ANJUMAN-I-ISLAM's KALSEKAR TECHNICAL CAMPUS
SCHOOL OF ENGINEERING & TECHNOLOGY

(Autonomous Institute Affiliated to University of Mumbai)

MULTIDISCIPLINARY MINOR

SEMESTER III & IV

Syllabi Effective from Academic Year 2025-26

Multidisciplinary Minor Courses

Program	Option 1	Option 2	Option 3	Option 4
Civil Engineering	Design Thinking	Construction Insights	Software Applications to Civil Systems	Urban Infrastructure Planning
Computer Engineering	Design Thinking	**Data Science**	**Artificial Intelligence (AI)**	GenAI
Computer Science and Engineering (AIML)	Design Thinking	**Artificial Intelligence (AI)**	**Machine Learning (ML)**	**Deep Learning (DL)**
Computer Science and Engineering (DS)	Design Thinking	Foundation of Data Science	Data Mining	Data Analytics & Visualization
Electrical & Computer Engineering	Design Thinking	Element of Electrical Engineering	Electrical Measurement & Instruments	Electrical Machine
Electronics and Computer Science	Design Thinking	Smart Sensors	Microcontroller Application	Industrial IOT
Mechanical Engineering	Design Thinking	Engineering Graphics & AutoCAD	CNC and 3D Printing	Industrial Automation

SEMESTER - III MULTIDISCIPLINARY COURSE

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEMDC301X	Design Thinking	2	0	0	2	0	0	2
		Evaluation Scheme						
		Component		IA-I	MSE		ESE	Total
		Theory		20	20		40	80

Prerequisite: Nil

Course Objectives:
This course aims to:

1. Introduces the fundamental principles and process of design thinking.
2. Explore human-centered problem-solving approaches.
3. Understand the stages of empathy, ideation, prototyping, and testing
4. Analyze design thinking frameworks and real-world applications
5. Examine visualization and storytelling as tools for innovation.

Course Outcomes (COs): At the End of the course students will be able to

CO 1	**Explain** the philosophy, mindset, and stages of design thinking.
CO 2	**Describe** frameworks used for customer empathy and defining problems.
CO 3	**Use** ideation tools and creativity methods for generating solutions
CO 4	**Evaluate** different approaches to prototyping and solution testing
CO 5	**Analyze** how storytelling and visualization aid design thinking

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	**Introduction to Design Thinking**		**CO 1**	**2**	**6**
	1.1	Definition and origin of design thinking			
	1.2	Design thinking vs Traditional problem-solving approaches			

	1.3	Importance of design thinking in modern innovation			
	1.4	Design thinking mindsets: empathy, experimentation, optimism			
	1.5	Overview of models: Stanford d. school 5-step process, Double Diamond model			
	1.6	Principles of human-centered design			
	Case Studies: IDEO, Apple, Airbnb **Activities:** ❖ Group exercise: Identify real-world challenges ❖ Comparative discussion: Engineering Design vs. Design Thinking				
2	**Empathy and Problem Framing**		**CO 2**	**2**	**6**
	2.1	User empathy in design thinking			
	2.2	Techniques: Observation, interviews, shadowing			
	2.3	Empathy tools: Empathy maps, journey maps			
	2.4	Framing problems: POV statements, HMW questions			
	2.5	Design thinking for social impact			
	Theoretical Focus: Cognitive bias, User perspective, Systems thinking **Activities:** ❖ Field Observation (Virtual/Physical) ❖ Create Empathy Map and User Persona ❖ Develop a Problem Statement				
3	**Ideation and Creative Thinking**		**CO 3**	**4**	**6**
	3.1	The psychology of creativity in problem solving			
	3.2	Ideation methods: Brainstorming, Mind Mapping, SCAMPER, Lateral Thinking			
	3.3	Innovation heuristics and analogies			
	3.4	Overcoming fixed mindsets and cognitive blocks			
	3.5	Convergent vs divergent thinking			
	3.6	Idea selection: Feasibility vs impact			

	Case Analysis: Creative ideation at Google, IDEO **Activities:** ❖ Ideation Sprint in Teams ❖ Affinity Diagramming ❖ Concept Selection				
4	**Prototyping and Testing Strategies**		**CO 4**	**5**	**6**
	4.1	Concept of prototyping and its purpose in design thinking			
	4.2	Types of prototypes: Low fidelity, high fidelity, MVP (theory only)			
	4.3	Prototyping strategies for products and services			
	4.4	Testing concepts: A/B testing, feedback loops, usability testing			
	4.5	Role of experimentation and failure			
	4.6	Metrics: Desirability, viability, feasibility			
	Discussion: Design validation through user feedback / Experimentation and learning from failure **Activities:** ❖ Build Low-Fi Prototypes (Paper, LEGO, Sketch) ❖ Test with Peers and Refine Based on Feedback				
5	**Visualization, Storytelling and Application**		**CO 5**	**4**	**6**
	5.1	Role of storytelling in communicating ideas			
	5.2	Storytelling structures: Pixar framework, Hero's journey			
	5.3	Visualization tools: Mind maps, affinity diagrams, journey maps			
	5.4	Scenario planning and role-based narratives			
	5.5	Strategic application of design thinking in business, education, and healthcare			
	5.6	Challenges and limitations of design thinking			
	Readings: Industry application cases from IBM, SAP, and educational settings **Activities:** ❖ Prepare Final Storyboard and Pitch ❖ Present Team Prototypes + Roadmap ❖ Reflective Group Discussion				

Text Books:	
1	**Tim Brown** – *Change by Design: How Design Thinking Creates New Alternatives for Business and Society*, Harper Business
2	**Idris Mootee** – *Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School*, John Wiley & Sons
3	**Jeanne Liedtka, Andrew King, Kevin Bennett** – *Solving Problems with Design Thinking*, Columbia Business School Publishing
Reference Books:	
1	**Roger Martin** – *The Design of Business: Why Design Thinking is the Next Competitive Advantage*, Harvard Business Review Press
2	**Tom Kelley & David Kelley** – *Creative Confidence: Unleashing the Creative Potential Within Us All*, Crown Publishing
3	**Tom Kelley** – *The Art of Innovation*, Currency
4	**Maurício Vianna et al.** – *Design Thinking: Business Innovation*, MJV Press
5	**L.T.M. Blessing & A. Chakrabarti** – *DRM, A Design Research Methodology*, Springer
6	**Karl T. Ulrich**, *Design: Creation of Artifact in Society*, University of Pennsylvania
7	**Pavan Soni**, *Design Your Thinking*, Penguin India, 2020

MDM - Construction Insights
(offered by Civil Engineering Department)

Course Code	Teaching Scheme (Hrs/week)			Credits Assigned			
	L	T	P	L	T	P	Total
25MDC401X	3	-	-	3	-	-	3
	Evaluation Scheme						
	Component			CIA	MSE	ESE/Oral	Total
	Maximum Marks			20	30	50	100
	Passing Marks			8	12	20	-

Prerequisites:

- Basic Engineering Drawing skills
- Introductory knowledge of Civil Engineering
- Awareness of construction materials and structural components
- Basic understanding of surveying and soil mechanics (conceptual)

Course Objectives: The course will enable students to:

1	Understand the classification, components, and documentation involved in building construction.
2	Analyze site conditions and apply basic techniques for layout, excavation, and foundations.
3	Comprehend superstructure elements and finishing methods using standard practices.
4	Apply planning principles, safety practices, and interpret basic building drawings.

