Marathwada Shikshan Prasarak Mandal's
DEOGIRI INSTITUTE OF ENGINEERING AND MANAGEMENT STUDIES
(An Autonomous Institute)
Affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere, Raigad |B.Tech | M. Tech
Affiliated to Dr. Babasaheb Ambedkar Marathwada University, CSN| MBA
Approved by AICTE/UGC- Govt. of India & DTE- Govt. of Maharashtra
Deogiri College Campus, Railway Station Road, Chhatrapati Sambhajinagar-431005 (MS)
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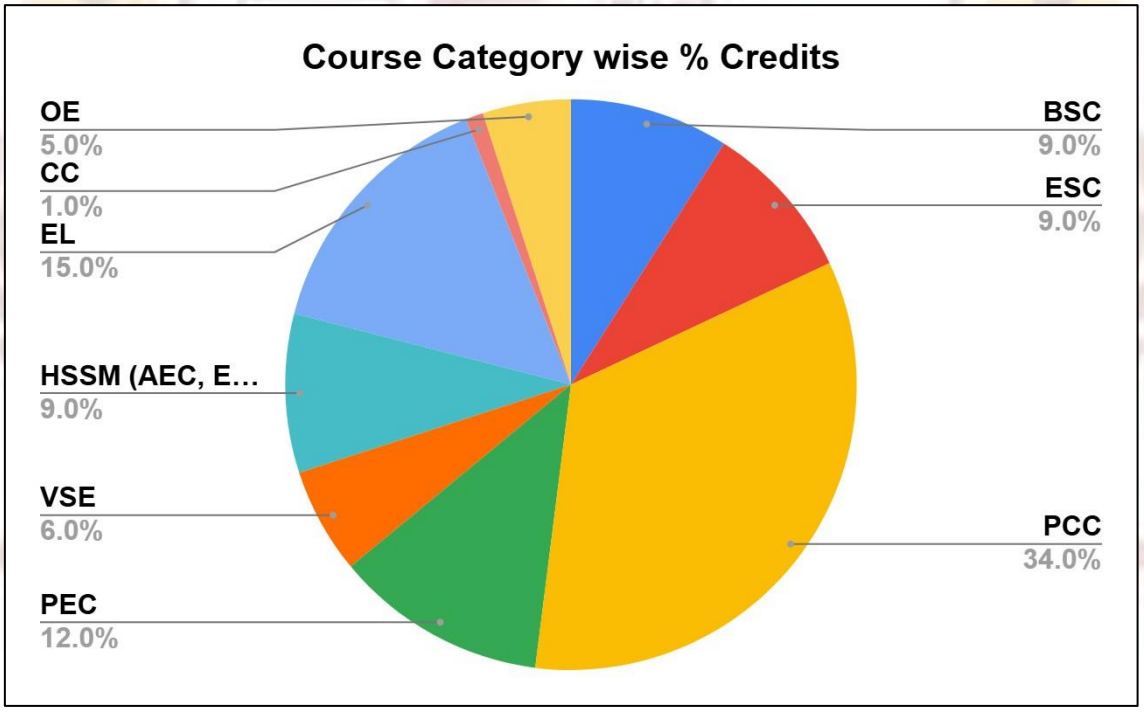
Department of Computer Science and Engineering
(Artificial Intelligence and Machine Learning)
B.TECH. PROGRAM STRUCTURE (2026-30)

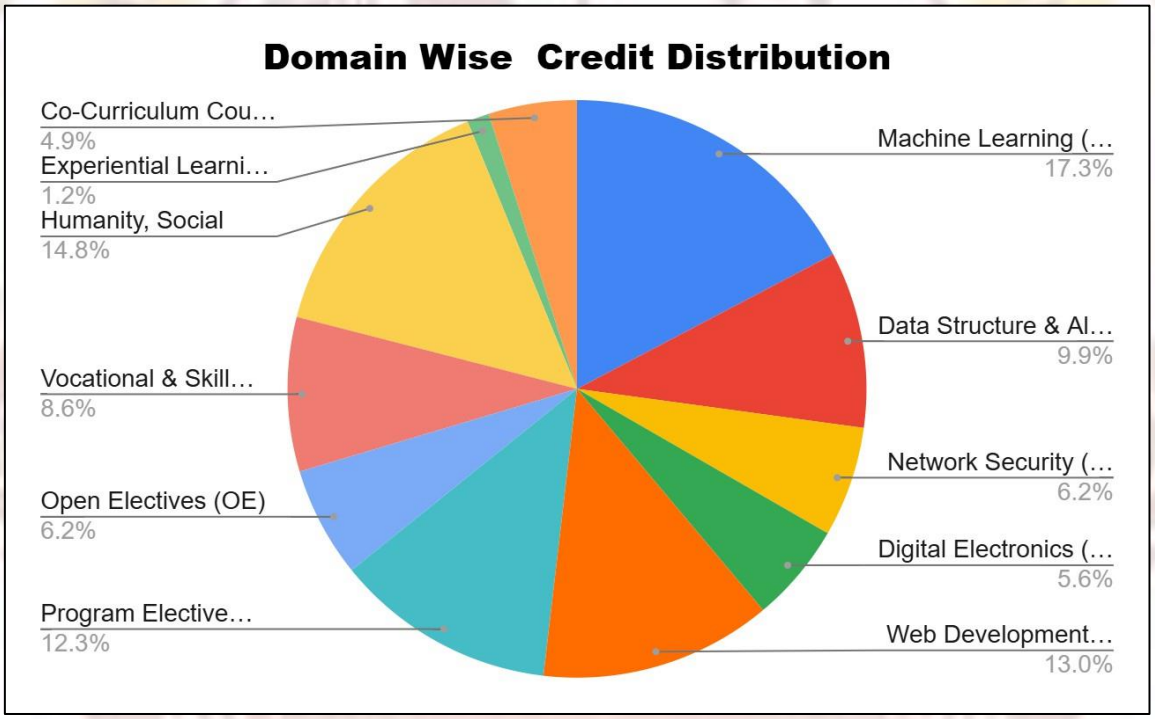
Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC/ESC	08	07	--	--	--	--	--	--	15
Engineering Science Course		07	08	--	--	--	--	--	--	15
Program Core Course (PCC)	Program Courses	--	02	10	10	10	10	12	--	54
Program Elective Course (PEC)		--	--	--	--	04	06	04	06	20
Vocational Courses (Industrial Collaboration Course)	Skill Courses	--	--	--	--	--	--	02	--	10
Skill Enhancement Course (Professional Development)		01	01	01	01	02	02	--	--	
Ability Enhancement Course (AEC -01, AEC-02) (Ex. Modern Indian Languages)	Humanities Social Science and Management (HSSM)	02	--	--	02	--	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--	--	02	02	--	--	--	--	04
Indian Knowledge System (IKS)		--	02	--	--	--	--	--	--	02
Value Education Course (VEC) (Ex. UHV-II, Environmental Courses)		--	--	02	02	--	--	--	--	04
Constitution of India		--	--	--	AU	--	--	--	--	AU
Do It Yourself (DIY)	Experiential Learning Courses	AU	AU	01	01	01	01	01	--	05
Problem/Project Based Learning (PBL)		01	01	01	01	01	01	01	--	07
Internship/On Job Training (OJT)		--	--	--	--	--	--	--	12	12
Co-curricular Courses (CC) (NSS / YOGA/ Health & Wellness)	Liberal Learning Courses	01	01	--	--	--	--	--	--	02
Open Elective (OE)		--	--	04	02	02	--	--	--	08
Total Credits (Major)		**20**	**22**	**21**	**21**	**20**	**20**	**20**	**18**	**162**

Multidisciplinary Minor (MDM)	Multidisciplinary Courses	--	--	02	02	04	02	04	--	**14**
• **(B.E./ B.Tech. or Equivalent) in Engineering/ Technology with Multidisciplinary Minor** • **Major + MDM = 162+14 = 176 Credits**										**176**
Honors and Multidisciplinary Minor		--	--	02	04	04	04	04	--	**18**
• **4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engineering/ Technology - Honors and Multidisciplinary Minor** • **Major + Honors + MDM = 162+18+14 = 194 Credits** • Students with minimum **CGPA of 7.5** without backlog courses at the end of Second semester and should have earned **42 credits** are eligible for admission to the UG Bachelor's Degree with Honors.										**194**
Honors with Research and Multidisciplinary Minor		--	--	--	--	--	--	08	10	**18**
• **4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engineering/ Technology - Honors with Research and Multidisciplinary Minor** • **Major + Research MDM = 162+18+14 = 194 Credits** • Students with minimum **CGPA of 7.5** without backlog courses at the end of Sixth semester and should have earned **124 credits** are eligible for admission to the UG Bachelor's Degree with Research.										**194**
Double Minors (Multidisciplinary and Specialization Minors)		--	--	02	04	04	04	04	--	**18**
• **4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engineering/ Technology - Major Engineering Discipline with Double Minors (Multidisciplinary and Specialization Minors)** • **Major + MDM + Specialized Minor= 162+14+18 = 194 Credits** • Students with minimum **CGPA of 7.5** without backlog courses at the end of Second semester and should have earned **42 credits** are eligible for admission to the UG Bachelor's Degree with Double Minor.										**194**

B.Tech. in Computer Science and Engineering (Artificial Intelligence and Machine Learning)		
Course Category	**Credits**	**% Credits**
Basic Science **(BSC)**	15	9%
Engineering Science **(ESC)**	15	9%
Program Core Courses **(PCC)**	54	34%
Program Elective Courses **(PEC)**	20	12%
Vocational & Skill Enhancement **(VSE)**	10	6%
Humanity, Social Science & Management (AEC, EM, IKS, VEC) **HSSM**	14	9%
Experiential Learning **(EL)**	24	15%
Co-Curriculum Courses **(CC)**	02	1%
Open Electives **(OE)**	08	5%
Total Credits	**162**	



B.Tech. in CSE(AI&ML) Engineering		
Domain	**Credits**	**% Credits**
Machine Learning (**ML**)	28	17%
Data Structure & Algorithm (**DS&A**)	16	10%
Network Security (**NS**)	10	6%
Digital Electronics (**DE**)	09	6%
Web Development (**WD**)	21	13%
Program Elective Courses (**PEC**)	20	12%
Open Electives (**OE)**	10	6%
Vocational & Skill Enhancement (**VSE**)	14	8%
Humanity, Social Science & Management (AEC, EM, IKS, VEC) **HSSM**	24	14%
Experiential Learning (**EL**)	02	3%
Co-Curriculum Courses (**CC**)	08	5%
Total Credits	**162**	



SEMESTER III													
Category	Course Code	BOS	Name of the Course	Teaching Scheme				Evaluation Scheme					Credits
				L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	
PCC	AI253202	AI	Discrete Mathematics and Statistics	3			3	10	10	20	60	100	3
PCC	AI253203	AI	Data Structures	3			3	10	10	20	60	100	3
PCC	AI253204	AI	Operating System	3			3	10	10	20	60	100	3
HSSM -EEMC	AI253701	AI	Financial Management	2			2	10	10	20	60	100	2
HSSM -VEC	AI253702	BSH	Universal Human Values -II	2			2	10	10	20	60	100	2
OE	AI2535--	AI	OE-I	4			4	10	10	20	60	100	4
PCC	AI253205	AI	Data Structures& Operating System Lab			2	2	15	15		20	50	1
SC-SEC	GE253603	AI	Professional Development (PD) - III			2	2	15	15		20	50	1
ELC	GE253805	AI	P.B.L -III: Problem Based Learning			2	2	15	15		20	50	1
ELC	GE253806	AI	Do It Yourself- III			2	2	15	15		20	50	1
Total for Major				**17**	**-**	**8**	**25**	**120**	**120**	**120**	**440**	**800**	**21**
MDM	AI253401	AI	MDM-1 *	2			2	10	10	20	60	100	2
Total for Major with Multidisciplinary Minor (Mandatory Credits)													**23**
HMM	AI253206	AI	HMM 1	2			2	10	10	20	60	100	2
OR (*Students will be allotted for either HMM or DM as per defined criteria)													
DM	AI253207	AI	DM 1	2			2	10	10	20	60	100	2
Total for Major with MDM + (HMM/DM)				**21**		**8**	**29**					**1000**	**25**

SEMESTER IV													
Category	Course Code	BOS	Name of the Course	Teaching Scheme				Evaluation Scheme					Credits
				L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	
PCC	AI254208	AI	Object Oriented Programming in Java	3			3	10	10	20	60	100	3
PCC	AI254209	AI	Exploratory Data Analysis	3			3	10	10	20	60	100	3
PCC	AI254210	AI	Database Management System	3			3	10	10	20	60	100	3
OE	AI2545--	AI	OE-II	2			2	10	10	20	60	100	2
HSSM -AEC	AI254703	BSH	Modern Indian Language -II (MIL)	2			2	10	10	20	60	100	2
HSSM -EEMC	AI254704	AI	Entrepreneurship Development Program	2			2	10	10	20	60	100	2
HSSM -VEC	AI254705	AI	Environmental and Sustainable Engineering	2			2	10	10	20	60	100	2
PCC	AI254211	AI	Object Oriented Programming in Java &Database Management System lab			2	2	15	15		20	50	1
SC-SEC	GE254604	AI	Professional Development (PD) -IV			2	2	15	15		20	50	1
ELC	GE254808	AI	Do It Yourself- IV			2	2	15	15		20	50	1
ELC	GE254807	AI	P.B.L-IV: Problem to Project Based Learning			2	2	15	15		20	50	1
Total for Major				**17**		**8**	**25**					**900**	**21**
MDM	AI254402	AI	MDM 2*	2			2	10	10	20	60	100	2
Total for Major with Multidisciplinary Minor (Mandatory Credit)													**23**
HMM	AI254212	AI	HMM 2	3	1		4	10	10	20	60	100	4
OR													
DM	AI254213	AI	DM 2	3	1		4	10	10	20	60	100	4
Total for Major with MDM + (HMM/DM)				**23**	**2**	**8**	**35**	**160**	**160**	**200**	**680**	**1200**	**27**

Open Elective Bucket Offered by All Departments						
Department	**OE I (SEM III)**		**OE II (SEM IV)**		**OE III (SEM V)**	
	Credit: 4		Credit: 2		Credit: 2	
	Course code	Course Name	Course code	Course Name	Course code	Course Name
Mechanical	ME253501	Mechatronics	**ME254504**	**3D Printing Technologies**	**ME255507**	**3D Printing and Rapid Prototyping**
	ME253502	Project Management for Engineers	ME254505	Robotics and Automation	ME255508	EV Technology
	ME253503	Numerical Methods in Engineering	ME254506	Energy Storage and Management Systems	ME255509	Renewable Energy Sources
Civil	**CE253501**	Environmental Impact Assessment	**CE254504**	**Remote Sensing and Geographic Information Systems**	**CE256507**	Interior Designs and Drawing
	CE253502	Experimental Stress Analysis	CE254505	Town Planning	CE256508	Development Engineering
	CE253503	Composite Materials	CE254506	Operation Research	CE256509	Planning for Sustainable Development
E&TC	**ET253501**	**Digital Electronics**	**ET254504**	**Sensors and Actuators**	**ET255507**	**Internet of Things**
	ET253502	Signals & Systems	ET254505	Electrical Machines	ET255508	Instrumentation Engineering
	ET253503	Electronic Devices and Circuits	ET254506	Computer Architecture	ET255509	Wireless Communication Basics
CSE	**CS253501**	**C Programming**	**CS254504**	**Object Oriented Programming using Java**	**CS255507**	**Advanced JAVA**
	CS253502	Data Science and Analytics	CS254505	Fundamentals of Machine Learning	CS255508	Artificial Intelligence and Applications
	CS253503	Open Source and Software Technology	CS254506	Web Development Technologies	CS255509	Computer Network and Security

AIML*	**AI253501**	**Python Programming**	AI254504	Cyber Security Fundamentals	**AI255507**	**Internet of Things**
	AI253502	Prompt Engineering	AI254505	Artificial Intelligence & Data Science	AI255508	Autonomous Intelligent System
	AI253503	Components and Applications of the Internet of Things	AI254506	Ethical Hacking	AI255509	Quantum Computing

***The Open Elective (OE) courses offered by the Department of CSE(AI&ML) Engineering are exclusively intended for students of other departments and are not open to students of the CSE(AI&ML) Engineering.**

Multidisciplinary Minor (MDM) Courses Offered by All Departments										
Department	**MDM-I (SEM III)**		**MDM-II (SEM IV)**		**MDM- III (SEM V)**		**MDM- IV (SEM VI)**		**MDM-V (SEM VII)**	
	Credit: 2		Credit: 2		Credit: 4		Credit: 2		Credit: 4	
	Course code	Course Name	Course code	Course Name	Course code	Course Name	Course code	Course Name	Course code	Course Name
Mechanical	ME253401	Basic Mechanical Engineering	ME254402	Metrology and Mechanical Measurements	ME255403	Product Design and Development	ME256404	Smart Materials	ME257405	Automobile Engineering
Civil	CE253401	Basic Civil Engineering	CE254402	Building Construction and Materials	CE255403	Building Planning & Drawing	CE254404	Building Estimates & Tendering	CE254405	Construction Management
E&TC	ET253401	Basic Electronics and Communication Engineering	ET254402	Digital Electronics and Logic Design	ET255403	Microprocessors and Microcontrollers	ET256404	Communication Systems and Networking	ET257405	Embedded Systems
CSE	CS253401	Database Systems	CS254402	Computational Statistics for AI	CS255403	Predictive Analytics and Visualization	CS256404	Advanced Machine Learning	CS257405	Prompt Engineering
AIML*	AI253401	Database Systems	AI254402	Computational Statistics for AI	AI255403	Predictive Analytics and Visualization	AI256404	Advanced Machine Learning	AI257405	Prompt Engineering

***The MDM courses offered by the Department of CSE(AI&ML) Engineering are exclusively intended for students of other departments and are not open to students of the CSE(AI&ML) Engineering**

***Honors**

Semester	Code	BOS	Minor	No. of Credits
SEM III	AI253206	AI	HMM I	2
SEM IV	AI254212	AI	HMM II	4

***Honors courses offered by the Department of CSE(AI&ML) Engineering are exclusively for CSE(AI&ML) Engineering students. Only students with a minimum CGPA of 7.5 and no backlogs at the end of the Second Semester are eligible for the Honors Track. Students must maintain a minimum CGPA of 7.5 and remain free of backlogs throughout the program to continue in the Honors Track.**

*Specialization Minor (Double Minor)

Semester	Code	BOS	Minor	No. of Credits
SEM III	AI253207	AI	DM I	2
SEM IV	AI254213	AI	DM II	4

***The Specialization Minor (Double Minor) offered by the CSE(AI&ML) Engineering is exclusively for CSE(AI&ML) Engineering students. Only students with a minimum CGPA of 7.5 and no backlogs at the end of the Second Semester are eligible. Students must maintain a minimum CGPA of 7.5 and remain free of backlogs throughout the program. To earn the Specialization Minor (Double Minor), students must complete one specialization track in a CSE(AI&ML) Engineering domain offered by the Department.**

Course Title: Discrete Mathematics and Statistics **Course Code: AI253202**		**Course Category: PCC**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs. / week	CA-1	10 Marks
Tutorial: --	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:

- **Basic Mathematics** – Arithmetic operations, fractions, percentages, ratios, algebraic manipulation.
- **Basic Statistics** – Mean, median, mode, probability basics.

