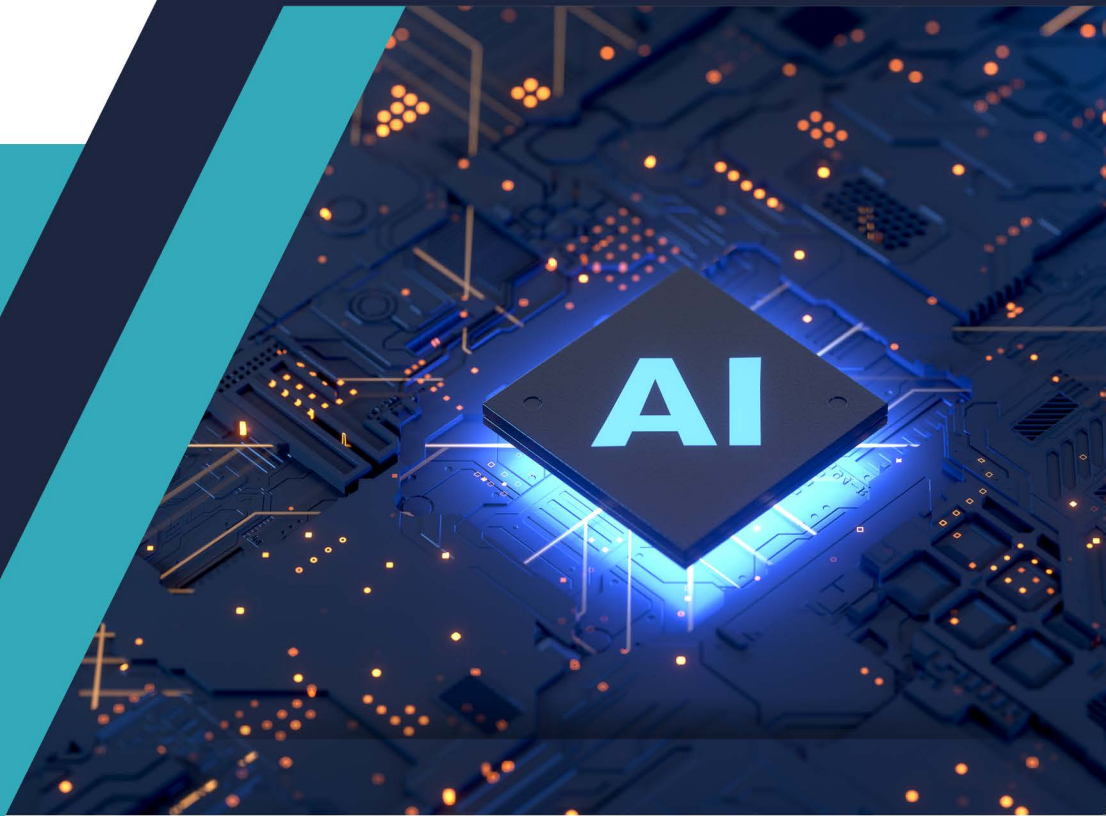




DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Academic Year 2026 - 2027



3rd and 4th Semesters Scheme & Syllabus

BATCH: 2025 - 2029

CREDITS: 160

[2025 Scheme]

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INSTITUTION

Vision

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

Quality Policy

To provide educational services of the highest quality, both curricular and co-curricular, to enable students to integrate skills and serve the industry and society equally well at the global level.

Mission

- To strengthen the theoretical, practical, and ethical dimensions of the learning process by fostering a culture of research, and innovation among faculty members, and students
- To encourage long-term interaction between academia and industry through their involvement in the design of curriculum and its hands-on implementation.
- To strengthen and mould students in the professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

Values

* Academic Freedom

* Inclusiveness

* Innovation

* Professionalism

* Integrity

* Social Responsibility

DEPARTMENT OF AI & ML

Vision

To develop an outstanding AI and ML professionals with profound practical, research & managerial skills to meet ever changing Industrial Social and Technological needs of the Society.

Mission

- To provide strong theoretical foundations and hands-on competence in Artificial Intelligence and Machine Learning, fostering research, innovation, and technical excellence in alignment with industry and national needs.
- To establish sustainable academia–industry collaboration for curriculum enrichment, real-time problem solving, internships, and emerging AI technology implementation.
- To develop ethically responsible, socially conscious, and environmentally aware AI professionals through holistic learning and active participation in co-curricular and professional activities.

Program Educational Objectives (PEOs)

PEO1	Graduates will build successful careers in Artificial Intelligence and Machine Learning by applying strong theoretical foundations, analytical skills, and modern tools to solve complex industrial and societal problems.
PEO2	Graduates will pursue higher education, research, entrepreneurship, or leadership roles in emerging AI technologies through continuous learning, innovation, and industry collaboration.
PEO3	Graduates will demonstrate ethical responsibility, environmental awareness, and social consciousness while developing and deploying AI solutions for sustainable societal impact.

PEO to Mission Statement Mapping

Mission Statements	PEO1	PEO2	PEO3
To provide strong theoretical foundations and hands-on competence in Artificial Intelligence and Machine Learning, fostering research, innovation, and technical excellence in alignment with industry and national needs.	√		√
To establish sustainable academia–industry collaboration for curriculum enrichment, real-time problem solving, internships, and emerging AI technology implementation	√	√	
To develop ethically responsible, socially conscious, and environmentally aware AI professionals through holistic learning and active participation in co-curricular and professional activities.	√		√

Knowledge and Attitude Profile (WK)

- WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
- WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
- WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
- WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
- WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
- WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
- WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
- WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
- WK9:** Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

- P01:** Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified to develop to the solution of complex engineering problems.
- P02:** Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
- P03:** Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
- P04:** Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
- P05:** Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
- P06:** The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
- P07:** Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
- P08:** Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

- P09:** Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- P010:** Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- P011:** Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

Program Specific Outcomes (PSOs)

A graduate of the Artificial Intelligence and Machine Learning Program will demonstrate:

- PS01:** Ability to design, develop, and deploy intelligent systems using machine learning algorithms, deep learning architectures, data analytics, and AI frameworks to address real-world applications.
- PS02:** Ability to analyze large-scale data, interpret model outcomes, and implement responsible, secure, and ethical AI solutions aligned with industry standards and societal needs.

NEW HORIZON COLLEGE OF ENGINEERING
B. E. in Artificial Intelligence and Machine Learning
Scheme of Teaching and Examinations for 2025- 2029 BATCH (2025 Scheme)

III Semester																
Sl No	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	TLP Contact Hrs / Sem	TW & SL / Sem	Total Hrs /Sem	Exam Hrs	Marks		
					L	T	P	S						CIE	SEE	Total
1	BSC	25MAC31	Numerical methods, vector spaces and probability distributions	BS	3	0	0	0	3	45	45	90	3	50	50	100
2	PCC	25CSK32	Data Structures	CSE	3	0	0	0	3	45	45	90	3	50	50	100
3	PCCL	25CSLK32	Data Structures Lab	CSE	0	0	1	0	1	30	-	30	3	50	50	100
4	PCC	25AIM33	Data Science	AIML	3	0	0	0	3	45	45	90	3	50	50	100
5	PCCL	25AIL33	Data Science Lab	AIML	0	0	1	0	1	30	-	30	3	50	50	100
6	PCC	25AIM34	Computer Architecture	AIML	3	0	0	0	3	45	45	90	3	50	50	100
7	HSMS	25CSK35	Software Engineering and Project Management	CSE	3	0	0	0	3	45	45	90	3	50	50	100
8	AEC	25AIM36X	Ability Enhancement Course – III	AIML	0	0	1	0	1	30	-	30	3	50	50	100
9	PROJ	25CPD37	Community Project using Innovation and Design Thinking	AIML	0	0	0	1	1	-	30	30	3	50	50	100
10	NCMC	25NSS30	National Service Scheme	-	0	0	0	0	0	-	30	30	--	50	--	50
		25PED30	Physical Education and Sports	-												
		25YOG30	Yoga	-												
		25MUS30	Music	-												
Total					19	315		285	600	27	500	450	950			

1	CMC	25DMAT31*	Basic Applied Mathematics -I	BS	0	0	0	0	0	15	15	30	--	50	--	50
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BSC: Basic Science Course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC:** Ability Enhancement Course, **PROJ:** Mini Project work, **L:** Lecture, **T:** Tutorial, **P:** Practical **S:** SDA: Skill Development Activity, **TW & SL-** Term Work & Self Learning, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation.

25DMAT31*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Ability Enhancement Course - III (0-0-1-0)			
25AIM361	Introduction to OpenCV	25AIM364	Data Visualization with Power BI
25AIM362	Golang Programming	25AIM365	Bio Inspired Design and Innovation (1-0-0-0)
25AIM363	Web Application Development		

Community Project using Innovation and Design Thinking: A community is a social unit or group of people sharing socially-significant characteristics, such as place, set of norms, culture, religion, values, customs, or identity. The Community Project using Innovation and Design Thinking course involves addressing complex issues within such a community through a human-centered lens. By integrating design thinking methodologies, these projects move beyond traditional service to focus on empathy, iterative problem-solving, and the creation of sustainable, innovative solutions. Whether establishing welfare initiatives like orphanages, implementing renewable energy systems, or developing environmental technologies, the process begins with deep community engagement to uncover latent needs before defining specific challenges.