Course Outcomes (COs): At the end of the course, students will be able to:

25MDC401X .01	Classify building types and components, and interpret construction documentation and Building Information Modeling (BIM) concepts using standard building classifications, construction lifecycle stages, and drawing conventions in a classroom or CAD/BIM software environment with correct identification of building categories, components, and BIM elements on sample projects and plans.
25MDC401X .02	Analyze site conditions and identify appropriate layout and foundation techniques by applying principles of site analysis, soil investigation, and construction layout methods using site plans and soil reports with selection of appropriate foundation and layout procedures matching of site characteristics and project requirements.

25MDC401X .02	Describe construction methods for masonry, openings, flooring, staircases, roofs, and finishes by referring to standard construction practices and architectural drawings in the classroom with an accurate explanation of techniques, material choices, and functional components based on construction details provided.
25MDC401X .03	Apply building planning principles and safety practices, and interpret basic civil drawings in studio/lab environments using building regulations, NBC guidelines, and typical architectural plans with correct interpretation of 2D drawings and successful application of planning and safety principles.

Module	Detailed Contents	CO	BL	Hrs
1	**1. Building Types, Documentation & Lifecycle** 1.1 Classification of buildings: Residential, commercial, industrial, public 1.2 Building components: Substructure and superstructure 1.3 Importance of construction drawings; Introduction to Building Information Modeling (BIM) 1.4 Project lifecycle: Phases of a construction project 1.5 Regulatory clearances and approval processes	**CO1**	2	8
2	**2. Site Analysis, Layout & Foundation Systems** 2.1 Site selection criteria and basic soil investigation (SPT, boreholes) 2.2 Site preparation: Clearing, leveling, drainage, dewatering 2.3 Building layout and setting out: Common methods using theodolite, level, tapes 2.4 Excavation techniques and shoring: Types and selection factors 2.5 Foundations: Shallow (spread, strip, raft), Deep (pile, caisson) 2.6 Foundation selection criteria and typical failures (settlement, tilting, cracks)	**CO2**	3	8
3	**3. Superstructure, Openings & Finishes** 3.1 Masonry: Bonds in brick, block, and stone masonry 3.2 Doors and windows: Types, materials, and fixtures 3.3 Openings: Lintels, arches, chajjas 3.4 Types of staircases 3.5 Industrial and residential flooring systems 3.6 Roof systems: Flat and pitched roofs 3.7 Finishes: Plastering, pointing, painting, DPC	**CO3**	2	8
4	**4. Construction Safety & Sustainable Practices** 4.1 Formwork and scaffolding: Types and safety precautions 4.2 Site safety: PPE, hazard identification, OSH basics	**CO4**	3	6

	4.3 Sustainable construction: Green building materials, low-VOC materials 4.4 Eco-friendly practices: Waste management, rainwater harvesting			
5	**5. Fundamentals of Building Design** 5.1 Principles of planning: Roominess, circulation, comfort 5.2 Basic terminology: Built-up area, carpet area, plinth area, FSI/FAR 5.3 Building orientation and influencing factors (sunlight, wind, climate) 5.4 Minimum room dimensions and space standards (as per NBC)	**CO4**	2	5
6	**6. Building Drawing Basics** 6.1 Symbols and conventions in civil drawings (doors, windows, fixtures, materials) 6.2 Plan reading: Floor plans, elevations, section views 6.3 Introduction to line plans and concept drawings 6.4 Interpreting basic building layouts	**CO4**	2	5
Total				**40**

Text Books :	
1	**Sushil Kumar**, *Building Construction*, Standard Publishers
2	B.C. Punmia, Building Construction, Laxmi Publications
3	Bindra & Arora, Building Construction: Planning Techniques and Methods, Dhanpat Rai Publications
Reference Books :	
1	S.K. Sharma, A Textbook of Building Construction, S. Chand.
2	G.S. Birdie, Building Construction, Dhanpat Rai & Sons
3	National Building Code (NBC) of India, BIS

Construction Insights LAB (By the Civil Engineering)

Course Code	Teaching Scheme (Hrs/week)			Credits Assigned			
	L	T	P	L	T	P	Total
25MDL401	-	-	2	-	-	1	1
	Evaluation Scheme						
	Component			CIA	MSE	ESE/Oral	Total
	Maximum Marks			25	-	25	50
	Passing Marks			10	-	10	-

Prerequisite: Basic knowledge of construction elements (gained through classroom sessions) Familiarity with basic engineering drawing Ability to observe construction processes through videos, models, or site visits	
Course Objectives: The course will enable students to:	
1	Interpret basic construction drawings and recognize building classifications.
2	Demonstrate elementary site layout, excavation, and foundation techniques.
3	Identify and sketch basic building elements including masonry, doors, windows, staircases, and finishes.
4	Apply safety practices and develop skills in basic building design and drawing interpretation.
Course Outcomes (COs): At the end of the course, students will be able to:	
25MDL401X .1	**Interpret** building types and construction documentation elements **using** visual media, physical models, and real-life case studies in a lab/studio or site-based learning environment with correct classification and explanation of key components and building types based on provided examples or field observations.
25MDL401X .2	**Apply** building layout marking techniques and identify structural components practically on the field or lab setup **using** tapes, levels, pegs, and layout tools during model or plan-based exercises with successful execution of layout markings and correct identification of substructure and superstructure elements in assigned tasks.
25MDL401X .3	**Identify and reproduce** fundamental construction practices such as masonry bonds, staircases, and surface finishes **through** sketching, model making, and on-

	site/component-based observations with accuracy in bond patterns, component detailing, or layouts as per standard practice.
25MDL401X .4	**Demonstrate** safety protocols and interpret basic building drawings and planning standards **using** NBC norms, safety PPE, construction symbols, and planning tools in guided practicals and plan-reading exercises with compliance to all major safety norms and correct interpretation of drawing elements and planning rules in tasks and assessments.

