/B Testing, Blue-Green , Model Serving: REST APIs, gRPC, TensorFlow Serving , Monitoring Models in Production: Accuracy, Drift , Logging, Alerts, and Rollbacks , Model Governance, explain ability and Fairness , Privacy and Security in ML Systems , Case Study: ML Monitoring using Prometheus and Grafana – (C), Capstone: Building an End-to-End MLOps Pipeline (C).

Text Books:

1. Mark Treveil, Alok Shukla – Introducing MLOps: How to Scale Machine Learning Projects with Continuous Delivery, Monitoring, and Governance‖, O'Reilly.
2. Emmanuel Raj – Machine Learning Engineering with MLOps‖, Packt Publishing.
3. Carl Osipov – MLOps Engineering at Scale‖, Wiley.

Reference Books:

1. Chip Huyen – Designing Machine Learning Systems‖, O'Reilly.
2. Andrew Ng – Machine Learning B.Techning‖ (Online Resource).
3. Chris Fregly & Antje Barth – Data Science on AWS‖, O'Reilly.

Online Resources:

- Coursera: MLOps Specialization by DeepLearning.AI – https://www.coursera.org/specializations/mlops
- Google Cloud MLOps Resources – https://cloud.google.com/architecture/mlops-continuous delivery-and-automation-pipelines-in-machine-learning
- AWS Machine Learning Ops Workshop – https://catalog.us-east 1.prod.workshops.aws/workshops/

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30411T	PE	No SQL Databases	3	0	0	3

Pre -Requisites: Basics of Database Management Systems, Data Modeling, and Computer Networks.

Course Objectives:

- To introduce the fundamental concepts and characteristics of Big Data.
- To equip students with knowledge of Hadoop, Spark, and distributed computing systems.
- To develop the ability to process, store, and analyze Big Data using modern tools.
- To implement various big data analytics techniques on real-world data.
- To apply big data tools and frameworks in domains such as finance, health, and e-commerce.

Course Outcomes (COs):

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

CO1: Analyze the concepts of Big Data, Hadoop architecture, HDFS, and ecosystem components to address data storage and processing challenges. (L4)

CO2: Analyze and implement MapReduce programming concepts and Hadoop ecosystem tools such as Hive, Pig, Sqoop, and Flume for efficient big data processing and management. (L4)

CO3: Analyze NoSQL database concepts and implement HBase data models and operations for efficient storage and management of large-scale data. (L4)

CO4: Analyze and implement Apache Spark components and analytics techniques, including RDDs, Spark SQL, streaming, and MLlib, for real-time big data processing and optimization. (L4)

CO5: Analyze and design big data solutions for real-world applications across domains, integrating cloud platforms while addressing data privacy, security, and ethical considerations. (L4)

Unit I: Introduction to Big Data and Hadoop Ecosystem:

Definition, Characteristics of Big Data (Volume, Variety, Velocity, Veracity, Value), Types of Data: Structured, Semi-Structured, and Unstructured, Traditional vs Big Data Systems, Big Data Challenges and Benefits, Introduction to Hadoop: Architecture and Components, Hadoop Distributed File System (HDFS): Features, Design, Blocks, YARN and MapReduce Overview, Hadoop Ecosystem Components: Pig, Hive, HBase, Sqoop, Flume.

Unit II: MapReduce Programming and Hadoop Tools:

MapReduce Programming Model: Mapper, Reducer, Partitioner, InputSplit and RecordReader, Combiner, Writing MapReduce Programs in Java, Advanced MapReduce Concepts: Counters, Joins, Secondary Sort, Hive: Data Warehousing Concepts, HiveQL, Partitions, Buckets, Pig: Data Flow, Pig Latin Scripts, Data Import & Export with Sqoop, Real-Time Data Collection using Flume.

Unit III: NoSQL Databases and HBase:

Introduction to NoSQL Databases, Types of NoSQL: Key-Value, Document, Column, Graph, Differences between RDBMS and NoSQL, HBase Data Model: Column Families, Regions, Tables, HBase Architecture and Internals, HBase CRUD Operations using Java, Integration of HBase with Hadoop, Case Study: Big Data Storage in Social Media.

Unit IV: Apache Spark and Big Data Analytics:

Apache Spark: RDDs and DAG Execution Model, Spark Core and Spark SQL, DataFrames and Datasets in Spark, Spark Streaming: Architecture and DStreams, Spark MLlib: Machine Learning on Big Data, GraphX: Graph Processing in Spark, Performance Tuning and Optimization in Spark, Case

Study: Building a Spark Application for Real-Time Analytics.

Unit V: Applications and Case Studies in Big Data:
Big Data in Healthcare: Predictive Analysis, Genomics, Big Data in Finance: Fraud Detection, Risk Analytics, Big Data in E-Commerce: Customer Behavior, Personalization, Sentiment Analysis using Big Data, Big Data for Smart Cities and IoT, Big Data and Cloud Computing Integration (AWS, GCP, Azure), Data Privacy, Security, and Ethical Issues – (E), Mini-Project: Design and Development of a Big Data Solution.

Text Books:
1. Tom White, Hadoop: The Definitive Guide , O'Reilly Media.
2. V. Srinivasa Subramanian, Big Data Analytics, Wiley India.
3. Anand Rajaraman and Jeffrey D. Ullman, Mining of Massive Datasets, Cambridge University Press.

Reference Books:
1. Chuck Lam, Hadoop in Action, Manning Publications.
2. Bill Franks, Taming the Big Data Tidal Wave, Wiley.
3. Alex Holmes, Hadoop in Practice , Manning Publications.
4. Michael Minelli, Big Data, Big Analytics: Emerging Business Intelligence , Wiley.

Online Resources:
1. Coursera – Big Data Specialization by UC San Diego
2. edX – Big Data Analysis with Apache Spark (UC Berkeley)
3. Udacity – Data Engineering Nanodegree

Professional Elective –V (PE - V)

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: Basics of Data Analysis, Statistics, Python Programming, and Database Concepts.

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, Student 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, Beautiful Soup, Working with Databases using SQL Alchemy 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.

Text Books:

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:

- Data Wrangling with pandas (Datacamp): https://www.datacamp.com/courses/data manipulation-with-pandas
- Coursera: Data Wrangling, Analysis and AB Testing with SQL – https://www.coursera.org/learn/data-wrangling-analysis-abtesting
- edX: Data Wrangling with R – https://online.rice.edu/courses/data-wrangling-r
- Real Python Tutorials on pandas: https://realpython.com/learning-paths/pandas/
- Kaggle Notebooks (Data Cleaning & Wrangling): https://www.kaggle.com/learn/pandas

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30413T	PE	Drone Technology	3	0	0	3

Pre -Requisites: Basics of Electronics, Embedded Systems, Physics, and Programming Concepts.

Course Objectives:

- Introduce the fundamentals of Unmanned Aerial Vehicles (UAVs), their classification, and working principles.
- Explain the components, aerodynamics, and propulsion systems essential for drone flight and control.
- Develop skills in drone programming, control systems, and communication protocols. Explore applications of drones across industries, such as agriculture, defense, surveillance, logistics, and mapping.
- Educate learners on regulatory, safety, and ethical concerns related to the use of drone technologies.

Course Outcomes (COs):

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

CO1: Apply the types, components, and functioning of drones and UAV systems. (L3)

CO2: Analyze and evaluate flight dynamics, control systems, and navigation technologies used in drones. (L4)

CO3: Apply programming, assembly, and testing techniques for drones using open-source and commercial platforms. (L3)

CO4: Apply drone technology to solve real-world problems in agriculture, disaster management, defense, and delivery systems. (L3)

CO5: Explain and apply regulations related to drone policies, airspace restrictions, and privacy/security guidelines. (L3)

Unit I: Introduction to Drone Systems:

History and evolution of UAVs, Classification of drones – fixed wing, rotary wing, hybrid, Key components of a drone – frame, ESC, flight controller, GPS, camera, etc., Introduction to drone subsystems – propulsion, navigation, payload, Basic flight physics and principles of lift, thrust, drag, UAV vs. traditional aircraft systems, Overview of global drone market and applications, Introduction to drone platforms (DJI, Ardupilot, PX4).

Unit II: Drone Hardware and Aerodynamics:

Airframe types and material selection, Brushless motors and electronic speed controllers (ESC), Propeller dynamics and thrust calculations, Battery technologies – Li-Po, Li-ion: specifications and management, Sensors – IMU, gyroscope, magnetometer, barometer, GPS and real-time positioning systems, Flight control boards – Ardupilot, Pixhawk, Naza, Aerodynamic challenges in drone flight and tuning PID parameters.

Unit III: Drone Communication and Control System:

Remote control and ground station basics, Telemetry and radio communication protocols (LoRa, WiFi, RF, LTE), First Person View (FPV) systems – components and latency issues, Drone programming and mission planning using Mission Planner, QGroundControl, Fail-safe, return-to home, and geo-fencing functionalities, Integration of autopilot systems, Indoor and outdoor localization techniques, Introduction to swarm drone communication.

Unit IV: Drone Applications and Emerging Use Cases:

Drones in precision agriculture – spraying, mapping, crop monitoring, Disaster management and rescue operations, Aerial surveillance and security, Environmental monitoring and wildlife conservation, Logistics and delivery drones – case studies (Amazon, Zipline), Construction and infrastructure inspections, Cinematography and media production, AI integration in drones – object detection, tracking, anomaly alerts.

Unit V: Safety, Regulations, and Future Trends:

DGCA guidelines and certification requirements, International drone policies (FAA, EASA), UAV flight permissions and NPNT (No Permission, No Takeoff) protocol, Safety procedures and risk mitigation, Drone cybersecurity and data protection, Ethical concerns – surveillance, privacy, military applications, Future of drone technology – nano drones, delivery drones, flying taxis, Career opportunities and entrepreneurship in drone industry.

Text Books

1. Unmanned Aircraft Systems: UAVS Design, Development and Deployment by Reg Austin, Wiley
2. Introduction to UAV Systems by Paul G. Fahlstrom and Thomas J. Gleason
3. Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs by John Baichtal

Reference Books

1. Small Unmanned Aircraft: Theory and Practice by Randal W. Beard and Timothy W. McLain
2. Drones (The MIT Press Essential Knowledge series)by Andy Miah
3. FPV Flight Dynamics by Christian Mollica
4. DGCA Drone Training Manual (India) – Latest Version

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30414T	PE	Robotics	3	0	0	3

Pre -Requisites: Basics of Programming, Electronics, Mechanics, and Control Systems.

Course Objectives:

- To introduce the fundamentals of robotics and its components.
- To understand the kinematics, dynamics, and control of robotic systems.
- To study various sensors, actuators, and robotic perception systems.
- To explore applications of AI in robotics, including motion planning and machine learning.
- To analyze real-world applications and ethical issues in robotics.

Course Outcomes (COs):

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

CO1: Apply the structure and functions of robotic systems. (L3)

CO2: Analyze robotic movements using kinematics and dynamics. (L4)

CO3: Analyze motion planning and control algorithms for robotic systems. (L4)

CO4: Apply AI and machine learning techniques in robotic tasks. (L3)

CO5: Analyze the application of robotics in real-world domains and evaluate associated ethical implications. (L4)

Unit I: Introduction to Robotics :

Definition, classification, and types of robots – (U), Components of a robotic system – (U), History and evolution of robotics – (U), Sensors, actuators, controllers – (U), Degrees of freedom and configurations – (U), Power sources and drive systems – (A), End effectors and robotic grippers – (U), Introduction to ROS (Robot Operating System) – (A).

Unit II: Kinematics and Dynamics of Robots:

Coordinate frames and transformations – (A), Forward kinematics for robotic manipulators – (A), Inverse kinematics and solutions – (A), Jacobian matrix and velocity kinematics – (AN), Dynamics of manipulators using Lagrangian and Newton-Euler – (AN), Redundant robots and singularities – (E), Trajectory planning: Linear, polynomial, and spline paths – (A), Introduction to simulation tools (Gazebo, V-REP) – (A).

Unit III: Sensors, Perception and Localization :

Types of sensors: IR, ultrasonic, LIDAR, vision – (U), Sensor fusion and integration – (A), Robotic vision: Cameras, image formation, and filtering – (A), Object recognition and feature extraction – (AN), Mapping: Grid-based, topological, and semantic – (AN), SLAM (Simultaneous Localization and Mapping) – (AN), Localization algorithms: Kalman filter, particle filter – (A), Obstacle detection and avoidance – (A)

Unit IV: Robotic Motion Planning and Control:

Path planning algorithms: Dijkstra, A*, RRT – (A), Motion control: PID, adaptive and robust control – (A), Inverse dynamics and computed torque control – (AN), Trajectory tracking and motion stabilization – (A), Motion planning for mobile and humanoid robots – (AN), Collision detection and avoidance techniques – (A), Human-robot interaction and teleoperation – (A), Case study: Designing motion plan for an autonomous robot – (C)

Unit V: AI and Applications in Robotics:

Integration of AI in robotics – (AN), Machine learning for perception and control – (E), Reinforcement learning for robotic agents – (E), Deep learning in visual perception and grasping – (E), Applications in industrial, medical, military, and service robots – (AN), Ethical considerations and safety standards – (E), Autonomous navigation and decision-making – (C), Capstone task: Proposing a robotic system for a societal problem – (C).