Course Description: This course introduces core concepts of discrete mathematics and statistics designed for Computer Science, AI/ML, and Data Science applications. It develops logical reasoning through propositional logic, predicates, and inference techniques used in algorithms and intelligent systems. The course covers sets, functions, relations, graphs, and trees, forming the foundation for data structures, networks, and machine learning models. It also introduces statistical methods, probability, and distributions essential for data analysis and predictive modeling. Further, it focuses on inferential statistics and hypothesis testing for data-driven decision-making and model evaluation.

Course Objectives:

1. **To develop** logical reasoning skills using propositional logic, predicates, and rules of inference for solving computational problems.
2. **To understand** fundamental concepts of sets, functions, relations, graphs, and trees for their applications in computer science and data structures.
3. **To introduce** statistical methods and probability theory for analyzing data and understanding uncertainty in real-world scenarios.
4. **To apply** inferential statistical techniques, including hypothesis testing, for data-driven decision making and evaluation of models in AI/ML and data science.

Course Outcomes:		
COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** fundamental concepts of propositional logic, set theory, graph theory, statistics, probability, and hypothesis testing.	Remember (Level 1)
CO2	**Explain** principles of logical reasoning, set operations, functions, graph structures, statistical measures, probability distributions, and hypothesis testing procedures.	Understand (Level 2)
CO3	**Interpret** logical rules, set operations, graph algorithms, statistical measures, and probability concepts to solve computational and data analysis problems.	Apply (Level 3)
CO4	**Examine** complex problems using logical inference, graph-based models, statistical methods, and hypothesis testing techniques for data-driven decision making.	Analyze (Level 4)

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	–	–	–	–	–	–	2	1	1
CO2	3	2	1	1	–	–	–	–	–	–	2	2	1
CO3	3	3	2	2	2	–	–	–	–	1	2	3	2
CO4	3	3	2	3	2	1	–	–	–	1	3	3	2

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction to Propositional Logic** Propositions, truth values, truth tables for operators, truth tables of compound propositions, precedence of logical operators. Propositional equivalences: logical equivalences, constructing new logical equivalences, normal forms. Predicates and quantifiers, universal and existential, nested quantifiers, order of quantifiers, negating nested quantifiers. Rules of inference: valid arguments in propositional logic, Rules of inference for propositional logic, using rules of inference to build arguments, resolution, fallacies.	6 Hrs.
Unit 2	**Basic Discrete Structures** Sets: Venn diagrams, subsets, size of a set, power sets, Cartesian products, set operations, Function: subjective, injective, bijective and inverse functions, composition of function, relation and its properties, equivalence and partial order relations, Pigeonhole principle, permutation and combination	6 Hrs.
Unit 3	**Graph and Trees** Basic terminology, multi graphs and weighted graphs, Paths and circuits, shortest path problems, Euler and Hamiltonian paths, representation of graphs, isomorphic graphs, planar graphs, connectivity, matching coloring. Trees: Rooted trees, Path length in rooted tree, Binary search trees, spanning trees and cut set, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree.	6 Hrs.
Unit 4	**Introduction to Statistics** Introduction of Statistics, population, sample, Types of statistical data- categorical, numerical (Continuous), ordinal, interval, ratio, univariate and bivariate analysis, measures of central tendency: mean, median, mode, harmonic mean, measures of dispersion - variance, standard deviation and coefficient of variation, outliers, data visualization- line graph, scatter, box plots, histogram.	6 Hrs.
Unit 5	**Probability and Distributions** Basics of probability- random experiments, sample space, events, axioms of probability, addition and multiplication laws of probability, conditional probability and independence, Bayes' theorem, discrete, continuous random variables, Introduction to inferential statistics, what is distribution, concept of probability distributions, expectation(mean) and variance, skewness and interpretations, kurtosis.	6 Hrs.

Unit 6	**Hypothesis Testing and Statistical Tests** Typical analysis procedures, introduction to inferential statistics, point estimation, confidence intervals, hypothesis testing concept, null and alternative hypotheses, Type I and Type II errors, rejection region, level of significance, p-value, one-tailed and two-tailed tests, tests on numerical data– distribution of sample mean, comparison of two groups– Z-test. Real-world case study on hypothesis testing in data-driven decision making.	6 Hrs.

Sr. No.	Textbooks
1.	S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revied and Enlarged Edition, 2016.
2.	C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Publication, 3 rd Edition, 2008.
Sr. No.	**Reference Books**
1.	Kishor S. Trivedi, Probability, Statistics with Reliability, Queuing and Computer Science Applications, Wiley India Pvt. Ltd, 2nd Edition, 2001.
2.	Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability and Statistics, Schaum's Outlines, 4th Edition, 2013.
3.	Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw-Hill Publication, 6 th Edition, 2010
4.	Lipschutz, Discrete Mathematics, McGraw-Hill Publication, 3 rd Edition, 2009
Sr. No.	**Web Resources**
1.	**NPTEL -Discrete Mathematics (IIT Ropar)** https://onlinecourses.nptel.ac.in/noc26_cs68/
2.	**NPTEL -Introduction to Probability and Statistics (IIT Madras)** https://onlinecourses.nptel.ac.in/noc26_mg59/
3.	**Udemy - Discrete Mathematics 1** https://www.udemy.com/courses/search/?q=discrete+mathematics&src=sac&kw=discrete+Mathema
4.	**Coursera -Probability & Statistics for Machine Learning & Data Science** https://www.coursera.org/learn/machine-learning-probability-and-statistics

Course Title: Data Structures **Course Code: AI253203**		**Course Category: PCC**
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs / week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:

- **Programming Languages fundamentals**: Familiarity with data types, variables, operators, Input/output statements, conditional and control statements, Pointers, Arrays, Strings
- **Problem-Solving Skills**: Logical thinking and algorithmic approach to solving problems, Ability to write simple algorithms or flowcharts.

Course Description: This course introduces fundamental data structures and their applications in efficient problem solving. Students learn arrays, linked lists, stacks, queues, trees, and graphs, along with algorithm design, complexity analysis, and memory management. Emphasis is placed on implementation, performance tradeoffs, and real-world use cases to develop logical thinking and programming skills for scalable software development in modern computing environments today.

Course Objectives:

1. Explain fundamental concepts of data, data types, data structures, and Abstract Data Types (ADT), and analyze algorithms in terms of time and space complexity.
2. Solve computational problems by applying appropriate data structures such as arrays, hash tables, stacks, queues, and linked lists.
3. Implement tree and graph data structures, including binary trees, binary search trees, heaps, and adjacency matrix representations, and perform related operations and traversals.
4. Demonstrate proficiency in searching and sorting algorithms, including sequential, binary search, skip lists, insertion sort, selection sort, and radix sort.
5. Select and implement suitable data structures and algorithms to develop efficient, maintainable, scalable software solutions.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Identify** fundamental concepts of data structures, abstract data types (ADTs), algorithm design principles and their classifications.	Remember (Level 1)
CO2	**Explain** the representation and types of linear and non linear data structures.	Understand (Level 2)
CO3	**Demonstrate** the operations of linear and non-linear data structures, including arrays, linked lists, stacks, queues, trees, and graphs.	Apply (Level 3)
CO4	**Examine** the efficiency of algorithms and data structures using time and space complexity	Analyze (Level 4)
CO5	**Implement** and **explore** data structure operations and algorithms (such as traversal, insertion, deletion, searching, and sorting) to solve real-world problems effectively.	Analyze (Level 4)
CO6	**Compare** and **assess** appropriate searching, sorting, and hashing techniques for problem solving.	Evaluate (Level 5)

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	–	–	–	–	–	–	–	–	1	2	1
CO2	3	2	–	–	1	–	–	–	–	–	–	2	1
CO3	2	2	1	–	2	–	–	1	–	–	–	2	2
CO4	3	3	–	2	–	–	–	–	–	–	1	3	1
CO5	3	2	2	2	3	–	–	1	1	–	1	3	3
CO6	2	2	2	2	–	1	–	–	–	–	1	3	2

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction** Data, Data types, Data structure, Classification of Data Structures, Abstract Data Type, representation of Information in memory, Characteristics of algorithm, algorithm design basics, Program analysis and Performance measurement, Introduction to space and time complexity, Asymptotic Notations.	6 Hrs.
Unit 2	**Arrays and Hash Tables** Introduction, Array Operations, representation of Arrays in Memory, Implementation of One- & Two-Dimensional Arrays in Memory, Concept of sequential organization, Linear and non-linear data structures, Storage representation, Array processing, Sparse matrices, Transpose of sparse matrices, Hash table, Direct address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.	6 Hrs.
Unit 3	**Linked List** Concept of linked organization, Singly and doubly linked list , Circular linked list, Operations such as insertion, deletion, concatenation, traversal of linked list, dynamic memory allocation concepts, garbage collection and memory management basics.	6 Hrs.
Unit 4	**Stacks and Queues** Introduction, stack and queue as ADT, Representation and implementation of stack and queue using Sequential and linked allocation, Circular queue and its implementation, Priority queue. Application of stack for expression evaluation and expression conversion, Recursion.	6 Hrs.

Unit 5	**Trees and Graphs** Basic terminology, Binary trees and its representation, Insertion and deletion of nodes in binary tree, Binary search tree and its traversal, Threaded binary tree, Heap, Balanced Trees, Terminology and representation of graphs using adjacency matrix, Warshall's algorithm.	6 Hrs
Unit 6	**Searching and Sorting** Sequential, Binary searching, Skip lists – dictionaries, Skip list representation, operations – insertion, deletion, searching, Insertion sort, Selection sort, Radix sort, Shell sort.	6 Hrs

Sr. No.	Textbooks
1.	Weiss, Data structures and algorithms analysis in C++, Pearson Education, 4th Edition,2013
2.	Horowitz and Sahani, Fundamentals of Data Structures, Universities Press, 2nd Edition,2008
	Reference Books
1.	S. Lipschutz, Data Structures, McGraw-Hill Publication, Revised 1st Edition, 2014
2.	Y. Langsm, M. Augenstin, A. Tanenbaum, Data Structure using C and C++, Prentice Hall India Learning Private Limited,2nd edition,1998
3.	Thomas Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition,2002
4.	Venkatesan & Rose, Data Structures, Wiley Publication, 1st Edition,2015
5.	Goodrich & Tamassia, Data Structure & Algorithm in C++, Wiley Publication, 2nd Edition, 2011.
	Web Resources
1.	NPTEL course: Programming, data structures and algorithms using Python (IITM): https://onlinecourses-archive.nptel.ac.in/noc18_cs34/
2.	NPTEL course: Data Structures and Algorithms Design https://onlinecourses.nptel.ac.in/noc25_cs81/

Course Title: Operating Systems **Course Code: AI253204**		**Course Category: PCC**
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs / week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:

- Basic understanding of programming (C or any high-level language),Fundamentals of Computer System, Concepts of data structures such as arrays, stacks, queues, and linked lists

Course Description: This course provides a comprehensive understanding of operating system concepts, design principles, and functionalities. It focuses on process management, scheduling, synchronization, memory management, file systems, and I/O management. The course enables students to understand how operating systems efficiently manage hardware and software resources.

Course Objectives:

1. To understand fundamental concepts and functions of operating systems
2. To study process management, scheduling, and synchronization mechanisms.
3. To analyze memory management and virtual memory techniques
4. To explore file systems and I/O management
5. To evaluate Operating System performance and resource management strategies

Course Outcomes:		
COs	**After completion of the course students will be able to:**	**Bloom's Level**
CO1	**Define** fundamental concepts of operating systems including processes, memory, file systems, and Input/output management.	Remember (Level 1)
CO2	**Explain** the structure, services, and working of operating system components such as scheduling, synchronization, memory, and file management.	Understand (Level 2)
CO3	**Implement** Operating system algorithms for process and resource management	Apply (Level 3)
CO4	**Utilize** process management, memory management and virtual memory techniques for efficient resource utilization in operating systems.	Apply (Level 3)
CO5	**Compare** the performance of operating system techniques including scheduling, synchronization, memory, and disk management.	Analyze (Level 4)
CO6	**Select** appropriate operating system strategies for efficient system and resource management.	Evaluate (Level 5)

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	-	-	-	-	-	-	2	2
CO2	3	2	–	–	1	–	–	–	1	–	1	2	3
CO3	3	3	2	1	2	–	–	–	–	–	1	3	2
CO4	3	2	2	1	2	–	–	–	–	–	1	3	2
CO5	3	3	2	2	2	1	–	–	1	–	2	3	2
CO6	3	3	3	2	2	1	1	–	1	–	2	3	3

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction to Operating System** Operating System definition and functions, User view, System view, Operating System structures (Layered, Micro Kernel, Modular), Operating System services, System Calls, Types of system calls, Types of OS: Batch, Multiprogramming, Time sharing, Parallel, Distributed & Real-time, System Design and Implementation, System Generations.	6 Hrs.
Unit 2	**Process and CPU Scheduling** Process Concept, process State Transition, Process Scheduling, Operation on process, Inter-process Communication, Introduction to threads: Multi-threading models, Scheduling Criteria, Types of Scheduling: Preemptive, Nonpreemptive, Long-term, Medium-term, Short-term. Scheduling Algorithms: First Come First Serve (FCFS), Shortest Job First (SJF), Shortest Remaining Job First (SRTF), Priority, Round Robin, etc.	6 Hrs.
Unit 3	**Process Synchronization and Deadlock** Synchronization: The critical-section problem, Critical regions, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.	6 Hrs.

Unit 4	**Memory Management** Logical and Physical address, Memory Allocation, Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Fragmentation, Paging, Segmentation, Address translation, Placement Strategies: First Fit, Best Fit, Next Fit and Worst Fit.	6 Hrs.
Unit 5	**Virtual Memory** Concept of Virtual Memory, Swapping, Demand Paging, Page Table (Basic Idea), Translation Lookaside Buffer (TLB), Page Replacement Algorithms (First In First Out, List Recent Use, Optimal), Thrashing and Performance Issues	6 Hrs.
Unit 6	**I/O and File Management** File concepts, File organization, File operations, File directories, File System Implementation, I/O devices, Types and characteristics of devices, OS design issues for I/O management, Disk Structure, Disk scheduling algorithms: First Come First Serve, Shortest Seek Time First (SSTF), SCAN, C-SCAN, Swap Space Management	6 Hrs.

Sr. No.	**Textbooks**
1.	William Stallings, Operating Systems: Internals and Design Principles, Pearson Publication, 8th Edition, 2018.
2	Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, CreateSpace Publication, 2018.
	Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley Publication, 8th Edition, 2008.
Sr. No.	**Reference Books**
1.	Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.
2.	D. M. Dhamdhere, Systems Programming and Operating Systems, McGraw-Hill, 2nd Edition, 1996.
3.	Garry Nutt, Operating Systems Concepts, Pearson Publication, 3rd Edition, 2003.
4.	Harvey M. Deitel, An Introduction to Operating Systems, Addison Wesley Publication, 2nd Edition, 1990.
5.	Thomas W. Doeppner, Operating System in Depth: Design and Programming, Wiley Publication, 2011
Sr. No.	**Web Resources**
1.	https://archive.nptel.ac.in/courses/106/105/106105214/
2.	https://onlinecourses.nptel.ac.in/noc21_cs72/preview
3.	Coursera:(https://www.coursera.org)
4.	https://codex.cs.yale.edu/avi/os-book/OS8/os8c/slide-dir/

Course Title: FINANCIAL MANAGEMENT **Course Code: AI253701**		**Course Category:** **HSSM -EEMC**
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs / week	CA-1	10 Marks
Tutorial:-	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite: Students should have basic knowledge of: Fundamentals of Economics, Basic Mathematics and Accounting, Principles of Management

Course Description: This course introduces the fundamentals of financial management, including financial decisions, cost concepts, accounting systems, and budgeting techniques. It covers financial statement analysis, depreciation, and financial planning for effective decision-making. The course also provides an overview of product development and production planning with a focus on financial implications.

Course Objectives:

1. To introduce the fundamental concepts, scope, and key financial decisions in financial management.
2. To develop understanding of cost concepts, cost management systems, and budgeting techniques.
3. To enable students to understand accounting systems and analyze financial statements and performance.
4. To provide knowledge of depreciation.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Define** and list the fundamental concepts of entrepreneurship, financial management, cost concepts, and market equilibrium.	Remember L1
CO2	**Explain** financial management principles, costing methods, budgeting techniques, and financial statements.	Understand L2
CO3	**Apply** cost analysis tools such as CVP analysis, break-even analysis, depreciation methods, and budgeting techniques to solve business problems.	Apply L3
CO4	**Analyze** financial statements, ratio analysis, financial planning, forecasting techniques, and production strategies for effective decision-making.	Analyze L4

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	-	-	1	1	1	1
CO2	3	2	1	1	-	-	-	-	-	2	2	1	2
CO3	3	3	2	2	-	-	-	-	-	2	2	2	3
CO4	3	3	3	3	-	-	-	-	1	2	3	2	3

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Finance Management** – Conceptual Foundations Introduction to Business Finance, Objectives of Financial Management, Roles and Responsibilities of Finance Manager, Finance Decisions: Investment Decision; Financing Decisions; and Dividend Decisions, Wealth maximization, profit maximization.	4 Hrs.
Unit 2	**Planning and Analysis** Meaning and importance of financial planning, Introduction to Income Statement and Balance Sheet, Theoretical overview of Ratio based analysis: liquidity, solvency, profitability, and turnover ratios.	4 Hrs
Unit 3	**Sources of Finance and Cost of Capital** Internal and External Financing: Concept and difference. Long term and short term sources of finance. Concept of cost of capital: cost of equity, cost of debt, preference shares, and weighted average cost of capital (WACC) – theoretical overview.	4 Hrs
Unit 4	**Capital Budgeting** Meaning of Capital Budgeting, Nature and Characteristic, Importance, Objective, Capital Budgeting Techniques: Payback Period; Discounted Payback Period; IRR; ARR; NPV, Factors Affecting Capital Budgeting Decisions, Limitations of Capital Budgeting	4 Hrs
Unit 5	**Working Capital** Concept of working capital, operating cycle, Nature of working capital, Types of Working Capital, Profitability, Liquidity, Inventory Management: Types, Motives of holding inventory, Cash Management- Motives of Holding Cash, Factors Determining Cash, Receivables in credit management. Brief overview of credit policy decisions (collection period, credit terms).	4 Hrs
Unit 6	**Working Capital Financing** Meaning of Working Capital Financing, Need, Short term and long-term Financing, Trade Credit, Bank credit: OD; Term Loan; CC; Hypothecation Loan; Bill Discounting.	4 Hrs.