Detailed Contents

Sr No	Detailed Contents (Tutorial)	CO Mapped	BL	PI	Hrs
1	Study and Interpretation of Building Types (Residential, Commercial, Industrial, Public) using case images and videos	CO1	3		2
2	Reading and Interpreting Construction Drawings (site plan, elevation, section views)	CO4	3		2
3	Study of Doors, Windows, Staircases, and Roof Types through catalogues or site visits	CO3	3		2
4	Design Exercise on Room Arrangement Based on Planning Principles (roominess, circulation)	CO4	3		2

Sr No	Detailed Contents (Practical) (Model Making, Poster making, as per the course owner)	CO Mapped	BL	PI	Hrs
1	Identification of Substructure and Superstructure Components in real or model structures	CO1	3		4
2	Identification and Sketching of Masonry Bonds (English, Flemish, Rat-trap, Stone)	CO3	3		4
3	Drawing Symbols, Plan Reading, and Line Plan Creation of a small residential unit	CO4	3		4
4	Layout and planning of a Simple Building Plan to justify the Fundamentals of Building Design	CO2	3		4

Note: It is appreciated if the faculty choose different problem statements for different student groups. (The group may consist of 3 to 4 students, depending on the type of problem statement) Also, faculty has the liberty to change the problem statement/type of work/types of model, etc

Textbooks:	
1	**Sushil Kumar**, *Building Construction*, Standard Publishers
2	**B.C. Punmia**, *Building Construction*, Laxmi Publications
3	**Bindra & Arora**, *Building Construction*, Dhanpat Rai Publications
Reference Books:	
1	S.K. Sharma, A Textbook of Building Construction, S. Chand.
2	G.S. Birdie, Building Construction, Dhanpat Rai & Sons
3	National Building Code (NBC) of India, BIS

Multidisciplinary Course II (Data Science)

Cou)rse Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25COMDC402	Data Science	3	-	-	3	-	-	3

Evaluation Scheme					
Continuous Internal Assessment (CIA)				Mid Semester Examination	End Semester Examination
Activity	Test	Att	Total		
10	05	05	20	30	50

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)
Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)
Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)
As per the rubric provided by the Attendance committee.

Prerequisite: Problem Solving using Imperative Programming

Course Objectives: The course will enable students to:

1	Apply necessary skills to leverage data for problem-solving in various engineering disciplines.
2	Apply to collect, analyze, and interpret data to gain valuable insights and make data-driven decisions
3	Apply linear regression and logistic regression on the given dataset.

Course Outcomes (COs): At the end of the course, students will be able to:	
CO1	Analyze the importance of Data Science and its Applications in Engineering. (BL3)
CO2	Analyze Data Collection and Preprocessing tasks. (BL3)
CO3	Analyze basics statistics concepts required for Data Science. (BL3)
CO4	Apply machine learning algorithms for prediction and classification tasks. (BL3)
CO5	Apply these understandings on Real-world problems and challenges. (BL3)

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	**Introduction to Data Science**		CO1	BL3	07
	1.1	Overview of the course			
	1.2	Importance of data science in engineering			
	1.3	Real-world examples of data-driven engineering solutions			
	1.4	Self-Learning: Philosophy of Exploratory Data Analysis, Data Science process and Data Scientist's role in this process			
2	**Data Collection and Preprocessing**		CO2	BL4	09
	2.1	Data types and sources, Data collection methods, Data cleaning and preprocessing techniques			
	2.2	Exploratory Data Analysis and Data Visualization			
	2.3	Descriptive statistics, Data visualization techniques using tools: in Python			
	2.4	Self-Learning: Basic tools of EDA			
3	**Statistical Analysis for Data Science**		CO3	BL3	10
	3.1	Introduction to Statistical Analysis			
	3.2	Overview of statistical concepts and terms, Probability distributions			
	3.3	Hypothesis testing and significance, Statistical Inference			
	3.4	Estimation and confidence intervals, Parametric and non-parametric tests,			
	3.5	Self-Learning: Describing Data with Averages - Describing Variability			

4	**Machine Learning Algorithms**		**CO4**	**BL3**	**10**
	4.1	Introduction to Machine Learning, Basic concepts and types of machine learning algorithms, Supervised vs. unsupervised learning			
	4.2	Regression and Classification: Linear regression, Simple and Multiple Linear Regression, Logistic regression			
	4.3	Correlation vs. Regression, Precision, Recall, ML Models Score and Error			
	4.4	Self-Learning: KNN, K-means			
5	**Case Studies & Applications**		**CO5**	**BL3**	**07**
	5.1	Real-world case studies demonstrating the use of data science in engineering			
	5.2	Discussion of ethical challenges and considerations in these case studies.			
	5.3	Self-Learning: Case-Study on any available recommendation system.			
			Total	**42**	

Textbooks:	
1	Fundamentals of data science, Dr. Aijaz Ali, Khan,Anita Rani Mehta,Vandana Ahuja, Rivers Publication, 2023
2	U. Dinesh Kumar, “Data Science: Theory and Practice,” Wiley India
3	V.K. Jain, “Data Science and Analytics.”
Reference Books:	
1	Python for Data Analysis-by WMc Kinney, OREILLY Publication.
2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, “*The Elements of Statistical Learning,"* Springer.

Data Science Lab

Lab Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25COMDL402	Data Science Lab	-	-	2	-	-	1	2

Examination Scheme					
Continuous Internal Assessment (CIA)					External
IPE	Exp	Activity	Att	Total	Prac & Oral
15	05	03	02	25	25

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)
Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)
Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)
As per the rubric provided by the Attendance committee.

Prerequisite: Basics of Python

Lab Objectives: The course will enable students to

1	Apply necessary skills to leverage data for problem-solving in various engineering disciplines.
2	Apply to collect, analyze, and interpret data to gain valuable insights and make data-driven decisions.
3	Apply linear regression and logistic regression on the given dataset
Course Outcomes (COs): At the End of the course students will be able to:	
CO1	Apply the Data Analysis tools on different databases for summarization and interpretation. (BL3)
CO2	Analyze Data Collection and Preprocessing tasks. (BL3)
CO3	Analyze basic statistics concepts required for Data Science. (BL3)
CO4	Apply machine learning algorithms for prediction and classification tasks. (BL3)
CO5	Apply these understandings on Real-world problems and challenges. (BL3)

Week No.	**Suggested Experiment**	**CO Mapped**	**BL**	**Hrs**
1	**Apply** pivot table of Excel to perform data analysis	CO1, CO2	BL3	2
2	**Apply** descriptive statistical techniques on the given dataset using Python to summarize and interpret the data.	CO1, CO2	BL3	2
3	**Generate and interpret** histogram plots using Python to identify distribution patterns in the dataset.	CO3	BL3	2
4	**Apply** simple linear regression using Python and **analyze** the regression output to interpret relationships between variables.	CO3, CO4	BL3, BL4	2

5	**Perform** multiple linear regression using Python and **evaluate** the regression table to identify significant predictors and understand model accuracy.	CO3, CO4	BL4	2
6	**SUBMISSION & ASSESSMENT**			2
7	**Apply** logistic regression on the given dataset and **analyze** the regression output to interpret classification results.	CO3, CO4	BL3, BL4	2
8	**Install and explore** Tableau to **identify and understand** the user interface components such as Dimensions, Measures, Pages, Filters, Marks, and Show Me. **Connect datasets** and **create basic visualizations**.	CO2, CO5	BL3	2
9	**Apply** various chart types in Tableau, **integrate** maps and geolocation data, and **develop** an interactive dashboard. **Publish** the dashboard to Tableau Public.	CO5	BL3, BL4	2
10	**Construct** scatter plots, apply data highlighters, and use Pages, Cards, and Annotations. **Design** a story and **publish** it on Tableau Public.	CO5	BL3	2
11	Case study: **Apply** interactive data visualization techniques using Tableau to explore and represent datasets effectively.	CO5	BL3, BL4	2
12	Case Study: **Use** Power BI to **visualize and analyze** customer segmentation data from a case study, and **evaluate** visualization effectiveness.	CO5	BL3, BL4	2
13	**SUBMISSION AND ASSESSMENT**			2
Assignment	**Choose any open dataset. Perform the tasks mentioned below. Submit a detailed report with screenshots and code snippet.** **1. Dataset understanding** **2. Data Cleaning and Preprocessing** **3. Descriptive statistics** **4. Basic Analysis** **5. Report Writing.**	**All**	**BL3**	**2**