Text Books:

1. John J. Craig – Introduction to Robotics: Mechanics and Control
2. Saeed B. Niku – Introduction to Robotics: Analysis, Control, Applications
3. Mikell P. Groover – Industrial Robotics: Technology, Programming, and Applications

Reference Books:

1. Roland Siegwart, Illah Nourbakhsh, Davide Scaramuzza – Introduction to Autonomous Mobile Robots
2. Peter Corke – Robotics, Vision and Control
3. Richard D. Klafter – Robotic Engineering: An Integrated Approach

Online Courses:

- Coursera – Modern Robotics: Mechanics, Planning, and Control (Northwestern University)
https://www.coursera.org/specializations/modernrobotics
- edX – Robotics MicroMasters (Columbia University)
https://www.edx.org/micromasters/columbiax-robotics
- Udacity – Robotics Software Engineer Nanodegree
https://www.udacity.com/course/robotics-software-engineer--nd209
- MIT OpenCourseWare – Robotics: Science and Systems
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-141-robotic science-and-systems-i-fall-2020/

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE30415T	PE	Mining Massive Data Sets	3	0	0	3

Pre-Requisites: Basics of Data Structures, Database Systems, Statistics, and Machine Learning Concepts.

Course Objectives:

- Introduce fundamental concepts and scalable algorithms used in mining massive datasets.
- Enable understanding of key techniques like clustering, classification, frequent itemset mining, and graph analysis on large-scale data.
- Familiarize students with distributed computing frameworks such as Hadoop and Spark.
- Provide practical insights into web and social network mining.
- Equip students with the ability to analyze massive datasets using real-world tools and platforms.

Course Outcomes (COs):

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

CO1: Apply the challenges involved in mining large-scale datasets. (L3)

CO2: Apply efficient algorithms for clustering, classification, and association rule mining in big data environments. (L3)

CO3: Analyze and implement scalable solutions using frameworks such as MapReduce, Hadoop, and Spark. (L4)

CO4: Apply data mining techniques to solve real-world problems involving link analysis, recommendation systems, and web/social data mining. (L3)

CO5: Evaluate algorithms based on scalability, efficiency, and effectiveness in large datasets. (L5)

Unit I : Introduction to Massive Data and MapReduce Model:

Types of Massive Data – Structured, Unstructured, and Semi-Structured, Challenges of Mining Massive Data Sets, Storage Systems – Distributed File Systems, HDFS, Introduction to MapReduce Programming Model, Designing MapReduce Algorithms, Matrix-Vector Multiplication by MapReduce, Workflow Management in Hadoop, Limitations of MapReduce.

Unit II: Frequent Itemset and Association Rule Mining:

Market Basket Model, A-Priori Algorithm – Scalable Variants, Handling Large Datasets in Frequent Pattern Mining, Park-Chen-Yu Algorithm, SON Algorithm, Multistage and Multihash Algorithms, PCY Algorithm and its Enhancements, Association Rules – Concepts and Evaluation, Finding Frequent Itemsets in Streaming Data.

Unit III: Clustering and Classification Techniques:

Hierarchical and Partitional Clustering, K-Means Clustering and its Scalability, BFR and CURE Clustering Algorithms, Decision Trees and Rule-Based Classification, Naïve Bayes Classifier for Large Datasets, Logistic Regression and SVM for Massive Data, Parallel Clustering Techniques, Evaluation of Clustering Results.

Unit IV : Link Analysis and Mining of Web/Social Networks

Web Graph Structure and Crawling, PageRank and its Variants, Hubs and Authorities (HITS Algorithm), Link Spam Detection, Community Detection in Large Graphs, Mining Social Network Graphs, Recommendation Systems – User-Based and Item-Based Collaborative Filtering, Content Based Filtering.

Unit V: Frameworks and Real-World Applications:

Introduction to Apache Spark and RDDs, Spark MLlib for Data Mining, Streaming and Real-Time Data Analysis, Mining on Cloud Platforms (AWS, GCP, Azure), Case Study: E-commerce, Finance, and Healthcare, Scaling Algorithms to Petabyte-Level Data, Big Data Ethics and Governance, Research Trends in Mining Massive Data Sets .

Text Books :

1. "Mining of Massive Datasets" by Jure Leskovec, Anand Rajaraman, and Jeffrey Ullman
2. "Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei
3. "Big Data: Principles and Best Practices of Scalable Real-Time Data Systems" by Nathan Marz and James Warren

Reference Books:

1. "Big Data Analytics with Spark" by Mohammed Guller
2. "Hadoop: The Definitive Guide" by Tom White
3. "Practical Machine Learning with Spark" by Ajay Ohri
4. IEEE/ACM Journals and Conference Proceedings on Data Mining and Big Data

Online Courses :

1. Mining Massive Datasets – Stanford University (Coursera)
2. Big Data Analysis with Apache Spark – edX (BerkeleyX)
3. Data Mining Specialization – University of Illinois (Coursera)

Open Elective – III
(OE - III)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01405T	OE	**Building Materials and Services** (Common to EEE, ECE, CSE, AI&DS, CSE- AI, and CSE-AI&ML)	3	0	0	3

Pre -Requisites:

- Basic Knowledge of Construction Materials and Building Components.
- Familiarity with Building Systems and Service Requirements.

Course Objectives:

- Understand properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
- Analyze the composition, manufacturing process, and properties of cement and admixtures.
- Apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
- Evaluate masonry, mortars, finishing techniques, and formwork systems.
- Assess various building services including plumbing, ventilation, air conditioning, acoustics, and fire protection.

Course Outcomes (COs):

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

CO1: Apply knowledge of conventional and modern building materials to explain their properties, specifications, and construction applications. (L3)

CO2: Analyze the performance characteristics of building materials under various environmental and structural loading conditions. (L4)

CO3: Evaluate building services systems including water supply, drainage, electrical, fire protection, and HVAC for efficient building operation. (L5)

CO4: Apply appropriate material selection criteria and service system design principles for safe and sustainable building construction. (L3)

CO5: Assess the integration of smart building technologies and energy management systems for optimized building performance. (L5)

Unit I: Stones, Bricks, Tiles, Timber, Aluminum, Glass, Paints and Plastics:

Stones and Bricks, Tiles: Building Stones – Classifications and Quarrying – Properties – Structural Requirements – Dressing. Bricks – Composition of Brick Earth – Manufacture and Structural Requirements, Fly Ash, Ceramics. Timber, Aluminum, Glass, Paints and Plastics: Wood – Structure – Types and Properties – Seasoning – Defects; Alternate Materials for Timber – GI/Fibre – Reinforced Glass Bricks, Steel & Aluminum, Plastics.

Unit II: Cement & Admixtures:

Types of Cement – Ingredients of Cement – Manufacture – Chemical Composition – Hydration – Field & Lab Tests – Fineness – Consistency – Initial & Final Setting – Soundness. Admixtures – Mineral & Chemical Admixtures – Uses.

Unit III: Building Components:

Lintels, Arches, Walls, Vaults – Stair Cases – Types of Floors – Types of Roofs: Flat, Curved, Trussed; Foundations – Types; Damp Proof Course; Joinery – Doors – Windows – Materials – Types.

Unit IV: Mortars, Masonry and Finishing's Mortars:

Lime and Cement Mortars. Brick Masonry – Types – Bonds; Stone Masonry – Types; Composite Masonry – Brick-Stone Composite; Concrete, Reinforced Brick. Finishes: Plastering, Pointing, Painting, Claddings – Types – Tiles – ACP. Formwork: Types – Requirements – Standards – Scaffolding – Design; Shoring, Underpinning.

Unit V: Building Services:

Plumbing Services: Water Distribution, Sanitary Lines & Fittings; Ventilation: Functional Requirements, Systems of Ventilation. Air-Conditioning – Essentials and Types; Acoustics – Characteristics – Absorption – Acoustic Design; Fire Protection – Fire Hazards – Classification of Fire-Resistant Materials and Constructions.

Text Books:

1. Building Materials and Construction – Arora & Bindra, Dhanpat Roy Publications.
2. Building Materials and Construction by G C Sahu, Joygopal Jena, McGraw Hill Pvt Ltd, 2015.

Reference Books:

1. Building Construction by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications (P) Ltd., New Delhi.
2. P. C. Varghese, Building Materials, Prentice Hall of India, 2015.
3. N. Subramanian, Building Materials Testing and Sustainability, Oxford Higher Education, 2019.
4. R. Chudley, Construction Technology, Longman Publishing Group, 1973.
5. S. K. Duggal, Building Materials, Oxford & IBH Publishing Co. Ltd., New Delhi, 2019.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01406T	OE	**Environmental Impact Assessment** (Common to EEE, ECE, CSE, AI&DS, CSE- AI, and CSE-AI&ML)	3	0	0	3

Pre -Requisites:

- Basic Knowledge of Environmental Science and Ecology.
- Familiarity with Pollution, Resource Management, and Sustainability Concepts.

Course Objectives:

- Understand the principles, methodologies, and significance of Environmental Impact Assessment (EIA).
- Analyze the impact of developmental activities on land use, soil, and water resources.
- Evaluate the impact of development on vegetation, wildlife, and assess environmental risks.
- Develop environmental audit procedures and assess compliance with environmental regulations.
- Understand and apply environmental acts, notifications, and legal frameworks in EIA studies.

Course Outcomes (COs):

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

CO1: Apply EIA methodologies to explain the significance and legal framework governing Environmental Impact Assessment. (L3)

CO2: Analyze the environmental impacts of developmental projects on air, water, land, and ecological systems. (L4)

CO3: Evaluate environmental clearance procedures, mitigation measures, and monitoring plans for infrastructure development. (L5)

CO4: Apply risk assessment and environmental audit techniques to ensure regulatory compliance in developmental projects. (L3)

CO5: Assess the effectiveness of EIA processes and recommend improvements for sustainable project development. (L5)

Unit I: Concepts and Methodologies of EIA:

Initial Environmental Examination, Elements of EIA, Factors Affecting 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 synchro phasor technology, PMUs, and PDCs.
- To introduce the concepts and applications of smart metering, AMR, and Advanced Metering Infrastructure (AMI).
- To impart understanding of communication technologies and protocols used in Smart Grid systems.

Course Outcomes (COs):

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

CO1: Describe the evolution, architecture, and enabling technologies of Smart Grid systems along with national and international deployment initiatives. (L3)

CO2: Analyze Wide Area Monitoring Systems using synchro phasor technology, PMU, and PDC for grid monitoring and blackout analysis. (L4)

CO3: Examine smart metering systems including AMR, AMI, smart meter functionalities, and demand-side management applications. (L4)

CO4: Analyze communication technologies and protocols used in Smart Grid systems including RF, PLC, optical fiber, and mobile communication. (L4)

CO5: Evaluate Smart Grid applications and cybersecurity aspects including renewable integration, energy storage systems, EVs, and security risk assessment. (L5)

Unit I: Introduction to Smart Grid:

Evolution of Electric Grid – Need for Smart Grid – Difference between Conventional & Smart Grid – Overview of Enabling Technologies – International Experience in Smart Grid Deployment – Smart Grid Road Map for India – Smart Grid Architecture.

Unit II: Wide Area Monitoring System:

Fundamentals of Synchrophasor Technology – Concept and Benefits of Wide Area Monitoring System – Structure and Functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC) – Road Map for Synchrophasor Applications (NAPSI) – Operational Experience and Blackout Analysis using PMU.

Unit III: Smart Meters:

Features and Functions of Smart Meters – Functional Specification – Category of Smart Meters – Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) Drivers and Benefits – AMI Protocol – Demand Side Integration: Peak Load, Outage and Power Quality Management.

Unit IV: Information and Communication Technology

Overview of Smart Grid Communication System – Modulation and Demodulation Techniques: Radio Communication – Mobile Communication – Power Line Communication – Optical Fibre Communication – Communication Protocol for Smart Grid.

Unit V: Smart Grid Applications and Cyber Security:
Applications: Overview and Concept of Renewable Integration – Introduction to Distributed Generation – Role of Protective Relaying in Smart Grid – House Area Network – Advanced Energy Storage Technology: Flow Battery, Fuel Cell, SMES, Super Capacitors, Plug-in Hybrid Electric Vehicles. Cyber Security: Security Issues in DG, Distribution Automation, AMI, Electric Vehicle Management Systems – Approach to Assessment of Smart Grid Cyber Security Risks – Methodologies, Cyber Security Requirements – Smart Grid Information Model.

Text Books:
1. James Momoh, Smart Grid: Fundamentals of Design and Analysis, John Wiley and Sons, New York, 2012.
2. Janaka Ekanayake et al., Smart Grid: Technology and Applications, John Wiley & Sons, New Jersey, 2012.

Reference Books:
1. Power Grid Corporation of India Limited, Smart Grid Primer, 1st Edition, Bangalore, India, 2013.
2. Fereidoon P. Sioshansi, Smart Grid – Integrating Renewable, Distributed and Efficient Energy, Academic Press, USA, 2011.
3. Stuart Borlase, Smart Grids: Infrastructure, Technology and Solutions, CRC Press, England, 2013.
4. Phadke A G, Thorp J S, Synchronized Phasor Measurements and Their Applications, Springer, New York, 2012.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03403T	OE	**3D Printing Technologies** (Common to all branches of Engineering)	3	0	0	3

Pre -Requisites:

- Basic Knowledge of Engineering Materials and Manufacturing Processes.
- Familiarity with Technical Drawing and Design Fundamentals.