This experiential learning activity encourages students to identify, analyze, and address real-life problems by

synthesizing engineering knowledge with creative strategy. The design thinking framework guides students through stages of empathy, ideation, and rapid prototyping, ensuring that the final interventions are not only technically sound but also culturally appropriate and user-validated. This approach promotes social responsibility and civic engagement while fostering interdisciplinary collaboration and the practical application of theoretical concepts. By navigating the ambiguity of real-world constraints through an innovative mindset, students contribute meaningfully to community welfare and sustainable development. Students may undertake these projects individually or in collaborative groups 2 to 4 members.

CIE:

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work shall be based on the rubrics.

25XXX35(HSMS)- This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.

For IT allied Branches: Software Product/ Project Management

For Core Branches: Engineering Economics and Management / Industrial Management and Entrepreneurship

National Service Scheme /Physical Education/Yoga/ Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PED) (Sports and Athletics), Yoga (YOG), and Music (MUS) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester and IV semester (for 2 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga or Music.

NEW HORIZON COLLEGE OF ENGINEERING
B. E. in Artificial Intelligence and Machine Learning
Scheme of Teaching and Examinations for 2025- 2029 BATCH (2025 Scheme)

IV Semester																
Sl. No	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	TLP Contact Hours / Sem	TW & SL / Sem	Total Hours /Sem	Exam Hrs	Marks		
					L	T	P	S						CIE	SEE	Total
1	BSC	25MAC41	Discrete Mathematics and Graph Theory	BS	3	0	0	0	3	45	45	90	3	50	50	100
2	PCC	25CSK42	Object Oriented Programming Using Java	CSE	3	0	0	0	3	45	45	90	3	50	50	100
3	PCCL	25CSLK42	Object Oriented Programming using Java Lab	CSE	0	0	1	0	1	30	-	30	3	50	50	100
4	PCC	25AIM43	Machine Learning	AIML	3	0	0	0	3	45	45	90	3	50	50	100
5	PCCL	25AIL43	Machine Learning Lab	AIML	0	0	1	0	1	30	-	30	3	50	50	100
6	PCC	25CSK44	Database Management Systems	CSE	3	0	0	0	3	45	45	90	3	50	50	100
7	PCCL	25CSLK44	Database Management Systems Lab	CSE	0	0	1	0	1	30	-	30	3	50	50	100
8	PEC	25AIM45X	Professional Elective Course-I	AIML	3	0	0	0	3	45	45	90	3	50	50	100
9	AEC	25AIM46X	Ability Enhancement Course – IV	AIML	0	0	1	0	1	30	-	30	3	50	50	100
10	PROJ	25EPP47	Environmental Science Project	AIML	0	0	2	0	2	-	60	60	3	50	50	100
11	NCMC	25NSS40	National Service Scheme	-	0	0	0	0	0	-	30	30	--	50	--	50
		25PED40	Physical Education and Sports	-												
		25YOG40	Yoga	-												
		25MUS40	Music	-												
Total									21	345	315	660	30	550	500	1050

12	NCMC	25DMAT41*	Basic Applied Mathematics -II	BS	0	0	0	0	0	15	15	30	--	50	--	50
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BSC: Basic Science Course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC:** Ability Enhancement Course, **PROJ:** Mini Project work, **L:** Lecture, **T:** Tutorial, **P:** Practical **S:** SDA: Skill Development Activity, **TW & SL-** Term Work & Self Learning, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation.

25DMAT41*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Professional Elective Course-I			
25AIM451	Principles of Artificial Intelligence	25AIM454	Introduction to Embedded Systems
25AIM452	Computer Networks	25AIM455	Fundamentals of Sensor Technology
25AIM453	Finite Automata and Formal Languages		

Ability Enhancement Course – IV (0-0-1-0)			
25AIM461	Advanced Python Programming	25AIM464	IoT Systems Design and Programming
25AIM462	Cloud Service Management	25AIM465	Problem Solving using Scala
25AIM463	Digital Electronics using HDL		

Environmental Science Project: The Environmental Science Project is an applied learning component designed to develop students' awareness, understanding, and responsibility toward the environment. It provides an opportunity to study real-world environmental issues and apply scientific and engineering principles to design feasible and sustainable solutions. Central to this course is the alignment with the United Nations Sustainable Development Goals (SDGs), providing a global framework for students to address urgent environmental challenges through localized action.

The topics under environment include, but are not limited to, climate change, biodiversity, air and water pollution, land use, excess use of natural resources, earthquakes, rise in the earth's temperature, power generation, and soil erosion. By exploring these themes, students contribute to the realization of specific global targets, including Clean Water and Sanitation, Affordable and Clean Energy, Climate Action, Life Below Water, and Life on Land.

The project involves problem identification, field surveys, case studies, data collection, environmental audits, analysis, and the proposal of remedial or preventive measures. These interventions are aimed at improving biodiversity, air quality, and thermal comfort while promoting Responsible Consumption and Production and Sustainable Cities and Communities. Students can take up the project individually or in a group not exceeding four members. Participants are also encouraged to opt for Interdisciplinary Projects, fostering the collaborative thinking essential for achieving a sustainable balance between human activity and the natural world.

CIE:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the project work shall be based on the rubrics. The marks awarded for the project report shall be the same for all the batches mates.

National Service Scheme /Physical Education/Yoga/ Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PED) (Sports and Athletics), Yoga (YOG), and Music (MUS) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester and IV semester (for 2 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga or Music.

Verticals for Professional Electives-2025-29 Scheme						
Sl. No	Semester	Advanced AI	Cyber Security and Networks	Computer Science Concepts	IoT and Communication	Emerging Technologies
1	IV	Principles of Artificial Intelligence	Computer Networks	Finite Automata and Formal Languages	Fundamentals of Sensor Technology	Introduction to Embedded Systems
2	VI	AI in Information Retrieval	Cryptography and Network Security	Enterprise Application Development	IoT for Intelligent Computing	Augmented and Virtual Reality
3	VII	Recommender Systems	AI for Cyber Security	Optimization Techniques	Mobile Communication and Technology	Quantum Computing
4	VIII	Agentic AI	Digital and Mobile Forensics	Software Architecture	Edge AI	Bioinformatics
5	VIII	Ensemble Learning	Social Network Security	Soft computing	Cognitive IoT	Elements of Blockchain Technology

NUMERICAL METHODS, VECTOR SPACES AND PROBABILITY DISTRIBUTIONS			
Course Code	25MAC31	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25MAC31.1	Apply numerical techniques to solve engineering problems involving nonlinear equations and estimation of unknown data values.		
25MAC31.2	Analyse engineering problems and select appropriate numerical techniques to obtain accurate approximate solutions.		
25MAC31.3	Apply the concepts of vector spaces, inner product spaces, orthogonality, and linear transformations to represent and solve engineering and scientific problems.		
25MAC31.4	Analyse engineering problems involving uncertainty and random processes and select appropriate probability distributions.		
25MAC31.5	Apply the principles of statistical hypothesis testing by formulating null and alternative hypotheses to take the decision for the samples in the real time scenarios.		
25MAC31.6	Analyze small-sample data to make statistical inferences, including tests for mean, variance and goodness of fit		
MODULE-1	NUMERICAL SOLUTIONS AND INTERPOLATION	25MAC31.1	9 Hours
Numerical solution of algebraic and transcendental equations - Newton-Raphson Method. Interpolation / Extrapolation: Newton's forward and backward formulae for equal intervals, Newton divided differences, Lagrange's formulae for unequal intervals.			
Self-study	Numerical solution of algebraic and transcendental equations using bisection method, Regula – Falsi method. Inverse Lagrange interpolation		
Text Book	Text Book 1: 28.2, 28.3, 29.6, 29.10, 29.11, 29.13, Text Book 2: 19.2, 19.3.		
MODULE-2	NUMERICAL INTEGRATION, SOLUTION OF DIFFERENTIAL EQUATIONS	25MAC31.2	9 Hours
Numerical integration by Simpson's 1/3rd, 3/8th & Weddle's rules. Application of numerical integration to velocity, area and volume. Numerical solution to 1 st order & 1 st degree ordinary differential equations by Taylor's series method, Modified Euler's method and Runge-Kutta method of 4 th order.			
Self-study	Numerical differentiation, Numerical integration by Trapezoidal rule. Numerical solution to 1 st order & 1 st degree ordinary differential equations by Picard's method.		
Text Book	Text Book 1: 32.3, 32.5, 32.7, 32.9, 30.7, 30.8, 30.10, Text Book 2: 19.5, 21.1.		
MODULE-3	VECTOR SPACES AND LINEAR TRANSFORMATIONS	25MAC31.3	9 Hours
Vector Space examples, Subspaces, Linear dependence and Independence, Spanning Sets, Basis and dimension. Inner product space, Orthogonal and Orthonormal basis by Gram Schmidt orthogonalization process. Introduction to Linear Transformations, matrix of linear transformation, rank and nullity theorem			
Self-study	Verifying the given basis is Orthogonal and Orthonormal basis. Orthogonal compliment, projection mapping.		
Text Book	Text Book 3: 4.1, 4.2, 4.3, 4.4, 4.5.		
MODULE-4	PROBABILITY DISTRIBUTIONS	25MAC31.4	9 Hours
Random variables, discrete and continuous random variables, probability density functions, Expectation and Standard deviation. Discrete Probability distribution, Binomial and Poisson Distributions. Continuous Probability distribution, Normal distribution. Joint probability distribution - dependent and independent Random variables, Covariance, Correlation coefficient.			
Self-study	Basic probability theory, Baye's theorem, Bernoulli distribution, uniform distribution, exponential distribution		
Text Book	Text Book 1: 25.12, 25.13, 26.8, 26.9, 26.10, 26.11, 26.12, 26.14, 26.15, 26.16.		
MODULE-5	SAMPLING THEORY	25MAC31.5 25MAC31.6	9 Hours
Sampling, Sampling distributions, Level of significance, Type-I & Type-II errors, one tail and two tail tests, test of hypothesis of large samples for means and proportions, Inferences for variance and proportion. Central			