Sr. No.	Textbooks
1.	I. M. Pandey – Financial Management, Vikas Publishing House
2.	Prasanna Chandra – Financial Management: Theory and Practice, McGraw Hill
3.	Financial Management-Rajiv Srivastava and Anil Mishra (Oxford University press)
	Reference Books
1.	Brigham & Houston – Fundamentals of Financial Management, Cengage Learning
2.	Fundamentals of Financial Management by James C. VanHorne
3.	Financial Management: Text and Problems---MY Khan and PK Jain
4.	Brealey.Myers. Principles of corporate finance (710h ed.). Tata McGraw Hill
	Web Resources
1.	Financial Management for Managers—Prof. Anil K Sharma https://onlinecourses.nptel.ac.in/noc20_mg31/preview
2.	Corporate Finance---By Prof. Abhijeet Chandra IIT Kharagpur https://onlinecourses.nptel.ac.in/noc21_mg93/preview

Course Title: Universal Human Values-II **Course Code: AI253702**	**Course Category: VEC**	
Teaching Scheme	**Examination Scheme**	
Lectures: 02hrs. / week	CA-1	10 Marks
Tutorial:	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:

- Universal Human Values -I

Course Description: This course introduces the fundamentals of **value education**, focusing on self-exploration, human aspirations, and continuous happiness. It emphasizes harmony within the individual, in relationships, society, and nature. The course develops understanding of **human values, ethics, and professional responsibility**. It encourages students to adopt a **holistic and sustainable approach** to life and decision-making. Learners are guided to apply these values in personal and professional contexts.

Course Objectives:

1. Explain the concept of value education, self-exploration, and the relationship between happiness, prosperity, and basic human aspirations.
2. Distinguish between the needs of self and the body and apply methods to achieve harmony within the individual and between the self and the body.
3. Demonstrate understanding of harmony in the family and society by applying foundational values such as trust and respect in human relationships.
4. Analyze the interconnectedness and mutual fulfillment among the four orders of nature and relate it to sustainable living and coexistence.
5. Apply a holistic understanding of human values to professional ethics, decision-making, and strategies for value-based life and profession.

Course Outcomes:		
COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Define** the concepts of value education, human aspirations, harmony in human beings, family, society, nature and professional ethics.	Remember (Level 1)
CO2	**Explain** the role of self-exploration, human values, relationships and harmony in achieving continuous happiness and prosperity.	Understand (Level 2)
CO3	**Demonstrate** the interrelationship among human beings, society, nature and ethical conduct for universal human order.	Apply (Level 3)
CO4	**Distinguish** the human values and professional ethics in personal and professional life.	Analyze (Level 4)

CO-PO-PSO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	2	3	1	-	-	3	-	-
CO2	-	-	-	-	-	2	3	2	-	-	3	-	-
CO3	-	-	-	-	-	3	3	2	-	-	2	-	-
CO4	-	-	-	-	-	3	3	3	-	-	3	-	-

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction to Value Education:** Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity, the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity, Current Scenario, Method to Fulfill the Basic Human Aspirations.	4 Hrs
Unit 2	**Harmony in the Human Being:** Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, Harmony of the Self with the Body, self-regulation and Health.	4 Hrs
Unit 3	**Harmony in the Family and Society:** Harmony in the Family, the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Relationship, 'Respect'– as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order	4 Hrs.
Unit 4	**Harmony in the Nature (Existence):** Understanding Harmony in Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.	4 Hrs.
Unit 5	**Implications of Holistic Understanding** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order.	4 Hrs.
Unit 6	**Value-Based life and Professional Practices** Competence in Professional Ethics- Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.	4 Hrs.

Sr. No.	Textbooks
1.	A Foundation Course in Human Values and Professional Ethics R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.
2.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2
Sr. No.	**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 - Pandit Sunderlal
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)
Sr. No.	**Web Resources**
1.	https://uhv.org.in/UHV-II_Course_Material

Course Title: Python Programming **Course Code: AI253501**		**Course Category: OE-I**
Teaching Scheme	**Examination Scheme**	
Practical's/Sessions: 04 Hours/Week	CA-1	10 Marks
Tutorial:--	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:

- Basic knowledge of programming
- Fundamental understanding of statistics and probability concepts.
- Familiarity basic mathematics.

Course Description: This course introduces the basics of Python programming and its applications in data science. It covers Python features, syntax, variables, data types, operators, input–output operations and control flow statements such as conditional statements and loops. The course also includes functions, recursion, and Python data structures like lists, tuples, sets, and dictionaries. Additionally, it provides an overview of data science concepts, data sources, data collection methods, and essential data preprocessing techniques such as handling missing data, data transformation, and data cleaning to prepare data for analysis.

Course Objectives:

1. To introduce the fundamental concepts of Python programming including syntax, variables, data types, and operators.
2. To develop programming skills using control structures and functions in Python.
3. To understand and use Python data structures such as lists, tuples, sets, and dictionaries for data handling.
4. To introduce the basic concepts and applications of Data Science and its importance in decision making.
5. To provide knowledge of data collection, pre-processing, and data cleaning techniques for preparing data for analysis.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Explain** the basic concepts of Python programming including syntax, variables, data types, operators, and input–output statements.	Remember (Level 1)
CO2	**Apply** control flow statements and functions to develop Python programs for solving computational problems.	Understand (Level 2)
CO3	**Implement** Python data structures such as lists, tuples, sets, and dictionaries for data manipulation and processing.	Apply (Level 3)
CO4	To provide knowledge of data collection, pre-processing, and data cleaning techniques for preparing data for **analysis**.	Analyze (Level 4)

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	2	-	–	-	–	–	–	–	–
CO2	2	3	2	-	2	–	–	-	–	–	–	–	–
CO3	2	3	2	-	3	–	–	–	–	–	–	–	–
CO4	2	3	2	2	3	–	–	-	–	–	–	–	–

Assessment	
CA-1 (a)	Subjective Test / Assignment /PowerPoint Presentation etc.
CA-2 (b)	Subjective Test /Model Making / Assignment / Presentation etc.
MSE (c)	Subjective Test

Unit 1	**Introduction of Python programming** Features of Python, History of Python and version, Python Applications, Installation of Python IDE, Indentation and Comment in Python, Input and output Statements, Keyword, Identifier, Literals Variables and data types, Operators.	8 Hrs
Unit 2	**Control Flow and Functions Decision making Statements**: Conditional Statements- if, else, elif, Loops: for and while loop, Break and Continue statement. Functions: Defining functions, Parameters and return, Lambda function, Recursive function	8 Hrs
Unit 3	**Data Structures in Python**: **Lists (list):** Creating and Accessing Lists, List Methods (append(), insert(), pop(), remove(), sort(), etc.) List Comprehension Slicing and Iteration. **Tuples (tuple**): Tuple Characteristics and Usage Tuple Packing and Unpacking Immutable Nature of Tuples. **Sets (set):** Properties of Sets Set Operations (Union, Intersection, Difference) Removing Duplicates using Sets. **Dictionaries (dict**): Dictionary Methods (keys(), values(), items(), get(), pop(), etc. Dictionary Comprehension, Nested Dictionaries	8 Hrs
Unit 4	**Introduction to Data Science:** Definition of Data Science, evolution of data science, importance of data in decision making, components of data science, roles of data scientists, applications of data science in healthcare, finance, business, and social media, overview of the data science lifecycle, Python Libraries	8 Hrs
Unit 5	**Data Collection and Data Sources:** Types of data (structured, semi-structured, unstructured), sources of data, data acquisition techniques, data storage formats, introduction to data repositories and open datasets.	8 Hrs
Unit 6	**Data Preprocessing and Data Cleaning:** Handling missing data, noise and outliers, data transformation, data normalization and scaling, feature selection and feature extraction, data integration techniques.	8 Hrs

Sr. No.	Textbooks
1.	Cathy O'Neil and Rachel Schutt, **Doing Data Science**, O'Reilly Media
2.	Joel Grus, **Data Science from Scratch**, O'Reilly Media.
	Reference Books
1.	Foster Provost and Tom Fawcett, **Data Science for Business**, O'Reilly Media.
2.	Nina Zumel and John Mount, **Practical Data Science with R**, Manning Publications.
	Web Resources
1.	https://www.kaggle.com/learn
2.	https://www.coursera.org/data-science
3.	https://www.edx.org/data-science

Course Title: Prompt Engineering **Course Code: AI253502**		**Course Category: OE I**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs./ week	CA-1	10 Marks
Tutorial: -	CA-2	10 Marks
Credits: 4	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:
Basic knowledge of Python programming is required. Students should be familiar with fundamental concepts of Artificial Intelligence and Machine Learning. Introductory understanding of Natural Language Processing and basic statistics is desirable.

Course Description: This course introduces the fundamentals of prompt engineering for Large Language Models and Generative AI systems. Students learn to design, test, and optimize prompts using basic and advanced techniques. The course also covers real-world applications along with safety and ethical considerations

Course Objectives:

1. To introduce the fundamentals of Large Language Models and prompt engineering.
2. To enable students to design effective prompts using standard and advanced techniques.
3. To develop skills for evaluating, optimizing, and debugging prompt outputs.
4. To apply prompt engineering in real-world AI applications.
5. To understand ethical, safety, and bias issues in generative AI systems.

Course Outcomes:

COs	**After completion of the course Students will be able to**	**Bloom's Level**
CO1	**Recall** the fundamental concepts of Generative AI, Large Language Models, tokens, embeddings, and the basic principles of prompt engineering.	Remember L2
CO2	**Explain** the structure of prompts and the working of various prompting strategies including zero-shot, one-shot, and few-shot prompting techniques.	Understand L3
CO3	**Apply** prompt engineering techniques and LLM APIs for tasks such as text generation, summarization, question answering, and chatbot development.	Apply L3
CO4	**Analyze** advanced prompting strategies, evaluation metrics, and safety challenges such as hallucination, bias, and adversarial prompts in LLM-based systems.	Analyze L4

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	–	–	–	–	–	–	1	2	1
CO2	3	2	1	1	2	–	–	–	1	–	1	2	2
CO3	3	3	3	2	3	–	–	–	1	–	1	3	3
CO4	3	3	2	3	2	2	1	2	1	–	2	3	3

Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Introduction to Generative AI and LLMs** Evolution from NLP to Generative AI, Overview of Large Language Models, Tokens, embeddings, context windows, working of chat-based models, Applications of LLMs, Prompting vs fine-tuning	6 Hrs.
Unit 2	**Basics of Prompt Engineering** Define prompt, Components of a good prompt, Instruction-based prompting, Delimiters and formatting, Controlling output (temperature, top-p)	6 Hrs.
Unit 3	**Standard Prompting Techniques** Zero-shot prompting, One-shot prompting, Few-shot prompting, Prompt patterns and templates, Prompt evaluation basics, Prompt debugging	6 Hrs.
Unit 4	**Advanced Reasoning Techniques** Chain-of-Thought (CoT) prompting, Self-ask prompting, ReAct prompting, Tree-of-Thought (overview), Prompt chaining, Multimodal prompting basics	6 Hrs.
Unit 5	**Prompt Engineering Applications** Prompting for: Text generation, Code generation, Chatbots, Summarization, Question answering Introduction to: LangChain, LLM APIs, Prompt templates in Python	6 Hrs.
Unit 6	Prompt Optimization, Safety and Ethics, Hallucination and mitigation, Bias and toxicity, Adversarial prompts and jailbreaks, Prompt robustness testing. Evaluation metrics: BLEU, ROUGE, BERTScore, Human evaluation Future trends: RAG, tool use, agents	6 Hrs.

Sr. No.	Textbooks
1.	**Isa Fulford and Andrew Ng**, Prompt Engineering for Everyone, DeepLearning.AI, Latest Edition.
2.	**Nathan Hunter**, The Art of Prompt Engineering with OpenAI APIs, Latest Edition.
3.	**Lewis Tunstall, Leandro von Werra, and Thomas Wolf**, Natural Language Processing with Transformers, O'Reilly Media.
	Reference Books
1.	**Jay Alammar and Maarten Grootendorst**, Hands-On Large Language Models, O'Reilly.
2.	**Daniel Jurafsky and James H. Martin**, Speech and Language Processing, Pearson
	Web Resources
1.	OpenAI Prompt Engineering Guide
2.	Prompt Engineering Guide (GitHub)
3.	Hugging Face Prompt Engineering Docs

Course Title: Components and Applications of Internet of Things **Course Code: PL263303**		**Course Category: OE**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs. / week	CA-1	10 Marks
Tutorial: -	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:
Basic understanding of Computer Networks and Internet fundamentals, Familiarity with microcontrollers or microprocessors, Understanding of data communication concepts

Course Description:
This course provides an in-depth understanding of the Internet of Things (IoT)— its architecture, devices, sensing technologies, communication protocols, security challenges, and modern application domains. Students will study the fundamentals of sensors, embedded systems, ARM-based microcontroller programming, and device interfacing techniques.

Course Objectives:

1. The objective of this course is to learn about Basics of IoT, Components of IoT including Sensors and actuators, computing, and communication systems.
2. It will also cover IoT Protocols, Security of IoT, Cloud based design and AI/Deep learning-based analytics

Course Outcomes:

COs	**After completion of the course Students will be able to**	**Bloom's Level**
CO1	**Identify** IoT Components: Recognize and classify key components of IoT systems, including sensors, actuators, communication protocols, and data processing units	Apply L3
CO2	**Explore** IoT Communication: Understand various wireless and wired communication technologies used in IoT networks and their suitability for different application scenarios.	Analyze L4
CO3	**Design** IoT Applications: Create IoT solutions by integrating hardware and software components, demonstrating proficiency in prototyping, programming, and data handling.	Apply L3
CO4	**Analyze** Data from IoT Devices: Collect, analyze, and interpret data generated by IoT devices to extract meaningful insights and support informed decision-making.	Analyze L4

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	–	–	–	–	–	–	1	2	1
CO2	3	2	1	1	2	–	–	–	1	–	1	2	2
CO3	3	3	3	2	3	1	1	1	2	1	1	3	3
CO4	3	3	2	3	2	1	1	1	1	–	2	3	3

Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Basics of IoT and Application Domains** Basics of IoT Introduction to Internet of things, Various sensors, and sensing techniques. Technological trends in IoT. impact of IoT on society. Review of various IoT application domain including agriculture, healthcare, manufacturing, device management, and vehicle to vehicle communication and wearable computing devices.	6 Hrs.
Unit 2	**Microcontrollers and Interfacing Techniques for IoT Devices** Microcontroller and Interfacing Techniques for IoT Devices Introduction to IoT and architecture layers, IoT smart devices, Typical embedded computing systems, Introduction to ARM architecture and programming method, Embedded system development: a case study, Introduction to interfacing techniques	6 Hrs.
Unit 3	**Networking Protocols and Security in IoT Systems** IoT Protocols & Security Networking and basic networking hardware. Networking protocols, Interaction between software and hardware in an IoT device. IoT components and technologies to secure systems and devices. Various security issues related to the IoT and security architecture. Hardware security threats and security vulnerabilities; protecting physical hardware	6 Hrs.
Unit 4	**Device Localization and Tracking in IoT** Location Tracking Introduction to device localization and tracking; different types of localization techniques: time-of-arrival (TOA) based, time-difference of-arrival (TDOA) based, angle-of-arrival (AOA) based, received signal strength (RSS) based, Radio-Frequency Identification (RFID) based and fingerprinting based; Monte-Carlo tracking; Kalman filter based tracking; Cramer Rao lower bound (CRLB) for device location estimator; Device diversity/heterogeneity issue in IoT networks.	6 Hrs.
Unit 5	**AI and Deep Learning for Intelligent IoT Systems** Evolution of IoT and emergence of AI-enabled IoT, Role of deep learning in smart IoT systems, Characteristics of IoT data (real-time, streaming, heterogeneous, noisy), Edge vs Cloud intelligence, Artificial Neural Networks (ANNs), Convolutional Neural Networks (CNNs) for image/video-based IoT, Recurrent Neural Networks (RNN), LSTM, GRU for time-series IoT data, Autoencoders for anomaly detection and data compression, Generative Adversarial Networks (GANs) for synthetic IoT data generation	6 Hrs.
Unit 6	**IoT Applications in Smart Grids** IoT Applications Smart grid: Introduction to smart grid, Integration of IoT into smart grid, Standardization activities for IoT aided smart grid, Applications of IoT aided smart grid, Architectures for IoT sided smart grid, Prototypes, Applications of big data and cloud computing, Open Issues, and challenges.	6 Hrs.

Sr. No.	Textbooks
1.	Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press.
2.	Rajkamal, Internet of Things: Architecture and Design Principles, McGraw Hill
3.	Andrew S. Tanenbaum & David Wetherall, Computer Networks, Pearson.
	Reference Books
1.	Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley.
2.	Adrian McEwen & Hakim Cassimally, Designing the Internet of Things, Wiley.
	Web Resources
1.	https://onlinecourses.swayam2.ac.in/e-learning/preview/arp20_ap03

Course Title: Data structures and Operating System Lab **Course Category : PCC**		**Course Code:AI253205**
Teaching Scheme	**Examination Scheme**	
Practical's/Sessions: 02 Hours/Week	CA-I	15 Marks
Credits: 1	CA-II	15 Marks
Semester: Second Year (Semester III)	ESE	20 Marks

Assessment	
CA-I (a) (15M)	As per practical evaluation sheet
CA-II (b) (15M)	As per practical evaluation sheet

Sr. No.	**List of Experiments/Activities**
1.	Defining schema for applications.
2.	Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3.	Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4.	Sub-queries, Set operations, Joins.
5.	Applying Data Normalization, Procedures on databases.
6.	Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management.
7.	Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project.
8.	Studying Large objects – CLOB, NCLOB, BLOB and BFILE.
9.	Design and Implementation of One-Dimensional and Two-Dimensional Arrays with Traversal, Insertion, Deletion, and Memory Address Calculation
10.	Representation of Sparse Matrices Using 3-Tuple Form and Implementation of Fast Transpose Algorithm
11.	Design and Implementation of Hash Tables Using Division and Mid-Square Hash Functions with Collision Resolution via Chaining and Linear Probing
12.	Implementation of Stack Using Array and Linked List with Applications in Infix to Postfix Conversion and Postfix Expression Evaluation
13.	Implementation of Linear Queue, Circular Queue, and Priority Queue Using Array Representation with Overflow and Underflow Handling
14.	Implementation of Singly, Doubly, and Circular Linked Lists with Operations: Insertion (Beginning, End, Position), Deletion, Traversal, and Concatenation
15.	Implementation of Binary Tree and Binary Search Tree with Operations: Insertion, Deletion, and Traversals (Inorder, Preorder, Postorder)
16.	Implementation of Min-Heap and Max-Heap with Priority Queue Operations (Insertion, Deletion, Heapify)
17.	Implementation of Graph Representation Using Adjacency Matrix and Adjacency List with Breadth First Search (BFS) and Depth First Search (DFS) Traversals
18.	Implementation and Performance Comparison of Searching (Linear and Binary Search) and Sorting Algorithms (Insertion, Selection, Merge, Quick, Radix) Using Time Complexity Analysis

Course Title: Professional Development III **Course Code: GE263603**		**Course Category : SC/SEC**
Teaching Scheme	**Examination Scheme**	
Practical's/Sessions: 02 Hours/Week	CA-I	15 Marks
Credits: 1	CA-II	15Marks
Semester: Second Year (Semester III)	ESE	20 Marks

Course Prerequisite:

- Basic Computer Literacy, Mathematical Knowledge, Keyboard Skills.