Course Objectives:

- Understand the fundamental concepts of prototyping and distinguish between traditional and rapid prototyping methods.
- Demonstrate the working principles, materials, and applications of solid-, liquid-, and powder- based RP systems.
- Define the processes and classifications of rapid tooling and reverse engineering techniques.
- Identify common errors in 3D printing and evaluate pre-processing, processing, and post- processing issues.
- Familiarize RP-related software and its role in applications such as design, manufacturing, and medical fields.

Course Outcomes (COs):

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

CO1: Apply the fundamentals of rapid prototyping technologies, including classification, processes, comparison with traditional manufacturing methods, and their role in product development. (L3)

CO2: Analyze working principles, materials, advantages, limitations, and applications of solid and liquid based rapid prototyping systems such as FDM, LOM, SLA, DLP, and SGC. (L4)

CO3: Analyze powder-based and other rapid prototyping systems including SLS, DMLS, LENS, EBM, 3DP, BPM, and SDM for suitable engineering and manufacturing applications. (L4)

CO4: Apply reverse engineering and rapid tooling concepts including scanning methods, data processing, and tool development for product design and manufacturing. (L3)

CO5: Evaluate errors in 3D printing processes, related software tools, data formats, and applications of rapid prototyping in engineering, medical, and industrial domains. (L5)

Unit I: Introduction to 3D Printing:

Introduction to Prototyping, Traditional Prototyping vs. Rapid Prototyping (RP), Need for Time Compression in Product Development, Usage of RP Parts, Generic RP Process, Distinction between RP and CNC, Classification of RP.

Unit II: Solid and Liquid Based RP Systems:

Working Principle, Materials, Advantages, Limitations and Applications of: Fusion Deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Stereolithography (SLA), Direct Light Projection System (DLP) and Solid Ground Curing (SGC).

Unit III: Powder Based & Other RP Systems:

Powder Based RP Systems: Working Principle, Materials, Advantages, Limitations and Applications of Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS) and Electron Beam Melting (EBM). Other RP Systems: Three-Dimensional Printing (3DP), Ballistic Particle Manufacturing (BPM), Shape Deposition Manufacturing (SDM).

Unit IV: Rapid Tooling & Reverse Engineering:

Rapid Tooling: Conventional Tooling vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling Methods. Reverse Engineering (RE): Meaning, Use, RE Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model Development.

Unit V: Errors in 3D Printing and Applications:

Pre-processing, processing and post-processing errors. Part building errors in SLA, SLS, etc. Software: MIMICS, Magics, Surgi Guide, 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.

Online Resources:

- NPTEL Course on Rapid Manufacturing.
- https://nptel.ac.in/courses/112/104/112104265/
- https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/
- https://slideplayer.com/slide/6927137/
- https://www.mdpi.com/2073-4360/12/6/1334
- https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-
- %20FDM.pdf
- https://lecturenotes.in/subject/197
- https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20 RP ilovepdfcompressed.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
- https://www.youtube.com/watch?v=NkC8TNts4B4

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PC04312T	**OE**	**Microprocessors and Microcontrollers** (Common to all branches of Engineering)	**2**	**1**	**0**	**3**

Pre-Requisites: Basics of Digital Electronics and Programming for microprocessors and micro controllers

Course Objectives:

- To comprehend the architecture, operation, and configurations of the 8086 microprocessors.
- To get familiar with 8086 programming concepts, instruction set, and assembly language development tools.
- To study the interfacing of 8086 with memory, peripherals, and controllers for various applications.
- To learn the architecture, instruction set, and programming of the 8051 microcontrollers.
- To understand microcontroller interfacing techniques, peripheral programming, and processor comparisons.

Course Outcomes (COs):

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

CO1: Learn the fundamental architectural concepts of microprocessors. Apply knowledge of 8086 architecture to identify the roles of Bus Interface Unit (BIU) and Execution Unit (EU) in instruction execution. (L3)

CO2: Analyse the 8086-instruction set and addressing modes to develop assembly language programs for arithmetic and logical operations (L4)

CO3: Examine and Interfacing of Peripheral devices with the 8086 microprocessors. (L4)

CO4: Analyse the fundamentals of 8051 and the function of SFRs and I/O ports in executing control operations. (L4)

CO5: Evaluate the interfacing of peripheral devices with the 8086 microprocessors for efficient system performance(L5)

Unit I :8086 Architecture:

Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

Unit II :8086 Programming:

Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

Unit III :8086 Interfacing:

Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

Unit IV :Microcontroller :

Microcontroller - Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

Unit V: Interfacing Microcontroller:

Interfacing Microcontroller - Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

Text Books:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rdEdition,1994.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson, 2012.

References 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)	2	1	0	3

Pre -Requisites:

- Basic Knowledge of Materials Science and Solid-State Physics.
- Familiarity with Material Properties and Basic Characterization Techniques.

Course Objectives:

- Provide exposure to smart materials and their engineering applications.
- Impart knowledge on the basics and phenomenon behind the working of smart materials.
- Explain the properties exhibited by smart materials.
- Educate various techniques used to synthesize and characterize smart materials.
- Identify the required smart material for distinct applications/devices.

Course Outcomes (COs):

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

CO1: Describe the classification, characteristics, and applications of smart materials, including shape memory, chromoactive, magnetorheological, photoactive materials, and polymer composites. (L3)

CO2: Apply the optical, electrical, dielectric, piezoelectric, ferroelectric, pyroelectric, and magnetic properties of smart materials to explain their functional behavior. (L3)

CO3: Discuss the synthesis methods of smart materials using chemical routes, mechanical alloying, and thin film deposition techniques. (L3)

CO4: Analyze the role of characterization techniques such as X-ray diffraction, Raman spectroscopy, UV-Visible spectroscopy, SEM, TEM, and AFM in determining the structural and morphological properties of smart materials. (L4)

CO5: Evaluate the working principles and applications of smart material-based devices such as robotic hands, piezoelectric devices, MEMS, and intelligent systems. (L5)

Unit I: Introduction to Smart Materials:

Historical account of the discovery and development of smart materials, Shape memory materials, chromo active materials, magnetorheological materials, photoactive materials, Polymers and polymer composites (Basics).

Unit II: Properties of Smart Materials:

Optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials.

Unit III: Synthesis of Smart Materials:

Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Mechanical alloying. 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 Aliof khazraei, Handbook of Functional Nanomaterials, Vol (1 & 2), Nova Publishers, 2014.
3. Handbook of Smart Materials, Technologies, and Devices, Chaudhery Mustansar Hussain, Paolo Di Sia, Springer, 2022.
4. Fundamentals of Smart Materials, Mohsen Shahinpoor, Royal Society of Chemistry, 2020.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB410T	OE	**Introduction to Quantum Mechanics** (Common to all branches of Engineering)	2	1	0	3

Pre -Requisites:

- Basic Knowledge of Calculus, Linear Algebra, and Differential Equations.
- Familiarity with Classical Mechanics, Waves, and Elementary Physics Concepts

Course Objectives:

- Understand the fundamental differences between classical and quantum mechanics.
- Study wave-particle duality, uncertainty principle, and their implications.
- Learn and apply Schrödinger equations to basic quantum systems.
- Use operator formalism and mathematical tools in quantum mechanics.
- Explore angular momentum, spin and their quantum mechanical representations.

Course Outcomes (COs):

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

CO1: Describe the fundamental principles of quantum mechanics, including wave-particle duality, uncertainty principle, and Schrödinger wave equations for describing microscopic systems. (L3)

CO2: Apply quantum mechanical principles to analyze one-dimensional systems such as potential step, potential well, potential barrier, periodic potential, and harmonic oscillator. (L4)

CO3: Discuss the operator formalism of quantum mechanics, including operator algebra, eigenvalues, eigenvectors, and matrix representation of wave functions and operators. (L3)

CO4: Analyze the mathematical tools of quantum mechanics, including matrix algebra, Hermitian operators, Dirac notation, expectation values, and ladder operators. (L4)

CO5: Evaluate angular momentum and spin systems using angular momentum operators, Pauli spin matrices, Clebsch–Gordon coefficients, and rigid rotator models. (L5)

Unit I: Principles of Quantum Mechanics:

Introduction: Limitations of Classical Mechanics, Difficulties with Classical Theories of Black Body Radiation and Origin of Quantum Theory of Radiation. Wave-Particle Duality: de Broglie wavelength, Heisenberg Uncertainty Principle. Schrödinger time independent and time dependent wave 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 (tunnelling effect). Periodic Potential and Harmonic Oscillator, Energy Eigen functions and Eigen values.

Unit III: Operator Formalism:

Operators, Operator Algebra, Eigen values and Eigen vectors, Postulates of Quantum Mechanics, Matrix representation of wave functions and linear operators.

Unit IV: Mathematical Tools for Quantum Mechanics:

The concept of row and column matrices, Matrix algebra, Hermitian operators. Dirac's bra and ket notation, Expectation values, Heisenberg (operator) representation of harmonic oscillator, Ladder operators and their significance.

Unit V: Angular Momentum and Spin:

Angular Momentum Operators: Definition. Eigen functions and Eigen values of angular momentum operators. Matrix representation of angular momentum operators, System with spin half (1/2), Spin Angular Momentum, Pauli's Spin Matrices. Clebsch-Gordon Coefficients. Rigid Rotator: Eigen functions and Eigen values.

Text Books:

1. Quantum Mechanics, Vol 1, A. Messaia, North-Holland Pub. Co., Amsterdam, 1961.
2. A Text Book of Quantum Mechanics, P.M. Mathews and K. Venkatesan, Tata McGraw Hill, New Delhi, 1976.
3. Introduction to Quantum Mechanics, R.H. Dicke and J.P. Witke, Addison-Wesley Pub. Co. Inc., London, 1960.

Reference Books:

1. Quantum Mechanics, L.I. Schiff, McGraw Hill Book Co., Tokyo, 1968.
2. Introduction to Quantum Mechanics, Richard L. Liboff, Pearson Education Ltd., 4th Edition, 2003.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB411T	OE	**Green Chemistry and Catalysis for Sustainable Environment** (Common to all branches of Engineering)	3	0	0	3

Pre-Requisites:

- Basic Knowledge of Chemistry, Chemical Reactions, and Catalysis.
- Familiarity with Environmental Science and Sustainable Development Concepts.

Course Objectives:

- Understand Principles and Concepts of Green Chemistry.
- Understand the Types of Catalysis and Industrial Applications.
- Apply Green Solvents in Chemical Synthesis.
- Enumerate different sources of Green Energy.
- Apply Alternative Greener Methods for Chemical Reactions.

Course Outcomes (COs):

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

CO1: Apply the Green chemistry Principles for day-to-day life as well as synthesis, describe the sustainable development and green chemistry, explain economic and un-economic reactions, Demonstrate Polymer recycling. (L3)

CO2: Explain Heterogeneous catalyst and its applications in Chemical and Pharmaceutical Industries, Differentiate Homogeneous and Heterogeneous catalysis, Identify the importance of Bio and Photo Catalysis, Discuss Transition metal and Phase transfer Catalysis (L3)

CO3: Demonstrate Green solvents and importance, Discuss Supercritical carbon dioxide, Explain Supercritical water, recycling of green solvents. (L3)

CO4: Describe importance of Biomass and Solar Power, Illustrate Sonochemistry, Apply Green Chemistry for Sustainable Development; discuss the importance of Renewable resources, mechanochemical synthesis. (L4)

CO5: Discuss Alternative green methods like Photo redox catalysis, single electron transfer reactions (SET), Photochemical Reactions, Microwave-assisted Reactions and Sono chemical reactions, examples and applications. (L3)

Unit I: Principles and Concepts of Green Chemistry:

Introduction, Green Chemistry Principles, Sustainable Development and Green Chemistry, E Factor, Atom Economy. Atom Economic Reactions: Rearrangement and Addition Reactions. Atom Un-economic Reactions: Substitution, Elimination and Wittig Reactions. Reducing Toxicity. Waste – Problems and Prevention: Design for Degradation, Polymer Recycling.

Unit II: Catalysis and Green Chemistry:

Introduction, Types of Catalysis, Heterogeneous Catalysis: Basics, Zeolite and the Bulk Chemical Industry, Heterogeneous Catalysis in Fine Chemical and Pharmaceutical Industries, Catalytic Converters. Homogeneous Catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, and Phase Transfer Catalysis. Bio-catalysis and Photo-catalysis with examples.

Unit III: Green Solvents in Chemical Synthesis:

Green Solvents: Concept, Tools and Techniques for Solvent Selection. Supercritical Fluids: Supercritical CO2, Supercritical Water. Polyethylene Glycol (PEG), Ionic Liquids, Recycling of Green Solvents.

Unit IV: Emerging Greener Technologies:

Biomass as Renewable Resource, Energy from Biomass, Solar Power, Chemicals from Renewable Feedstocks, Chemicals from Fatty Acids, Polymers from Renewable Resources. Alternative Economies: The Syngas Economy, The Biorefinery, Design for Energy Efficiency, Mechanochemical Synthesis.

Unit V: Alternative Greener Methods:

Photochemical Reactions – Examples, Advantages and Challenges. Photoredox Catalysis, Single Electron Transfer Reactions (SET). Microwave-assisted Reactions and Sonochemical Reactions – Examples and Applications.