limit theorem, confidence limits for means, Student's t-distribution, F-distribution and Chi-square distribution for test of goodness of fit for small samples.

Self-study Confidence limits problems.

Text Book Text Book 1: 27.2, 27.4, 27.6, 27.8, 27.10, 27.12, 27.14, 27.16, 27.18, 27.20,

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create			-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

- 1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
- 2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.
- 3) David C Lay, Linear Algebra and its applications, Addison-Wesley Publishers, Fourth Edition, 2012, ISBN: 9780321385178

Reference Books:

- 1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
- 2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
- 3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
- 4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=f_EqOpgRwRM&t=16s
- <https://www.youtube.com/watch?v=Xb9Ypn77LBo&t=16s>
- <https://www.youtube.com/watch?v=csgvZol6Wfw>
- <https://www.youtube.com/watch?v=Atv3IsQsak8>
- <https://www.youtube.com/watch?v=aEF5PPbv80c>
- <https://www.youtube.com/watch?v=Pwk7p8WiCh0>
- https://www.youtube.com/watch?v=LGxE_yZYigI
- <https://www.youtube.com/watch?v=RfIAiEXRwoo>
- <https://www.youtube.com/watch?v=RfIAiEXRwoo&t=128s>
- <https://www.youtube.com/watch?v=sMYtHaSIXbU>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

DATA STRUCTURES			
Course Code	25CSK32	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25CSK32.1	Apply appropriate data structures and Abstract Data Types to solve programming and data organization problems.		
25CSK32.2	Analyze the operational characteristics and applications of stacks and queues for solving computational problems.		
25CSK32.3	Design linked list-based solutions for efficient data storage and manipulation.		
25CSK32.4	Develop tree-based solutions for efficient data organization, searching, and retrieval.		
25CSK32.5	Evaluate graph traversal techniques for efficient data representation and problem solving.		
25CSK32.6	Interpret sorting and hashing techniques for efficient data access, storage, and retrieval.		
MODULE-1	INTRODUCTION	25CSK32.1	9 Hours
Data, Data Objects, Data Types, Abstract Data Types, Data Structures, Classification, Data Structure Operations, Arrays, Dynamic Arrays, Multidimensional Arrays, Strings, Structures, Self- Referential Structures, Unions, Sparse Matrices, Pointers - Pointer as function arguments, Dynamic Memory Allocation Functions.			
Self-study	Investigate the applications of sparse matrices		
Text Book	Text Book 1: 2.1-2.4,3.9,5.1-5.6,3.15, 1.11.1-1.11.6		
MODULE-2	STACKS AND QUEUES	25CSK32.2	9 Hours
Stacks, Applications of Stacks: Recursion - Factorial, Fibonacci Sequence, Tower of Hanoi, Evaluation of Expressions, Multiple Stacks. Queues: Queue representation, Primitive operations, Circular queue, Priority queue, Double ended queue, Applications of queues.			
Case Study	Analyze the implementation of browser navigation (Back/Forward), call stack management		
Text Book	Text Book 1: 7.1,7.3,7.4, Text Book 2: 4.5.1,4.5.3,4.5.4,4.5.6,5.1-5.4,6.4.1,6.4.3,6.4.4		
MODULE-3	LINKED LISTS	25CSK32.3	9 Hours
Introduction to Linked List, Representation of linked list in memory, Single Linked List, Doubly linked list, Header linked list, Linked representation of stack, Linked representation of queue, Circular linked list, Operations on linked lists, Applications of Linked List – Polynomials Representation, Addition of two polynomials.			
Self Study	Explore the implementation of linked lists in real-world applications		
Text Book	Text Book 1: 6.1,6.2,6.4,6.5,6.8		
MODULE-4	TREES	25CSK32.4	9 Hours
Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees, Heaps. Binary Search Trees, Selection Trees, Forests, Balanced Trees, AVL Trees, Single rotation, Double rotation, Application of Trees - Evaluation of Expression			
Case Study	A college library stores thousands of books in alphabetical order. Suggest an appropriate tree data structure for organizing the records to enable fast searching, insertion, and deletion of books. Justify your choice by comparing it with other tree structures.		
Text Book	Text Book 1: 9.1, 9.3, 9.5, 9.7, Text Book 2: 10.1, 10.3, 10.5, 10.7		
MODULE-5	GRAPHS, SORTING & HASHING	25CSK32.5, 25CSK32.6	9 Hours
Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search. Sorting – Merge Sort, Quick Sort, Hashing: The symbol table, Hashing Functions, Collision Resolution Techniques.			
Case Study	A university maintains records of thousands of students that need to be sorted by USN and searched frequently. Compare the suitability of Bubble Sort, Insertion Sort, and Hashing for different operations, and justify the most efficient approach.		
Text Book	Text Book 1:13.1,13.2,13.3,8.1,8.2 & Text Book 2:10.1,10.2		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:**Text Books:**

1. Reema Thareja, Data Structures Using C. Oxford University Press, 3rd Edition, 2023. ISBN-13: 978-0199491689.
2. E. Balagurusamy, Data Structures Using C, 2nd Edition, McGraw Hill, 2025, ISBN: 978-9364443012.
3. Amol M. Jagtap and Ajit S. Mali, Data Structures using C: A Practical Approach for Beginners. Chapman & Hall/CRC Press (Taylor & Francis Group), 1st Edition, 2022. ISBN-13: 978-0367616311

Reference Books:

1. Douglas Baldwin, Greg Scragg, Introduction to Algorithms and Data Structures, 1st Edition, Cengage Learning, 2024, ISBN: 978-0357673560.
2. Bradley N. Miller, David L. Ranum, Roman Yasinovskyy, Problem Solving with Algorithms and Data Structures Using Python, Franklin, Beedle & Associates, 2024. ISBN-13: 978-9355426178.

Web links and Video Lectures (e-Resources):

1. <https://www.udemy.com/course/datastructurescncpp/>
2. <https://www.coursera.org/specializations/data-structures-algorithms>
3. <https://nptel.ac.in/courses/106102064>

Activity-Based Learning (Suggested Activities in Class)

- Problem Solving Exercises
 - <https://github.com/bollwarm/DataStructuresAlgorithms>
 - <https://www.hackerrank.com/domains/datastructures>