Course Description:

This course introduces students to essential office productivity tools used for professional documentation, presentations, and data management. Students will learn to create and format documents using word processing software, design effective presentations using presentation tools, and organize and analyze data using spreadsheet applications. The course emphasizes hands-on practice with features such as formatting, charts, data validation, pivot tables, and spreadsheet functions. Through practical exercises, students will develop skills in preparing professional documents, visual presentations, and structured data sheets. The course is important for improving digital literacy and enabling students to efficiently handle academic, professional, and workplace documentation tasks.

Course Objectives:

1. To introduce students to the fundamental features and tools of office productivity software used for document preparation, presentations, and spreadsheet management.
2. To provide practical exposure to creating, formatting, and presenting professional documents and presentations using appropriate digital tools.
3. To familiarize students with spreadsheet techniques for organizing, managing, and visualizing data using charts, tables, and formatting tools.
4. To develop digital competency by training students in spreadsheet functions, data validation, pivot tables, and other tools for efficient data handling and analysis in academic and professional environments.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** fundamental concepts, features, and interfaces of office productivity tools including word processing, presentation software, spreadsheets, and professional email communication.	Remember (Level 1)
CO2	**Explain** the working principles, functionalities, and best practices of word processing, presentation design, spreadsheet operations, and email writing etiquettes for professional communication.	Understand (Level 2)
CO3	**Apply** office productivity tools to create structured documents, professional emails, effective presentations, and organized spreadsheets using appropriate features and formatting techniques.	Apply (Level 3)
CO4	**Analyze** and **interpret** data using spreadsheet techniques such as charts, validation, pivot tables, and functions to support information processing and decision-making in real-world scenarios.	Analyze (Level 4)

CO PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	1	-	-	2	-	-	-	1	-	1	-	1
CO2	1	1	-	-	2	-	1	-	2	-	1	-	2
CO3	2	1	1	-	3	-	1	1	3	1	1	1	3
CO4	2	3	1	2	3	-	-	1	2	1	2	2	3
CO5	1	1	-	-	2	-	-	-	1	-	1	-	1

Assessment	
CA-I (a)	Performance & Evaluation of activities on word & Presentation Module.
CA-II (b)	Performance & Evaluation of activities on spreadsheet Module
ESE (c)	Viva-voce/Activity Evaluation of different module.

Sr. No.	List of Experiments
1	To explore word processor interface and navigation tools for efficient document handling and professional drafting.
2	To apply basic text entry and formatting tools in word processor for creating structured documents.
3	To apply advanced formatting techniques for consistency and improved presentation of created report.
4	To create presentations using slides, themes, and multimedia elements for effective communication.
5	To analyze and modify presentation designs using software tools for improving visual impact.
6	To perform data entry and worksheet formatting in spreadsheet software for organized data management.
7	To apply conditional formatting and create charts in spreadsheets for data visualization.
8	To implement data validation and filtering techniques in spreadsheets for accurate data analysis.
9	To generate pivot tables using spreadsheet tools for summarizing and analyzing large datasets.
10	To apply spreadsheet functions (text, date-time, mathematical, statistical, and logical) for data processing and decision-making.
11	To explore email significance, navigation tools and Id creation to inculcate essential principles.
12	To compose professional emails using proper email writing etiquettes for effective workplace communication.

Sr. No.	Textbooks
1.	Abigail Rusu, Andrea Long, Heather Maye, Jennifer Evans, Amy Ledgerwood, and Jeanine Preuss, Introduction to Microsoft Office, Maricopa Millions Grant.
2.	Helen Holding, Clare Martin, Mastering Microsoft Office, Red Globe Press.
3.	R. P. Soni, Harshal Arolkar, Sonal Jain, Working with Personal Computer Software, Wiley India.
	Reference Books
1.	Stephanie Krieger, Documents, Presentations, and Workbooks: Using Microsoft Office to Create Content That Gets Noticed, Microsoft Press.
2.	Marjorie S. Hunt, Barbara Clemens, Illustrated Microsoft Office 365 & Office 2016, Cengage Learning.
3.	Linda Foulkes, Learn Microsoft Office 2019, Packt Publishing.
	Web Resources
1.	Step-by-step learning resources for office software, https://www.tutorialspoint.com/word https://www.tutorialspoint.com/excel https://www.tutorialspoint.com/powerpoint
2.	Spreadsheet concepts and functions tutorials, https://www.w3schools.com/excel

Course Title: Problem Based Learning **Course Code: GE253805**		**Course Category: ELC**
Teaching Scheme	**Examination Scheme**	
Practical: 02 hrs/ week	CA-1	15 Marks
Credits: 01	CA-2	15 Marks
Semester: Second Year (Semester III)	ESE	20 Marks
Course Prerequisite: Use of analytical skills and drawing tools, Design Thinking Module.		
Course Description: This course enables students to learn engineering concepts through solving real-world course related technical problems at detailed project level. It emphasizes application of domain knowledge, critical thinking, and systematic problem-solving. In this course students will remain engaged in need identification, solution development, prototyping, and validation within given constraints. The course promotes teamwork and hands-on learning. Outcomes are demonstrated through a representational prototype of proposed solution along with detailed documentation. The course coordinators will guide to the students in the journey of problem solving by providing the resources in the lab activity sessions and also monitor the students progress.		
Course Objectives: 1. To enable students to apply domain knowledge for solving real-world course related technical problems through a structured problem-based learning approach. 2. To guide students in analyzing problems, generating feasible solutions, and making informed engineering decisions. 3. To facilitate the development of design, implementation, and testing skills through project-based activities. 4. To cultivate teamwork, communication, and professional skills through continuous mentoring and evaluation.		

Course Outcomes:		
COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Understand** real-world engineering problems by identifying basic requirements, limitations, and relevant knowledge.	L2 Understand
CO2	**Apply** engineering concepts, tools, and methods to develop a working solution.	L3 Apply
CO3	**Analyze** engineering problems by connecting theory with practical situations and finding possible solution approaches.	L4 Analyze
CO4	**Evaluate** different engineering solutions based on factors like feasibility, cost, efficiency, and sustainability.	L5 Evaluate
CO5	**Create** and present engineering solutions by testing performance and explaining results clearly.	L6 Create

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	2		1								2	2
CO2	3	2	2	2	2			2			1	3	2
CO3	3	3	3	1	1			2			1	3	2
CO4	2	2	3	2	2	1		1			1	3	3
CO5			3		2			3	2	2	2		

Assessment	
CA-I (a)	Identify a real-life problem related to your subject. Clearly explain the problem, understand the needs of users, and list the important constraints (such as cost, materials, and time). Study existing solutions for the same problem. Then, generate different possible solutions and select the best one based on practicality, cost, and effectiveness.
CA-II (b)	Based on the selected solution, design and build a representational model of prototype. Prepare a proper plan, use suitable tools and methods to develop it. Make improvements if needed, and finally demonstrate the representational model with clear documentation.
ESE (c)	Assigned Task Completion.

Sr. No.	List of Activities
1	To identify a course-related technical problems.
2	To define the problem clearly with objectives, basic requirements, and constraints.
3	To study existing solutions or methods related to the problem and find the gap
4	To generate different possible solutions using basic engineering concepts.
5	To select the best solution based on different applicable criteria's i.e. feasibility, simplicity, and cost-effectiveness.
6	To prepare the design, list of materials and use the required tools for the solution.
7	To develop a basic representational model of prototype using available resources.
8	To test the developed solution based on the peer-reviewed feedback.
9	To improve the solution based on test results and feedback.
10	To present the final solution and prepare a simple technical report.

Sr. No.	Textbooks
1.	Nigel Cross,Design Thinking: Understanding How Designers Think and Work, Berg Publishers.
2.	Nigel Cross,Engineering Design Methods: Strategies for Product Design, John Wiley & Sons.
	Reference Books
1.	Guerra, Aida, Ulseth, Ronald, Kolmos, Anette, PBL in Engineering Education: International Perspectives on Curriculum Change, Springer, 2017.
	Web Resources
1.	NPTEL Online Courses- Problem Based learning, NITTTR. (https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr20_ed12)

Course Title: Do It Yourself III **Course Code:GE253806**		**Course Category :ELC**
Teaching Scheme		**Examination Scheme**
Practical's/Sessions:02Hours/Week	CA-I	15Marks
Credit:01	CA-II	15Marks
Semester :Second Year (Semester III)	ESE	20Marks

Course Prerequisite:

- Basic knowledge of computer hardware components and operating systems.
- Basic understanding of networking concepts such as LAN, IP address, and cable types.
- Familiarity with basic computer operations and use of Linux commands.

Course Description: This course provides practical knowledge about computer hardware, operating system installation, and computer networking. Students learn to identify computer components and perform tasks such as formatting a hard disk, installing operating systems, and configuring dual boot systems. They also gain hands-on experience in preparing LAN cables, creating peer-to-peer and star network connections, and sharing resources over a network. Additionally, students learn to set up wired and wireless LANs using switches and routers. The module also includes solving Linux-based challenges to improve practical skills in the Linux environment practical activities

Course Objectives:

1. To understand the basic components of a computer system and perform operating system installation and configuration.
2. To develop practical skills in computer networking such as preparing LAN cables and setting up wired and wireless networks.
3. To apply Linux commands and problem-solving techniques to complete Linux-based challenges.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Identify** basic computer hardware components and understand the fundamentals of operating system installation.	Remember (Level1)
CO2	**Explain** the process of hard disk formatting, operating system installation, and dual boot configuration.	Understand (Level 2)
CO3	**Demonstrate** preparation of LAN cables and configure peer-to-peer, star, wired, and wireless networks for resource sharing.	Apply (Level3)
CO4	**Analyze** and **solve** Linux-based challenges using appropriate Linux commands and problem-solving techniques.	Analyze (Level4)

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	-	1	1	-	2	-	-	-	-	-	-	-	-
CO2	-	2	2	1	3	-	-	-	-	-	-	-	-
CO3	-	2	3	2	3	-	-	-	2	1	2	2	1
CO4	-	3	2	3	3	-	-	-	-	-	2	2	3

Assessment	
CA-I(a)	Based on Activities related to 1 to 5 practical
CA-II (b)	Based on Activities related 6 to 9 practical's

Sr. No.	List of Activities
1	Identify the different components of the computer system
2	Demonstrate formatting of HDD as per the given specifications and installation of an operating system
3	Demonstrate installation of dual boot Operating System
4	Prepare a straight through and crossover LAN cable
5	Prepare a P2P network connection and sharing of files and folders
6	Prepare a star network using a switch and sharing of resources.
7	Prepare a physical LAN using a switch
8	Prepare a wireless LAN using a router
9	Solving LINUX based challenge Part I
10	Solving LINUX based challenge Part II

Course Title: Database System **Course Code: AI251401**		**Course Category: MDM-I**
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:

Computer Fundamentals: Familiarity with operating system basics, such as processes and memory management. Understanding of File and File organization

Data Structure Basics: Understanding of fundamental data structures such as arrays, linked lists, stacks, and queues. Knowledge of simple searching and sorting techniques.

Course Description: This course introduces the fundamentals of database systems, including data models, and ER modeling. It develops skills in SQL for data management and covers normalization, transaction processing, and concurrency control. The course also provides an overview of NoSQL databases and modern data handling techniques for real-world applications.

Course Objectives:

1. To learn and understand database system architecture, functioning and applications.
2. To understand representation of real-life objects or data elements and their relationship for a specified system using ER modeling to conceptualize design for the database.
3. To enable students to write SQL queries for data definition, manipulation, and retrieval along with normalization and transaction management techniques.
4. To provide exposure to NoSQL databases for modern data management.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** basic concepts of database systems, database architecture, data models, and types of database languages.	Remember (Level 1)
CO2	**Explain** ER modeling concepts, relational database design, normalization forms, SQL query structure, integrity constraints, and NoSQL.	Understand (Level 2)
CO3	**Use** ER modeling techniques and SQL commands to design and implement relational databases and perform data manipulation.	Apply (Level 3)
CO4	**Illustrate** database design and transaction processing, SQL and NoSQL, concurrency control, and recovery techniques.	Analyze (Level 4)

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	–	–	–	–	–	1	–	–	–
CO2	3	2	1	–	1	–	–	–	–	1	–	–	–
CO3	3	2	3	1	3	–	–	–	1	1	–	–	–
CO4	3	3	2	2	2	–	–	–	–	1	–	–	–

Assessment	
CA-1 (a)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b)	Subjective Test/Course Project/Assignments/Presentation
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction to DBS** Database System Applications, Purpose of Database Systems, View of Data, Schemas and Instances, Overview of Database Languages, Database Architecture, Types of Data Models.	4 Hrs
Unit 2	**ER Modeling** Entity Relationship Model, Notation for ER Diagram, Constraints, Concepts of Super Key, Candidate Key, Primary Key, Weak Entity Sets, Codd's Rule, E-R Diagrams, Mapping Cardinality, Extended ER Model, Generalization, Aggregation, Reduction of an ER Diagrams to Tables.	4 Hrs
Unit 3	**Introduction to SQL** Overview of SQL, Database Languages (DDL, DML, DCL, TCL), Basic Structure of SQL Queries, Integrity Constraints, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub Queries, Join, View, SQL Data Types, and Authorization.	4 Hrs
Unit 4	**Relational Database Design** RDBMS Design Process: Features of Good Relational Designs and Functional Dependencies. Normalization: Normal Forms, First, Second, Third Normal Forms, BCNF.	4 Hrs
Unit 5	**NO SQL** Introduction to NoSQL: Need, Features, CAP Theorem, BASE Properties, Types of Data: Structured, Unstructured Data and Semi-Structured Data, Comparative study of SQL and NoSQL. MongoDB (with syntax and usage): CRUD Operations, Indexing, Aggregation, MapReduce. Case Study: Use of NOSQL database for Processing of Unstructured Data from SocialMedia.	4 Hrs
Unit 6	**Transaction Processing** Transaction Concept, A simple Transaction Model, ACID Properties, ACID Vs BASE. Schedules: Serial, Parallel Schedule. Serializability: View and Conflict, Concurrency Control Techniques: Lock based Protocols, Deadlock Handling, Time stamp-Based Protocols, Recovery System.	4 Hrs

Sr. No.	Textbooks
1.	Henry Korth, Abraham Silberschatz & S. Sudarshan, Database System Concepts, McGraw-Hill Publication, 6th Edition, 2011.
2.	Navathe, Fundamentals of Database System, Addison-Wesley Publication, 6th Edition, 2012.
3.	MongoDB: The Definitive Guide by Kristina Chodorow
	Reference Books
1.	Thomas M. Connolly, Carolyn E. Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", Addison Wesley, fifth Edition
2.	Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill Publication, 3rd Edition, 2003
3.	Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates,2nd Edition, 2014.
4.	C. J. Date "Introduction to Database Systems", Addition Wesley, Seventh Edition
5.	Atul Kahate,"Introduction to Database Management System", Third Edition, Pearson Education
	Web Resources
1.	NPTEL course: Database management system (IITK): https://onlinecourses.nptel.ac.in/noc21_cs04/
2.	https://www.geeksforgeeks.org/dbms/dbms/

Course Title: Artificial Intelligence Fundamentals **Course Code:AI253206**		**Course Category: HMM I**
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs / week	CA-1	10 Marks
Tutorial: 00 hrs / week	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 arks

Course Prerequisite:

- Basic knowledge of programming concepts.
- Fundamental understanding of data structures and algorithms.
- Basic knowledge of probability and statistics.
- Familiarity with logical reasoning and problem solving.

Course Description: This course introduces the fundamental concepts of Artificial Intelligence including intelligent agents, search techniques, knowledge representation, reasoning, and machine learning basics. Students will learn how AI systems solve complex problems and how these technologies are applied in real-world domains such as healthcare, robotics, finance, and natural language processing.

Course Objectives:

1.To introduce fundamental concepts of Artificial Intelligence.
2.To understand intelligent agents and problem-solving techniques.
3.To study knowledge representation and reasoning methods.
4.To understand machine learning concepts used in AI systems.
5.To explore real-world applications and ethical issues of AI.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Remember** the fundamental concepts, terminology, and components related to the subject.	Remember (Level 1)
CO2	**Explain** the important principles, techniques, and methodologies used in the subject domain.	Understand (Level 2)
CO3	**Implement** appropriate methods, algorithms, or techniques to solve practical problems.	Apply (Level 3)
CO4	**Differentiate** and **organize** various approaches, models, or systems to evaluate their effectiveness in real-world applications.	Analyze (Level 4)

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	–	1	–	1	–	1	–	1	2
CO2	3	2	1	2	1	–	–	1	–	1	–	2	2
CO3	2	3	3	3	3	–	–	–	-	1	–	3	3
CO4	2	3	2	3	2	1	–	1	-	2	–	3	3

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction to Artificial Intelligence:** Definition, history and evolution of AI, characteristics of intelligent systems, types of AI, AI, Machine Learning and Deep Learning, applications of AI.	4 Hrs.
Unit 2	**Intelligent Agents** Concept of agents, agent architecture, types of agents, PEAS representation, agent environment characteristics.	4 Hrs.
Unit 3	**Problem Solving and Search Techniques:** State space representation, uninformed search techniques – BFS, DFS, uniform cost search, depth limited search, iterative deepening search.	4 Hrs.
Unit 4	**Informed Search Techniques** Heuristic functions, greedy best-first search, A* algorithm, local search algorithms, hill climbing.	4 Hrs.
Unit 5	**Knowledge Representation:** Types of knowledge, propositional logic, predicate logic, semantic networks, frames, rule-based systems, reasoning techniques.	4 Hrs.
Unit 6	**Machine Learning and AI Applications:** Introduction to machine learning, types of ML, basic ML algorithms, model evaluation, AI applications and ethical considerations.	4 Hrs.

Sr. No.	Textbooks
1.	Stuart Russell and Peter Norvig, **Artificial Intelligence: A Modern Approach**, Pearson Education
2.	Elaine Rich and Kevin Knight, **Artificial Intelligence**, McGraw-Hill.
	Reference Books
1.	an W. Patterson, **Introduction to Artificial Intelligence and Expert Systems**, PHI.
2.	George F. Luger, **Artificial Intelligence: Structures and Strategies for Complex Problem Solving**, Pearson..

Course Title: Data Mining & Analysis **Course Code: AI253207**		**Course Category: DM I**
Teaching Scheme	**Examination Scheme**	
Lectures: 02hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:

Linear algebra, probability, statistics, and calculus. Proficiency in Python programming with libraries such as NumPy and scikit-learn is required, Basic knowledge of machine learning concepts, optimization methods, and prior exposure to data science or related courses is recommended.

Course Description: This course introduces fundamental and advanced techniques in data mining and data analytics for extracting meaningful patterns from large datasets. It covers data preprocessing, frequent pattern mining, clustering, classification, and predictive modeling. The course also explores high-dimensional data analysis, text mining, and big data frameworks. Emphasis is given to real-world applications and domain-specific case studies to bridge theory and practice.