Text Books:

1. M. Lancaster, Green Chemistry: An Introductory Text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry: Theory and Practice, 4th Edition, Oxford University Press, USA.

Reference Books:

1. Green Chemistry for Environmental Sustainability, 1st Edition, Sanjay K. Sharma and Ackmez Mudhoo, CRC Press, 2010.
2. Edited by Alvise Perosa and Maurizio Selva, Handbook of Green Chemistry Volume 8: Green Nanoscience, Wiley-VCH, 2013.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHS404T	OE	**Employability Skills** (Common to all branches of Engineering)	3	0	0	3

Pre -Requisites:

- Basic Knowledge of Communication and Writing Skills.
- Familiarity with Presentation, Teamwork, and Interpersonal Skills.

Course Objectives:

- Encourage all round development of the students by focusing on productive skills.
- Make the students aware of Goal Setting and Writing Skills.
- Enable them to know the importance of Presentation Skills in achieving desired goals.
- Help them develop Organizational Skills through group activities.
- Function effectively with heterogeneous teams.

Course Outcomes (COs):

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

CO1: Apply goal-setting and self-management techniques, including SMART goals, motivation strategies, and SWOT analysis, for personal and professional development. (L3)

CO2: Develop professional written communication such as resumes, CVs, cover letters, emails, and statements of purpose by applying appropriate writing conventions and etiquette. (L3)

CO3: Demonstrate effective technical presentation skills through planning, preparation, stage management, and delivery of PPT and poster presentations in academic and professional contexts. (L3)

CO4: Analyze group behaviour, team dynamics, leadership qualities, and corporate etiquette to participate effectively in group discussions, debates, and collaborative tasks. (L4)

CO5: Evaluate interview situations and employ appropriate job-cracking strategies, including interview preparation, answering techniques, and mock interview performance, to enhance employability. (L5)

Unit I: Goal Setting and Self-Management:

Definition, importance, types of Goal Setting – SMART Goal Setting – Advantages – Motivation – Intrinsic and Extrinsic Motivation – Self-Management – Knowing about Self – SWOC Analysis.

Unit II: Writing Skills:

Definition, significance, types of Writing Skills – Resume Writing vs CV Writing – E-Mail Writing, Cover Letters – E-Mail Etiquette – SoP (Statement of Purpose).

Unit III: Technical Presentation Skills:

Nature, meaning & significance of Presentation Skills – Planning, Preparation, Presentation, Stage Dynamics – Anxiety in Public Speaking (Glossophobia) – PPT & Poster Presentation.

Unit IV: Group Presentation Skills:

Body Language – Group Behaviour – Team Dynamics – Leadership Skills – Personality Manifestation – Group Discussion – Debate – Corporate Etiquette.

Unit V: Job Cracking Skills:

Nature, characteristics, importance & types of Interviews – Job Interviews – Skills for Success – Job Searching Skills – STAR Method – FAQs – Answering Strategies – Mock Interviews.

Text Books:

1. Sabina Pillai, Agna Fernandez, Soft Skills & Employability Skills, Cambridge Publisher, 2014.
2. Alka Wadkar, Life Skills for Success, Sage Publications, 2016.

Reference Books:

1. Gangadhar Joshi, Campus to Corporate, Sage Publications, 2015.
2. Sherfield Montogomery Moody, Cornerstone: Developing Soft Skills, Pearson Publications, 4th Ed., 2008.
3. Shikha Kapoor, Personality Development and Soft Skills, Wiley, 2017.
4. M. Sen Gupta, Skills for Employability, Innovative Publication, 2019.

Open Elective – IV
(OE - IV)

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01407T	OE	**Geo-Spatial Technologies** (Common to EEE, ECE, CSE, AI&DS, CSE-AI, and CSE-AI&ML)	2	1	0	3

Pre -Requisites:

- Basic Knowledge of Maps, Measurements, and Geometry.
- Familiarity with Computer Applications and Spatial Data Basics.

Course Objectives:

- Understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
- Analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
- Apply network analysis techniques for geo coding, shortest path analysis, and location-allocation problems.
- Evaluate surface and geo statistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
- Assess GIS customization, Web GIS, and mobile mapping techniques for real-world applications.

Course Outcomes (COs):

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

CO1: Apply concepts of remote sensing, GIS, and GPS to explain their principles, components, and applications in civil engineering. (L3)

CO2: Analyze satellite imagery and geospatial data for mapping, land use classification, and change detection applications. (L4)

CO3: Evaluate GIS-based spatial analysis techniques for infrastructure planning, transportation, and environmental management. (L5)

CO4: Apply digital terrain modeling and photogrammetry principles for topographic mapping and engineering survey applications. (L3)

CO5: Assess geospatial technology applications in disaster management, urban planning, and resource mapping decision-making. (L5)

Unit I: Raster Analysis:

Raster Data Exploration: Query Analysis – Local Operations: Map Algebra, Reclassification, Logical and Arithmetic Overlay Operations – Neighborhood Operations: Aggregation, Filtering – Extended Neighborhood Operations – Zonal Operations – Statistical Analysis – Cost-Distance Analysis – Least Cost Path.

Unit II: Vector Analysis:

Non-Topological Analysis: Attribute Database Query, Structured Query Language, Co-Ordinate Transformation, Summary Statistics, Calculation of Area, Perimeter and Distance. Topological Analysis: Reclassification, Aggregation, Overlay Analysis: Point-In-Polygon, Line-In-Polygon, Polygon-On-Polygon: Clip, Erase, Identity, Union, Intersection – Proximity Analysis: Buffering.

Unit III: Network Analysis:

Network – Introduction – Network Data Model – Elements of Network – Building a Network Database – Geocoding – Address Matching – Shortest Path in a Network – Time and Distance Based Shortest Path Analysis – Driving Directions – Closest Facility Analysis – Catchment/Service Area Analysis – Location-Allocation Analysis.

Unit IV: Surface and Geostatistical Analysis:

Surface Data – Sources of X, Y, Z Data – DEM, TIN – Terrain Analysis – Slope, Aspect, Viewshed. Watershed Analysis: Watershed Boundary, Flow Direction, Flow Accumulation, Drainage Network. Spatial Interpolation: IDW, Spline, Kriging, Variogram.

Unit V: Customization, Web GIS, Mobile Mapping:

Customization of GIS: Need, Uses, Scripting Languages – Embedded Scripts – Use of Python Script. Web GIS: Web GIS Architecture, Advantages of Web GIS, Web Applications. Location Based Services: Emergency and Business Solutions – Big Data Analytics.

Text Books:

1. Kang-Tsung Chang, Introduction to Geographical Information System, 4th Ed., Tata McGraw Hill Edition, 2008.
2. Lo C.P. and Yeung Albert K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall, 2002.

Reference Books:

1. Michael N. Demers, Fundamentals of Geographic Information Systems, Wiley, 2009.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasaraju, An Introduction to Geographical Information Systems, Pearson Education, 2nd Edition, 2007.
3. John Peter Wilson, The Handbook of Geographic Information Science, Blackwell Pub., 2008.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE01408T	OE	**Solid Waste Management** (Common to EEE, ECE, CSE, AI&DS, CSE-AI, and CSE-AI&ML)	2	1	0	3

Pre -Requisites:

- Basic Understanding of Environmental Science and Pollution Control.
- Familiarity with Waste Generation and Resource Management Concepts.

Course Objectives:

- Understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
- Analyze engineering systems for solid waste collection, storage, and transportation.
- Apply resource and energy recovery techniques for sustainable solid waste management.
- Evaluate landfill design, construction, and environmental impact mitigation strategies.
- Assess hazardous waste management techniques, including biomedical and e-waste disposal.

Course Outcomes (COs):

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

CO1: Apply knowledge of solid waste characterization to explain sources, classification, and health impacts of municipal solid waste. (L3)

CO2: Analyze collection, transportation, and storage systems for solid waste management in urban and rural settings. (L4)

CO3: Evaluate thermo-chemical and bio-chemical waste treatment methods for energy recovery and waste minimization. (L5)

CO4: Apply design principles for engineered sanitary landfills including site selection, leachate management, and closure plans. (L3)

CO5: Assess integrated solid waste management strategies, recycling policies, and regulatory frameworks for sustainable waste handling. (L5)

Unit I: Solid Waste Fundamentals:

Definitions, Types of Solid Wastes, Sources of Solid Wastes, Characteristics, and Perspectives; Properties of Solid Wastes, Sampling of Solid Wastes, Elements of Solid Waste Management – Integrated Solid Waste Management, Solid Waste Management Rules 2016.

Unit II: Engineering Systems for Solid Waste Management:

Solid Waste Generation; On-Site Handling, Storage and Processing; Collection of Solid Wastes; Stationary Container System and Hauled Container Systems – Route Planning – Transfer and Transport; Processing Techniques.

Unit III: Engineering Systems for Resource and Energy Recovery:

Processing Techniques; Materials Recovery Systems; Recovery of Biological Conversion Products – Composting, Pre and Post Processing, Types of Composting, Critical Parameters, Problems with Composting; Recovery of Thermal Conversion Products: Pyrolysis, Gasification, RDF; Recovery of Energy from Conversion Products; Materials and Energy Recovery Systems.

Unit IV: Landfills:

Evolution of Landfills – Types and Construction of Landfills – Design Considerations – Life of Landfills – Landfill Problems – Lining of Landfills – Types of Liners – Leachate Pollution and Control – Monitoring Landfills – Landfills Reclamation.

Unit V: Hazardous Waste Management:

Sources and Characteristics, Effects on Environment, Risk Assessment – Disposal of Hazardous Wastes – Secured Landfills, Incineration – Monitoring – Biomedical Waste Disposal, E-Waste Management, Nuclear Wastes, Industrial Waste Management.

Text Books:

1. Tchobanoglous G., Theisen H. and Vigil S.A., Integrated Solid Waste Management, Engineering Principles and Management Issues, McGraw-Hill, 1993.
2. Vesilind P.A., Worrell W. and Reinhart D., Solid Waste Engineering, Brooks/Cole Thomson Learning Inc., 2002.

Reference Books:

1. Peavy H.S., Rowe D.R., and G. Tchobanoglous, Environmental Engineering, McGraw Hill Inc., New York, 1985.
2. Qian X., Koerner R.M. and Gray D.H., Geotechnical Aspects of Landfill Design and Construction, Prentice Hall, 2002.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE02404T	OE	**Electric Vehicles** (Common to CE, ECE, CSE, AI&DS, CSE -AI, and CSE- AI&ML)	3	0	0	3

Pre -Requisites:

- Basic Knowledge of Electrical and Electronic Fundamentals.
- Familiarity with Energy Storage Systems and Electric Machines.

Course Objectives:

- Remember and understand the differences between conventional vehicles and electric vehicles, electro mobility and environmental issues of EVs.
- Analyze various EV configurations, parameters of EV systems and electric vehicle dynamics.
- Analyze the basic construction, operation and characteristics of fuel cells and battery charging techniques in HEV systems.
- Design and analyze the various control structures for electric vehicles.

Course Outcomes (COs):

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

CO1: Describe the evolution, configuration, and system architecture of electric vehicles along with environmental impacts and comparison of EV technologies. (L3)

CO2: Analyze electric vehicle propulsion systems including motor configurations, transmission types, and vehicle dynamics for performance evaluation. (L4)

CO3: Examine fuel cell systems and hybrid electric vehicle technologies including modeling, performance characteristics, and system comparison. (L4)

CO4: Analyze battery charging systems and control strategies including charger architecture, wireless charging, and feedback controller design for EV applications. (L4)

CO5: Evaluate energy storage technologies and energy management systems in electric vehicles, including batteries, supercapacitors, SMES, and smart grid integration. (L5)

Unit I: Introduction to EV Systems and Energy Sources:

Past, Present and Future of EV – EV Concept – EV Technology – State-of-the-Art of EVs – EV Configuration – EV System – Fixed and Variable Gearing – Single and Multiple Motor Drive – In-wheel Drives – EV Parameters: Weight, Size, Force and Energy, Performance Parameters. Electro Mobility and the Environment – History of Electric Power Trains – Carbon Emissions from Fuels – Green Houses and Pollutants – Comparison of Conventional, Battery, Hybrid and Fuel Cell Electric Systems.

Unit II: EV Propulsion and Dynamics:

Choice of Electric Propulsion System – Block Diagram – Concept of EV Motors – Single and Multi-Motor Configurations – Fixed and Variable Geared Transmission – In-Wheel Motor Configuration – Classification – Electric Motors Used in Current Vehicle Applications – Recent EV Motors – Vehicle Load Factors – Vehicle Acceleration.

Unit III: Fuel Cells:

Introduction of Fuel Cells – Basic Operation – Model – Voltage, Power and Efficiency – Power Plant System – Characteristics – Sizing – Example of Fuel Cell Electric Vehicle – Introduction to HEV – Brake Specific Fuel Consumption – Comparison of Series-Parallel Hybrid Systems.

Unit IV: Battery Charging and Control:

Battery Charging: Basic Requirements – Charger Architecture – Charger Functions – Wireless Charging – Power Factor Correction. Control: Introduction – Modelling of Electro Mechanical System – Feedback Controller Design Approach – PI Controller's Designing – Torque-Loop, Speed Control Loop Compensation – Acceleration of Battery Electric Vehicle.