DATA STRUCTURES LAB			
Course Code	25CSLK32	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes:			
At the end of the course, the student will be able to:			
25CSLK32.1	Apply the concepts of Arrays and Structures for programming and problem solving.		
25CSLK32.2	Analyze the operational characteristics of stacks and queues for efficient data management.		
25CSLK32.3	Implement linked list-based solutions for dynamic data organization and manipulation.		
25CSLK32.4	Develop tree-based and searching solutions for efficient data storage, traversal, and retrieval.		
Pgm. No.	List of Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	- Basic C Programs (Arrays, User defined Functions, Structures, Pointers) - Basic Commands in Linux	2	NA
PART-A			
1	Design, Develop and Implement a menu driven Program in C for the following array operations. - Creating an array of N Integer Elements - Display of array Elements with Suitable Headings - Inserting an Element (ELEM) at a given valid Position (POS) - Deleting an Element at a given valid Position (POS) - Exit. Support the program with functions for each of the above operations.	2	25CSLK32.1
2	Design, Develop and Implement a Program in C to create a structure to store the name, account number and balance of 3 and store their information. - Write a function to print the names of all the customers having balance less than MINIMUM_AMOUNT. - Write a function to add BONUS_AMOUNT in the balance of all the customers having more than \$1000 in their balance and then print the incremented value of their balance	2	25CSLK32.1
3	Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) - Push an Element on to Stack - Pop an Element from Stack - Demonstrate how Stack can be used to check Palindrome - Demonstrate Overflow and Underflow situations on Stack - Display the status of Stack - Exit Support the program with appropriate functions for each of the above operations	2	25CSLK32.2
4	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.	2	25CSLK32.2
5	Design, Develop and Implement a Program in C for the following Stack Application: Evaluation of Postfix expression with single digit operands and operators: +, -, *, /, %, ^.	2	25CSLK32.2
6	Design, Develop and Implement a Program in C for the following Stack Application: Solving Tower of Hanoi problem with n disks.	2	25CSLK32.2
PART-B			
7	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) Insert an Element on to Circular QUEUE	2	25CSLK32.2

	b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above Operations.		
8	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, Phone #. a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL (Demonstration of stack) e. Exit	2	25CSLK32.3
9	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Salary, Phone #. a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it. c. Perform Insertion and Deletion at End of DLL. d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit	2	25CSLK32.3
10	Using circular representation for a polynomial, design, develop, and execute a program in C to accept two polynomials, add them, and then print the resulting polynomial.	2	25CSLK32.3
11	Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers. a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit	2	25CSLK32.4
12	Demonstrate the Binary Search algorithm by first sorting the list of elements using any one of the standard sorting techniques. The program should accept a list of elements, sort them in ascending order, and then perform a Binary Search to find a given target element. Display appropriate messages indicating whether the element was found and its position.	2	25CSLK32.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

- <https://ds1-iiith.vlabs.ac.in/exp/poly-arithmetic/polynomial-arithmetic-linked-list/multiplication-of-polynomials.html>
- <https://www.cs.usfca.edu/~galles/visualization/Algorithms.html>
- <https://visualgo.net/en/sorting>
- <https://ds1-iiith.vlabs.ac.in/exp/hash-tables/hash-tables/hash-tables-operations.html>

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	5
L4	Analyze	10	5
L5	Evaluate	10	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:**Reference Books:**

1. Reema Thareja, Data Structures Using C. Oxford University Press, 3rd Edition, 2023. ISBN-13: 978-0199491689.
2. E. Balagurusamy, Data Structures Using C, 2nd Edition, McGraw Hill, 2025, ISBN: 978-9364443012.
3. Amol M. Jagtap and Ajit S. Mali, Data Structures using C: A Practical Approach for Beginners. Chapman & Hall/CRC Press (Taylor & Francis Group), 1st Edition, 2022. ISBN-13: 978-0367616311.

DATA SCIENCE			
Course Code	25AIM33	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM33.1	Apply the predictive modelling techniques for different dataset using necessary python packages		
25AIM33.2	Utilize various statistical concepts and transformation techniques to effectively process and prepare datasets		
25AIM33.3	Design appropriate data wrangling techniques to transform diverse datasets into a clean and usable format		
25AIM33.4	Analyze the performance and suitability of diverse strategies for handling and processing multi-source data		
25AIM33.5	Implement various data transformation and dimension reduction techniques for specific data sources.		
25AIM33.6	Optimize end-to-end regression pipelines using Python libraries, based on feature selection and data transformation techniques to solve predictive modelling problems.		
MODULE-1	BASIC CONCEPTS AND PYTHON PACKAGES	25AIM33.1	9 Hours
Basic Concepts: Data Science Workflow, Train-Test Split, K-fold cross validation, Data Leakage and avoidance measure, Python Packages: NumPy, Matplotlib, pandas, SciPy, scikit, Data frame, Loading Machine Learning data, Dataset formats (CSV, Excel, JSON).			
Case Study	E-Commerce Customer Churn Pipeline		
Text Book	Textbook1: Ch:1,2,3		
MODULE-2	DESCRIPTIVE STATISTICS AND DATA PREPARATION	25AIM33.1, 25AIM33.2 25AIM33.4	9 Hours
Descriptive Statistics: Reasons to study Statistics, Sampling, Data Analysis Process, Mean, Median, Standard Deviation, Skewness, Kurtosis, Graphical Representation-Box Plots, Pivot Table, Heat Map Correlation, Statistics-ANOVA. Data Preparation: Need for Data Pre-processing, Data Transforms, and Rescale Data Standardize Data, Normalize Data, Binarize Data, Univariate, Bivariate and Multivariate Analysis, Handling imbalanced datasets.			
Case Study	E-Commerce Customer Lifetime Value & Marketing Performance (Bivariate Analysis)		
Text Book	Textbook 1: Ch:2,3,4. Textbook 2: Ch:16,25,26,27,28.		
MODULE-3	DATA CLEANING AND FEATURE SELECTION	25AIM33.3, 25AIM33.4	9 Hours
Data Cleaning: Basic data cleaning, Outlier Identification and Removal, Identifying and Removing Missing Data, Statistical Imputation, KNN Imputation, Iterative Imputation. Feature Selection: Statistics for feature selection: Chi-Square, Correlation based selection, Mutual Information. Methods for categorical input, Methods for Numerical input, Select Features for Numerical Output, RFE for Feature Selection, Significance of feature selection.			
Case study	K-Nearest Neighbors (KNN) Concept on E-commerce customer segmentation		
Text Book	Text Book1: Ch 2,9.		
MODULE-4	DATA TRANSFORM AND DIMENSIONALITY REDUCTION	25AIM33.4, 25AIM33.5	9 Hours
Data Transforms: Scaling data source, min-max scalar and standard scaler, Scale data with outliers, encode categorical data, Label Encoding vs One Hot Encoding Deriving new input variables. Dimensionality reduction: Techniques for Dimensionality Reduction, Linear Discriminant Analysis, PCA Dimensionality Reduction, SVD Dimensionality Reduction.			
Case Study	Genomic Disease Classification & Visualization (PCA)		
Text Book	Text Book1: Ch 2,3,4,5,6,7.		
MODULE-5	PREDICTIVE MODELLING	25AIM33.4, 25AIM33.5, 25AIM33.6	9 Hours

Predictive Modelling: Overview, Introduction to Regression, Feature Selection for Regression, Target Transformation in Regression, Introduction to Classification, Building Models using Scikit-learn, Model Persistence: Saving and Loading Models and Transformations using pickle and joblib.

Case Study **Regression for continuous value prediction.**

Text Book Textbook 1: Ch:22,24,25, 26

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	10	5
L4	Analyze	5	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	--

Suggested Learning Resources:

Text Books:

- 1) Aurelien Geron “Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow”, O'Reilly Media, 3rd Edition, 2022, ISBN-9781098122461.
- 2) Jake VanderPlas, “Python Data Science Handbook”, O'Reilly Media, 2nd Edition, 2022, ISBN: 9781098121211

Reference Books:

- 1) Sam Lau, Joseph Gonzalez, Deborah Nolan, “Learning Data Science”, O'Reilly Media, 1st Edition, 2023, ISBN: 978-1098112998.
- 2) Sebastian Raschka, Yuxi (Hayden) Liu, Vahid Mirjalili, “Machine Learning with PyTorch and Scikit-Learn”, Packt Publishing, 1st Edition, 2022, ISBN: 978-1837021956.

Web links and Video Lectures (e-Resources):

- 1) Data Science for Beginners: <https://youtu.be/ua-CiDNNj30?si=WITWD-1xMlmcW5Mq>
- 2) Data Science: <https://www.coursera.org/browse/data-science?msocid=1383f52857d96b6229f4e5e156746a8b>
- 3) Data Science Full Course: <https://www.youtube.com/live/4cExalx09xU?si=uaGrbCaqp0JNo1DA>
- 4) Machine Learning Model Evaluation Metrics: https://youtu.be/wpQiEHYkBy?si=n_M1ClfCs9fMkXAs
- 5) Principal Component Analysis (NPEL): https://youtu.be/agWD_JySWwQ?si=qhGIX_xoaPkL3Zm

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Dataset Exploration Activity
- Class Presentation.
- Kaggle Based Learning
- Quiz-Based Learning
- Industry Dataset Analysis