Multidisciplinary Minor II
Artificial Intelligence

<table>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Course Name</th><th colspan="3">Teaching Scheme (Hrs/week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>L</th><th>T</th><th>P</th><th>Total</th></tr>
<tr><td rowspan="5">25CAIMDC4021</td><td>MDM-II-Artificial Intelligence</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="4">Continuous Internal Assessment (CIA)</td><td colspan="2" rowspan="2">Mid Semester Examination</td><td colspan="2" rowspan="2">End Semester Examination</td></tr>
<tr><td>Activity</td><td>Test</td><td>Att</td><td>Total</td></tr>
<tr><td>10</td><td>05</td><td>05</td><td>20</td><td colspan="2">30</td><td colspan="2">50</td></tr>
</table>

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)
Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)
As per the rubric provided by the Attendance committee.

Prerequisite: C Programming

Course Objectives:

1	Describe the fundamental characteristics of intelligent environments and compare various agent architectures
2	Understand different search algorithms to solve problems
3	Discuss knowledge representation techniques and reasoning methods to evaluate and solve problems.
4	Analyze and evaluate different decision-making approaches used in uncertain situations.
5	Explain and differentiate between various machine learning techniques
Course Outcomes (COs): At the End of the course students will be able to	
CO1	**Understand** the characteristics of the environment and differentiate between various agent architectures. (BL4)
CO2	**Apply** and **analyze** search algorithms to solve problems using various search techniques (BL3)
CO3	Use knowledge and reasoning to **analyze** problems and **evaluate** solutions (BL3)
CO4	**Evaluate** and reason through uncertain situations to make informed decisions. (BL5)
CO5	**Comprehend** various learning techniques (BL2)

Module No.	**Detailed Contents**		**CO Mapped**	**BL**	**Hrs**
1	**Title**	**Introduction to Artificial Intelligence**	**CO1**	**BL2**	**6**
	1.1	Artificial Intelligence (AI): History of AI, Applications of AI, The present state of AI, Ethics in AI	**CO1**	**BL2**	
	1.2	Intelligent Agents and Environment the structure of an agent, Types of Agents, Environments and Its Properties, PEAS Representation for an Agent	**CO1**	**BL2**	
		Self Learning: Applications of AI			**1**

2	**Title**	**Problem-Solving using Searching**	**CO2**	**BL3, BL4**	**11**
	2.1	Solving Problems by Searching, Performance evaluation of search strategies, Time Complexity, Space Complexity, Completeness, Optimality	**CO2**	**BL4**	
	2.2	Uninformed Search: Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bidirectional Search	**CO2**	**BL3**	
	2.3	Informed Search: Heuristic Function, Admissible Heuristic, Informed Search Technique, Greedy Best First Search, A* Search, Local Search: Hill Climbing Search, Simulated Annealing Search, Optimization: Genetic Algorithm	**CO2**	**BL4**	
	2.4	Game Playing, Adversarial Search Techniques, Mini-max Search, Alpha-Beta Pruning	**CO2**	**BL4**	
		Self Learning: Solving Problems by Searching Techniques			**1**
3	**Title**	**Knowledge and Reasoning**	**CO3**	**BL2, BL3**	**12**
	3.1	Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems	**CO3**	**BL2**	
	3.2	Propositional Logic (PL): Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula, Introduction to logic programming (PROLOG)	**CO3**	**BL3**	
	3.3	Predicate Logic: FOPL, Syntax, Semantics, Quantification, Inference rules in FOPL	**CO3**	**BL3**	
	3.4	Forward Chaining, Backward Chaining and Resolution in FOPL	**CO3**	**BL4**	
		Self Learning: Case study on Knowledge and Reasoning in AI			**1**

4	**Title**	**Reasoning Under Uncertainty**	**CO4**	**BL3, BL4**	**7**
	4.1	Handling Uncertain Knowledge, Random Variables, Prior and Posterior Probability, Inference using Full Joint Distribution	**CO4**	**BL4**	
	4.2	Bayes' Rule and its use, Bayesian Belief Networks	**CO4**	**BL3**	
		Self Learning: Case study and Applications on Healthcare Systems			**1**
5	**Title**	**Planning and Learning**	**CO5**	**BL2, BL3, BL4**	**6**
	5.1	The planning problem, Partial order planning, total order planning	**CO5**	**BL4**	
	5.2	Learning in AI, Learning Agent, Concepts of Supervised, Unsupervised, Semi -Supervised Learning, Reinforcement Learning, Ensemble Learning	**CO5**	**BL2**	
	5.3	Expert Systems, Components of Expert System: Knowledge base, Inference engine, user interface, working memory, Development of Expert Systems	**CO5**	**BL3**	
		Self Learning: Types of Learning			**1**
				Total	**42***

*Total Hours 42 Excluding Self Learning Session

Text Books :	
1	Stuart J. Russell and Peter Norvig, "Artificial Intelligence, A Modern Approach —Second Edition" Pearson Education.
2	Elaine Rich and Kevin Knight —Artificial Intelligence‖ Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3	George F Luger —Artificial Intelligence‖ Low Price Edition, Pearson Education., Fourth edition.

Reference Books :	
1	Ivan Bratko ―PROLOG Programming for Artificial Intelligence‖, Pearson Education, Third Edition
2	D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall
3	Saroj Kaushik ―Artificial Intelligence‖, Cengage Learning.

Multidisciplinary Minor II Lab

Artificial Intelligence Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CAIMDC4021	Artificial Intelligence Lab	0	0	1	0	0	1	1
	Examination Scheme							
	Continuous Internal Assessment (CIA)							External
	IPE	Exp	Activity		Att	Total		Prac & Oral
	15	05	03		02	25		25

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)
Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)
Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)
As per the rubric provided by the Attendance committee.

Prerequisite: Python Programming

Course Objectives:

1	Design an appropriate agent architecture tailored to solve a real-world AI problem.
2	Implement knowledge representation and reasoning techniques using an AI programming language.
3	Develop a problem-solving agent capable of addressing specific tasks effectively.
4	Incorporate methods of reasoning under uncertainty to enhance the decision-making capabilities of an AI agent.
Course Outcomes (COs): At the End of the course students will be able to	
CO1	**Identify** suitable Agent Architecture for a given real world AI problem. (L2)
CO2	**Implement** simple programs using Prolog. (L3)
CO3	**Implement** various search techniques for a Problem-Solving Agent. (L3)
CO4	**Construct** a Bayesian Belief Network for a given problem and draw probabilistic inferences from it. (L3)

Suggested Experiments: Students are required to complete at least 10 experiments.