Unit V: Energy Storage Technologies:

Role of Energy Storage Systems – Thermal – Mechanical – Chemical – Electrochemical – Electrical – Efficiency of Energy Storage Systems – Super Capacitors – Superconducting Magnetic Energy Storage (SMES) – SOC – SoH – Fuel Cells – G2V – V2G – Energy Storage in Micro-grid and Smart Grid – Energy Management with Storage Systems – Battery SCADA.

Text Books:

1. C.C. Chan, K.T. Chau, Modern Electric Vehicle Technology, Oxford University Press Inc., New York, 2001, 1st Edition.
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2017, 1st Edition.

Reference Books:

1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press, 2021, 3rd Edition.
2. Francisco Díaz-González et al., Energy Storage in Power Systems, Wiley Publication, 2016.
3. A.G. Ter-Gazarian, Energy Storage for Power Systems, The Institution of Engineering and Technology (IET), 2nd Edition, 2011.
4. Mehrdad Ehsani, Yimi Gao et al., Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Online Resources:

1. https://nptel.ac.in/courses/108/102/108102121
2. https://nptel.ac.in/syllabus/108103009/

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE03404T	OE	**Total Quality Management** (Common to all branches of Engineering)	2	1	0	3

Pre-Requisites:

- Basic Understanding of Management and Organizational Concepts.
- Familiarity with Problem-Solving and Process Improvement Basics.

Course Objectives:

- Familiarize the basic concepts of Total Quality Management.
- Expose with various quality issues in Inspection.
- Gain knowledge on quality control and its applications to real time.
- Understand the extent of customer satisfaction by the application of various quality concepts.
- Demonstrate the importance of Quality Standards in Production.

Course Outcomes (COs):

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

CO1: Apply the fundamental concepts of Total Quality Management, including quality dimensions, quality planning, and quality cost analysis for improving organizational quality performance. (L3)

CO2: Analyze the historical evolution of TQM, contributions of quality gurus, strategic planning concepts, and barriers in implementing Total Quality Management practices. (L4)

CO3: Analyze customer satisfaction, employee involvement, continuous process improvement, and supplier partnership concepts to enhance organizational quality systems. (L4)

CO4: Apply quality improvement tools such as benchmarking, QFD, Taguchi method, TPM, FMEA, Six Sigma, and other quality management tools for process enhancement. (L3)

CO5: Evaluate quality management systems including ISO 9000, ISO 14000, and QS 9000 standards, along with their implementation, documentation, and auditing processes. (L5)

Unit I: Introduction:

Definition of Quality, Dimensions of Quality, Definition of Total Quality Management, Quality Planning, Quality Costs – Analysis, Techniques for Quality Costs, Basic Concepts of Total Quality Management.

Unit II: Historical Review:

Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of Successful Quality Leader, Contributions of Gurus of TQM, Case Studies.

Unit III: TQM Principles:

Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention. Employee Involvement – Motivation, Empowerment Teams. Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen. Supplier Partnership – Partnering, Sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case Studies.

Unit IV: TQM Tools:

Benchmarking – Reasons to Benchmark, Benchmarking Process. Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits. Taguchi Quality Loss Function. Total Productive Maintenance (TPM) – Concept, Improvement Needs. FMEA – Stages of FMEA. The Seven Tools of Quality, Process Capability, Concept of Six Sigma, New Seven Management Tools, Case Studies.

Unit V: Quality Systems:

Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

Text Books:

1. Dale H. Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata McGraw Hill Publishing Company Ltd., 2005.
3. Joel E. Ross, Total Quality Management, Third Edition, CRC Press, 2017.

Reference Books:

1. Narayana V. and Sreenivasan N.S., Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L. Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd., 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata McGraw Hill, 2015.

Online Resources:

- https://www.youtube.com/watch?v=VD6tXadibk0
- https://www.investopedia.com/terms/t/total-quality-management-tqm.asp
- https://blog.capterra.com/what-is-total-quality-management/
- https://nptel.ac.in/courses/110/104/110104080/
- https://onlinecourses.nptel.ac.in/noc21_mg03/preview
- https://nptel.ac.in/courses/110/104/110104085/
- https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mg39/

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OE04403T	PC	**Transducers and Sensors** (Common to CE, EEE, CSE, AI&DS, CSE-AI, and 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: Analyze the characteristics of instrumentation systems and operating principles of motion transducers for measurement applications. (L4)

CO2: Analyze 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: Analyze 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 ChaudharyK.K , —Instrumentation Measurement and Analysis‖, Second Edition, Tata McGraw-Hill Publication Ltd.2006.

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24PE05310T	**OE**	**Introduction to Quantum Computing** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre -Requisites: Basics of Mathematics and Physics

Course Objectives:

- Introduce the principles and mathematical foundations of quantum computation.
- Understand quantum gates, circuits, and computation models.
- Explore quantum algorithms and their advantages over classical ones.
- Develop the ability to simulate and write basic quantum programs.
- Understand real-world applications and the future of quantum computing in AI, cryptography, and optimization.

Course Outcomes (COs):

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

CO1: Apply the fundamental concepts of quantum mechanics, including superposition, entanglement, and quantum states, in quantum computing applications. (L3)

CO2: Construct and analyze quantum circuits using standard gates. .(L4)

CO3: Apply quantum algorithms like Deutsch-Jozsa, Grover's, and Shor's. .(L3)

CO4: Develop simple quantum programs using Qiskit or similar platforms. .(L5)

CO5: Analyze applications and challenges of quantum computing in real-world domains.(L4)

Unit I: Fundamentals of Quantum Mechanics and Linear Algebra:

Classical vs Quantum Computation, Complex Numbers, Vectors, and Matrices, Hilbert Spaces and Dirac Notation, Quantum States and Qubits, Superposition and Measurement, Tensor Products and Multi-Qubit Systems.

Unit II: Quantum Gates and Circuits:

Quantum Logic Gates: Pauli, Hadamard, Phase, Controlled Gates and CNOT. Unitary Operations and Reversibility, Quantum Circuit Representation, Quantum Teleportation, Simulation of Quantum Circuits.

Unit III: Quantum Algorithms and Complexity:

Quantum Parallelism and Interference, Deutsch and Deutsch-Jozsa Algorithms, Grover's Search Algorithm, Shor's Factoring Algorithm, Quantum Fourier Transform, Complexity Classes: BQP, P, NP, and QMA.

Unit IV: Quantum Programming and Simulation Platforms:

Introduction to Qiskit and IBM Quantum Experience, Writing Quantum Circuits in Qiskit, Measuring Qubits and Results, Classical-Quantum Hybrid Programs, Noisy Intermediate-Scale Quantum (NISQ) Systems, Limitations and Current State of Quantum Hardware.

Unit V: Applications and Future of Quantum Computing:

Quantum Machine Learning: Basics and Models, Quantum Cryptography and Quantum Key Distribution, Quantum Algorithms in AI and Optimization, Quantum Advantage and Supremacy, Ethical and Societal Impact of Quantum Technologies, Future Trends and Research Directions.

Text Books:

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.

Online Resources:

- IBM Quantum Experience and Qiskit Tutorials
- Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
- edX – The Quantum Internet and Quantum Computers
- YouTube – Quantum Computing for the Determined by Michael Nielsen
- Qiskit Textbook – IBM Quantum

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB412T	OE	**Financial Mathematics** (Common to all branches of Engineering)	2	1	0	3

Pre -Requisites:

- Basic Knowledge of Calculus, Probability, and Statistics.
- Familiarity with Algebra and Fundamental Financial Concepts.

Course Objectives:

- Provide mathematical foundations for financial modelling, risk assessment and asset pricing.
- Introduce stochastic models and their applications in pricing derivatives and interest rate modelling.
- Develop analytical skills for fixed-income securities, credit risk, and investment strategies.
- Equip students with computational techniques for pricing financial derivatives.

Course Outcomes (COs):

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

CO1: Apply fundamental financial concepts such as arbitrage, valuation, and risk to analyse 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:

- MIT– Mathematics for Machine Learning https://ocw.mit.edu
- Coursera – Financial Engineering and Risk Management (Columbia University) https://www.coursera.org/
- National Stock Exchange (NSE) India – Financial Derivatives https://www.nseindia.com

B. Tech. – IV Year I Semester

Course Code	Category	Name of the Course	L	T	P	C
24OEHB413T	**OE**	**Sensors and Actuators for Engineering Applications** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre -Requisites:

- Basic Knowledge of Physics and Electrical Measurement Concepts.
- Familiarity with Basic Electronic Components and Signal Principles.

Course Objectives:

- To Provide exposure to various kinds of sensors and actuators and their engineering applications.
- To Impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators.
- To Explain the operating principles of various sensors and actuators.
- To Educate the fabrication of sensors.
- To Explain the required sensor and actuator for interdisciplinary application.

Course Outcomes (COs):

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

CO1: Describe the principles, fabrication methods, and applications of sensors and actuators used in engineering systems. (L3)

CO2: Apply the working principles of temperature and mechanical sensors to measure thermal and mechanical parameters in practical applications. (L3)

CO3: Illustrate the operating principles and characteristics of optical and acoustic sensors used for detection and signal conversion. (L3)

CO4: Analyze the working principles and applications of magnetic and electromagnetic sensors and actuators in measurement and control systems. (L4)

CO5: Evaluate the performance and applications of chemical and radiation sensors for monitoring physical and environmental parameters. (L5)

Unit I: Introduction to Sensors and Actuators:

Sensors: Types of Sensors: Temperature, Pressure, Strain, Active and Passive Sensors, General Characteristics. 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** (Common to all branches of Engineering)	**3**	**0**	**0**	**3**

Pre -Requisites:

- Basic Knowledge of Chemistry, Materials Science, and Atomic Structure.
- Familiarity with Chemical Bonding and Basic Characterization Concepts.

Course Objectives:

- To Understand basics and characterization of nanomaterials.
- To Understand synthetic methods of nanomaterials.
- To Apply various techniques for characterization of nanomaterials.
- To Understand studies of nano-structured materials.
- To Enumerate the applications of advanced nanomaterials in engineering.

Course Outcomes (COs):

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

CO1: Classify the nanostructure materials; describe scope of nanoscience and importance technology. (L3)

CO2: Describe the top-down approach, explain aerosol synthesis and plasma arc technique, differentiate chemical vapor deposition method and electrode position method, Discuss about high energy ball milling. (L4)

CO3: Discuss different technique for characterization of nanomaterial, explain electron microscopy techniques for characterization of nanomaterial, Describe BET method for surface area analysis. (L4)

CO4: Explain synthesis and properties and applications of nanomaterials, discuss about fullerenes and carbon nanotubes, Differentiate nanomagnetic materials and thermoelectric materials, nonlinear optical materials. (L4)

CO5: Illustrate advance engineering applications of Water treatment, sensors, electronic devices, medical domain, civil engineering, chemical engineering, metallurgy and mechanical engineering, food science, agriculture, pollutants degradation. (L3)

Unit I: Basics and Characterization of Nanomaterials:

Introduction, Scope of Nanoscience and Nanotechnology, Nanoscience in Nature, Classification of Nanostructured Materials, Importance of Nanomaterials.

Unit II: Synthesis of Nanomaterials:

Top-Down Approach: Inert Gas Condensation, Arc Discharge Method, Aerosol Synthesis, Plasma Arc Technique, Ion Sputtering, Laser Ablation, Laser Pyrolysis, 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 to all branches of Engineering)	2	1	0	3

Pre -Requisites:

- Basic Knowledge of English Language and Reading Comprehension.
- Familiarity with Literary Forms such ss Poetry, Prose, Drama, and Fiction.

Course Objectives:

- Inculcate passion for aesthetic sense and reading skills.
- Encourage respecting others' experiences and creative writing.
- Explore emotions, communication skills and critical thinking.
- Educate how books serve as the reflection of history and society.
- Provide practical wisdom and duty of responding to events of the times.

Course Outcomes (COs):

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

CO1: Analyze the themes, poetic devices, and social relevance of the prescribed poems to interpret literary expression and meaning. (L4)

CO2: Analyze the plot, themes, characterization, and literary elements of Twelfth Night to interpret dramatic techniques and contextual significance. (L4)

CO3: Examine the themes, characterization, and narrative techniques in the prescribed short stories to interpret human values and social perspectives. (L4)

CO4: Evaluate the ideas, style, and autobiographical elements in the prescribed prose essays and autobiographical writings to relate literary texts to personal and social contexts. (L5)

CO5: Analyze the plot, themes, characterization, and literary features of Hard Times to interpret the social concerns and artistic vision of the novelist. (L4)

Unit I: Poetry:

- Ulysses – Alfred Lord Tennyson
- Ain't I a Woman? – Sojourner Truth
- The Second Coming – W.B. Yeats
- Where the Mind is Without Fear – Rabindranath Tagore

Unit II: Drama – Twelfth Night (William Shakespeare):

- Shakespeare – Life and Works
- Plot & Sub-plot and Historical Background of the Play
- Themes and Criticism
- Style and Literary Elements
- Characters and Characterization

Unit III: Short Story:

- The Luncheon – Somerset Maugham
- The Happy Prince – Oscar Wilde
- Three Questions – Leo Tolstoy
- Grief – Anton Chekhov

Unit IV: Prose – Essay and Autobiography:

- My Struggle for an Education – Booker T. Washington
- The Essentials of Education – Richard Livingston
- The Story of My Life – Helen Keller
- Student Mobs – J.B. Priestley

Unit V: Novel – Hard Times (Charles Dickens):

- Charles Dickens – Life and Works
- Plot and Historical Background of the Novel
- Themes and Criticism
- Style and Literary Elements
- Characters and Characterization

Text Books:

1. Charles Dickens, Hard Times, (Sangam Abridged Texts), Vantage Press, 1983.
2. DENT J.C., William Shakespeare, Twelfth Night, Oxford University Press, 2016.