Course Objectives:

1. Understand fundamental concepts of data analysis and data representation.
2. Apply data preprocessing and feature engineering techniques to prepare datasets.
3. Analyze and implement pattern mining and association rule techniques.
4. Apply clustering and classification algorithms for predictive modeling.
5. Evaluate models using appropriate performance metrics.
6. Explore advanced analytics techniques and domain-specific applications

Course Outcomes		
COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** the fundamental concepts of data types, data representation, similarity measures, and basic principles of data analysis and visualization.	Remember (Level 1)
CO2	**Explain** the techniques of data preprocessing, feature engineering, dimensionality reduction, and handling data quality issues for effective data analysis.	Understand (Level 2)
CO3	**Apply** pattern mining, clustering, and classification algorithms to discover patterns and build predictive models from data.	Apply(Level 3)
CO4	**Analyze** the performance of data mining models, evaluation metrics, and AI applications, including ethical considerations in intelligent data-driven systems.	Analyze (Level 4)

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO 2**
CO1	3	1	–	–	–	1	–	1	–	1	–	1	2
CO2	3	2	1	2	2	–	–	1	–	1	–	2	3
CO3	2	3	3	3	3	–	–	–	1	1	–	3	3
CO4	2	3	3	3	3	1	–	2	1	2	–	3	3

Assessment	
CA-1 (a) (10M)	Subjective Test / Open book test / etc
CA-2 (b) (10M)	Model Making / Assignment / Presentation / etc
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Data Analysis Foundations** Types of Data: Structured, Semi-structured, Unstructured, Data Objects and Attributes (Numeric & Categorical), Basic Matrix Representation, Introduction to Similarity & Distance Measures, Basics of Data Visualization	4 Hrs
Unit 2	**Data Preprocessing** Data Cleaning: Missing Values & Noise, Data Transformation: Normalization, Basic Data Reduction (Feature Selection – Intro only),Handling Outliers, Introduction to Imbalanced Data	4 Hrs
Unit 3	**Frequent Pattern Mining** Introduction to Pattern Mining, Frequent Itemsets Concept, Apriori Algorithm (Concept + Simple Example),Association Rules: Support & Confidence	4 Hrs
Unit 4	**Clustering Techniques** Introduction to Clustering, K-Means Algorithm (Core focus, Hierarchical Clustering (Basic idea only), Introduction to DBSCAN	4 Hrs
Unit 5	**Classification and Predictive Modeling** Supervised Learning Concept, Decision Trees (Basic), k-Nearest Neighbors (k-NN), Naïve Bayes (Concept only), Model Evaluation: Accuracy, Precision, Recall	4Hrs
Unit 6	**Applications, Ethics** Applications of AI: Computer Vision, Natural Language Processing, Speech Recognition, Introduction to Neural Networks (very basic idea), Explainable AI (Concept only), Ethical Issues: Bias, Fairness, Accountability	4Hrs

Sr. No.	Textbooks
1.	Data Mining: Concepts and Techniques – Jiawei Han, MichelineKamber, Jian Pei, Morgan Kaufmann.
2	Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson.
	Reference Books
1.	Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer.
2.	The Elements of Statistical Learning – Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer.
3.	Mining of Massive Datasets – Jure Leskovec, AnandRajaraman, Jeffrey D. Ullman, Cambridge University Press.
	Web Resources
1	https://onlinecourses.nptel.ac.in/noc26_cs58/preview
2	https://www.coursera.org/browse/data-science

Course Title: Object Oriented Programming in Java **Course Code: AI254208**		**Course Category: PCC**
Teaching Scheme	**Examination Scheme**	
Lecture: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:

Programming Fundamentals: Basics of programming language.

Course Description: This course provides a detailed introduction to Java programming, covering its architecture, object-oriented principles, and features like Java Virtual Machine (JVM), byte code and Just-In-Time (JIT) compiler. It explores class fundamentals, inheritance, arrays, strings and advanced concepts such as packages, interfaces, and exception handling. Students will learn Java Database Connectivity (JDBC) for database integration. The course includes GUI development using Swing, with a focus on components, containers, event handling and layout management.

Course Objectives:

1. To understand the core concepts of Java programming, including object-oriented principles, JVM architecture and key features like bytecode and the JIT compiler.
2. To develop proficiency in creating and managing classes, objects, inheritance, exception handling for building robust and reusable applications.
3. To enable students to use Java packages, interfaces and JDBC for modular programming and database connectivity in real-world scenarios.
4. To equip students with skills to design graphical user interfaces using Swing components, containers and event handling mechanisms..

Course Outcomes:		
COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** and Define fundamental Java concepts	Remember (Level 1)
CO2	**Explain** arrays, vectors, strings, wrapper classes and package concepts using Java	Understand (Level 2)
CO3	**Implement** inheritance, method overriding, abstract classes, interfaces, and multiple inheritance concepts to design reusable Java programs	Apply (Level 3)
CO4	**Test** types of errors and exceptions, analyze exception hierarchy, and implement exception handling using try, catch, finally, throw, and throws	Analyze (Level 4)
CO5	**Design** and implement database connectivity using JDBC components	Create (Level 6)
CO6	**Develop** event-driven GUI applications using Java Swing	Create (Level 6)

CO PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	-	-	-	-	-	1	3	2
CO2	3	2	-	-	1	-	-	-	-	-	1	3	3
CO3	3	2	2	-	2	-	-	1	-	-	1	3	3
CO4	2	3	-	2	2	-	-	-	-	-	1	3	3
CO5	3	2	3	2	3	1	-	1	-	1	1	3	3
CO6	3	2	3	1	3	1	-	2	-	1	1	3	3

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ Mini Application/ MCQ Test etc.
MSE	Subjective Test

Course Contents		
Unit 1	**Introduction to Java Applications** Features of Java, Java Virtual Machine, Byte Code, JIT Compiler, Class fundamentals, Declaring Objects, Nested and Inner Classes, Introducing Methods, Constructors, Garbage Collection, Overloading Methods, Using Objects as Parameters, Returning Objects, Access Control.	6Hrs
Unit 2	**Arrays and Packages** Arrays, Vectors, Strings, Wrapper classes, Using Command-Line Arguments, Packages: Defining a Package and types, Finding Packages and CLASSPATH, A Short Package Example, Access Protection, Importing Packages, Study of java. lang & java.util packages.	6Hrs
Unit 3	**Inheritance and Polymorphism** Inheritance Basics, Using Super, Method Overriding, Abstract Classes, Using final Keyword with Inheritance, Interfaces: Defining an Interface, Implementing Interfaces, Variables in Interfaces, Extending Interfaces, Multiple Inheritance.	6Hrs
Unit 4	**Exception Handling** Types of Errors, Exception Hierarchy, Built-in Exceptions, User-defined Exceptions, Arithmetic Exception, InputMismatch Exception, Exception Handling using try, catch, finally, throw and throws keyword.	6Hrs
Unit 5	**Java Database Connectivity** Introduction, Types of JDBC Drivers, Driver interface and Driver Manager class, Connection Interface, Statement Interface, Prepared Statement, ResultSet, JDBC Program for executing Statements and processing Result Set, Using Prepared Statement.	6Hrs
Unit 6	**Swing** Introduction to Swing, Swing Architecture, Swing Components: JLabel, JTextField, JTextArea, JButton, JCheckBox, Containers and layout managers FlowLayout, BorderLayout and GridLayout. Event handling: ActionListener, menus, dialog boxes, and basic graphics in Swing.	6Hrs

Sr. No.	Textbooks
1.	E Balagurusamy, Programming with Java, Tata Mc Graw Hill, 4th edition, 2010
2.	Kathy sierra and bert bates,Head first java**,** Third Edition, 2022
	Reference Books
1.	Herbert Schildt, Java The Complete Reference, McGraw-Hill Publication, 9thEdition, 2014.
2.	Steven Holzner, Java 2 Black Book,DreamTech Press, 2008.
3.	Patrick Niemeyer, Daniel Leuck, Learning Java, O'Reilly Media, 4th Edition, 2013.
4.	Bruce Eckel, Thinking in Java by,6th Edition,2006.
	Web Resources
1.	https://www.javatpoint.com/java-swing

Course Title: Exploratory Data Analysis **Course Code: AI254209**		**Course Category: PCC**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:

- Basic knowledge of statistics and probability.
- Familiarity with programming concepts (preferably Python).
- Understanding of data structures and datasets.
- Basic knowledge of data visualization techniques.

Course Description: This course introduces the concepts and techniques of Exploratory Data Analysis (EDA) used for analyzing datasets and summarizing their main characteristics. The course focuses on data preprocessing, descriptive statistics, visualization methods, and discovering patterns in datasets. Students will learn to explore datasets, detect anomalies, understand relationships between variables, and prepare data for machine learning models.

Course Objectives:

1. To introduce the concept and importance of exploratory data analysis in data science.
2. To understand data preprocessing and cleaning techniques.
3. To explore statistical and visualization methods for analyzing datasets.
4. To identify patterns, relationships, and anomalies in data.
5. To prepare datasets for machine learning and predictive analytics.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Remember** the fundamental concepts, terminology, and techniques used in exploratory data analysis.	Remember (Level 1)
CO2	**Explain** data preprocessing, descriptive statistics, and visualization techniques used for data exploration.	Understand (Level 2)
CO3	**Implement** exploratory data analysis techniques using statistical methods and visualization tools on datasets.	Apply (Level 3)
CO4	**Analyze** datasets to identify patterns correlations and anomalies using EDA	Analyze (Level 4)

CO-PO Mapping:													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	–	1	–	1	–	1	–	1	2
CO2	3	2	1	2	2	–	–	1	–	1	–	2	3
CO3	2	3	2	3	3	–	–	–	-	1	–	3	3
CO4	2	3	2	3	3	1	–	1	-	2	–	3	3
CO5	2	3	2	3	2	1	–	2	-	2	–	3	3
CO6	2	3	2	3	2	-	-	1	-	-	-	1	2

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction to Exploratory Data Analysis:** Concept of EDA, objectives of EDA, role of EDA in data science workflow, types of data, structured and unstructured data, importance of data exploration.	6 Hrs.
Unit 2	**Data Collection and Data Preprocessing:** Data sources, data cleaning, handling missing values, detecting and removing outliers, data transformation and normalization techniques.	6 Hrs
Unit 3	**Descriptive Statistics:** Measures of central tendency (mean, median, mode), measures of dispersion (variance, standard deviation), statistical data summarization techniques.	6 Hrs
Unit 4	**Data Visualization for EDA:** Histograms, box plots, scatter plots, bar charts, correlation heat maps, graphical representation for identifying patterns.	6 Hrs.
Unit 5	**Correlation and Relationship Analysis:** Correlation coefficient, covariance, relationship between variables, multivariate analysis basics, identifying trends and patterns.	6 Hrs.
Unit 6	**Applications of EDA:** Anomaly detection, pattern discovery, preparing datasets for machine learning models, case studies of EDA in real-world applications.	6 Hrs.

Sr. No.	Textbooks
1.	John Tukey, **Exploratory Data Analysis**, Addison-Wesley.
2.	Wes McKinney, **Python for Data Analysis**, O'Reilly Media.
	Reference Books
1.	Cathy O'Neil and Rachel Schutt, **Doing Data Science**, O'Reilly Media.
2.	Hadley Wickham and Garrett Grolemund, **R for Data Science**, O'Reilly Media.
	Web Resources
1.	https://www.kaggle.com/learn
2	https://pandas.pydata.org
3	https://matplotlib.org

Course Title: Database Management System **Course Code: AI254210**		**Course Category: PCC**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs / week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:

- **Computer Fundamentals**: Familiarity with operating system basics, such as processes and memory management. Understanding of File and file organization
- **Data Structure Basics**: Understanding of fundamental data structures such as arrays, linked lists, stacks, and queues. Knowledge of simple searching and sorting techniques.

Course Description: This course introduces the fundamentals of database systems, including data models, and ER modeling. It develops skills in SQL and PL/SQL for data management and covers normalization, transaction processing, and concurrency control. The course also provides an overview of NoSQL databases and modern data handling techniques for real-world applications.

Course Objectives:

1. To learn and understand database system architecture, functioning and applications.
2. To understand representation of real life objects or data elements and their relationship for a specified system using ER modeling to conceptualize design for the database.
3. To enable students to write SQL queries for data definition, manipulation, and retrieval.
4. To impart knowledge of normalization and transaction management techniques.
5. To provide exposure to PL/SQL programming and NoSQL databases for modern data management.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** basic concepts of database systems, ER modeling, and SQL.	Remember (Level 1)
CO2	**Explain** database design, normalization, and SQL concepts including PL/SQL, NoSQL.	Understand (Level 2)
CO3	**Implement** sql queries, joins, subqueries, and PL/SQL constructs to perform data manipulation and database operations.	Apply (Level 3)
CO4	**Examine** relational schemas using normalization and dependency, and transaction management concepts including concurrency control.	Analyze (Level 4)
CO5	**Assess** different database models, ACID properties, concurrency techniques, and compare RDBMS with NoSQL databases.	Evaluate (Level 5)
CO6	**Design** and develop database applications using ER modeling, SQL, PL/SQL, and NoSQL techniques for real-world problems.	Create (Level 6)

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	1	-	-	-	-	-	-	2	-
CO3	3	3	2	-	2	-	-	-	-	-	-	3	1
CO4	3	3	2	2	1	-	-	-	-	-	-	3	1
CO5	2	3		2	1	-	-	-	-	-	-	2	2
CO6	3	3	3	2	2	-	-	1	1	1	1	3	3

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction and ER Modeling** Database System Applications, Purpose of Database Systems, View of Data, Schemas and Instances, Overview of Database Languages, Database Architecture, Types of Data Models, Entity Relationship Mode, Notation for ER Diagram, Constraints, Super Key, Candidate Key, Primary Key, Weak Entity Sets, Codd's Rule, E-R Diagrams, Mapping Cardinality, Extended ER Model, Generalization, Aggregation, Reduction of an ER Diagrams to Tables.	6 Hrs.
Unit 2	**Introduction to SQL** Overview of SQL, Database Languages , Basic Structure of SQL Queries, Integrity Constraints, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database, Intermediate SQL : Join Expressions, View, Integrity Constraints, SQL Data Types and Authorization.	6 Hrs.
Unit 3	**Relational Database Design** RDBMS Design Process: Features of Good Relational Designs, Functional Dependencies. Normalization: Normal Forms, First, Second, Third Normal Forms, BCNF, Multivalued Dependencies, Fourth Normal Form.	6 Hrs.
Unit 4	**Procedural Language / Structured Query Language(PL/SQL)** Overview of PL/SQL, Structure of PL/SQL block (DECLARE, BEGIN, EXCEPTION, END), Conditional and Iterative Control Statement (if-else, loop), Concept of Stored Procedures and Functions, Exception Handling, Cursors, Triggers, Assertions, Roles and Privileges.	6 Hrs.
Unit 5	**NoSQL Databases** Introduction to NoSQL: Need, Features, CAP Theorem, BASE Properties, Types of Data: Structured, Unstructured Data and Semi-Structured Data, Comparative study of SQL and NoSQL. MongoDB (with syntax and usage): Working with Documents and Collections, MangoDB Methods, Indexing, Aggregation, MapReduce. Case Study: Use of NOSQL database for processing of unstructured data from social media.	6 Hrs.

Unit 6	**Transaction Processing** Transaction Concept, A simple Transaction Model, ACID Properties, ACID, BASE. Schedules: Serial, Parallel Schedule. Serializability: View and Conflict, Concurrency Control Techniques: Lock based Protocols, Deadlock Handling, Time Stamp-Based Protocols, Recovery System.	6 Hrs.

Sr. No.	Textbooks
1.	Henry Korth, Abraham Silberschatz & S. Sudarshan, Database System Concepts, McGraw-Hill Publication, 6th Edition, 2011.
2.	Navathe, Fundamentals of Database System, Addison-Wesley Publication, 6th Edition, 2012.
3.	MongoDB: The Definitive Guide, Kristina Chodorow, O'Reilly Media, 2nd Edition, 2013.
	Reference Books
1.	Thomas M. Connolly, Carolyn E. Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", Addison Wesley,fifth Edition, 2014
2.	Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-HillPublication, 3rd Edition, 2003
3.	Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates,2nd Edition, 2014.
4.	C. J. Date "Introduction to Database Systems", Addition Wesley, Seventh Edition, 2000
5.	AtulKahate, "Introduction to Database Management System", Third Edition, Pearson Education, 2013
	Web Resources
1.	NPTEL course : Database management system(IITK): https://onlinecourses.nptel.ac.in/noc21_cs04/
2.	https://www.geeksforgeeks.org/dbms/dbms/
3.	NPTEL Course: https://onlinecourses.nptel.ac.in/noc26_cs39/preview

Course Title: Cyber Security Fundamentals **Course Code:AI254504**		**Course Category: OE II**
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:

- Basic knowledge of computers, operating systems, and Internet usage.
- Familiarity with web browsing, email, and common digital applications.

Course Description:

This course introduces the fundamental concepts of cyber security and safe computing practices. It provides an overview of cyber threats, malware, network security, cyber-crimes, cyber laws, data privacy, and security best practices. The course is designed to create awareness among students from non-computer science disciplines and equip them with the knowledge required to protect digital assets and use information technology securely.

Course Objectives:

1. Understand the basic concepts and significance of cyber security.
2. Identify common cyber threats, vulnerabilities, and attack techniques.
3. Apply safe computing and Internet security practices.
4. Understand cyber-crimes, cyber laws, and ethical issues in cyberspace.
5. Recognize methods for protecting personal and organizational data.
6. Develop cyber hygiene practices for secure digital communication and online activities.

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** the fundamentals of cyber security and cyber threats.	L1 Remember
CO2	**Explain** cyber security concepts, security mechanisms, and cyber laws.	L2 Understand
CO3	**Apply** cyber security practices to protect networks, systems, and data.	L3 Apply
CO4	**Analyze** cyber-attacks, vulnerabilities, and security solutions.	L4 Analyze

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2			1			2				1	2
CO2	2	3	2	2	3			2				2	3
CO3	2	3		3	2	2		3				2	3
CO4	2	2	3	3	3	2	1	3	2	2	2	3	3

Assessment	
CA-1 (a)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b)	Subjective Test/Course Project/Assignments/Presentation
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction to Cyber Security** Fundamentals of Cyber Security, Need for and Importance of Cyber Security CIA Triad (Confidentiality, Integrity, Availability), Cyber Space and Digital Assets, Types of Cyber Threats and Vulnerabilities	4 Hrs
Unit 2	**Malware and Cyber Attacks** Malware: Virus, Worm, Trojan Horse, Spyware, Adware, Ransomware, Phishing and Spear Phishing, Social Engineering Attacks, Password Attacks, Denial-of-Service (DoS) and Distributed DoS (DDoS) Attacks	4 Hrs
Unit 3	**Network and Internet Security** Basics of Computer Networks, Internet Security Concepts, Secure Web Browsing, Email Security, Firewalls, Antivirus, and Virtual Private Networks (VPNs)	4 Hrs
Unit 4	**Data Protection and Digital Privacy** Data Privacy and Confidentiality, Data Backup and Recovery, Cloud Security Basics, Mobile Device Security, Social Media Security, Secure Online Transactions	4 Hrs
Unit 5	**Cyber Crimes and Cyber Laws** Introduction to Cyber Crimes, Identity Theft and Online Fraud, Cyber Bullying and Cyber Stalking, Overview of the Information Technology (IT) Act, 2000, Digital Signatures and Electronic Records, Ethical Issues in Cyberspace	4 Hrs
Unit 6	**Cyber Hygiene and Emerging Trends** Cyber Hygiene Practices, Security Awareness and Incident Reporting, Authentication and Access Control, Internet of Things (IoT) Security, Artificial Intelligence in Cyber Security, Future Challenges and Career Opportunities in Cyber Security	4 Hrs

Sr. No.	Textbooks
1.	**William Stallings**, *Effective Cybersecurity: A Guide to Using Best Practices and Standards*, Addison-Wesley, 2018.
2.	**Charles P. Pfleeger** and **Shari Lawrence Pfleeger**, *Security in Computing* (5th Edition), Pearson, 2015.
	Reference Books
1.	**Behrouz A. Forouzan**, *Data Communications and Networking* (5th Edition), McGraw-Hill Education, 2013
2.	**Debarati Halder** and **K. Jaishankar**, *Cyber Crime and the Victimization of Women: Laws, Rights and Regulations*, IGI Global, 2012.
	Web Resources
1.	Cybersecurity and Infrastructure Security Agency (CISA)
2.	National Institute of Standards and Technology (NIST) Cybersecurity Resources
3.	CERT-In (Indian Computer Emergency Response Team)
4.	Ministry of Electronics and Information Technology (MeitY), Government of India

Course Title: Artificial Intelligence & Data Science **Course Code: PL261103**		**Course Category: OE**
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs./ week	CA-1	10 Marks
Tutorial: ---	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second year (Semester IV)	ESE	60 Marks

Course Prerequisite:
Prior knowledge of programming (preferably Python), data structures and algorithms, discrete mathematics, linear algebra, and basic probability & statistics. Familiarity with fundamental machine learning concepts is desirable.