Week No.	Exp. No.	Detailed Contents	CO Mapped	Bloom's Level	Hrs
1	1	Case study on AI applications published in IEEE/ACM/Springer or any prominent journal.	CO1	BL2	2
2	2	Provide the PEAS description and TASK Environment for a given AI problem.	CO1	BL2	2
3	3	Write simple programs using PROLOG as an AI programming Language.	CO2	BL3	2
4	4	Write a program using PROLOG for first order logic.	CO2	BL3	2
5	5	Implement any one of the Uninformed search techniques.	CO3	BL3	2
6	**Internal Assessment -I & Submission**				

7	7	Implement a hill climbing algorithm to solve 8 puzzle problems.	CO3	BL3	2
8	8	Implement any 2 player game using game playing algorithms.	CO3	BL3	2
9	9	Implement adversarial search using min-max algorithm.	CO3	BL3	2
10	10	Implement BFS and DFS search problems using Python.	CO3	BL3	2
11	11	Create a Bayesian Network for the given Problem Statement and draw inferences from it.	CO4	BL3	2
12	12	Implement Q-Learning for Grid World Navigation problem.	CO1, CO3	BL3, BL3	2
13	**Internal Assessment -II & Submission**				
14	14	Design a prototype of an expert system.	CO1, CO4	BL3, BL3	2

Text Books :	
1	Stuart J. Russell and Peter Norvig, "Artificial Intelligence, A Modern Approach —Second Edition" Pearson Education.
2	Elaine Rich and Kevin Knight —Artificial Intelligence‖ Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3	George F Luger —Artificial Intelligence‖ Low Price Edition, Pearson Education., Fourth edition.
Reference Books :	
1	Ivan Bratko —PROLOG Programming for Artificial Intelligence‖, Pearson Education, Third Edition
2	D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall
3	Saroj Kaushik —Artificial Intelligence‖, Cengage Learning.

Foundation of Data Science

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSMDC402	Foundation of Data Science	3	-	-	3	-	-	3

Evaluation Scheme					
Continuous Internal Assessment (CIA)				Mid Semester Examination	End Semester Examination
Activity	Test	Att	Total		
10	05	05	20	30	50

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)
Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)
Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)
As per the rubric provided by the Attendance committee.

Prerequisite: Problem Solving using Imperative Programming

Course Objectives: The course will enable students to:

1	Apply necessary skills to leverage data for problem-solving in various engineering disciplines.
2	Apply to collect, analyze, and interpret data to gain valuable insights and make data-driven decisions
3	Apply linear regression and logistic regression on the given dataset.

Course Outcomes (COs): At the end of the course, students will be able to:	
CO1	Analyze the importance of Data Science and its Applications in Engineering. (BL3)
CO2	Analyze Data Collection and Preprocessing tasks. (BL3)
CO3	Analyze basics statistics concepts required for Data Science. (BL3)
CO4	Apply machine learning algorithms for prediction and classification tasks. (BL3)
CO5	Apply these understandings on Real-world problems and challenges. (BL3)

Module No.	**Detailed Contents**		**CO Mapped**	**BL**	**Hrs**
1	**Introduction to Data Science**		**CO1**	**BL3**	**07**
	1.1	Overview of the course			
	1.2	Importance of data science in engineering			
	1.3	Real-world examples of data-driven engineering solutions			
	1.4	Self-Learning: Philosophy of Exploratory Data Analysis, Data Science process and Data Scientist's role in this process			
2	**Data Collection and Preprocessing**		**CO2**	**BL4**	**09**
	2.1	Data types and sources, Data collection methods, Data cleaning and preprocessing techniques			
	2.2	Exploratory Data Analysis and Data Visualization			
	2.3	Descriptive statistics, Data visualization techniques using tools: in Python			
	2.4	Self-Learning: Basic tools of EDA			
3	**Statistical Analysis for Data Science**		**CO3**	**BL3**	**10**
	3.1	Introduction to Statistical Analysis			
	3.2	Overview of statistical concepts and terms, Probability distributions			
	3.3	Hypothesis testing and significance, Statistical Inference			

	3.4	Estimation and confidence intervals, Parametric and non-parametric tests,			
	3.5	Self-Learning: Describing Data with Averages - Describing Variability			
4	**Machine Learning Algorithms**		**CO4**	**BL3**	**10**
	4.1	Introduction to Machine Learning, Basic concepts and types of machine learning algorithms, Supervised vs. unsupervised learning			
	4.2	Regression and Classification: Linear regression, Simple and Multiple Linear Regression, Logistic regression			
	4.3	Correlation vs. Regression, Precision, Recall, ML Models Score and Error			
	4.4	Self-Learning: KNN, K-means			
5	**Case Studies & Applications**		**CO5**	**BL3**	**07**
	5.1	Real-world case studies demonstrating the use of data science in engineering			
	5.2	Discussion of ethical challenges and considerations in these case studies.			
	5.3	Self-Learning: Case-Study on any available recommendation system.			
			Total	**42**	

Textbooks:	
1	Fundamentals of data science, Dr. Aijaz Ali, Khan,Anita Rani Mehta,Vandana Ahuja, Rivers Publication, 2023
2	U. Dinesh Kumar, “Data Science: Theory and Practice,” Wiley India
3	V.K. Jain, “Data Science and Analytics.”
Reference Books:	
1	Python for Data Analysis-by WMc Kinney, OREILLY Publication.
2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, “*The Elements of Statistical Learning,"* Springer.

SEMESTER - IV MULTIDISCIPLINARY COURSE

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEMDC402	Elements of Electrical System	3	0	0	3	0	0	3
		Evaluation Scheme						
		Component		CIA	MSE		ESE	Total
		Theory		20	30		50	100

Prerequisite: Basic physics, Electromagnetic induction, AC circuit analysis (phasors, impedance) Basics of transformers and power factor, Ohm's Law, Kirchhoff's Laws.

Course Objectives:

1. **To list & describe the different methods of Power generation**
2. **To elaborate the various types of transmission lines**
3. **To discuss the various types of electrical loads**
4. **To understand and calculate the power consumption in electrical system**
5. **To explain the various types of electrical energy storage system**
6. **To discuss the various types of electrical meters**

Course Outcomes (COs): At the End of the course students will be able to

CO1	**Evaluate the sending end and receiving end voltage of transmission line**
CO2	**Study the various types of electrical loads**
CO3	**Understand the ratings and calculate the electrical energy consumption**
CO4	**Study the various types of electrical storage**
CO5	**Illustrate the working of different types of meters in electrical system**

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	**Generation of Electrical Power**		**CO1**	**L2**	**8**
	1.1	Overview of different methods of Power generation: thermal (fossil fuels, nuclear), renewable (solar, wind, hydro, geothermal), nuclear and emerging technologies (tidal, wave, biomass).			