DATA SCIENCE LAB			
Course Code	25AIL33	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIL33.1	Apply Data Science techniques to solve the problem		
25AIL33.2	Develop solutions for real-time challenges by interacting with and manipulating diverse real-time datasets		
25AIL33.3	Create data visualization techniques, calculate correlation and covariance, and implement regression models to uncover insights and relationships within datasets		
25AIL33.4	Evaluate Classification and Clustering techniques to address real-world problems		
Pgm. No	List of Programs	Hrs	COs
Prerequisite Programs			
	Recall the following python Libraries commands for data science. a. Numpy b. Pandas c. Matplotlib d. Scipy	2	NA
PART-A			
1	i. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location. a. Reading Excel data sheet using Python Pandas. b. Reading XML dataset using Python Pandas. c. Reading JSON data using Python Pandas ii. Create three datasets in different formats: employees.xlsx (Excel), departments.xml (XML), and salaries.json (JSON). Perform the following tasks: a. Read all three datasets into Pandas Data Frames. b. Merge these datasets based on a common column (e.g., employee_id). c. Save the merged Data Frame to a new CSV file in a specified disk location.	2	25AIL33.1 25AIL33.2
2	Design a Python program to perform exploratory data analysis tasks on a sample dataset. Select an appropriate data set for your experiment and draw the following graphs. a. Find the data distributions using box and scatter plot. b. Find the outliers using plot. c. Plot the histogram, bar chart and pie chart on sample data. d. Plot the Heat Map	2	25AIL33.1 25AIL33.2
3	Implement K-fold cross validation techniques. Perform a cross validation experiment on for a given set of training data examples stored in a .CSV file using 10 folds.	2	25AIL33.1 25AIL33.2
4	i. Perform the following methods in order to remove outliers a. Standard Deviation Method b. Interquartile Range Method ii. Create a statistics_metrics.csv dataset with columns quarter, revenue, expenses and profit, and perform the following tasks: a. Identify and remove outliers using both the Standard Deviation method and the Interquartile Range (IQR) method. b. Compare the datasets before and after outlier removal using box plots and scatter plots.	2	25AIL33.1 25AIL33.3
5	Implement the program to avoid Data leakage with Naïve Data preparation. Select an appropriate data set for your experiment and validate the results	2	25AIL33.1 25AIL33.4
6	Apply the following on for a given set of training data examples stored in a .CSV file Find the correlation matrix. a. Plot the correlation plot on dataset and visualize giving an overview of relationships among data. b. Interpret the correlation matrix and identify any strong correlations between features and housing prices. c. Perform ANOVA to compare the means of the numerical features across different neighborhoods or zones in Boston	2	25AIL33.1 25AIL33.3 25AIL33.4

PART-B			
7	. Implement the following for a given set of training data examples stored in a .CSV file a. Load data set b. Convert into Dataframe c. Apply Scaler method d. Fit the Scaler Data into PCA e. Plot the visualization diagram for PCA ii. Evaluate the Dimensionality Reduction: a. Compare the performance of a machine learning algorithm (e.g., logistic regression or k-nearest neighbours) on the original dataset versus the reduced dimensional dataset using cross-validation or another suitable evaluation metric.	2	25AIL33.1 25AIL33.2 25AIL33.3
8	Implement the following Imputation for a given set of training data examples stored in a CSV file: a. Statistical Imputation b. KNN Imputation c. Iterative Imputation	2	25AIL33.3 25AIL33.4
9	Implement the following Encoding methods for a given set of training data: a. Ordinal Encoding b. One Hot Encoding c. Dummy Variable Encoding	2	25AIL33.3 25AIL33.4
10	Implement the following Transform methods on a numerical dataset: Uniform Discretization Transform, K-Means Discretization Transform	2	25AIL33.1 25AIL33.3 25AIL33.4
11	Write a program to implement Linear Regression for a given dataset.	2	25AIL33.1 25AIL33.3
12	Write a program to implement Binary classification and Multi - Classification for a given dataset.	2	25AIL33.1 25AIL33.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours) (To be done during Lab but not to be included for CIE or SEE)

- Data Science Concepts:
<https://iitmdatascience.com/notes.html>
<https://cse.iitm.ac.in/~pratyush/cs6741.html>
<https://archive.nptel.ac.in/courses/106/106/106106179/>
- Regression Models:
<http://www.r-bloggers.com/how-to-perform-a-logistic-regression-in-r/>
<http://www.coastal.edu/kingw/statistics/R-tutorials/logistic.html>
- Classification: <http://www.ats.ucla.edu/stat/r/data/binary.csv>

CIE Assessment Pattern (50 Marks - Lab)

RBT Levels		Weekly Assessment	Test (s)
		20	30
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks - Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

- Nailong Zhang, "A Tour of Data Science", Taylor & Francis, 2024, ISBN: 9781032939435.
- Sam Lau, Joseph Gonzalez, Deborah Nolan, "Learning Data Science", O'Reilly Media, 1st Edition, 2023, ISBN: 978-1098112998.

COMPUTER ARCHITECTURE			
Course Code	25AIM34	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM34.1	Understand the fundamentals of computer organization, instruction set architecture, memory, and I/O operations.		
25AIM34.2	Analyze memory hierarchy, cache organization, and memory technologies for AI applications.		
25AIM34.3	Apply the principles of arithmetic operations, ALU organization, and fast arithmetic circuits to solve computer architecture problems.		
25AIM34.4	Design CPU organization, instruction pipelining, and control unit.		
25AIM34.5	Compare GPU, TPU, and parallel processing architectures for AI and high-performance computing.		
25AIM34.6	Utilize emerging computing tools and frameworks through self-directed learning to address changing technological demands in professional practice		
MODULE-1	INTRODUCTION	25AIM34.1	9 Hours
Basic Structure of Computers Instruction Set Architecture: Functional Units, Basic Operational Concepts, Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Introduction to Assembly Language Basic Input/Output: Accessing I/O Devices, Interrupts, Bus Structure			
Case Study	Analyze the instruction execution cycle to determine the number of required memory access cycles for a three-word machine instruction.		
Text Book	Text Book 1: 1.1 - 1.3, 2.1 - 2.5, 3.1, 3.2		
MODULE-2	MEMORY SYSTEM	25AIM34.1, 25AIM34.2	9 Hours
Basic Concepts, Memory Hierarchy, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Write Policies, Performance Considerations, Virtual Memory: Paging, Segmentation, TLB.			
Case Study	Evaluate the memory system assuming an initially empty cache governed by the Least Recently Used (LRU) algorithm: 1. Find the total page/block capacity of the cache. 2. Tabulate the cache contents after each memory access, identify hits/misses, and calculate the Hit Ratio . 3. Compute the Effective Access Time (EAT) for the any execution trace.		
Text Book	Text Book 1: 8.1 - 8.6		
MODULE-3	ARITHMETIC UNIT	25AIM34.3,25AIM34.4	9 Hours
Arithmetic Numbers, Arithmetic Operations, Addition and Subtraction of Signed Numbers, Overflow Detection, Floating-Point Arithmetic, ALU Organization, Arithmetic, Logic, Shift and Rotate Operations, High-Speed Arithmetic Circuits: Ripple Carry Adder, Carry Look-Ahead Adder, Hardware Multipliers and Their Role in AI Computations.			
Case Study	Demonstrate the worst-case delay of the ripple carry adder.		
Text Book	Textbook 1: 9.1 – 9.6 Text Book 2: 3.1 – 3.5		
MODULE-4	BASIC PROCESSING AND PARALLEL PROCESSING UNIT	25AIM34.4, 25AIM34.5	9 Hours
CPU Organization, Register Organization, Instruction Cycle, Instruction Fetch–Decode–Execute Cycle, Basic Instruction Pipelining, Pipeline Hazards, Hardwired Control Unit, Introduction to Microprogrammed Control Unit, Comparison of Hardwired and Microprogrammed Control.			
Case Study	A four-stage pipeline has the stage delays as 150, 120, 160 and 140 ns respectively. Registers are used between the stages and have a delay of 5 ns each. Assuming constant clocking rate, determine the total time taken to process 1000 data items on the pipeline.		
Text Book	Text Book1: Ch.5 (5.1–5.10), Ch.6 (6.1–6.8), Ch.12 (12.1–12.3); Text Book 2: Ch.4 (4.1–4.10)		
MODULE-5	EMERGING PROCESSING UNITS	25AIM34.5,25AIM34.6	9 Hours

GPU-Architecture, GPU Applications in Graphics, Deep Learning, and HP. Domain Specific Architecture: Guidelines for DSAs, Introduction to Tensor Processing Units, Google Tensor Processing, NVIDIA A100 and T4 GPUS, Overview of Next Generation Processors.

Case Study The team is evaluating how to optimize the device's computer architecture to meet the following constraints: Low power consumption and High-speed image processing

Text Book Text Book 3: Ch.4,7

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	10	15
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	5	5
L4	Analyze	10	-	10
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	20
L5	Evaluate	-
L6	Create	--

Suggested Learning Resources:

Text Books:

- 1) Carl Hamacher, "Computer Organization and Embedded Systems", 6th Edition, McGraw Hill Higher Education, 2023. ISBN: 978-9355323729.
- 2) David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by, Elsevier, 2022. ISBN: 978-0-12-383872-8
- 3) John L. Hennessy, David A. Patterson, Christos Kozyrakis, Computer Architecture: A Quantitative Approach, 7th Edition, Morgan Kaufmann (Elsevier), 2025. ISBN: 978-0443154072.