Reference Books:

1. W.J. Long, History of English Literature, Rupa Publications India, 2015.
2. R.K. Kaushik and S.C. Bhatia, Essays, Short Stories and One Act Plays, Oxford University Press, 2018.
3. Dhanvel S.P., English and Soft Skills, Orient Blackswan, 2017.
4. New Horizon, Pearson Publications, New Delhi, 2014.

Online Resources :

- https://www.litcharts.com/poetry/alfred-lord-tennyson/ulysses
- https://www.litcharts.com/lit/ain-t-i-a-woman/summary-and-analysis
- https://englishliterature.education/articles/poetry-analysis/the-second-coming-by-w-b-yeats critical-analysis-summary-and-line-by-line-explanation/#google_vignette
- https://sirjitutorials.com/where-the-mind-is-without-fear-poem-notes-explanation/
- https://www.litcharts.com/lit/twelfth-night/themes
- https://smartenglishnotes.com/2021/11/28/the-luncheon-summary-characters-themes-and-irony

B. Tech. – IV Year
II Semester

B. Tech. – IV Year II Semester

Course Code	Category	Name of the Course	L	T	P	C
24IPIN404L	**IP**	**Internship** (Common 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

Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON3001T	**Advanced Machine Learning & Statistical Modelling**	**2**	**1**	**0**	**3**

Pre -Requisites: Basics of machine learning, probability, statistics, and Python programming.

Course Objectives:

- To provide in-depth knowledge of advanced machine learning techniques and algorithms.
- To impart statistical modelling concepts that support predictive and inferential learning.
- To enable the learners to design, implement, and evaluate robust ML models.
- To expose students to real-world data and model deployment techniques.
- To encourage critical thinking in selecting and optimizing ML/statistical models for varied
- applications.

Course Outcomes (COs):

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

CO1: Analyze advanced supervised learning techniques—including regularization methods, Support Vector Machines (SVMs), gradient boosting algorithms, and hyperparameter tuning techniques for effective model development. (L4)

CO2: Apply deep learning models such as feedforward neural networks, CNNs, RNNs, and optimization techniques for solving complex learning problems. (L3)

CO3: Analyze unsupervised learning and dimensionality reduction techniques including clustering and feature extraction methods. (L4)

CO4: Apply statistical modelling and probabilistic learning techniques including GLMs, Bayesian methods, and Markov models. (L3)

CO5: Analyze ensemble methods, model evaluation metrics, explain ability techniques, and deploy machine learning models using modern tools. (L4)

Unit I: Advanced Supervised Learning:

Review of foundational ML concepts, regularization: L1, L2, Elastic Net, Support Vector Machines (SVM) with Kernels, Gradient Boosting Machines (XGBoost, LightGBM), Hyperparameter tuning: Grid Search, Random Search, Bayesian Optimization

Unit II: Deep Learning & Neural Networks:

Deep Feed forward Neural Networks, Back propagation and Optimization (SGD, Adam, RMSProp), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), LSTM, GRU, Transfer Learning and Fine-Tuning Pretrained Models

Unit III: Unsupervised Learning & Dimensionality Reduction:

Clustering Algorithms: K-Means, DBSCAN, Agglomerative Clustering, Gaussian Mixture Models (GMM), Principal Component Analysis (PCA), t-SNE, UMAP, Autoencoders and Variational Autoencoders (VAE)

Unit IV: Statistical Modelling & Probabilistic Learning:

Linear & Logistic Regression (Advanced), Generalized Linear Models (GLM), Bayesian Inference and Bayesian Networks, Markov Chain Monte Carlo (MCMC), Gibbs Sampling, Hidden Markov Models (HMMs)

Unit V: Ensemble Methods & Model Deployment:

Bagging, Boosting, and Stacking techniques, Random Forests and Voting Classifiers, Model Evaluation: Cross-validation, ROC, AUC, Precision-Recall, Model Explainability: SHAP, LIME, Model Deployment using Flask/Streamlit and MLflow.

Text Books:

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, The Elements of Statistical Learning, Springer, 2017.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 3rd Edition, 2023.
3. David Barber, Bayesian Reasoning and Machine Learning, Cambridge University Press.

Online Resources:

1. Stanford CS229: Machine Learning by Andrew Ng (YouTube & Coursera)
2. Fast.ai - Practical Deep Learning for Coders
3. Deep Learning Specialization – Coursera

Course Code	Name of the Course	L	T	P	C
24HON3002T	**Scalable AI & Big Data**	**2**	**1**	**0**	**3**

Pre-Requisites: Basics of artificial intelligence, big data concepts, databases, and Python programming.

Course Objectives:

- To introduce the fundamentals and technologies used in big data ecosystems.
- To explore scalable AI techniques and platforms for processing massive datasets.
- To enable students to perform real-time analytics using distributed frameworks.
- To understand storage, processing, and analysis challenges with big data.
- To develop scalable machine learning and AI models on cloud-based environments.

Course Outcomes (COs):

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

CO1: Apply the concepts of Big Data characteristics, architecture, Hadoop ecosystem, and NoSQL databases to identify suitable data storage and processing solutions. (L3)

CO2: Apply Apache Spark components such as RDDs, DataFrames, and Structured Streaming to process and manage large-scale datasets efficiently. (L3)

CO3: Analyze and implement scalable machine learning techniques using Spark MLlib and distributed deep learning frameworks for handling big data. (L4)

CO4: Analyze real-time data processing systems and cloud-based analytics platforms to select appropriate tools for scalable AI applications. (L4)

CO5: Analyze scalable AI applications and evaluate ethical, privacy, and regulatory challenges in big data environments. (L4)

Unit I: Introduction to Big Data Ecosystem :

Characteristics and types of Big Data (Volume, Velocity, Variety, Veracity, Value), Big Data Architecture, Hadoop Ecosystem: HDFS, MapReduce, YARN, NoSQL Databases: HBase, Cassandra, MongoDB, Introduction to Data Lakes

Unit II: Distributed Computing with Apache Spark:

Spark Architecture and RDDs, Spark SQL and DataFrames, Spark Streaming: Structured Streaming, Kafka integration, Performance optimization in Spark, Introduction to Delta Lake

Unit III: Scalable Machine Learning:

MLlib in Spark: Feature extraction, classification, regression, clustering, Model tuning and evaluation at scale, Distributed training with TensorFlow and PyTorch, Transfer Learning with large datasets, AutoML in big data environments

Unit IV: Real-time and Cloud-based Analytics :

Stream Processing: Apache Kafka, Flink, and Spark Structured Streaming, Cloud platforms: AWS (EMR, S3, SageMaker), Azure, Google BigQuery, BigQuery ML and Vertex AI, Serverless Big Data Pipelines, Data Warehousing with Snowflake/Redshift

Unit V: Scalable AI Applications & Ethics:

Case Studies: Recommender Systems, Fraud Detection, Smart Cities, Federated Learning and Edge

AI with Big Data, Explainable AI at Scale (XAI), Ethical and Privacy concerns in Big Data AI, Responsible AI frameworks and regulations (GDPR, Bias Mitigation)

Text Books:

1. Viktor Mayer-Schonberger & Kenneth Cukier, Big Data: A Revolution That Will Transform How We Live, Work, and Think, Houghton Mifflin Harcourt.
2. Bill Chambers and Matei Zaharia, Spark: The Definitive Guide, O‘Reilly Media, 2018.
3. Jules S. Damji et al., Learning Spark: Lightning-Fast Data Analytics, 2nd Edition, O‘Reilly, 2020.

Reference Books:

1. Tom White, Hadoop: The Definitive Guide, O'Reilly, 4th Edition.
2. Rajkumar Buyya, Rodrigo N. Calheiros, and Amir Vahid Dastjerdi, Big Data: Principles and Paradigms, Morgan Kaufmann.
3. Davy Cielen, Arno D. B. Meysman, and Mohamed Ali, Introducing Data Science: Big Data, Machine Learning, and more, Manning Publications.

Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON3003T	Advanced Deep Learning for Data Science Applications	2	1	0	3

Pre-Requisites: Basics of deep learning, neural networks, machine learning, and Python programming.

Course Objectives:

- To understand the theoretical foundations and architectures of deep learning.
- To apply deep learning models to solve real-world data science problems.
- To develop skills in training, tuning, and deploying deep neural networks.
- To explore use-cases in image, text, time-series, and tabular data analytics.
- To gain hands-on experience with popular frameworks such as TensorFlow and PyTorch.

Course Outcomes (COs):

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

CO1: Analyze the fundamental concepts and Mathematical Foundations of Deep Learning. (L4)
CO2: Analyze and implement various deep neural network architectures for data-driven tasks. (L4)
CO3: Analyze data science problems and apply suitable Deep Learning techniques. (L4)
CO4: Analyze and fine-tune Deep Learning models using appropriate metrics. (L4)
CO5: Analyze and Deploy end-to-end Deep Learning applications in domains such as vision, NLP, and forecasting. (L4)

Unit I: Fundamentals of Deep Learning:

Introduction to Deep Learning and Neural Networks, Perceptron, Activation Functions, and Backpropagation, Loss Functions and Optimizers (SGD, Adam, etc.), Regularization (Dropout, Batch Normalization, Weight Decay), Evaluation Metrics for Regression and Classification

Unit II: Convolutional Neural Networks (CNNs):

Basics of CNNs: Convolution, Pooling, Padding, Deep Architectures: LeNet, AlexNet, VGG, ResNet, Data Augmentation and Transfer Learning, Applications: Image Classification, Object Detection, Semantic Segmentation, Tools: OpenCV, Keras/TensorFlow for Vision Tasks.

Unit III: Recurrent Neural Networks (RNNs) and Sequence Modelling:

RNNs, vanishing gradient problem, LSTM and GRU networks, Sequence to Sequence Models, Attention Mechanisms, NLP Applications: Sentiment Analysis, Text Classification, Translation, Libraries: NLTK, SpaCy, HuggingFace Transformers.

Unit IV: Deep Learning for Structured and Time-Series Data:

Deep Learning for Tabular Data (TabNet, Deep & Cross Networks), Time Series Forecasting with RNNs, TCNs, and LSTMs, Anomaly Detection in Time-Series, Multivariate Time Series Prediction, Visualization and Interpretation Tools: SHAP, LIME.

Unit V: Generative Models and Deployment:

Autoencoders, Variational Autoencoders (VAE), Generative Adversarial Networks (GANs) and their Applications, Model Optimization and Quantization, Deployment using Flask, FastAPI, TensorFlow Serving, Case Studies: Health Analytics, Finance, Retail, and Industrial AI.

Text Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
2. Francois Chollet, Deep Learning with Python, 2nd Edition, Manning Publications, 2021.
3. Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, Springer, 2018.

Reference Books:

1. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 3rd Edition, 2023.
2. Josh Patterson and Adam Gibson, Deep Learning: A Practitioner's Approach, O‘Reilly Media.
3. Tariq Rashid, Make Your Own Neural Network, CreateSpace Independent Publishing.

Course Code	Name of the Course	L	T	P	C
24HON3004T	Data Engineering & Cloud-based AI Pipelines	2	1	0	3

Pre -Requisites: Basics of data engineering, cloud computing, databases, and Python programming.

Course Objectives:

- To understand the foundational concepts of data engineering and the lifecycle of data.
- To design and implement data pipelines for scalable and efficient data processing.
- To leverage cloud platforms (AWS, GCP, Azure) for AI pipeline development.
- To integrate data engineering with machine learning workflows in production.
- To explore modern tools and frameworks for orchestration, streaming, and automation.

Course Outcomes (COs):

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

CO1: Understand and implement the components of a modern data engineering pipeline. (L4)

CO2: Analyze cloud services for data ingestion, transformation, storage, and processing. (L4)

CO3: Analyze scalable and fault-tolerant data pipelines using cloud-native and open-source tools. (L4)

CO4: Apply automation and orchestration of ML workflows using tools such as Airflow and Kubeflow. (L3)

CO5: Apply learned concepts in real-world domains like IoT, finance, healthcare, and recommendation systems. (L3)

Unit I: Foundations of Data Engineering:

Data Lifecycle and Pipeline Architectures, Types of Data: Structured, Semi-structured, Unstructured, Data Modeling and Schema Design, Batch vs Stream Processing, ETL vs ELT pipelines .

Unit II: Data Ingestion and Storage:

Data Ingestion Tools: Apache Kafka, AWS Kinesis, GCP Pub/Sub, Relational and NoSQL Databases: PostgreSQL, MongoDB, Bigtable, Data Lakes and Data Warehouses: S3, BigQuery, Snowflake, Redshift, Data Formats: JSON, Avro, Parquet, ORC, Partitioning, Bucketing, and Sharding

Unit III: Data Transformation and Processing:

Distributed Processing Frameworks: Apache Spark, Apache Beam, Dataproc, Data Cleaning, Feature Engineering at Scale, Handling Missing Data, Outliers, and Anomalies, Stream Processing with Apache Flink and Structured Streaming, Serverless Data Processing: AWS Lambda, GCP Cloud Functions.