	1.2	Layout of hydroelectric power station, thermal power plant, solar generation, nuclear power plant with their advantages and disadvantages.			
	1.3	Cost of generation, peak load and base load plant			
2	**Transmission**		**CO1**	**L2**	**6**
	2.1	Short, medium and long transmission lines, Types of conductors used,			
	2.2	Single phase transmission line, 3 phase transmission line (single circuit and double circuit).			
	2.3	Application of KVL, KCL to find sending end and receiving end voltage.			
	2.4	Calculations of Power transmitted			
3	**Utilization of Electrical Energy**		**CO3**	**L2**	**8**
	3.1	Electric Power Distribution: Generation, Transmission and distribution systems: grid structure, voltage levels.			
	3.2	Types of loads: Residential: lighting load, refrigeration and air conditioning, washing machine. Agricultural load: pumps. Industrial load:			
	3.3	Electrical Drives- AC-DC, furnace, Electric heating & welding, Machines (Motors and generators: AC vs. DC)			
4	**Rating & Calculation of Energy Consumption**		**CO4**	**L2**	**7**
	4.1	Power rating of household appliances such as tube light, fan, air conditioners, PCs, laptops, printers, etc.			
	4.2	Definition of “unit” used for consumption of electrical energy,			
	4.3	Understand the calculation of electricity bill for LT & HT consumers.			
5	**Energy Storage**		**CO5**	**L2**	**7**
	5.1	Battery Technologies: Chemistry basics: lead-acid, lithium-ion, sodium-ion, solid-state batteries.			
	5.2	Charging and discharging characteristics. Battery management systems (BMS).			
	5.3	Battery storage: types (lead-acid, lithium-ion, flow batteries), applications.			

6	**Measurement in Electrical Energy Systems**		**CO6**	**L2**	**6**
	6.1	Importance of measurement in electrical energy systems. Basic principles of electrical measurements: instruments and techniques.			
	6.2	Moving coil and Moving iron Ammeters & Voltmeters,			
	6.3	Power measurement by wattmeter in single phase circuit			
Self-Study					**3***
TOTAL HOURS					**42**

Text Books:	
1	Mahesh Verma, Power Plant Engineering, Metrolitan Book Co Pvt Ltd
2	RK Rajput, A Text Book of Power System engineering, Laxmi Publication
3	D. P. Kothari, I. J. Nagrath, Power System Engineering, 3 Edition, Mc GrawHill
4	B.R. Gupta, Power System Analysis And Design, S.Chand
5	Mehta V.K., Principles of Power System, S Chand
6	AK Sawhney, Electrical & Electronic Measurements and Instrumentation, Dhanpat Rai & Sons
7	Dincer I., and Rosen M. A. (2011); Thermal Energy Storage: Systems and Applications, Wiley
Reference Books:	
1	W. D. Stevenson, Elements of Power System, 4 Edition TMH
2	Trevor M. Letcher, Storing Energy with Special Reference to Renewable Energy Source, Elsevier, 2016.
3	RS Sirohi & Radhakrisnan, Electrical Measurement & Instrumentation, New Age International

SEMESTER - IV MULTIDISCIPLINARY COURSE

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEMDL402	Elements of Electrical Systems Lab	0	0	2	0	0	1	1
		Evaluation Scheme						
		Component		CIA		ESE		Total
		Laboratory		25		25		50

Prerequisite:
Familiarity with Lab Equipment: Multimeters, tachometers, watmeters, and variacs.
Circuit Assembly: Comfort with wiring and interpreting circuit diagrams.
Safety Protocols: Understanding grounding, insulation, and emergency procedures.

Course Objectives: The course will enable students to:

1	Evaluate the performance of transmission lines.
2	Illustrate the performance parameters of a generator.
3	Evaluate the characteristics of batteries.
4	Study the operation and performance of an electric motor.
5	Analyze the performance of renewable energy sources.
6	Familiarize with electrical measurement techniques

Course Outcomes (COs): At the end of the course, students will be able to:

CO1	To study and analyze various aspects and operational behaviour of performance of different renewable energy sources and energy storage
CO2	To evaluate the efficiency and performance of DC machines (motor and generator) and analyze the behavior of a transmission line under load conditions.
CO3	To demonstrate the effective use of various meters to perform voltage, current and power measurements of single and three phase circuits.
CO4	To study the nature of V-I characteristics for single phase and three phase loads.

Week No.	Detailed Contents	CO Mapped	BL	Hrs
1	Measure and plot the no load magnetization (open circuit) characteristic (V-I curve) of a DC generator.	**CO3**	**L3**	**4**
2	Calculate efficiency and voltage regulation of DC generators using external characteristics.	**CO3**	**L3**	**4**
3	Case study to get the current-voltage (I-V) characteristics of a solar PV panel under different light intensities (simulated using lamps).	**CO1**	**L3**	**4**
4	Calculate the MPPT of a solar PV panel under different light intensities (simulation using lamps).	CO1	**L3**	**4**
5	Measure speed-torque characteristics of a DC motor under different load conditions.	CO3	**L3**	**4**
6	Measure charge-discharge characteristics of different types of batteries (e.g., lead acid, lithium-ion).	CO1	**L3**	**4**
7	To analyze efficiency, capacity, and voltage profiles of different types of batteries (e.g., lead-acid, lithium-ion) (simulation based or hands on).	CO1	**L3**	**4**
8	Perform voltage, current and power measurements in single phase circuit using analog meters and verify Ohm's law.	CO4	**L3**	**4**
9	Perform voltage, current and power measurements in single phase circuit using digital meters and verify Ohm's law.	CO4	**L3**	**4**
10	To perform load test using 1- phase and 3 phase sources and loads using MATLAB Simulink	CO5	**L3**	**4**
11	Generation of sinusoidal voltage waveform using MATLAB Simulink.	CO4	**L3**	**4**
12	Simulation of transmission line model using MATLAB Simulink	CO3	**L3**	**4**
13	Case Study to compare efficiency and reliability of different renewable energy sources	CO1	**L3**	**4**

Note: It is appreciated if the faculty choose different problem statements for different student batches.

Assessment:

At least 10 experiments covering the entire syllabus of this course should be set to have well predefined inference and conclusion. The experiments should be student centric and attempts should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiments must be graded from time to time. The grades should be converted into marks as per the NEP 2020 manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

<table>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hrs/week)</td><td colspan="4">Credits Assigned</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>L</td><td>T</td><td>P</td><td>Total</td></tr>
<tr><td rowspan="5">25ECSMDC402X</td><td rowspan="5">Multidisciplinary Minor-II (Smart Sensors and Instrumentation)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="2" rowspan="2">Component</td><td colspan="2">Internal Assessment</td><td colspan="2">External Assessment</td><td rowspan="2">Total</td></tr>
<tr><td>CIA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td colspan="2">Theory</td><td>20</td><td>30</td><td colspan="2">50</td><td>100</td></tr>
</table>

<table>
<tr><td colspan="2">Prerequisite:
1. Concept of internal characteristics of elements like resistor, capacitor, inductor, diode and transistors.
2. Working, knowledge of basic fundamentals of mechanical terms like position, strain, stress etc</td></tr>
<tr><td colspan="2">Course Objectives:</td></tr>
<tr><td>1</td><td>To understand various physical parameters and its sensing techniques</td></tr>
<tr><td>2</td><td>To familiarize about MEMS sensors and Actuators</td></tr>
<tr><td>3</td><td>To introduce wireless sensing technologies</td></tr>
<tr><td>4</td><td>To develop understanding about signal conditioning using ADC and DAC</td></tr>
<tr><td colspan="2">Course Outcomes (COs): At the End of the course students will be able to</td></tr>
<tr><td>CO1</td><td>Elaborate the transduction principle of various sensors.(BL2)</td></tr>
<tr><td>CO2</td><td>Select sensors suitable for required application.(BL4)</td></tr>
<tr><td>CO3</td><td>Analyze wireless sensing techniques.(BL3)</td></tr>
<tr><td>CO4</td><td>Design the data acquisition system and Identify signal conditioning method for particular application.(BL4)</td></tr>
<tr><td>CO5</td><td>Describe instrument communication standards.(BL2)</td></tr>
</table>