Reference Book:

1. M. Morris Mano and Michael D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, VHDL and System Verilog, 6th Edition, Pearson, 2021. ISBN: 978-0137501984.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_cs61/preview
- <https://www.geeksforgeeks.org/computer-organization-architecture/computer-organization-and-architecture-tutorials/>
- <http://www.cs.iit.edu/~virgil/cs470/Book/>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Discussion
- Flipped Class
- Seminar

SOFTWARE ENGINEERING AND PROJECT MANAGEMENT			
Course Code	25CSK35	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25CSK35.1	Apply appropriate software process models to solve real-world software engineering problems using the principles of the SDLC.		
25CSK35.2	Analyze software requirements through requirement engineering, modelling, and agile management practices.		
25CSK35.3	Design software systems using architectural, object-oriented, and user interface design principles.		
25CSK35.4	Implement software testing strategies using appropriate testing techniques and tools to verify and validate software systems.		
25CSK35.5	Examine software quality using object-oriented and web testing techniques and explore the security testing concepts.		
25CSK35.6	Develop software project management plans by incorporating risk management, software configuration management, and maintenance practices.		
MODULE-1	INTRODUCTION TO SOFTWARE ENGINEERING AND PROCESS MODELS	25CSK35.1	9 Hours
Introduction: Nature of software, Characteristics of good software, Software Engineering as a layered technology, Software process, project and product, Process models. Process Models: Waterfall Model, Evolutionary models, Introduction to Agility - Agile process - Extreme Programming (XP) process - Principles of Agile software development - Agile frameworks and tools - Scrum - Kanban.			
Case Study	A university is developing a Smart Campus Management System to automate student registration, attendance, fee payment, and library services. During development, stakeholders request new features such as mobile app and AI-based analytics. The development team must select an appropriate software process model to deliver a reliable, secure, and high-quality software product while accommodating changing requirements. - Identify the characteristics of good software required for this system. - Differentiate between the software process, project, and product. - Which software process model is most suitable for this project - Explain how Agile, Scrum, and Kanban can help manage changing requirements.		
Text Book	Text Book 1: Chapter 1.1 to 1.4, 2.1 to 2.6 3.1 to 3.5 Text Book 2: Chapter 1, 2		
MODULE-2	REQUIREMENTS ENGINEERING	25CSK35.2	9 Hours
Modelling Requirements: Software requirements- Types, Planning, Scope, Work Breakdown Structure, Milestones, Deliverables, Cost and estimates (human resources, time, costs), Requirement Engineering process, Requirement Elicitation, System modelling - Requirement Specification and Requirement Validation, Requirement Elicitation Techniques, Requirement Management in Agile			
Applications	A college plans to automate its library operations using a Library Management System. - Identify and elicit functional and non-functional requirements from stakeholders. - Prepare a Software Requirements Specification (SRS) document. - Define the project scope, WBS, milestones, deliverables, and cost estimates. - Validate the requirements and describe how requirement changes will be managed during development		
Text Book	Text Book 1: Chapter 7.1 to 7.6, 8.1 to 8.4 Text Book 2: Chapter 4.1,4.2		
MODULE-3	SOFTWARE DESIGN	25CSK35.3	9 Hours
Software Design: Design Concepts and Principles - Abstraction, Refinement, Modularity, Cohesion, Coupling, Architectural design, Detailed Design Transaction and Transformation, Refactoring of designs, Object-Oriented Design, User Interface Design.			

Applications	An organization plans to develop an Online Shopping System for customers and administrators. - Design the software architecture and detailed design using abstraction, refinement, modularity, cohesion, and coupling principles. - Develop an object-oriented design by identifying classes, relationships, and interactions. - Design a user-friendly User Interface (UI) for product browsing, ordering, and payment. Review and refactor the design to improve maintainability, reusability, and performance.		
Text Book	Text Book 1: Chapter 9.1 to 9.4, 10.1 to 10.5, 12.1 to 12.5 Text Book 2: Chapter 5, 6, 7.1 to 7.8, 9.1 to 9.3		
MODULE-4	SOFTWARE VERIFICATION AND VALIDATION	25CSK35.4 25CSK35.5	9 Hours

Verification and Validation: Software Testing -Testing fundamentals, test plan, test design, test execution, Reviews, inspections and auditing, White Box Testing, Black Box Testing, Regression Testing, Mutation Testing, Object-Oriented Testing and tools - JUnit, NUnit, Testing web-based systems and tool - Selenium, Overview: Security Testing

Case Study	A bank has developed an Online Banking System that allows customers to register, log in, transfer funds, pay bills, and view account statements. Before deployment, the bank wants to ensure that the software is reliable, secure, and error-free. - Prepare a test plan and test cases. - Perform white-box, black-box, and regression testing. - Use JUnit/NUnit and Selenium for testing. - Conduct reviews and security testing to ensure software quality.		
Text Book	Text Book 1: Chapter 19.1 to 19.6, 20.1 to 20.5 Text Book 2: Chapter 10		

MODULE-5	SOFTWARE PROJECT MANAGEMENT	25CSK35.6	9 Hours
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Software Project Management: Risk management, RMMM plan, CASE tools, Agile project management, Software maintenance, Types of maintenance, Software Configuration Management - overview, SCM tools, Re-engineering, Reverse engineering, Software reuse, Overview: Sustainable and Green software

Applications	Legacy System Modernization - Key Aspects to be Analyzed: - Maintenance type: Classify the maintenance activity involved (corrective, adaptive, perfective or preventive) in modernizing a legacy campus/enterprise application. - Configuration management: Identify how SCM tools track versions and changes during the re-engineering effort. - Re-engineering vs reverse engineering: Analyze the steps used to recover the design from legacy code and re-architect it for reuse.		
Text Book	Text Book 1: Chapter 22, 23, 26.1 to 26.7, 27.2 Text Book 3: Chapter 3, 22, 23, 25		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	-
L3	Apply	15	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:**Text Books:**

1. R. S. Pressman and Bruce Maxim, Software Engineering: A Practitioner's Approach, 9th Edition, McGraw-Hill, 2023, ISBN-13: 978-9355325044
2. Rajib Mall, Fundamentals of Software Engineering, 5th Edition, PHI Learning Private Limited, 2018 (Reprint 2025), ISBN-13: 978-9388028028
3. Ian Sommerville, Software Engineering, Pearson Education Global, 10th Edition, 2016 (Reprint 2025), ISBN-13: 978-1292096131

Reference Books:

1. Robert K. Wysocki, Effective Project Management: Traditional, Agile, Extreme, Hybrid, 8th Edition, Wiley, 2022, ISBN-13: 978-1119868170
2. David Farley, Modern Software Engineering: Doing What Works to Build Better Software Faster, 1st Edition, Addison-Wesley Professional, 2021, ISBN-13: 978-0137314911
3. Bob Hughes, Mike Cotterell and Rajib Mall, Software Project Management, 7th Edition, McGraw-Hill Education, 2023, ISBN-13: 978-1260577952

Web links and Video Lectures (e-Resources):

- <https://www.coursera.org/learn/introduction-to-software-engineering>
- <https://www.edx.org/learn/software-engineering>
- https://onlinecourses.nptel.ac.in/noc20_cs68/preview
- <https://alison.com/course/project-management-s-fundamentals>
- <https://software-engineering-book.com/slides/>
- <https://www.atlassian.com/software/jira/guides> (Jira for Agile project management)
- <https://www.selenium.dev/documentation> (Selenium testing documentation)
- <https://learn.github.com/skills> (GitHub Skills -- Git/GitHub hands-on)
- <https://www.coursera.org/learn/version-control-with-git-and-github>
- <https://www.coursera.org/specializations/agile-scrum-mastery-csm-psm-certification>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case studies / Case-lets on process models, project planning and quality assurance.
- Class presentations on Agile frameworks (Scrum, Kanban) and DevOps/testing tools (Jira, Selenium, JMeter).
- Hands-on exercises: preparing an SRS, drawing UML diagrams, writing JUnit/Selenium test scripts for a mini project.
- Maintain a GitHub portfolio of the mini-project (code, README, commit history) as a placement-ready artifact.
- Mock technical-interview rounds on SDLC, Agile, testing and system-design fundamentals covered in this course.