Unit IV: AI & ML Pipelines in the Cloud:

MLOps Fundamentals: Versioning, Model Registry, CI/CD for ML, AutoML and ML Pipelines: Vertex AI Pipelines, Azure ML Pipelines, SageMaker Pipelines, Model Monitoring, Drift Detection, and Logging, Case Study: Real-time Recommendation Engine on GCP/AWS, Edge Deployment and Federated Learning Integration.

Unit V: Orchestration, Governance & Security:

Workflow Orchestration with Apache Airflow and Prefect, Data Lineage, Quality, and Governance, Role-based Access Control (RBAC), IAM policies in Cloud, Data Encryption, Compliance (GDPR, HIPAA), Auditing and Cost Optimization Strategies.

Text Books:

1. Joe Reis & Matt Housley, Fundamentals of Data Engineering, O‘Reilly Media, 2022.
2. Ankur Taly, D. Sculley, Machine Learning Design Patterns, O‘Reilly Media, 2021.
3. Gwen Shapira, Todd Palino, Kafka: The Definitive Guide, O'Reilly Media, 2017.

Reference Books:

1. Ashish Thusoo, Joydeep Sen Sarma, Data Warehousing at Facebook: Apache Hive and the Journey to Petabyte Scale, O'Reilly.
2. Mansoor Ahmed, Data Engineering with Python, Packt Publishing.
3. Jean-Georges Perrin, Spark in Action, 2nd Edition, Manning Publications.
4. Mark Treveil and The Logical Clocks Team, Operational AI with DataOps and MLOps, O‘Reilly.

Online Resources:

1. Google Cloud: Data Engineering on GCP (Coursera)
2. AWS Data Engineering Path (AWS Skill Builder)

Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON3005T	Ethics, Bias & Explainability in AI	2	1	0	3

Pre -Requisites: Basics of artificial intelligence, machine learning concepts, and ethical computing principles.

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, Student will be able to

CO1: Apply ethical principles to address societal concerns associated with AI technologies. (L3)
CO2: Analyze and mitigate bias in datasets and Machine Learning models. (L4)
CO3: Apply explainable AI (XAI) techniques for model transparency. (L3)
CO4: Analyze AI systems based on fairness, accountability, and transparency. (L4)
CO5: Evaluate policy, legal, and human-centric implications of AI deployment. (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.

Honours Degree

Course Code	Name of the Course	L	T	P	C
24HON3006P	Big Data & AI Analytics Lab	0	0	3	1.5

Pre -Requisites: Basics of Python programming, databases, big data tools, and AI concepts.

Course Objectives:

- To gain practical exposure to distributed data processing using Hadoop and Spark.
- To develop skills in AI and ML model development using large datasets.
- To implement predictive analytics and recommendation systems on scalable platforms.
- To explore big data storage, ingestion, and analytics tools.

Course Outcomes (COs):

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

CO1: Apply distributed data processing techniques using Hadoop and Spark. (L3)
CO2: Analyze and deploy machine learning models on big data platforms. (L4)
CO3: Analyze large-scale datasets for AI-driven decision-making. (L4)
CO4: Apply real-time data stream processing for analytics and prediction tasks. (L3)
CO5: Analyze and integrate big data tools within cloud computing environments. (L4)

Tools Required

- Apache Hadoop
- Apache Spark
- Apache Kafka

List of 12 Experiments

1. **HDFS Operations** – Store, retrieve, and replicate data using HDFS commands.
2. **MapReduce Program** – Word count or log file analysis using MapReduce.
3. **Spark RDD & DataFrame Operations** – Load and manipulate datasets using RDDs and DataFrames.
4. **Big Data Cleaning with PySpark** – Clean messy data using Spark SQL and Python.
5. **Linear Regression with MLlib** – Train a regression model on a large dataset using Spark MLlib.
6. **Classification with Decision Trees** – Implement decision tree classifier using MLlib.
7. **Recommendation System** – Build a movie/book recommender using collaborative filtering.
8. **Streaming with Spark Streaming** – Analyze Twitter or sensor data in real-time.
9. **Sentiment Analysis** – Perform sentiment classification using Spark and logistic regression.
10. **Big Data Clustering** – K-Means clustering on a large customer dataset.
11. **Real-time Stock Data Analytics** – Use Kafka + Spark to stream and analyze stock data.
12. **Deploy AI Model on GCP/AWS** – Train and deploy a model using Google AI Platform or AWS SageMaker.

Course Code	Name of the Course	L	T	P	C
24HON3007P	Data Science & Visualization Lab	0	0	3	1.5

Pre -Requisites: Basics of Python programming, data analysis, and visualization techniques.

Course Objectives:

- To apply statistical and machine learning methods to extract insights from data.
- To build dashboards and visualizations for storytelling with data.
- To use Python/R for advanced data manipulation and plotting.
- To enable students to interpret model results and data distributions visually.

Course Outcomes (COs):

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

CO1: Analyze, pre-process, and visualize structured and unstructured data. (L4)

CO2: Apply various plotting libraries for effective and meaningful data storytelling. (L3)

CO3: Apply Machine Learning models and visualize their performance metrics. (L3)

CO4: Evaluate interactive dashboards for real-time data insights. (L5)

CO5: Evaluate and communicate results through data-driven narratives. (L5)

Tools Required

- Python (Pandas, Matplotlib, Seaborn, Plotly, Scikit-learn)
- R (ggplot2, dplyr, Shiny – optional)
- Jupyter Notebook / Google Colab
- Tableau / Power BI
- Streamlit (for building data apps)

List of 12 Experiments

1. **Data Cleaning and Preprocessing** – Handle missing values, outliers, and encoding techniques.
2. **Exploratory Data Analysis (EDA)** – Univariate, bivariate, and multivariate analysis.
3. **Statistical Visualization** – Use Matplotlib and Seaborn for histograms, box plots, heatmaps.
4. **Time Series Visualization** – Line plots and decomposition for stock/weather datasets.
5. **Interactive Plots with Plotly** – Build interactive bar, scatter, and 3D plots.
6. **Correlation Analysis** – Visualize and interpret correlation matrices.
7. **Classification Visualization** – ROC curve, confusion matrix, and decision boundaries.
8. **Clustering with Visualization** – Visualize K-means clusters with PCA or t-SNE.
9. **Feature Importance Visualization** – Use tree-based models and SHAP values.
10. **Geospatial Data Visualization** – Plot maps and location-based insights using Plotly or Folium.
11. **Dashboard Development in Tableau / Power BI** – Create visual dashboards from a real-world dataset.
12. **Build a Data App using Streamlit** – Build an interactive application to display model output and insights.

MINOR DEGREE

Minor Degree

Course Code	Name of the Course	L	T	P	C
24MCI3001T	Python for AI & Data Science	2	1	0	3

Pre -Requisites: Basics of programming concepts, mathematics, and logical problem-solving skills.

Course Objectives:

- Understand the fundamentals of Python programming relevant to AI and Data Science.
- Learn to handle, process, and visualize data using Python libraries.
- Apply Python-based techniques to build AI and machine learning models.
- Explore advanced AI concepts and implement them using Python.
- Develop skills to work with real-world datasets and AI applications using Python.

Course Outcomes (COs):

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

CO1: Analyze Python programming fundamentals and syntax for developing solutions in AI and Data Science applications. (L4)

CO2: Apply Python libraries for data manipulation and visualization. (L3)

CO3: Analyze data sets and extract meaningful insights using Python tools. (L4)

CO4: Analyze machine learning models implemented using Python to assess their performance and suitability. (L4)

CO5: Analyze and develop AI solutions using Python programming. (L4)

Unit I: Python Programming Fundamentals for AI & Data Science:

Introduction to Python: Features and Setup, Data Types and Variables, Control Structures: Conditional Statements and Loops, Functions and Modules, Exception Handling, File Handling in Python, Introduction to Object-Oriented Programming, Introduction to Python IDEs and Notebooks.

Unit II: Data Handling and Preprocessing Using Python Libraries:

Introduction to NumPy: Arrays and Operations, Pandas for Data Manipulation: Series and Data Frames, Handling Missing Data, Data Cleaning and Transformation, Data Aggregation and Grouping, Working with Dates and Time in Pandas, Data Input/Output: CSV, Excel, JSON, Introduction to Data Preprocessing Techniques.

Unit III: Data Visualization Techniques in Python:

Introduction to Matplotlib: Basic Plotting, Customizing Plots and Graphs, Seaborn for Statistical Visualizations, Plotting Categorical Data, Plotting Time Series Data, Pairplots, Heatmaps, and Correlation Plots, Interactive Visualizations with Plotly, Visualizing Distributions and Outliers.

Unit IV: Machine Learning Basics with Python:

Introduction to Scikit-learn, Supervised Learning Algorithms: Linear Regression, Logistic Regression, Unsupervised Learning: K-Means Clustering, Model Evaluation Metrics: Accuracy, Precision, Recall, F1-score, Cross-validation and Hyperparameter Tuning, Feature Selection and Engineering, Overfitting and Underfitting Concepts, Introduction to Pipeline and Model Persistence

Unit V: Advanced AI Applications with Python:

Introduction to Neural Networks with Keras and TensorFlow, Building and Training Deep Learning Models, Natural Language Processing with Python (NLTK, SpaCy), Computer Vision Basics with OpenCV, Reinforcement Learning Overview, Transfer Learning and Pretrained Models, Deploying

AI Models with Flask API, Ethical Considerations and Best Practices in AI

Text Books:

1. Jake VanderPlas, Python Data Science Handbook, O'Reilly, 2016.
2. Sebastian Raschka, VahidMirjalili, Python Machine Learning, Packt, 2019.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2019.

Reference Books:

1. Wes McKinney, Python for Data Analysis, O'Reilly, 2017.
2. Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly, 2019.
3. Francois Chollet, Deep Learning with Python, Manning, 2018.

Online Courses:

Platform	Course Title & Link
Coursera	Applied Data Science with Python Specialization – University of Michigan

Minor Degree

Course Code	Name of the Course	L	T	P	C
24MCI3002T	Data Structures & Algorithms for AI	2	1	0	3

Pre -Requisites: Basics of programming concepts, problem-solving techniques, and mathematical logic.

Course Objectives:

- To Understand fundamental data structures and algorithms relevant to AI applications.
- To Learn how to implement and analyze algorithms for efficient data processing in AI systems.
- To Apply data structures and algorithms to solve AI problems such as search, optimization, and learning.
- To Analyze algorithmic complexity and optimize AI solutions for performance.
- To Develop skills to design AI algorithms using appropriate data structures.

Course Outcomes (COs):

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

CO1: Apply basic and advanced data structures in AI applications. (L3)
CO2: Implement and apply fundamental algorithms for problem-solving in AI. (L3)
CO3: Analyze the time and space complexity of algorithms. (L4)
CO4: Analyze different algorithmic approaches and choose appropriate ones for AI problems. (L4)
CO5: Analyze efficient algorithms and data structures for AI systems. (L4)

Unit I: Fundamentals of Data Structures for AI:

Introduction to Data Structures and Algorithms, Arrays and Linked Lists, Stacks and Queues, Trees: Basic Terminology and Binary Trees, Graphs: Representation and Terminologies, Hashing and ash Tables, Recursion and Recursive Algorithms, Complexity Analysis: Big-O Notation.

Unit II: Searching and Sorting Algorithms in AI:

Linear Search and Binary Search, Bubble Sort, Selection Sort, Insertion Sort, Merge Sort and Quick Sort, Heap Sort and Counting Sort, Search Algorithms in Graphs: DFS and BFS, Heuristic Search: A* Algorithm, Algorithm Design Techniques: Divide and Conquer, Performance Analysis of Sorting and Searching Algorithms.

Unit III: Advanced Data Structures and Their Applications in AI :

Balanced Trees: AVL Trees and Red-Black Trees, B-Trees and B+ Trees, Trie and Suffix Trees, Priority Queues and Heaps, Disjoint Set Union (Union-Find), Graph Algorithms: Minimum Spanning Tree (Kruskal, Prim), Shortest Path Algorithms (Dijkstra, Bellman-Ford), Application of Advanced Data Structures in AI

Unit IV: Algorithms for AI Problem Solving:

Backtracking Algorithms, Branch and Bound Technique, Dynamic Programming and Memoization, Greedy Algorithms and their applications, Optimization Algorithms in AI, Local Search Algorithms, Evolutionary Algorithms and Genetic Algorithms, Complexity Classes: P, NP, NP-Complete, NP Hard.

Unit V: Designing AI Algorithms with Data Structures:

Designing Efficient Search Algorithms for AI, Data Structures for Knowledge Representation, Graph based Algorithms for Social Network Analysis, Tree-based Algorithms in Decision Making (Decision

Trees), Algorithms for Natural Language Processing, Algorithms for Computer Vision Tasks, Parallel and Distributed Algorithms in AI, Case Studies: Implementing AI Algorithms using Data Structures.

Text Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Pearson.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press.
3. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann (for AI algorithm context).

Reference Books:

1. Richard E. Neapolitan, Kumarss Naimipour, Foundations of Algorithms, Jones & Bartlett Publishers.
2. R. S. Salaria, Data Structures and Algorithms, Khanna Publishing House.
3. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson.