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	**Title**	**Introduction**	**CO1**	**L2**	**06**
	1.1	**Classification of Sensors :** The sensors are classified with criteria like primary physical quantity to be sensed , transduction principle, material and technology used and application			
	1.2	**Criteria to choose a Sensor:** Accuracy, Environmental condition, Range, Calibration, Resolution , Cost and Repeatability			
	1.3	**Digital sensors** : Principle and its advantage over analog sensors			
	1.5	**Smart Sensors:** Low-power, Self –diagnostic and Self-calibration			
2	**Title**	**Types of Sensors**	**CO2**	**L4**	**08**
	2.1	**Temperature Sensors :** RTD, Thermocouple and Thermistors sensor Photoelectric and Ultrasonic sensors			
	2.2	**Proximity Sensors :** Inductive (LVDT), Capacitive,			
	2.3	**Chemical Sensors :** Gas , Smoke, Conductivity and pH sensor			
	2.4	**Other Sensors :** Optical, Infrared (IR), Sound, Motion , Pressure , Level , Moisture, Humidity, Laser , Image and GPS sensor			
3	**Title**	**MEMS Sensors and Actuators**	**CO2**	**L4**	**07**
	3.1	**MEMS SENSORS:** General design methodology, techniques for sensing, Pressure sensor , Mass Flow sensor , Acceleration sensor , Angular Rate sensor and Gyroscopes, Micro machined microphones, Chemical sensors, Taguchi Gas sensor, Combustible Gas sensors			
	3.2	**MEMS ACTUATORS:** Techniques for actuation, Digital Micro mirror Device, Micro Machined Valves			

4	**Title**	**Wireless Sensing Technologies**	**CO3**	**L3**	**09**
	4.1	**Bluetooth:** Concepts of Pico net, Scatter net, Link types, Network connection establishments			6
	4.2	**ZigBee:** components, architecture, network topologies			
	4.3	**Ultra Wide Band (UWB), Near Field Communication (NFC) and RFID:** technical requirements, components and characteristics			
	4.4	**Self learning:**WLAN (WiFi) : WLAN Equipment, WLAN topologies , IEEE 802.11 Architecture			3
5	**Title**	**Data Acquisition and Signal Conditioning**	**CO4**	**L4**	**08**
	5.1	**Fundamentals of Data Acquisition:** Analog and Digital data acquisition system with different configurations, Data loggers, Noise and interference			
	5.2	**Signal Conditioning :** Wheatstone Bridge, Flash ADC, R2R DAC			
	5.2	Utilization of Signal conditioning circuits for Temperature, Pressure, Optical, Strain gauges, Displacement and piezoelectric Transducers			
6	**Title**	**Telemetry and Instrument communication standards**	**CO5**	**L2**	**07**
	6.1	Introduction to telemetry, landline telemetry, radio telemetry and types of multiplexing			
	6.3	Instrument interfacing, Current loop, RS232/485, Field bus, Modbus, GPIB, USB Protocol, and HART communication Protocol.			

Text Books :	
1	Sensors and Signal Conditioning, Ramon Pallas Areny, John G. Webster, 2nd edition, John Wiley and Sons, 2000.
2	Vijay K. Garg, “Wireless Communication and Networking”, Morgan -Kaufmann Series in Networking, Elsevier, 2010.
3	Er. R.K. Rajput “Instrumentation and Control Systems”, S. Chand & Company Ltd.
Reference Books :	
1	Nathan Ida, “Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction”, Second Edition, IET Control, Robotics and Sensors Series 127, 2020
2	Instrumentation Devices and System, C.S. Rangan, G.R. Sarma, V.S. Mani, TMH,1997

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECSMDL402X	Multidisciplinary Minor II Lab (Smart Sensors and Instrumentation Lab.)	0	0	2	0	0	1	1
		Evaluation Scheme						
		Component		CIA	MSE	Prac. and Oral		Total
		Laboratory		25	-	25		50

Prerequisite: Basic Electricals and Electronics Lab and Electronic devices Lab.	
Course Objectives:	
1	To familiarize students with various types of analog and digital sensors used in in different real time applications.
2	To provide hands-on experience in interfacing sensors with microcontrollers or embedded systems such as Arduino and ESP32.
3	To develop skills in sensor calibration and signal conditioning, including amplification and filtering of analog signals.
4	To introduce data acquisition techniques, enabling students to collect, process, and interpret sensor data.
Course Outcomes (COs): At the End of the course students will be able to	
CO1	**Describe** the principles, classifications, and characteristics of sensors. (BL2)
CO2	**Identify** and **describe** various types of sensors and their applications in real-world environments. (BL2)
CO3	**Demonstrate** the use of electromechanical transducers such as LVDT and strain gauges for measurement applications. (BL3)
CO4	**Implement** basic signal conditioning techniques. (BL4)
CO5	**Apply** data acquisition and signal conditioning techniques for different types of transducers.(BL4)
CO6	**Acquire** and log real-time data using IoT platforms. (BL2)

Experiment No	Detailed Contents/Experiments Detail	CO Mapped	BL	Hrs
1.	Demonstrate the working of basic sensor types: temperature, LDR, IR, ultrasonic	**CO1**	**L2**	**02**
2.	Interfacing LM35 (Temperature sensor) with Arduino and displaying on LCD	**CO2**	**L2**	**02**
3.	Interfacing PIR motion sensor to control a buzzer or light	**CO2**	**L2**	**02**
4.	Interfacing ultrasonic sensor (HC-SR04) for distance measurement	**CO2**	**L2**	**02**
5.	Gas and Smoke Detection using Chemical Sensors	**CO2**	**L2**	**02**
6.	Distance and Motion Detection using Optical and Infrared (IR) Sensors	**CO2**	**L2**	**02**
7.	Study and Characterization of an LVDT (Linear Variable Differential Transformer)	**CO3**	**L3**	**02**
8.	Signal Conditioning using Wheatstone Bridge with Strain Gauge	**CO4**	**L4**	**02**
9.	Wireless Sensor Data Transmission using ZigBee or Bluetooth	**CO4**	**L3**	**02**
10.	Analog Data Acquisition and Conversion using ADC/DAC	**CO5**	**L4**	**02**
11.	Instrument Communication using RS232 or Modbus Protocol	**CO6**	**L2**	**02**
12	Case Study	**All**	**L4**	**02**

Case study: Make a detailed report on industrial applications of sensors: Automotive, mobile phone, consumer products or household equipment such as fridge, washing machine (anyone, all students in a batch should take up different problem statements). The case study should include:

1. Name of equipment
2. Application of selected equipment
3. Sensors used in that equipment, working principle of each type of sensor
4. Draw the complete block diagram of equipment and explain the working of each block.
5. Summary
6. References