Course Description: This course introduces the fundamental concepts of Artificial Intelligence and Data Science. It covers intelligent search, knowledge representation, statistical foundations, and data preprocessing techniques. Students learn supervised and unsupervised learning methods for building predictive models. The course also explores advanced topics such as optimization, ensemble learning, and ethical AI, with practical implementation using real-world datasets.

Course Objectives:

1. To provide foundational knowledge of Artificial Intelligence concepts including search, knowledge representation and reasoning.
2. To develop understanding of statistical methods and their application in data analysis.
3. To equip students with techniques for data preprocessing, exploratory data analysis, and feature engineering.
   To enable students to design and implement supervised and unsupervised learning models.
4. To introduce advanced AI concepts such as optimization, ensemble learning, reinforcement learning, and ethical considerations in AI systems

Course Outcomes:

COs	**After completion of the course Student will be able to**	**Bloom's Level**
CO1	**Recall** the fundamental concepts of artificial intelligence, intelligent agents, search techniques, probability theory, and statistical foundations used in data science.	Remember L1
CO2	**Explain** the principles of data preprocessing, exploratory data analysis, feature engineering, and statistical methods used for data-driven decision making.	Understand L2
CO3	**Apply** supervised and unsupervised machine learning algorithms such as regression, decision trees, clustering, and association rule mining to solve data analysis problems.	Apply L3
CO4	**Analyze** the performance of AI models, optimization techniques, ensemble learning methods, and advanced AI applications, considering ethical aspects of AI systems.	Analyze L4

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	–	–	–	–	–	–	1	2	1
CO2	3	2	1	1	2	–	–	–	1	–	1	2	2
CO3	3	3	3	2	3	–	–	–	1	–	1	3	3
CO4	3	3	2	3	2	1	1	1	1	–	2	3	3

Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Model Making / Assignment / Presentation / etc.
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Introduction to AI:** History & Applications, Intelligent Agents & Rationality, State Space Representation, Uninformed Search (BFS, DFS, UCS),· Informed Search (Greedy, A*), Knowledge Representation (Propositional Logic, FOL), Inference Mechanisms.	6 Hrs.
Unit 2	**Statistical Foundations for Data Science:** Probability Theory & Random Variables, Probability Distributions (Binomial, Poisson, Normal), Bayes Theorem, Estimation & Confidence Intervals, Hypothesis Testing (t-test, Chi-square, ANOVA), Correlation & Regression Basics.	6 Hrs.
Unit 3	**Data Preprocessing & Exploratory Data Analysis:**· Data Cleaning & Missing Value Handling, Data Transformation & Scaling, Feature Engineering, Feature Selection, Outlier Detection, Exploratory Data Analysis (EDA), Data Visualization Techniques.	6 Hrs.
Unit 4	**Supervised Learning Methods:** Linear & Logistic Regression, k-NN and Naïve Bayes, Support Vector Machines, Decision Trees and Random Forest, Model Evaluation Metrics (Accuracy, Precision, Recall, F1, ROC), Cross Validation and Bias-Variance Tradeoff.	6 Hrs.
Unit 5	**Unsupervised Learning & Data Mining**: K-Means and Hierarchical Clustering, DBSCAN, Association Rule Mining (Apriori Algorithm), PCA (Dimensionality Reduction),LDA, Introduction to Recommender Systems.	6 Hrs.
Unit 6	**Advanced Topics in AI & Data Science**: Optimization Techniques (Gradient Descent Variants), Ensemble Learning (Bagging, Boosting, AdaBoost) , Introduction to Reinforcement Learning, Time Series Analysis, Ethical AI	6 Hrs.

Sr. No.	Textbooks
1.	**Stuart Russell & Peter Norvig**, Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson.
2.	**Gareth James, Daniela Witten, Trevor Hastie & Robert Tibshirani**, An Introduction to Statistical Learning with Applications in R, Springer.
	Reference Books
1.	**Christopher M. Bishop**, Pattern Recognition and Machine Learning, Springer.
2.	**Tom Mitchell**, Machine Learning, McGraw Hill.
3.	**Trevor Hastie, Robert Tibshirani & Jerome Friedman**, The Elements of Statistical Learning, Springer.
	Web Resources
1.	NPTEL – Artificial Intelligence & Data Science Courses https://nptel.ac.in
2.	Coursera – AI & Machine Learning Specializations https://www.coursera.org
3.	Scikit-Learn Official Documentation https://scikit-learn.org

Course Title: Ethical Hacking **Course Code: PL263302**		**Course Category: OE**
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs. / week	CA-1	10 Marks
Tutorial: -	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:
TCP/IP, network protocols, Network architecture - for identifying vulnerabilities., Knowledge of cryptography, encryption and security protocols.

Course Description:
This course provides an in-depth understanding of the principles, techniques, and tools used in ethical hacking and penetration testing. Students will learn how to identify, analyze, and mitigate security vulnerabilities in computer systems, networks, and applications.

Course Objectives:

1. To introduce the methodologies and framework of ethical hacking for enhancing security.
2. To understand impacts of Hacking; Types of Hackers; Information Security Models; Information Security Program; Business Perspective; Planning a Controlled Attack; Framework of Steps

Course Outcomes:

COs	**After completion of the course: Students will be able to**	**Bloom's Level**
CO1	**Implement** security controls and defensive measures to safeguard systems against common threats	Apply L3
CO2	**Analyze** and critically evaluate techniques used to break into an insecure web application and identify	Analyze L4
CO3	**Apply** potential counter measures to advanced hacking techniques.	Apply L3
CO4	**Demonstrate** a critical evaluation of an advanced security topic with an independent project.	Analyze L4

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	2	1	2	1	–	1	3	3
CO2	3	3	2	3	2	2	1	2	1	–	2	3	3
CO3	3	3	3	2	3	2	1	2	1	–	1	3	3
CO4	3	3	2	3	2	2	1	3	2	1	3	3	3

Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Hacking Impacts and the Hacker Framework** Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, Integration Information Security Models	6 Hrs.
Unit 2	**Ethical Hacking–Overview** Hacker types-Threats and attacks, Vulnerabilities, Phases of hacking Reconnaissance-Scanning-Maintaining Access with Backdoors and Rootkits-Clearing traces. System Hacking-Hacking Windows-Hacking UNIX Remote connectivity and VoIP Hacking. Software Hacking-Hacking code-Web Hacking-Hacking the Internet User	6 Hrs.
Unit 3	**Preparing for a Hack** Technical Preparation, Managing the Engagement Reconnaissance: Social Engineering, Physical Security, Internet Reconnaissance	6 Hrs.
Unit 4	**Hacking Techniques and attacks** Password Hacking-Dictionary Attack-Hybrid Dictionary Attack-Brute force attack-Rainbow tables. A study on various attacks– Input validation attacks – SQL injection attacks – Buffer overflow attacks - Privacy attacks.	6 Hrs.
Unit 5	**TCP / IP – IP Spoofing and Dos attacks** Port scanning, DNS Spoofing. Dos attacks – SYN attacks, Smurf attacks, UDP flooding, DDOS – Models. Batch File Programming	6 Hrs.
Unit 6	**Overview of computer forensics technology** Computer forensics services-Data Seizure-Data duplication and preservation Data recovery-Document searches-Media Conversion-Expert witness services Computer evidence service options-Other miscellaneous services.	6 Hrs.

Sr. No.	Textbooks
1.	Hacking Exposed: Network Security Secrets & Solutions, Stuart McClure, Joel Scambray and George Kurtz, McGraw-Hill, 2005
2.	Patrick Engebretson, The Basics of Hacking and Penetration Testing, Elsevier, 2013
3.	Ethical Hacking, Thomas Mathew, OSB Publisher, 2003.
	Reference Books
1.	Julia H. Allen, Sean Barnum, Robert J. Ellison, Gary McGraw and Nancy Mead Software Security Engineering: A Guide for Project Managers by. Addison-Wesley, (2004).
2.	Gary McGraw, Software Security: Building Security, Addison-Wesley (2006).
	Web Resources
1.	Ip spoofing, https://www.geeksforgeeks.org/computer-networks/ip-spoofing/
2.	Hacking Techniques, https://www.geeksforgeeks.org/computer-networks/what-is-adictionary-attack

Course Title: Modern Indian Language II		**Course Category: HSSM-AEC**
Course Code: AI254703		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester :Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:

देवनागरी लिपी वाचण्याचे आणि लिहिण्याचे प्राथमिक ज्ञान

Course Description: हा अभ्यासक्रम सर्व शाखांच्या अभियंत्यांना मराठी भाषेचे व्यावहारिक आणि उद्योगाभिमुख ज्ञान प्रदान करण्यासाठी तयार करण्यात आला आहे. यामध्ये विद्यार्थी मराठी भाषेचा इतिहास आणि व्याकरणाचा भक्कम पाया रचतील आणि त्यानंतर आकलन कौशल्ये व शब्दसंपत्ती वाढविण्यावर लक्ष केंद्रित करतील. हा अभ्यासक्रम प्रामुख्याने व्यावसायिक उपयोगांवर भर देतो, ज्यामध्ये अधिकृत पत्रव्यवहार, इतिवृत्त लेखन आणि अचूक पारिभाषिक व प्रशासकीय संज्ञांचा वापर शिकविला जाईल. याव्यतिरिक्त, तांत्रिक संकल्पनांचे अचूक संप्रेषण सुनिश्चित करण्यासाठी विद्यार्थी इंग्रजी आणि मराठी या दोन्ही भाषांमधील भाषांतर कौशल्ये विकसित करतील. सरतेशेवटी, हा अभ्यासक्रम भावी अभियंत्यांना स्थानिक उद्योग, कॉर्पोरेट क्षेत्र आणि शासकीय कार्यालयांमध्ये आत्मविश्वासाने आणि प्रभावीपणे संवाद साधण्यास सक्षम बनवितो.

Course Objectives:

1. विद्यार्थ्यांना मराठी भाषेचा उगम, विकास, देवनागरी लिपी आणि विविध साहित्यप्रकारांची ओळख करून देणे.
2. विद्यार्थ्यांना मराठी व्याकरणाचे मूलभूत नियम, शुद्धलेखन आणि अचूक वाक्यरचना यांचे सखोल ज्ञान देणे.
3. विद्यार्थ्यांची शब्दसंपत्ती वाढविणे आणि दैनंदिन तसेच व्यावसायिक संवादात वाक्प्रचार व म्हणींचा योग्य वापर करण्यास शिकविणे.
4. विद्यार्थ्यांमध्ये तांत्रिक आणि प्रशासकीय उताऱ्यांचे वाचन, विश्लेषण आणि अचूक आकलन करण्याची क्षमता विकसित करणे.
5. विद्यार्थ्यांना कार्यालयीन कामकाज, पत्रव्यवहार आणि अभियांत्रिकी क्षेत्रात वापरल्या जाणाऱ्या पारिभाषिक संज्ञांचे व्यावहारिक प्रशिक्षण देणे.
6. विद्यार्थ्यांना भाषांतराची तत्त्वे आणि पद्धती समजावून सांगणे आणि इंग्रजी–मराठी भाषांतराचा (विशेषतः तांत्रिक संदर्भात) सराव करून घेणे.

Course Outcomes:

COs	**अभ्यासक्रम पूर्ण झाल्यानंतर विद्यार्थी सक्षम असतील:** **(After completion of the course students will be able to)**	**Bloom's Level**
CO1	मराठीचा इतिहास आणि विकास, मराठी व्याकरण, शब्दसंपत्ती आणि भाषा समृद्धी, आकलन कौशल्ये, व्यावहारिक आणि उपयोजित मराठी तसेच भाषांतर कौशल्ये यांच्याशी संबंधित मूलभूत तथ्ये, माहिती, नियम आणि मानकांचे स्मरण करणे.	स्मरण (Remember) (Level 1)

CO2	मराठीचा इतिहास आणि विकास, मराठी व्याकरण, शब्दसंपत्ती आणि भाषा समृद्धी, आकलन कौशल्ये, व्यावहारिक आणि उपयोजित मराठी तसेच भाषांतर कौशल्ये यांच्याशी संबंधित विविध संकल्पना, रचना, आशय आणि कार्यपद्धती स्पष्ट करणे..	समज Understand (Level 2)
CO3	मराठीचा इतिहास आणि विकास, मराठी व्याकरण, शब्दसंपत्ती आणि भाषा समृद्धी, आकलन कौशल्ये, व्यावहारिक आणि उपयोजित मराठी तसेच भाषांतर कौशल्ये यांमधील शिकलेल्या नियमांचे, तत्त्वांचे आणि कौशल्यांचे प्रत्यक्ष कामकाजात उपयोग करणे.	उपयोजन Apply (Level 3)
CO4	मराठीचा इतिहास आणि विकास, मराठी व्याकरण, शब्दसंपत्ती आणि भाषा समृद्धी, आकलन कौशल्ये, व्यावहारिक आणि उपयोजित मराठी तसेच भाषांतर कौशल्ये यांच्याशी संबंधित विविध भाषिक घटक, रचना, साहित्याचा आशय आणि माहितीचे पृथक्करण व विश्लेषण करणे.	विश्लेषण Analyze (Level 4)

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	3	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	3	-	1	-	-	-

Assessment	
CA-1 (a)	वर्णनात्मक चाचणी / गृहपाठ / बहुपर्यायी प्रश्नचाचणी इत्यादी. (Subjective Test / Assignment / MCQ Test etc.)
CA-2 (b)	वर्णनात्मक चाचणी / गृहपाठ / बहुपर्यायी प्रश्नचाचणी इत्यादी. (Subjective Test / Assignment / MCQ Test etc.)
MSE (c)	वर्णनात्मक चाचणी (Subjective Test)
ESE (d)	अंतिमसत्रपरीक्षा (End Semester Exam)

Course Contents		
Unit 1	**मराठीचा इतिहास आणि विकास (History and Literature of Marathi):** मराठी भाषेचा उगम (Origin of Marathi Language), मराठी भाषेचा विकास (Development of Marathi Language), विविध मराठी साहित्यप्रकारांचा परिचय (Introduction to Various Marathi Literary Forms), प्रसिद्ध मराठी साहित्यिक (Famous Marathi Authors), निवडक साहित्यकृतींचा परिचय (Introduction to Selected Literary Works).	4 Hrs.

Unit 2	**मराठी व्याकरण (Marathi Grammar):** मराठी वर्णमाला (Marathi Alphabet), शब्दांच्या जाती (Parts of Speech), काळांचे प्रकार (Types of Tenses), अचूक वाक्यरचना (Correct Sentence Formation), शुद्धलेखनाचे नियम (Rules of Orthography/Spelling), विरामचिन्हांचा योग्य वापर (Proper Use of Punctuation).	4 Hrs.
Unit 3	**शब्दसंपत्ती आणि भाषा समृद्धी (Vocabulary Building):** समानार्थी शब्द (Synonyms), विरुद्धार्थी शब्द (Antonyms), शब्दांची उत्पत्ती: तत्सम, तद्भव, देशी शब्द (Word Origin), शुद्ध आणि अशुद्ध शब्दांची ओळख व दुरुस्ती (Identifying and Correcting Spelling Errors), दैनंदिन संवादात म्हणींचा वापर (Use of Proverbs in Daily Communication), वाक्प्रचारांचा वापर (Use of Idioms).	4 Hrs.
Unit 4	**आकलन कौशल्ये (Reading & Comprehension):** दिलेल्या उताऱ्याचे वाचन, विश्लेषण आणि त्यावरील प्रश्नांची अचूक उत्तरे लिहिणे (Reading, Analysis, and Answering Questions on a Given Passage), तांत्रिक किंवा प्रशासकीय उताऱ्यांचे वाचन आणि सारांश लेखन (Reading technical or administrative passages in Marathi and summarizing them).	4 Hrs.
Unit 5	**व्यावहारिक आणि उपयोजित मराठी (Practical & Applied Marathi):** औपचारिक पत्रे (Formal Letters), इतिवृत्त लेखन (Meeting Minutes Writing), पारिभाषिक संज्ञा (Technical Terminology), अभियांत्रिकी कामात वापरले जाणारे इंग्रजी–मराठी शब्द (English–Marathi Words Used in Engineering Work), प्रशासकीय कामात वापरले जाणारे इंग्रजी–मराठी शब्द (English–Marathi Words Used in Administrative Work).	4 Hrs.
Unit 6	**भाषांतर कौशल्ये (Translation Skills):** भाषांतराची तत्त्वे (Principles of Translation), भाषांतराच्या पद्धती (Methods of Translation), शब्दशः भाषांतर (Literal Translation), आशयनिष्ठ भाषांतर (Contextual/Sense Translation), मराठीतून इंग्रजीत भाषांतर (Marathi to English Translation), इंग्रजीतून मराठीत भाषांतर (English to Marathi Translation).	4 Hrs.