INTRODUCTION TO OPENCV			
Course Code	25AIM361	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM361.1	Apply OpenCV and Python programming techniques to perform fundamental image processing operations.		
25AIM361.2	Analyze digital images using filtering, smoothing, thresholding, segmentation, and enhancement techniques to improve image quality for computer vision applications.		
25AIM361.3	Develop graphical and interactive image processing applications using OpenCV drawing functions, mouse event handling, and image visualization tools.		
25AIM361.4	Design computer vision solutions for real-world applications involving object recognition, feature-based matching, color-based detection, shape analysis, and face detection.		
Pgm. No.	List of Programs	Hrs	COs
Prerequisite Programs			
	Basic Python Programming, Basic image processing concepts.	2	NA
PART-A			
1	a) Read a color image using OpenCV, display the original image, resize it to 300×300 pixels, and display both the original and resized images in separate windows. b) Convert the color image to grayscale, save the grayscale image to disk, and print the original image's: Height, Width, Number of Channels, Data Type.	2	25AIM361.1
2	a) Write a Python program using OpenCV to perform the following on the image: Cropping the image, flipping the image and rotating the image. b) Write a Python program using OpenCV to split a color image into its Blue, Green, and Red (B, G, R) channels and display each channel separately.	2	25AIM361.1
3	Apply a Gaussian Blur and Median Blur filter to a colour image using OpenCV and display both the original and blurred images side by side.	2	25AIM361.1 25AIM361.2
4	Write a Python program using OpenCV to perform image thresholding (simple, adaptive, gaussian, Otsu) on a grayscale image. Display the original grayscale image and the threshold binary image.	2	25AIM361.2
5	Create a blank white image using OpenCV and perform the following: a) Draw a line, rectangle, and circle on the image. b) Draw an ellipse with specified axis lengths and angle.	2	25AIM361.3
6	Write a Python program using OpenCV to bound mouse events.	2	25AIM361.3
PART-B			
7	Write a Python program using OpenCV to perform the edge detection techniques: Sobel Edge Detection, Laplacian Edge Detection and Canny Edge Detection.	2	25AIM361.2
8	Write a Python program using OpenCV to perform image enhancement using morphological transformations.	2	25AIM361.2
9	Write a Python program using OpenCV to perform Contour Detection and Shape Analysis.	2	25AIM361.4
10	Write a Python program using OpenCV to perform using HSV color space.	2	25AIM361.4
11	Write a Python program using OpenCV to perform Feature Detection and Image Matching.	2	25AIM361.4
12	Write a Python program using OpenCV to perform Face Detection using Cascade Classifier.	2	25AIM361.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. <https://cse19-iiith.vlabs.ac.in/exp/image-arithmetic/>
2. <https://cse19-iiith.vlabs.ac.in/exp/affine-transformation/simulation.html>
3. <https://cse19-iiith.vlabs.ac.in/exp/point-operations/objective.html>
4. <https://cse19-iiith.vlabs.ac.in/exp/neighbourhood-operations/objective.html>
5. <https://cse19-iiith.vlabs.ac.in/exp/image-histogram/objective.html>
6. https://docs.opencv.org/4.x/d6/d00/tutorial_py_root.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	25
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books:

- 1) Learning OpenCV 5 Computer Vision with Python (4th Edition), Joseph Howse and Joe Minichino, Packt Publishing, 2023. ISBN:978-1803234250.
- 2) Neural Network Computer Vision with OpenCV 5: Build Computer Vision Solutions Using Python and DNN Module, Gopi Krishna Nuti, BPB Publications, 2024. ISBN:978-9355516961.
- 3) Computer vision: algorithm and applications, Richard Szeliski, Springer Cham, 2022. ISBN:978-3030343729.

GOLANG PROGRAMMING			
Course Code	25AIM362	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM362.1	Apply the basic concepts of Go programming to develop simple programs.		
25AIM362.2	Analyze pointers, structures, methods, and user-defined functions to construct modular applications in Go programming.		
25AIM362.3	Implement goroutines, JSON processing, and file handling in Go applications.		
25AIM362.4	Design Go programs incorporating search algorithms and error-handling techniques to solve real-world problems.		
Pgm. No.	List of Programs	Hours	COs
Prerequisite Programs			
	Demonstration of Go installation, Go workspace, package structure, compilation, and execution of a simple "Hello World" program.	2	NA
PART-A			
1	Write a Go program to develop a Student Grade Calculator that accepts student details and marks, calculates the total, average, grade, and result using user-defined functions with multiple return values.	2	25AIM362.1 25AIM362.2
2	Write a Go program to implement a Simple Banking System that performs deposit, withdrawal, balance enquiry, and interest calculation using functions and control statements.	2	25AIM362.1 25AIM362.2 25AIM362.4
3	Write a Go program to perform Binary on an array of integers and display the result	2	25AIM362.1 25AIM362.4
4	Write a Go program to demonstrate array and slice operations including creation, traversal, insertion, deletion, appending, copying, and slicing.	2	25AIM362.1
5	Write a Go program to perform string processing using the strings package, including searching, replacing, splitting, joining, trimming, and case conversion	2	25AIM362.1
6	Write a Go program to manage student names and marks using maps by performing insertion, update, deletion, searching, and displaying records along with class average marks.	2	25AIM362.1 25AIM362.4
PART-B			
7	Write a Go program to demonstrate pointer operations by swapping two variables, modifying values through pointers, and passing pointers to user-defined functions	2	25AIM362.2
8	Write a Go program to demonstrate struct embedding by implementing Person and Employee/Student structures and accessing embedded fields and methods.	2	25AIM362.2
9	Write a Go program to accept the names and marks (three subjects) of multiple students. Create a separate goroutine for each student to calculate the total and average marks. Use sync. Wait Group to wait for all goroutines to complete.	2	25AIM362.3
10	Write a Go program to read and write student data from/to a text or CSV file, process the records, and display summary statistics.	2	25AIM362.3 25AIM362.4
11	Write a Go program to convert a student structure into JSON format and reconstruct it back into a structure using the encoding/json package. Display both the JSON representation and the reconstructed data.	2	25AIM362.3

12	a) Write a Go program that performs integer division and demonstrates the runtime panic caused by dividing by zero. b) Write a Go program to open a file that does not exist and handle the error returned by os.Open().	2	25AIM362.3 25AIM362.4
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PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. Software link: <https://go.dev/learn/>
2. Tutorial: <https://go.dev/doc/tutorial/>
3. Pointer and structures:
<https://www.digitalocean.com/community/conceptual-articles/understandingpointers-in-go>
4. Data Structures in go: <https://blog.logrocket.com/comprehensive-guide-data-structures-go/>

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Book:

1. Go Programming - From Beginner to Professional: Learn everything you need to build modern software using Go by Samantha Coyle, Packt Publishing Limited, 2024, **ISBN** : 978-1803243054

WEB APPLICATION DEVELOPMENT			
Course Code	25AIM363	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM363.1	Design semantic HTML5 document structures that serve as the foundation for modern responsive web applications.		
25AIM363.2	Create professional, responsive, and user-friendly websites using contemporary CSS practices.		
25AIM363.3	Apply XHTML and JavaScript to design structured web pages with dynamic functionality.		
25AIM363.4	Analyze XML documents to validate structural correctness using schemas and assess their suitability for diverse data-interchange scenarios.		
Pgm No.	List of Experiments / Programs	Hrs	COs
Prerequisite Experiments / Programs / Demo			
	- Basic computer literacy. - Fundamentals of programming. - Basic knowledge of Internet and web browsers. - Familiarity with a text editor/IDE for writing source code.	2	NA
PART-A			
1	Design a personal web page using HTML5 which should include: a) A brief description about yourself. b) A small quote describing you. c) Your photo as the profile picture d) An index which should be a list of different headings/sections present in a document in the form of link which when clicked takes you to that heading/section The different sections: - Your educational details (Has to be displayed using a table) - Your hobbies/interests with small description about that particular hobby. - Your Achievements.	2	25AIM363.1
2	Develop an HTML webpage that displays a weekly class timetable for an educational institution using an HTML table. The timetable should cover five working days (Monday to Friday) and include multiple class sessions for each day. While designing the timetable, make effective use of the colspan and rowspan attributes to represent common periods such as lunch breaks, laboratory sessions, seminars, or combined classes that span across multiple rows or columns. The timetable should be well-structured, easy to read, and visually organized using appropriate table headings and formatting. The timetable must include: - Days of the week as row headings. - Time slots as column headings. - A common Lunch Break shared by all days using rowspan or colspan. - At least one session (such as a laboratory or workshop) that spans multiple periods.	2	25AIM363.1
3	A university is planning to develop an online Course Registration System for students enrolling in the upcoming semester. Design an HTML form to collect the required information from students. The form should include the following controls: Text boxes for Student Name, USN, Email ID, and Mobile Number. Radio buttons for selecting Gender (Male/Female/Other). Checkboxes for selecting extracurricular interests such as Sports, Music, Coding Club, and NSS. A drop-down list to select the Department (CSE, ISE, AIML, ECE, etc.). A list control allowing students to choose their preferred elective course.	2	25AIM363.1