Text Books:	
1	Sensors and Signal Conditioning, Ramon Pallas Areny, John G. Webster, 2nd edition, John Wiley and Sons, 2000.
2	Vijay K. Garg, “Wireless Communication and Networking”, Morgan -Kaufmann Series in Networking, Elsevier, 2010.
3	Er. R.K. Rajput “Instrumentation and Control Systems”, S. Chand & Company Ltd.
Reference Books:	
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2	Instrumentation Devices and System, C.S. Rangan, G.R. Sarma, V.S. Mani, TMH,1997

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25MEMDM401	Multidisciplinary Minor II Course: Engineering Graphics	3	-	-	3	-	-	3
		Evaluation Scheme						
		Component		CIA	MSE	ESE		Total
		Theory		20	30	50		100

Prerequisite: Knowledge of construction of basic shapes like triangle, square, pentagon, hexagon etc **.,** Dividing a line into number of equal parts	
Course Objectives: The course will enable students to:	
1	To impart and inculcate proper understanding of the theory of projection.
2	To impart the knowledge to read and interpret a drawing
3	To improve the visualization skill.
4	To enable students to represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.
5	Read the 3-dimensional view and draw the orthographic projections
Course Outcomes (COs): At the end of the course, students will be able to:	
CO1	**Construct** basic engineering curves
CO2	**Apply** the basic principles of projections in Projection of points and Planes
CO3	**Draw** projection of regular solids inclined to both the reference planes.
CO4	**Draw** the development of lateral surfaces of solids with sections
CO5	**Read** the 3 dimensional view and **draw** the orthographic projections
CO6	**Read** the orthographic projection and **draw** isometric views

Module		Detailed Contents	CO Mapped	BL	Hrs
1	**Introduction to Engineering Graphics**		**CO1**	**3**	**8**
	1.1	Introduction to Engineering Graphics and its significance in Engineering domain. Types of Lines, Dimensioning Systems as per IS conventions.			
	1.2	Introduction to plain and diagonal scales.			
	1.3	Engineering Curves: Basic construction of Cycloid, and Involutes			
2	**Projection of Points and Planes**		**CO2**	**3**	**8**
	2.1.	Projections of points in any quadrants as well as resting on planes			
	2.2.	Projections of planes (Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular) inclined to both the Reference Planes. (Exclude composite planes).			
3	**Projection of Solids**		**CO3**	**3**	**10**
	3.1	Projections of solids with the axis inclined to one and both reference planes. (prism, pyramid, cylinder and cone only). Triangular to hexagonal prism and pyramids to be considered. Exclude Spheres, Composite, hollow solids and frustum of solids). Use change of position method			
4	**Section and development of Solids**		**CO4**	**3**	**10***
	4.1	Sections of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to one reference plane using change of position method			
	4.2	Development of lateral surface (only) of prism and pyramid.			
5	**Orthographic Projections**		**CO5**	**3**	**10***
	5.1	Fundamentals of orthographic projections like concept of quadrants, observer position, horizontal, vertical and profile plane, symbol etc. Different orthographic views, First and Third angle method of projection. Views of a simple machine part as per the first angle projection method only			
	5.2	Fundamentals of sectional projections like concept of section plane, its representation, section lines and its			

		features, need of sectional views, rib and web in section. Different sectional views of a simple machine part as per the first angle projection.			
6	**Isometric Projections**		**CO6**	**3**	**06***
	6.1	Basic concept of isometric projection. Difference between isometric projection and isometric views. Conversion of orthographic views to isometric views (Excluding sphere).			
*** To be covered during practical hours**					

Self-Learning topic

7	**Projection of Lines**		**CO2**	**3**	**04**
	7.1	Representation of lines in different spatial positions (perpendicular, parallel, inclined to reference planes), and the methods for determining true length and inclinations of lines			

Textbooks:	
1	N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.
2	N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.
Reference Books:	
1	Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publisher.
2	Prof. Sham Tickoo (Purdue University) & GauravVerma, "(CAD Soft Technologies).
3	Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25MEMDML401	Multidisciplinary Minor II Lab Engineering Graphics Lab	-	-	2	-	-	1	1
		Evaluation Scheme						
		Component		CIA	MSE	ESE		Total
		Lab		25	-	25		50

Prerequisite: 1. Basic Engineering Drawing Knowledge 2. Geometry Fundamentals 3. Coordinate system	
Course Objectives: The course will enable students to:	
1	Understand the importance of engineering graphics and its role in mechanical engineering.
2	Learn the conventions of technical drawing, including types of lines, dimensioning, and IS standards.
3	Develop the ability to draw engineering scales, curves, and projections manually and using AutoCAD.
4	Gain proficiency in using AutoCAD software to create accurate 2D technical drawings.
5	Interpret and generate views of mechanical components using orthographic projections and CAD tools.
Course Outcomes (COs): At the end of the course, students will be able to:	
CO1	**Understand and apply** IS conventions in technical drawings using lines, scales, and dimensions.
CO2	**Interpret** geometrical features and **develop** orthographic projections of mechanical components.
CO3	**Interpret orthographic projections and develop Isometric views**
CO4	**Communicate** technical information effectively through standardized CAD drawings.
CO5	**Interpret** geometrical features and **develop** 3D object.

Module	Detailed Contents		CO Mapped	BL	Hrs
1	**Introduction to Engineering Drawing**		**CO1**	**3**	**2**
	1.1	Significance of Engineering Drawing in Mechanical Engineering			
	1.2	Drawing instruments and drawing sheet layout			
	1.3	IS Code: Types of lines, lettering, dimensioning standards			
2	**Introduction to AutoCad**		**CO1**	**3**	**6**
	2.1.	Introduction to AutoCAD interface, commands, coordinate system			
	2.2.	Basic AutoCAD tools: LINE, CIRCLE, ERASE, MOVE, COPY, OFFSET, TRIM, EXTEND			
	2.3	Applying dimensions to objects, applying annotations to drawings, setting up and use of layers, layers to create drawings, Create, edit and use customized layers, changing line lengths through modifying existing lines			
3	**Orthographic Projections**		**CO2 CO4**	**3**	**8**
	3.1	Principles of orthographic projection (First angle method)			
	3.2	Drawing front view, top view, and side views of simple mechanical objects			
	3.3	Drawing sectional front view, top view, and side views of simple mechanical objects			
4	**Isometric views**		**CO3 CO4**	**3**	**6**
	4.1	Introduction to isometric views and scales			
	4.2	Conversion of Orthographic views into isometric views			
5	**Introduction to 3D drawing**		**CO5**	**3**	**04**
	5.1	Basic 3D object building			

Textbooks:	
1	Engineering Drawing + AutoCAD, K. Venugopal, New Age International
2	Engineering Graphics with AutoCAD 2022, James D. Bethune, Pearson Education
Reference Books:	
1	Engineering Graphics, P.S. Gill, S.K. Kataria & Sons
2	Engineering Drawing and Graphics + AutoCAD, T.Jeyapoovan, Vikas Publishing House
3	AutoCAD for Engineers and Designers, Sham Tickoo, CADCIM Technologies