Sr. No.	Textbooks
1.	मो. रा. वालिंबे, सुगम मराठी व्याकरण व लेखन, नितीन प्रकाशन.
2.	डॉ. ल. रा. नसीराबादकर, व्यावहारिक मराठी, फडके प्रकाशन.
	Reference Books
1.	यास्मिन शेख, मराठी लेखन मार्गदर्शिका, पद्मगंधा प्रकाशन.
2.	डॉ. स्नेहल तावरे, व्यावहारिक मराठी, स्नेहवर्धन प्रकाशन.
3.	भाषा संचालनालय, शासन व्यवहार कोश, महाराष्ट्र शासन.
4.	डॉ. कल्याण काळे, डॉ. अंजली सोमण, भाषांतर मीमांसा, प्रतिमा प्रकाशन
5.	अ. ना. देशपांडे, मराठी साहित्याचा इतिहास (खंड १ आणि २), व्हीनस प्रकाशन.
6.	शब्दकोश आणि शास्त्रीय व तांत्रिक परिभाषा कोश, महाराष्ट्र राज्य साहित्य आणि संस्कृती मंडळ.
7.	कृ. पां. कुलकर्णी, मराठी भाषा: उद्गम व विकास, मेहता पब्लिशिंग हाऊस.
	Web Resources
1.	महाराष्ट्र शासन, भाषा संचालनालय (Directorate of Languages, Govt. of Maharashtra): https://languages.maharashtra.gov.in
2.	राज्य मराठी विकास संस्था (RMVS): https://rmvs.maharashtra.gov.in
3.	मराठी विश्वकोश (Marathi Vishwakosh): https://marathivishwakosh.org
4.	भारत वाणी (Bharatavani Portal): https://bharatavani.in
5.	महाराष्ट्र राज्य साहित्य आणि संस्कृती मंडळ: https://sahitya.marathi.gov.in

Course Title: Entrepreneurship Development **Course Code: AI254704**		**Course Category:** **HSSM -EEMC**
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs. / week	CA-1	10 Marks
Tutorial:	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:

Basic knowledge of economics, management principles, and interest in entrepreneurship and innovation will be beneficial.

Course Description:

This course introduces the fundamentals of entrepreneurship, startup ecosystems, and innovation-driven business development. It covers idea generation, business model design, startup funding, financial planning, and government support initiatives for entrepreneurs. Learners will explore practical tools such as Business Model Canvas, value proposition design, and strategies for launching and scaling ventures. The course aims to develop entrepreneurial mindset, problem-solving ability, and business planning skills for creating sustainable enterprises.

Course Objectives:

- To develop understanding of the entrepreneurial mindset, attitudes, and core competencies required for entrepreneurship.
- To introduce the fundamentals of business planning, startup creation, and venture management.
- To equip with knowledge of funding opportunities, financial planning, and investment strategies for startups.
- To provide insights into market research, product development, customer needs, and business growth strategies.
- To build awareness of government policies, incubation support systems, startup ecosystems, and emerging industry trends.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Demonstrate** and **explain** fundamental concepts related to entrepreneurship and business practices.	Understand (Level 2)
CO2	**Implement** project planning techniques and evaluate feasibility, profit, and risk of business ideas.	Apply (Level 3)
CO3	**Utilize** appropriate techniques for planning, organizing, and managing activities in an entrepreneurial context.	Analyze (Level 4)
CO4	**Examine** various factors influencing performance, growth, and sustainability in business environments.	Create (Level 6)

CO-PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	1						1			2	1	1
CO2	2	3	2	2							2	1	2
CO3	1	2	3	1	1			1	2	2	3	2	2
CO4	2	3	2	2	1	2	3	2	1	1	2	3	2

Assessment	
CA-1 (a)	Entrepreneurial Ideation / Business Idea Exploration/MCQ Test etc.
CA-2 (b)	Case Study/ Business Plan Assignment / Startup Pitch Presentation / etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction To Entrepreneurship** Concept And Importance of Entrepreneurship, Competencies of Successful Entrepreneurs, Types of Entrepreneurs, Role of Entrepreneurship in Economic Development, Entrepreneurial Mindset and Motivation Theories, Barriers to Entrepreneurship.	4 Hrs.
Unit 2	**Business Idea Generation and Market Research** Advanced Techniques for Idea Generation and Opportunity Recognition, Opportunity Screening and Feasibility Analysis (Technical, Financial, Market), Market Research Methods, Consumer Behavior Analysis, Competitor Analysis.	4 Hrs
Unit 3	**Business Plan Development** Business Model Canvas (BMC): Value Proposition; Channels; Revenue Streams; Structure and Components of a Business Plan, Financial Planning Including Costing, Pricing, Budgeting and Break-Even Analysis, Risk Assessment and Mitigation Strategies.	4 Hrs
Unit 4	**Funding And Financial Management** Sources of Startup Funding: Bootstrapping; Angel Investors; Venture Capital; Crowd funding; Institutional Finance, Stages of Funding, Financial Statements, Valuation Basics, Overview of Government Initiatives and Schemes.	4 Hrs
Unit 5	**Business Operations and Legal Aspects** Forms of Business Organization, Business Registration Procedures and Regulatory Compliance, Intellectual Property Rights, Contract Management Basics, Startup Taxation Basics, Ethical Issues in Entrepreneurship, Corporate Social Responsibility (CSR) and Sustainability.	4 Hrs
Unit 6	**Growth Strategies and Case Studies** Startup Growth and Scaling Strategies, Branding and Positioning, Digital Marketing Strategies, Technology-Driven Entrepreneurship, Startup Ecosystem, Startup Pitching, Case Studies of Successful and Failed Startups.	4 Hrs.

Sr. No.	Textbooks
1.	Vasant Desai, "Entrepreneurial Development", Himalaya Publishing House, Mumbai.
2.	S.S. Khanka, "Entrepreneurial Development", S. Chand Publishing, New Delhi.
3.	Robert D. Hisrich, "Entrepreneurship", McGraw-Hill Education.
4.	Rajeev Roy, "Entrepreneurship", Oxford University Press, New Delhi.
	Reference Books
1	Peter F. Drucker, "Innovation and Entrepreneurship", Harper Business Publications.
2	Eric Ries, "The Lean Startup", Crown Business Publications.
3	Steve Blank and Bob Dorf, "The Startup Owner's Manual", K&S Ranch Press.
4	Alexander Osterwalder and Yves Pigneur, "Business Model Generation", Wiley Publications.
5	Aswath Damodaran, "Applied Corporate Finance", Wiley India.
	Web Resources
1	NITI Aayog – Startups: Policies, innovation strategies, and initiatives supporting entrepreneurship and startup growth (https://www.niti.gov.in/verticals/industry/startups)
2	Strategyzer – Business Model Canvas: (https://www.strategyzer.com/canvas/business-model-canvas)
3	Investopedia – Venture Capital: Covers startup funding sources such as venture capital, angel investment, valuation (https://www.investopedia.com/terms/v/venturecapital.asp)
4	Harvard Business Review – Entrepreneurship: Articles and insights on innovation, startup strategy, leadership, and business growth (https://hbr.org/topic/entrepreneurship)
5	Startup India – Government of India Startup Portal: Information on startup registration, schemes, entrepreneurship ecosystem support (https://www.startupindia.gov.in/)
6	MSME Ministry, Government of India: Resources for small business development, MSME schemes, entrepreneurship support, and policy initiatives (https://msme.gov.in/)

Course Title: Environmental & Sustainable Engineering **Course Code:AI254705**		**Course Category: HSSM-VEC**
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs / week	CA-1	10 Marks
Tutorial: –	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:

- Basic knowledge of science (physics, chemistry basics)
- Fundamental understanding of engineering concepts
- Awareness of environmental issues and energy usage.

Course Description: This course consists of different energy resources, environmental issues, and sustainable development. It also covers conventional and renewable energy systems, including solar, wind and hydropower, along with their working principles and applications. The course also covers environmental pollution and its causes, effects, and control measures. It also involves solid waste management techniques. Emphasis is given to sustainability concepts such as life cycle assessment, green technologies, and environmental impact assessment. Additionally, the course explores sustainable design practices, energy-efficient systems, e-waste management, and global initiatives like the United Nations Sustainable Development Goals (SDGs).

Course Objectives:

- To introduce concepts of energy resources and environmental impacts.
- To understand renewable energy systems and their applications.
- To develop knowledge of pollution control and waste management techniques
- To familiarize with sustainability principles and assessment tools (EIA)
- To promote awareness of sustainable design, green technologies, and SDGs

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Define** basic concepts of energy and environment.	Remember (Level 1)
CO2	**Identify** energy systems, environmental issues, and sustainability principles.	Understand (L2)
CO3	**Describe** methods for renewable energy use and pollution control.	Understand (L2)
CO4	**Apply** methods to address environmental impacts and sustainable solutions.	Apply (Level 3)

CO-PO Mapping:													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	1	-	-	-	-	1		
CO2	3	2	1	-	-	2	-	-	-	-	1		
CO3	3	3	2	1	-	3	-	1	-	-	2		
CO4	2	3	2	2	-	3	-	1	-	-	2		

Assessment	
CA-1 (a) - (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) - (10M)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) - (20M)	Subjective Test

Course Contents		
Unit 1	**Energy and Environmental Studies** Introduction, Renewable and Non-renewable Energy Resources, Global Energy Scenario, Indian Energy Scenario, Energy demand and environmental impacts: Climate Change; Global Warming; Necessity of Decarbonization; Carbon Foot Printing Basics.	4 Hrs.
Unit 2	**Solar Energy Systems** Introduction, Solar radiation fundamentals and measurement, Operational Principles of Flat-plate and Concentrating Solar Thermal Collectors, Solar photovoltaic (PV) systems: principles and components, Design basics of solar PV systems, Applications: Rooftop Systems; Solar Pumps; Street Lighting.	4 Hrs.
Unit 3	**Renewable Energy Sources** Introduction, Basic Working Principles and Plant Layout: Wind Energy; Nuclear Energy; Biomass Energy; Hydropower; Geothermal; Tidal Energy.	4 Hrs.
Unit 4	**Environmental Pollution and Control** Introduction, Environmental Pollution: Definition, Cause, Effects & Control Measures of Air Pollution; Water Pollution; Soil Pollution; Marine Pollution, Solid Waste Management: Landfill; Incineration; Composting.	4 Hrs.
Unit 5	**Sustainable Engineering** Introduction, Principles of Sustainability, Life Cycle Assessment (LCA), Green Technology and Green Business, Sustainable Materials and Manufacturing, Sustainable Agriculture, Environmental Impact Assessment (EIA).	4 Hrs.
Unit 6	**Sustainable Design and Development** Introduction, Energy-Efficient Machines and Thermal Systems, E- Waste Reduction and Recycling, Green Computing and Data Center Efficiency, United Nations Sustainable Development Goals (SDGs).	4 Hrs.

Sr. No.	Textbooks
1.	G. D. Rai, Non-Conventional Energy Sources, Khanna Publishers
2.	B. H. Khan, Non-Conventional Energy Resources, McGraw Hill Education
3.	C. S. Rao, Environmental Pollution Control Engineering, New Age International
4.	Bhavik R. Bakshi, Sustainable Engineering: Principles & Practice, Cambridge University Press
	Reference Books
1.	S. P. Sukhatme and J.K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill
2.	D. P. Kothari, K. C. Singal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning
3.	R. C. Gaur, Basic Environmental Engineering, New Age International
4.	D. L. Reeg, Industrial Energy Conservation, Pergamon Press
5.	Catherine N. Mulligan, Sustainable Engineering: Principles & Implementation, CRC Press
6.	Kailas L. Wasewar and Sunita Neti Rao, Sustainable Engineering, Energy & the Environment, CRC Press
	Web Resources
1.	Prof. Vaibhav Vasant Goud and Prof. R. Anandalakshmi, Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems, IIT Guwahati (https://nptel.ac.in/courses/103103206)
2.	Prof. P. Mondal, Basic Environmental Engineering and Pollution Abatement, IIT Roorkee (https://nptel.ac.in/courses/103107215)
3.	Prof. Prasanta Kumar Das and Prof. A Bhattacharya, Energy Conservation and Waste Heat Recovery, IIT Kharagpur (https://nptel.ac.in/courses/112105221)
4.	Prof. Brajesh Kumar Dubey, Sustainable Engineering Concepts and Life Cycle Analysis, IIT Kharagpur (https://onlinecourses.nptel.ac.in/noc21_ce47/preview)

Course Title: Object Oriented Programming using Java and Database Management System Lab Course **Category: PCC**
Course Code: AI254211

Teaching Scheme	Examination Scheme	
Practical/Sessions: 02 Hours/Week	CA-I	15 Marks
Credits: 01	CA-II	15 Marks
Semester: Second Year (Semester IV)	ESE	20 Marks

Course Prerequisite:

- Basic understanding of programming concepts
- Knowledge of object-oriented programming fundamentals.

Course Description: This course introduces Java programming and client-side scripting using JavaScript. Students will learn to design and implement object-oriented Java applications, covering classes, objects, arrays, inheritance, polymorphism, and exception handling. The JavaScript portion provides skills for interactive web pages, including DOM manipulation, event handling, validations, and client-side scripting techniques.

Course Objectives:

- To understand the fundamentals of Java programming and object-oriented concepts.
- To develop modular and reusable code using methods, arrays, inheritance, and polymorphism.
- To handle exceptions and errors effectively in Java applications.
- To learn JavaScript fundamentals for client-side scripting and web validations.
- To integrate Java and JavaScript concepts for building interactive and robust applications.

Note: CO-PO mapping is available in theory subject.

Sr. No.	List of Experiments
1	Write a program to demonstrate basic syntactical constructs of java. A. Operators & Expressions B. Decision Making Statement C. Looping Statement
2	Write a program to define a class, describe its constructor & overload its constructor.
3	Write a program to Implement Array & Package.
4	Write a program to implement different types of inheritances and polymorphism.
5	Write a program to implement interfaces.
6	Write a program to implement exception handling using built-in & user defined exceptions.
7	Develop a Java Program for Handling Database Transactions Using JDBC.
8	Implementation of a Graphical User Interface (GUI) Application using Java Swing Components and Event Handling.
9	Study and Implementation of DDL commands and Integrity constraints.
10	Study and Implementation of DML commands (SELECT/UPDATE/DELETE with GROUP BY, ORDER BY).
11	Study and Implementation of advanced queries (nested subqueries, set operations, aggregate functions and JOIN).

12	Create and manipulate Views and implement access control using GRANT and REVOKE (DCL/TCL).
13	Write PL/SQL programs using conditional statements, loops, and exception handling.
14	Study and Implementation of Cursors and Triggers.
15	Install and configure the MongoDB environment. Perform CRUD operations in MongoDB.
16	Implement Indexing, Aggregation operations, MapReduce operations in MongoDB.

Course Title: Professional Development IV **Course Code: GE254604**		**Course Category: SC-SEC**
Teaching Scheme	**Examination Scheme**	
Practical /Sessions: 02 Hours/Week	CA-I	15 Marks
Credits: 01	CA-II	15 Marks
Semester: Second Year (Semester IV)	ESE	20 Marks

Course Prerequisite:

- Basic knowledge of programming concepts
- Understanding of Java syntax
- Logical thinking and problem-solving skills

Course Description: This course focuses on problem-solving using Java through platforms like Hacker Rank and Leet Code. It covers fundamental to advanced concepts including input-output handling, control structures, data types, strings, collections, object-oriented programming, exception handling, and design patterns. The course aims to enhance coding skills and prepare students for technical interviews.

Course Objective

1. To understand basic Java programming concepts and syntax.
2. To apply problem-solving skills using loops, conditions, and data structures.
3. To develop efficient coding solutions using collections and OOP concepts.
4. To analyze and solve complex problems using advanced Java concepts and design patterns.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** Java syntax, input-output, and basic constructs	Remember (Level 1)
CO2	**Explain** control structures, data types, and string handling	Understand (Level 2)
CO3	**Apply** Java concepts to solve coding problems	Apply (Level 3)
CO4	**Analyze** complex problems using collections and advanced topics	Analyze (Level 4)

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	1	1	2	3	-	-	-	-	-	-	3	1
CO2	1	2	1	2	3	-	-	-	-	-	-	3	2
CO3	2	2	2	3	3	-	-	-	-	-	-	3	2
CO4	2	3	2	3	3	-	-	-	-	-	-	3	2

Assessment	
CA-I (a)	Based on Practical: Sr. No. 01 to 05
CA-II (b)	Based on Practical: Sr. No. 06 to 10

Sr. No.	List of Experiments
1	Basic Input and Output Operations
2	Conditional and Looping Constructs
3	Data Types and Type Conversion
4	String Processing and Regular Expressions
5	Date, Formatting and Utility Classes
6	Arrays and Collection Framework
7	Generics and Advanced Collections
8	Object Oriented Programming Concepts
9	Exception Handling and Annotations
10	Design Patterns and Advanced Concepts

Text Books	
1.	Core Java: An Integrated Approach – R. Nageswara Rao
2.	Java: The Complete Reference – Herbert Schildt
3.	Effective Java – Joshua Bloch
4.	Data Structures and Algorithms in Java – Robert Lafore.
Reference Books	
1.	Head First Java – Kathy Sierra & Bert Bates.
2.	Effective Java – Joshua Bloch
3.	Java Performance: The Definitive Guide – Scott Oaks
4.	Data Structures and Algorithms in Java – Robert Lafore
Web Resources	
1	https://www.hackerrank.com/domains/java
2	https://leetcode.com
3	https://www.geeksforgeeks.org/java/

Course Title: Do It Yourself IV **Course Code:GE254808**		**Course Category: ELC**
Teaching Scheme		**Examination Scheme**
Practical's/Sessions:02Hours/Week	CA-I	15Marks
Credit:01	CA-II	15Marks
Semester: Second Year (Semester IV)	ESE	20 Marks

Course Prerequisite:

- Students should have basic knowledge of the computer hardware and electronics components such as LEDs, resistors, sensors, and breadboards, and their basic connections.
- Students should also be familiar with basic programming concepts in **Python** and use of code editors.

Course Description:

This course introduces students to basic hardware interfacing using the Raspberry Pi Pico microcontroller. Students will learn to connect and control components such as LEDs, sensors, buzzers, and motors using GPIO pins. The course focuses on implementing simple embedded system applications using Python programming. By the end of the course, students will be able to develop small DIY projects using Raspberry Pi Pico and different sensors.