Online Courses

Platform	Course Title & Link
Coursera	Algorithms Specialization – Stanford University

Minor Degree

Course Code	Name of the Course	L	T	P	C
24PE31302T	Reinforcement Learning	2	1	0	3

Pre -Requisites: Basics of machine learning, probability, mathematics, and Python programming.

Course Objectives:

- To Understand the fundamental concepts and principles of reinforcement learning (RL).
- To Learn various RL algorithms including model-free and model-based methods.
- To Analyze the mathematical foundations and performance of RL algorithms.
- To Apply reinforcement learning techniques to real-world problems and AI applications.
- To Develop skills to design, implement, and evaluate RL systems effectively.

Course Outcomes (COs):

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

CO1: Apply core concepts such as Markov Decision Processes, policies, and rewards in Reinforcement Learning. (L3)

CO2: Implement fundamental RL algorithms like Dynamic Programming, Monte Carlo, and Temporal Difference. (L3)

CO3: Analyze convergence, stability, and exploration-exploitation trade-offs in RL algorithms. (L4)

CO4: Analyze the effectiveness of different RL algorithms on benchmark tasks. (L4)

CO5: Analyze advanced RL solutions for complex environments. (L4)

Unit I: Introduction and Foundations of Reinforcement Learning:

Overview of Reinforcement Learning, Key Elements: Agent, Environment, States, Actions, Rewards, Markov Decision Process (MDP) - Definition and Properties, Policies and Value Functions, Bellman Equations for State and Action Values, Concept of Return and Discount Factor, Exploration vs Exploitation dilemma, Examples of RL in Real World.

Unit II: Dynamic Programming and Monte Carlo Methods:

Policy Evaluation with Dynamic Programming, Policy Improvement and Policy Iteration, Value Iteration Algorithm, Monte Carlo Prediction and Control, First-visit and Every-visit MC Methods, On-policy vs Off-policy MC Methods, Importance Sampling in Monte Carlo, Applications of Dynamic Programming and Monte Carlo in RL.

Unit III: Temporal Difference Learning:

Introduction to Temporal Difference (TD) Learning, TD(0) Algorithm and its Properties, TD Prediction and Control Methods, SARSA Algorithm (On-policy TD Control), Q-Learning Algorithm (Off-policy TD Control), Eligibility Traces and TD(λ), Function Approximation in TD Learning, Convergence and Stability Analysis.

Unit IV: Policy Gradient and Advanced Methods:

Policy Gradient Theorem, REINFORCE Algorithm, Actor-Critic Methods, Deep Reinforcement Learning (DRL) Overview, Deep Q Networks (DQN), Trust Region Policy Optimization (TRPO), Proximal Policy Optimization (PPO), Exploration Strategies (ε-greedy, Boltzmann, UCB).

Unit V: Applications and Recent Advances in Reinforcement Learning:

Multi-agent Reinforcement Learning, Hierarchical Reinforcement Learning, Inverse Reinforcement Learning, RL in Robotics and Autonomous Systems, RL for Game Playing (Chess, Go, Atari), Safety and Ethics in RL, Transfer Learning and Meta-RL, Case Studies and Research Trends.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, 2nd Edition, MIT Press, 2018.
2. Csaba Szepesvári, Algorithms for Reinforcement Learning, Morgan & Claypool Publishers,2010.

Reference Books:

1. Marco Wiering and Martijn van Otterlo (Editors), Reinforcement Learning: State-of-the Art, Springer, 2012.
2. Deep Reinforcement Learning Hands-On by Maxim Lapan, Packt Publishing, 2018.
3. David Silver's Lecture Notes and Videos on Reinforcement Learning (available online).

Online Courses:

Platform	Course Title & Link
Coursera	Reinforcement Learning Specialization – University of Alberta

Minor Degree

Course Code	Name of the Course	L	T	P	C
24MCI3003T	Quantum Computing for AI	2	1	0	3

Pre -Requisites: Basics of linear algebra, probability, quantum mechanics concepts, and Python programming.

Course Objectives:

- Understand foundational concepts of quantum computing and its significance in Artificial Intelligence (AI).
- Explore quantum algorithms relevant to AI applications.
- Analyze the advantages and challenges of applying quantum computing in AI.
- Develop skills to implement basic quantum algorithms for AI tasks.
- Investigate emerging trends and research in Quantum AI.

Course Outcomes (COs):

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

CO1: Apply principles of quantum computing and their implications for AI. (L3)
CO2: Apply key quantum algorithms used in AI applications. (L3)
CO3: Apply quantum computing techniques to solve basic AI problems. (L3)
CO4: Analyze the benefits and limitations of quantum computing in AI contexts. (L4)
CO5: Analyze and develop quantum algorithms for AI applications. (L4)

Unit -I: Introduction to Quantum Computing and AI:

Classical Computing vs Quantum Computing, Qubits and Quantum States, Quantum Superposition and Entanglement, Quantum Gates and Circuits, Measurement in Quantum Systems, Basic Quantum Algorithms Overview, Introduction to Artificial Intelligence, Intersection of Quantum Computing and AI .

Unit -II: Quantum Algorithms for AI:

Quantum Search Algorithm (Grover's Algorithm), Quantum Fourier Transform, Quantum Amplitude Amplification, Quantum Phase Estimation, Variational Quantum Algorithms (VQA), Quantum Annealing and Optimization, Quantum Approximate Optimization Algorithm (QAOA), Quantum Machine Learning Overview.

Unit III: Quantum Machine Learning (QML) Fundamentals:

Quantum Data Encoding and State Preparation, Quantum Support Vector Machines (QSVM), Quantum Neural Networks (QNN), Quantum Clustering Algorithms, Quantum Principal Component Analysis (QPCA), Hybrid Quantum-Classical Models, Quantum Kernel Methods, Challenges in QML

Unit -IV: Quantum AI Applications and Implementations:

Quantum Reinforcement Learning Basics, Quantum Natural Language Processing (QNLP), Quantum Image Processing, Quantum Optimization for AI Problems, Error Correction and Noise in Quantum AI Systems, Quantum Hardware for AI (Qubits technologies), Performance Evaluation of Quantum AI Algorithms, Case Studies of Quantum AI Applications

Unit-V: Advanced Topics and Future Directions:

Designing Quantum Circuits for AI Tasks, Quantum AI Programming Frameworks (Qiskit, Cirq, etc.), Scalability and Resource Management in Quantum AI, Ethical and Security Implications of Quantum AI, Quantum AI Research Trends, Integration of Quantum AI with Classical AI, Quantum AI for Big Data Analytics, Emerging Quantum Technologies and AI

Text Books:

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010.
2. Maria Schuld and Francesco Petruccione, Supervised Learning with Quantum Computers, Springer, 2018.
3. Peter Wittek, Quantum Machine Learning: What Quantum Computing Means to Data Mining, Academic Press, 2014.

Reference Books:

1. Seth Lloyd, Quantum Machine Learning: An Applied Approach, MIT Press, 2020.
2. VlatkoVedral, Introduction to Quantum Information Science, Oxford University Press, 2006.
3. Jacob Biamonte et al., "Quantum Machine Learning," Nature, 2017.
4. Research papers and IEEE articles on Quantum AI and Quantum Machine Learning.

Online Courses:

Platform	Course Title & Link
IBM	Qiskit Introduction to Quantum Computing and Qiskit
Coursera	Quantum Machine Learning by University of Toronto

Minor Degree

Course Code	Name of the Course	L	T	P	C
24MCI3004T	Edge AI & IoT	3	0	0	3

Pre-Requisites: Basics of IoT concepts, embedded systems, artificial intelligence, and Python programming.

Course Objectives:

- To introduce the concept of Edge Computing and its integration with AI and IoT.
- To explore AI model deployment on edge devices.
- To understand IoT protocols, architectures, and security issues.
- To apply Edge AI techniques for real-time decision-making.
- To analyze case studies of Edge AI applications in smart systems.

Course Outcomes (COs):

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

CO1: Apply the fundamentals of Edge Computing and IoT systems. (L3)
CO2: Apply the architecture and protocols used in IoT and Edge AI. (L3)
CO3: Apply machine learning models to edge devices for real-time inference. (L3)
CO4: Analyze the constraints and trade-offs in deploying AI models on edge devices. (L4)
CO5: Analyze and develop edge-based AI systems for real-world applications. (L4)

Unit I: Introduction to Edge Computing and IoT:

Introduction to IoT: Definition, architecture, components, IoTvs Edge Computing, Edge, Fog, and Cloud Computing – Differences, Edge AI Overview – Concept and Applications, Characteristics and Benefits of Edge AI, Edge Devices: Microcontrollers, SBCs, Smart Cameras, Industry 4.0 and Smart Systems, Use Cases: Smart Home, Healthcare, Industry

Unit II: IoT and Edge AI Architectures & Communication Protocols:

IoT Architectures: 3-Layer, 5-Layer, Middleware, Edge AI Pipeline Architecture, MQTT, CoAP, HTTP, and AMQP Protocols, Data Collection and Preprocessing at the Edge, Real-time Data Transmission and Synchronization, Sensor Networks and Wireless Protocols (BLE, Zigbee, LoRaWAN), Communication Challenges in IoT, Interoperability and Integration Frameworks .

Unit III: AI and ML for Edge Devices:

AI/ML Workflow Overview: Training vs Inference, Model Compression Techniques (Quantization, Pruning), Knowledge Distillation for Edge AI, TinyML and Lightweight Model Deployment, Edge ML Frameworks: Tensor FlowLite, ONNX, PyTorch Mobile, Case Study: Deploying a CNN on Raspberry Pi, Energy and Latency Considerations, Model Evaluation Metrics for Edge AI.

Unit IV: Edge AI System Design and Optimization:

Hardware Selection: MCU, MPU, FPGA, ASIC, Power Consumption and Thermal Constraints, Model Accuracy vs Performance Tradeoffs, Data Management and Storage on Edge Devices, Federated Learning at the Edge, Edge-to-Cloud Integration Patterns, Edge AI Application Lifecycle, Security and Privacy at the Edge.

Unit V: Applications and Case Studies of Edge AI &IoT:

Smart City Applications: Traffic, Waste, Lighting, Healthcare Monitoring Systems using Edge AI, Industrial Automation with Edge-enabled Sensors, Agriculture: Soil Health, Irrigation, Crop

Monitoring, Surveillance & Real-time Video Analytics, Edge AI for Predictive Maintenance, AI on Drones and Autonomous Vehicles, Building Scalable Edge AI Solutions.

Text Books:

1. "Edge AI: Convergence of Edge Computing and Artificial Intelligence" – Xiaofei Wang, Springer, 2020.
2. "Internet of Things: Principles and Paradigms" – Rajkumar Buyya, Amir VahidDastjerdi, Elsevier, 2016.
3. "TinyML: Machine Learning with TensorFlowLite on Arduino and Ultra-Low-Power Microcontrollers" – Pete Warden, Daniel Situnayake, O'Reilly Media, 2019.

Reference Books:

1. "Architecting the Internet of Things" – Dieter Uckelmann, Springer.
2. "Hands-On Edge Analytics with Azure IoT" – ArvindRavulavaru, Packt Publishing.
3. Research papers from IEEE IoT Journal, ACM Transactions on IoT, Nature Electronics (Edge AI).

Online Courses:

Platform	Course Title & Link
Coursera	AI for Edge Computing – IBM

Minor Degree

Course Code	Name of the Course	L	T	P	C
24MCI3005P	**Python & DS Lab**	**0**	**0**	**3**	**1.5**

Pre -Requisites: Basics of programming concepts, Python fundamentals, and problem-solving techniques.

Course Objectives:

- To strengthen programming and DS skills for AI.

Course Outcomes (COs):

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

CO1: Apply Python programming techniques to solve AI-related problems. (L3)

CO2: Analyze and select appropriate data structures for efficient problem-solving in AI applications. (L4)

CO3: Evaluate the effectiveness of implemented solutions using Python and data structures in AI contexts. (L5)

Experiments:

1. Python basics and data types
2. Functions and recursion
3. Lists, Tuples, Sets
4. Dictionaries and comprehension
5. Stacks and Queues
6. Linked Lists implementation
7. Searching and Sorting
8. Tree traversals
9. Graph representation and DFS/BFS
10. Recursion with memoization
11. Implement AI heuristic search (A*)

Minor Degree

Course Code	Name of the Course	L	T	P	C
24MCI3006P	**RL & Quantum AI Lab**	**0**	**0**	**3**	**1.5**

Pre -Requisites: Basics of reinforcement learning, quantum computing concepts, and Python programming.

Course Objectives:

- To introduce RL and Quantum concepts in AI.

Course Outcomes (COs):

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

CO1: Apply Reinforcement Learning techniques to solve simple tasks and problems. (L3)

CO2: Analyze the components and functioning of basic quantum circuits. (L4)

CO3: Evaluate the performance of Reinforcement Learning approaches and quantum circuit implementations. (L5)

Experiments:

1. Intro to OpenAI Gym
2. RL environment setup
3. Q-learning implementation
4. Policy gradient methods
5. CartPole balancing with RL
6. Quantum computing basics (Qiskit)
7. Quantum circuits & gates
8. Superposition and entanglement
9. Quantum teleportation simulation
10. Quantum ML (VQC intro)
11. Reinforcement learning with function approximation
12. RL/Quantum hybrid demo