Course Objectives:

- Introduce students to the basic architecture and GPIO interfacing of the Raspberry Pi Pico microcontroller.
- To enable students to interface electronic components such as LEDs, sensors, buzzers, and motors.
- To develop basic programming skills for hardware control using Python.
- To encourage students to design and implement simple DIY embedded system projects using Raspberry Pi Pico

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Explain** Working of Rasberry Pi Pco, electronic components (LEDs, Resisters, Sensors) and basic interfacing concepts.	Understand (L2)
CO2	**Apply** Python Programming to interface Rasberry Pi Pco with basic components and execute simple input/output operations	Apply (L3)
CO3	**Analyze** and Troubleshoot hardware and software issues in microcontroller-based systems using appropriate debugging techniques	Analyze (L4)
CO4	**Design and develop** a simple microcontroller-based application using Rasberry Pi Pco and sensors	Create (L6)

CO-PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	-	2	1	_	2	1	_	-	_	-	_	2	1
CO2	-	2	2	1	3	-	_	_	_	-	_	3	2
CO3	_	3	2	3	3	_	_	_	-	-	2	2	3
CO4	_	3	3	2	3	-	-	-	2	1	2	2	3

Sr. No.	List of Activities
1	**Introduction to Raspberry Pi Pico and GPIO Pins:** Study the architecture of Raspberry Pi Pico, understand pin configuration, GPIO functionality, power pins, input/output pins, and install Micro Python/Thonny IDE for programming. Execute a basic program to verify board connectivity.
2	**LED Blinking:** Interface an LED with Raspberry Pi Pico using GPIO pins and write a Python program to blink the LED at different intervals. Understand digital output concepts and resistor usage.
3	**Controlling a Buzzer with a Button:** Interface a push button and buzzer with Raspberry Pi Pico. Write a Python program where pressing the button activates the buzzer. Learn digital input handling and event triggering.
4	**Temperature Measurement with a DHT11/DHT22 Sensor:** Connect DHT11/DHT22 temperature sensor with Raspberry Pi Pico and write a program to read temperature and humidity values. Display readings on serial monitor/output console.
5	**Temperature-based Fan Control:** Interface a DC motor/fan with temperature sensor. Develop a program that automatically turns ON the fan when temperature exceeds a threshold value. Learn automation concepts.
6	**Light Intensity Monitoring with an LDR:** Connect an LDR sensor to Raspberry Pi Pico and measure surrounding light intensity. Program the system to detect day/night conditions based on light levels.
7	**Motion Detection with a PIR Sensor**: Interface PIR motion sensor with Raspberry Pi Pico to detect human movement. Trigger an LED or buzzer alert when motion is detected.
8	**Sound-activated LEDs:** Connect a sound sensor module to Raspberry Pi Pico. Write a program that turns ON L when sound exceeds a specific threshold level.
9	**Controlling a Servo Motor with PWM:** Interface a servo motor and control its angular position using PWM signals generated through Raspberry Pi Pico. Demonstrate movement at different angles.
10	**Mini Project Based on Raspberry pi Pico:** Design and implement a small real-world application using Raspberry Pi Pico and sensors (e.g., smart home automation, smart lighting, temperature monitoring system, motion alarm system, etc.).

Course Title: Problem to Project Based Learning **Course Code: GE254807**		**Course Category: ELC**
Teaching Scheme	**Examination Scheme**	
Practical: 02 hrs./ week	CA-1	15 Marks
Credits: 01	CA-2	15 Marks
Semester: Second Year (Sem- IV)	ESE	20 Marks

Course Prerequisite: Use of analytical skills and drawing tools, Design Thinking Module, Course Level-Problem Based Learning.

Course Description:
This course provides an in-depth understanding of modern web development using Bootstrap, JavaScript, jQuery, PHP, MySQL, and the Laravel MVC framework. Students will learn to design responsive web pages with Bootstrap, implement interactive client-side functionality using JavaScript and jQuery, and create dynamic, database-driven web applications using PHP and MySQL.

Course Objectives:

1. To guide students in transforming identified problems into implementable engineering solutions.
2. To facilitate the design, development, and testing of working prototypes using domain knowledge.
3. To mentor students in applying systematic engineering and project management approaches.
4. To develop student's technical competency, teamwork, and communication through mini-project execution.

Course Outcomes:

COs	**After completion of the course: Student will be able to**	**Bloom's Level**
CO1	**Interpret** engineering problems and establish solution requirements in a practical context	L2 Understand
CO2	**Apply** suitable tools and techniques to develop a working model or prototype.	L3 Apply
CO3	**Analyze** and formulate solution strategies using relevant engineering principles	L4 Analyze
CO4	**Evaluate** alternative approaches and select appropriate design solutions	L5 Evaluate
CO5	**Develop** a functional working prototype using suitable tools and techniques	L6 Create

CO-PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	2		1								2	2
CO2	3	2	2	2	2			2			1	3	2
CO3	3	3	3	1	1						1	3	2
CO4	2	2	3	2	2	1		1			1	3	3
CO5			3		2			3	2	2	2		

Assessment	
CA-I (a)	Identify a real-life problem related to the course, clearly explain it with its needs and limitations, study existing solutions, suggest different possible solutions, and choose the best one based on cost, simplicity, and practicality.
CA-II (b)	Design a working model using suitable tools, test its performance, improve it based on results, and finally present the working solution with a simple report.
ESE (c)	Assigned Task Completion.

Sr. No.	List of Activities
1	To identify an open-ended problem related to the course for the mini-project.
2	To define the problem with its objectives, basic requirements, and limitations.
3	Literature review/survey of existing solutions and understand their drawbacks.
4	To identify different possible solutions using course-related concepts.
5	To select the best solution based on different criteria i.e. simplicity, cost, and practicality.
6	To prepare the design, list of materials and use the required tools for the solution.
7	To build a basic working model or prototype using available resources.
8	To test the model and check whether it meets the expected results.
9	To improve the model based on testing results and feedback.
10	To present the final mini project with a simple report including method, results, and conclusion.

Sr. No.	Textbooks
1.	Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers.
2.	Karl T. Ulrich, Steven D. Eppinger, Product Design and Development, McGraw-Hill Education.
	Reference Books
1.	Mahnaz MoallemWoei Hung Nada Dabbagh, The Wiley Handbook of Problem- Based Learning, Wiley, 2019.
2.	Kothari, C. R., & Garg, Research Methodology: Methods and Techniques, 2nd Revised Edition, 2019- New Age International Publishers, New Delhi.
	Web Resources
1.	NPTEL Online Courses- Problem Based learning, NITTTR. (https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr20_ed12)

Course Title: Computational Statistics for AI **Course Code: AI254402**		**Course Category: MDM-II**
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs./ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:

Mathematical Foundations: elementary mathematics, algebra, and functions, logical reasoning, mean, median, mode, probability basics.

Basics of Python: Basic computer skills, basic programming tools.

Course Description: This course introduces fundamental concepts of statistics and probability for data analysis and artificial intelligence applications. It covers data types, descriptive statistics, and visualization techniques to summarize and interpret real-world datasets. The course develops a strong foundation in probability theory, random variables, and probability distributions for modeling uncertainty. It further explores statistical modeling techniques, including correlation and regression, for analyzing relationships between variables. The course also focuses on inferential statistics and hypothesis testing to support data-driven decision making in practical scenarios.

Course Objectives:

1. **Introduce** fundamental concepts of statistics, data types, and data visualization for effective data understanding and analysis**.**
2. **Develop** a strong foundation in probability theory, including conditional probability and Bayes' theorem, for modeling uncertainty in data science applications.
3. **Understand** probability distributions and statistical modeling techniques, including regression and correlation, for analyzing real-world datasets.
4. **Apply** inferential statistical methods such as hypothesis testing and confidence intervals for data-driven decision making and evaluation of models.

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** fundamental concepts of statistics, probability theory, probability distributions, statistical modeling, and hypothesis testing.	Remember (Level 1)
CO2	**Explain** data types, descriptive statistics, probability laws, distributions, regression models, and hypothesis testing procedures used in data analysis.	Understand (Level 2)
CO3	**Interpret** statistical measures, probability concepts, distributions, regression techniques, and hypothesis testing methods to analyze real-world datasets and solve data-driven problems.	Apply (Level 3)
CO4	**Examine** data using statistical and probabilistic models, evaluate relationships between variables, and interpret hypothesis testing results for informed decision making.	Analyze (Level 4)

CO-PO Mapping:													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO 1**	**PSO2**
CO1	3	1	–	–	–	–	–	–	–	–	2	–	–
CO2	3	2	1	1	–	–	–	–	–	–	2	–	–
CO3	3	3	2	2	2	–	–	–	–	–	2	–	–
CO4	3	3	2	3	2	1	–	–	–	–	3	–	–

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction to Statistics** About statistics, population, sample, types of statistical data- categorical, numerical (continuous), ordinal, interval, ratio, univariate and bivariate analysis, Measures of central tendency: mean, median, mode, harmonic mean, Measures of dispersion - variance, standard deviation and coefficient of variation, outliers, data visualization- line graph, scatter, box plots, histogram. Case Study on real estate company dataset to measures of central tendency and dispersion.	4 Hrs.
Unit 2	**Probability Theory** Introduction to probability and its role in data science, Basics of probability- random experiments, sample Space, events, axioms of probability, addition and multiplication laws of probability, Conditional probability and independence, Bayes' theorem, discrete vs continuous random variables. Case Study on Customer Conversion Analysis for e-commerce site using Bayes' theorem.	4 Hrs.
Unit 3	**Data Modeling using Distributions** Introduction to inferential statistics, what is distribution, concept of probability distributions, expectation(mean) and variance, Skewness and interpretations, kurtosis, Central limit theorem. Case study on distribution analysis and sampling behaviour interpretation using real estate company dataset.	4 Hrs.
Unit 4	**Theoretical Distributions** Discrete distributions– Bernoulli distribution, Binomial distribution and Poisson distribution, Uniform distribution, Normal distribution. Case study on modeling the customer arrivals using appropriate distributions and its visualization.	4 Hrs.
Unit 5	**Statistical Modeling** Covariance and correlation, interpretation of correlation, Correlation coefficient, simple linear regression, multiple linear regression, concept of overfitting, model assumptions, estimation of regression coefficients, Error metrics– Mean Square Error. Case study on real-world housing dataset to analyze the relationship between property features.	4 Hrs
Unit 6	**Hypothesis Testing and Statistical Tests** Typical analysis procedures, introduction to inferential statistics, point estimation, confidence intervals, hypothesis testing concept, Null and Alternative hypotheses, Type I and Type II errors, Rejection region, level of significance, p-value, one-tailed and two-tailed tests, Tests on numerical data– distribution of sample mean, Comparison of two groups– Z-test. Case study on hypothesis testing in data-driven decision making.	4 Hrs.

Sr. No.	Textbooks
1.	Joel Grus, Data Science from Scratch, O'Reilly Media, ISBN- 9781491901427
2.	S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revied and Enlarged Edition, 2016.
	Reference Books
1.	Peter Bruce and Andrew Bruce, Practical Statistics for Data Scientists, First Edition, O'Reilly Media, ISBN- 978-1-491-95296-2.
2.	Claus Weihs, Olaf Mersmann, Uwe Ligges, Foundations of Statistical Algorithms, CRC Press, ISBN- 978-1-4398-7887-3.
3.	Kishor S. Trivedi, Probability, Statistics with Reliability, Queuing and Computer Science Applications, Wiley India Pvt. Ltd, 2nd Edition, 2001.
4.	Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, Wiley. Third Edition, ISBN:9781118799642
	Web Resources
1.	**NPTEL course: Statistics for Data Science, IITM:** https://study.iitm.ac.in/ds/course_pages/BSMA1002.html
2.	**NPTEL course: Statistical Methods for Scientists and Engineers, IITKGP:** https://nptel.ac.in/courses/111/105/111105077/#
3.	**NPTEL course: Essential Mathematics for Machine Learning, IIT Roorkee**: https://nptel.ac.in/courses/111/107/111107137/#
4.	**Coursera -Probability & Statistics for Machine Learning & Data Science** https://www.coursera.org/learn/machine-learning-probability-and-statistics

Course Title: AI Learning Algorithms **Course Code: AI254212**		**Course Category: HMM II**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs. / week	CA-1	10 Marks
Tutorial: 01 hrs. / week	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:

- Basic knowledge of Artificial Intelligence concepts.
- Understanding of Machine Learning fundamentals.
- Familiarity with Python programming.
- Basic knowledge of linear algebra, probability, and statistics.

Course Description:

This course provides detailed knowledge of Artificial Intelligence learning algorithms used to enable machines to learn patterns from data and make intelligent decisions. The course covers supervised learning, unsupervised learning, optimization techniques, model evaluation methods, and applications of AI algorithms in real-world problems. Students will learn how AI systems are trained, evaluated, and optimized for improved performance.

Course Objectives:

1. To understand fundamental concepts of AI learning algorithms.
2. To explore supervised and unsupervised learning techniques.
3. To study optimization methods used in AI model training.
4. To analyze model evaluation metrics and performance improvement methods.
5. To apply AI learning algorithms to real-world applications

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Remember** fundamental concepts, terminology, and types of AI learning algorithms.	Remember (L1)
CO2	**Explain** working principles of supervised and unsupervised learning algorithms.	Understand (L2)
CO3	**Implement** AI learning algorithms using appropriate tools and techniques.	Apply (L3)
CO4	**Analyze** performance of AI learning algorithms using evaluation metrics.	Analyze (L4)

CO-PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	–	1	–	1	–	1	–	1	2
CO2	3	2	1	2	2	–	–	1	–	1	–	2	2
CO3	2	3	3	3	3	–	–	–	–	1	–	3	3
CO4	2	3	3	3	3	1	–	2	–	2	–	3	3

Assessment	
CA-1 (a)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b)	Subjective Test/Course Project/Assignments/Presentation
MSE (c)	Subjective Test

Course Contents		
Unit 1	**Introduction to AI Learning Algorithms:** Concept of Artificial Intelligence learning, types of learning (supervised, unsupervised, reinforcement), training data, features and labels, role of AI learning algorithms in intelligent systems.	8 Hrs.
Unit 2	**Supervised Learning Algorithms:** Regression and classification concepts, Linear Regression, Logistic Regression, K-Nearest Neighbor (KNN), Decision Trees, concept of model training and prediction.	8 Hrs.
Unit 3	**Unsupervised Learning Algorithms:** Clustering techniques, K-Means clustering, hierarchical clustering, dimensionality reduction concepts, feature extraction basics.	8 Hrs.
Unit 4	**Optimization Techniques:** Loss functions, gradient descent algorithm, types of gradient descent, overfitting and underfitting, bias-variance tradeoff, regularization concepts.	8 Hrs.
Unit 5	**Model Evaluation Methods:** Confusion matrix, accuracy, precision, recall, F1-score, cross-validation, ROC curve, comparison of algorithm performance.	8 Hrs.
Unit 6	**Applications of AI Learning Algorithms:** AI in healthcare, finance, recommendation systems, fraud detection, image classification, real-world case studies and future trends.	8 Hrs.

Sr. No.	Textbooks
1.	Tom Mitchell, **Machine Learning**, McGraw-Hill.
2.	Stuart Russell and Peter Norvig, **Artificial Intelligence: A Modern Approach**, Pearson.
	Reference Books
1.	Christopher M. Bishop, **Pattern Recognition and Machine Learning**, Springer.
2.	Kevin P. Murphy, **Machine Learning: A Probabilistic Perspective**, MIT Press.
	Web Resources
1.	https://scikit-learn.org
2.	https://developers.google.com/machine-learning
3.	https://www.kaggle.com/learn
4.	https://towardsdatascience.com
5.	https://www.coursera.org

Course Title: Time Series Analysis **Course Code:AI254213**		**Course Category: DM II**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs. / week	CA-1	10 Marks
Tutorial: 01 hrs./ week	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: Second Year (Semester IV)	ESE	60 Marks

Course Prerequisite:

- Basic knowledge of Linear Algebra, Calculus, and Probability & Statistics.
- Familiarity with signals, programming (Python/MATLAB), and data analysis concepts is recommended

Course Description: This course introduces the fundamentals of Probability, Statistics, and Random Processes with applications in signal processing and time-series analysis. Students will learn to model and analyze stationary and non-stationary processes, compute correlation functions, and perform spectral analysis using Fourier methods. The course also covers SARIMA modeling, estimation theory, and various estimators for forecasting and signal property evaluation. Practical applications in real-world datasets and simulations are emphasized throughout**.**

Course Objectives:

- Understand the fundamental concepts of Probability, Statistics, Random Variables, and Random Processes and their applications in signal processing and machine learning.
- Analyze stationary, non-stationary, and ergodic processes, and compute correlation functions to characterize random signals.
- Model and simulate linear random processes and basic time-series models (AR, MA, ARMA, SARIMA) for forecasting and signal analysis.
- Apply Fourier analysis, spectral density estimation, and harmonic process theory to study the frequency domain properties of signals.
- Implement estimation techniques (LS, WLS, MLE, Bayesian) to estimate signal properties, forecast future data, and evaluate estimator performance in terms of bias, variance, efficiency, and consistency

Course Outcomes:

COs	**After completion of the course students will be able to**	**Bloom's Level**
CO1	**Recall** the fundamental concepts of probability theory, random variables, and random processes used in signal processing and machine learning applications.	Remember (L1)
CO2	**Explain** the properties of stationary and non-stationary processes, ergodicity, correlation functions, and time-series components such as trend, seasonality, and noise.	Understand (L2)
CO3	**Apply** time-series models including AR, MA, ARMA, and SARIMA, as well as spectral analysis techniques, for modeling and forecasting real-world data.	Apply (L3)
CO4	**Analyze** the performance of statistical estimators and estimation techniques such as least squares, maximum likelihood, and Bayesian estimation for signal and data analysis.	Analyze (L4)

CO-PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	–	–	–	1	–	1	–	1	–	1	2
CO2	3	2	1	2	2	–	–	1	–	1	–	2	2
CO3	2	3	3	3	3	–	–	–	1	1	–	3	3
CO4	2	3	3	3	3	1	–	2	1	2	–	3	3

Assessment	
CA-1 (a)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c)	Subjective Test

Course Contents		
Unit 1	Introduction to Probability & Random Processes Probability and Statistics (basic concepts), Random Variables and Random Processes, Classification of Random Processes, Applications in Signal Processing & ML.	8 Hrs.
Unit 2	Stationary, Ergodicity & Correlation Cleaning Stationary and Non-stationary Processes, Ergodicity, Auto-correlation and Cross-correlation functions, Partial Correlation Functions (PACF), Practical examples.	8 Hrs.
Unit 3	Linear Models of Random Processes Linear Stationary Processes, Linear Non-Stationary Processes, Introduction to Time Series Models, Trend, Seasonality, Noise, Basics of AR, MA, ARMA models.	8 Hrs.
Unit 4	Spectral Analysis & Fourier Methods Fourier Analysis of Signals, Power Spectral Density (PSD), Spectral Representation of Random Processes, Wiener–Khin chin Theorem, Harmonic Processes.	8 Hrs.
Unit 5	SARIMA & Time-Series Modeling Seasonal ARIMA (SARIMA) Models, Model Identification, Parameter Estimation, Forecasting, Applications in real-world data.	8 Hrs.
Unit 6	Estimation Theory & Estimators Introduction to Estimation Theory, Goodness of Estimators, Fisher's Information, Properties: Bias, Variance, Efficiency, Consistency, Cramér –Rao Bound, Estimators: Least Squares (LS), Weighted Least Squares (WLS),Non-linear LS, Maximum Likelihood (MLE),Bayesian Estimation. Estimation of Signal Properties.	8 Hrs.

Sr. No.	Textbooks
1.	Joel Grus, *Data Science from Scratch: First Principles with Python*, O'Reilly
2.	Cathy O'Neil and Rachel Schutt, *Doing Data Science: Straight Talk from the Frontline*, O'Reilly
3.	Lillian Pierson, *Data Science for Dummies*, Wiley

	Reference Books
1.	Wes McKinney, *Python for Data Analysis*, O'Reilly
2.	Foster Provost and Tom Fawcett, *Data Science for Business*, O'Reilly
3.	Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly
4.	Peter Bruce and Andrew Bruce, *Practical Statistics for Data Scientists*, O'Reilly
5.	Roger D. Peng and Elizabeth Matsui, *The Art of Data Science*

	Web Resources
1.	https://userpilot.com/blog/resources-for-data-analyst/
2.	https://onlinecourses.nptel.ac.in/noc21_cs45/preview
3.	https://nptel.ac.in/courses/106107220