	Submit and Reset buttons to submit the registration details or clear the form. Use appropriate labels, headings, and formatting to create a user-friendly registration form.		
4	Design a web page using HTML and CSS for a restaurant which plans to publish its menu online and wants an attractive presentation of food categories and pricing information that includes: - Styled lists to display food categories such as Starters, Main Course, Desserts, and Beverages. - A styled table showing item names, prices, and availability status. - CSS properties to customize list markers, table borders, row colors, hover effects, and spacing to create a visually appealing menu.	2	25AIM363.1 25AIM363.2
5	Design a web page for a Travel Agency using CSS to set a scenic background image for the entire page and separate background images for sections such as Tour Packages, Destinations, and Customer Reviews. Use the background-repeat property to manage image repetition and enhance the overall appearance of the webpage.	2	25AIM363.2
6	Design a web page for an Online Electronics Store using HTML and CSS . Display at least four electronic products such as a laptop, smartphone, headphones, and smartwatch in separate product cards arranged using the CSS Flexbox layout. Each product card should include a product image, product name, price, and an "Add to Cart" button. Apply basic CSS styling to improve the appearance of the webpage.	2	25AIM363.2
PART-B			
7	Create a JavaScript program that generates an HTML page to accept an integer and determine whether it is positive, negative, or zero.	2	25AIM363.3
8	Design and develop a XHTML document that includes JavaScript script to create stack of images such that images appear one top on another with images slightly visible. Whenever cursor is placed on an image that image should be completely visible and on moving cursor out image should go back to original position.	2	25AIM363.3
9	Develop and demonstrate using JavaScript, a XHTML document that displays text "TEXT-GROWING" with increasing font size in the interval of 100ms in RED COLOR, when the font size reaches 50pt it displays "TEXT-SHRINKING" in BLUE color. Then the font size decreases to 5pt.	2	25AIM363.3
10	Develop and demonstrate, using JavaScript, a XHTML document that collects the USN (the valid format is: A digit from 1 to 4 followed by two upper-case characters followed by two digits followed by two upper-case characters followed by three digits; no embedded spaces allowed) and semester (valid format digit from 1 to 8) of the user. Event handler must be included for the form element that collects this information to validate the input. Messages in the alert windows must be produced when errors are detected.	2	25AIM363.3
11	Create an XML document to store information about a hospital management system and apply a CSS stylesheet to display the data in a well-formatted manner. The XML document should include patient ID, patient name, doctor name, department, appointment date, and consultation fee.	2	25AIM363.4
12	Design an XML document with a DTD specification to store information about books in a library. The XML document should include Book ID, Title, Author, Publisher, Category, and Availability Status. Create sample data for three books. Develop a CSS stylesheet and use it to display the document in a structured and visually appealing format.	2	25AIM363.4
PART-C Beyond Syllabus Virtual Lab Content (4 Hours) (To be done during Lab but not to be included for CIE or SEE)			
https://getbootstrap.com/docs/5.3/getting-started/introduction/ https://developer.mozilla.org/en-US/docs/Learn_web_development/Core/Scripting/DOM_scripting https://developer.mozilla.org/en-US/docs/Web/CSS/Guides/Grid_layout https://developer.mozilla.org/en-US/docs/Web/API/Window/setInterval https://developer.mozilla.org/en-US/docs/Web/API/Fetch_API/Using_Fetch https://getbootstrap.com/docs/5.3/examples/			

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:**Reference Books:**

- 1) Robert W. Sebesta: Programming the World Wide Web, 8th Edition, 2022, Pearson Education, ISBN-13:978-0137618149.
- 2) Deitel, P. J., Deitel, H. M., & Deitel, A. Internet and World Wide Web: How to Program, 5th Edition, Pearson, 2021. ISBN-13: 9780137618279.

DATA VISUALIZATION WITH POWER BI			
Course Code	25AIM364	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes:			
At the end of the course, the student will be able to:			
25AIM364.1	Understand the basic concepts and terminology of the Power BI service.		
25AIM364.2	Apply the concept of data importing, charts and data cleaning.		
25AIM364.3	Analyze the concept of View and export data from dashboards and reports.		
25AIM364.4	Design Power BI dashboards by integrating reports, visualizations, and tiles to present business insights.		
Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	• Basic of Data Science Algorithms and Python	2	NA
PART-A			
1	Visualize different groups of data using bar chart, stacked bar charts to show the composition of each item.	2	25AIM364.1 25AIM364.2
2	Apply your knowledge of charts to perform the following: a) Load a dataset of monthly sales by region and product category. Create a clustered bar chart comparing total sales across regions. b) Create a line chart to visualize sales trends over time. Add data labels and customize the line colors.	2	25AIM364.1 25AIM364.2
3	Connect Power BI to a relational database (e.g., SQL Server/MySQL), import the required tables, and create a report containing at least three meaningful visualizations.	2	25AIM364.1 25AIM364.2
4	Handle data errors, duplicate records, missing values and data type mismatches on the imported data.	2	25AIM364.2 25AIM364.3
5	Create an interactive report by implementing appropriate filters and slicers.	2	25AIM364.2 25AIM364.3
6	Create a comprehensive dashboard report for the given dataset using suitable visualizations and interactive elements.	2	25AIM364.3 25AIM364.4
PART-B			
7	Design and visualize business KPIs using calculated DAX measures (e.g., profit margin, growth%).	2	25AIM364.3 25AIM364.4
8	Develop a dynamic report using What-if Parameters for user-driven business analysis.	2	25AIM364.3 25AIM364.4
9	Use conditional formatting to highlight performance metrics and thresholds across visuals.	2	25AIM364.3 25AIM364.4
10	Generate and analyze spatial or categorical heatmaps to identify patterns in dense data.	2	25AIM364.3 25AIM364.4
11	Create an interactive multi-level drill through report with contextual navigation.	2	25AIM364.4
12	Design a professional-grade analytical dashboard using Power BI for a real-world dataset. Implement storytelling techniques, interactive filters, bookmarks.	2	25AIM364.4
PART-C			
Beyond Syllabus Virtual Lab Content (4 Hours)			
(To be done during Lab but not to be included for CIE or SEE)			
1. Charts for visualization: https://windsor.ai/power-bi-visualization-charts/ 2. Heat-maps: https://intellipaat.com/blog/power-bi-heatmap/ 3. Colour and conditional Formatting: https://databear.com/changing-colours-using-dax-and-conditional-formatting-in-power-bi/ 4. Drill Trough: Power BI Drill Through: A Full Tutorial DataCamp 5. Using AI assistance to create Power BI custom visuals: https://www.sqlbi.com/articles/using-ai-assistance-to-create-power-bi-custom-visuals/			

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessments	Test (s)
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:**Reference Books:**

- 1) Greg Deckler and Brett Powell, “Mastering Microsoft Power BI: Expert Techniques to Create Interactive Insights for Effective Data Analytics and Business Intelligence”, 2nd Edition, Packt Publishing, 2022. ISBN: 978-1837028696.
- 2) Nikolai Schuler, “Microsoft Power BI - The Complete Masterclass - 2026 EDITION”, Packt Publishing, 2026. ISBN: 9781837634682.

BIO INSPIRED DESIGN AND INNOVATION					
Course Code		25AIM365	Credits	03	
L:T:P:S		1:0:0:0	CIE Marks	50	
TLP Contact Hours / Sem		15	SEE Marks	50	
TW & SL / Sem		15	Total Marks	100	
Total Hours /Sem		30	Exam Hours	03	
Course outcomes: At the end of the course, the student will be able to:					
25AIM365.1	Understand the fundamentals and significance of bio-inspired design and engineering.				
25AIM365.2	Apply biomaterials and bio-inspired healthcare systems for engineering applications.				
25AIM365.3	Analyse bio-inspired optimization techniques to solve sustainable engineering and environmental management problems.				
25AIM365.4	Apply bio-inspired AI innovations in manufacturing, automation, materials, and sustainable product development.				
MODULE-1	BIO-INSPIRED DESIGN AND ENGINEERING			25AIM365.1	3
Bio-Inspired Engineering and design, History, Need for Bio-Inspired Designs. Bio inspired Additive manufacturing techniques, (self-healing, self-assembly).					
Self-study	Investigate the Challenges of Bio inspired design, Compare with traditional areas of science and engineering				
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16				
MODULE-2	BIO MATERIALS AND BIO HEALTHCARE DESIGN			25AIM365.2	3
Biomaterials, Design of Forms- (Hexagonal unit cells, Intrinsic disorder, anisotropy), Bio- Mechanics, Applications of Biomaterials and Bio systems in Health care design (Human Prosthetics, Parasitic, Wasp Inspired Needle)					
Case Study	Investigate Bio-Compatible and health care applications.				
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15				
MODULE-3	BIO SUSTAINABLE DEVELOPMENT			25AIM365.3	3
Innovations in Energy (Termite mound inspired shopping malls), Innovations in Resource-Air purification, filtration), Dew water collection systems, water purification, desalination.					
Case Study	Explore the Bio inspired environmental constructions and development.				
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10				
MODULE-4	BIO-OPTIMISATION TECHNIQUES			25AIM365.3	3
No Free Lunch Theorem, Bat Algorithm, Flower Pollination Algorithm, Genetic Algorithm, Ant Colony Optimisation (ACO), Swam Intelligence- Particle Swam Optimisation (PSO).					
Self-study	Scrutinize the Different types of Optimization techniques, genetic research.				
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7				
MODULE-5	Applications of Bio-Inspired AI Innovations			25AIM365.4	3
Bio-inspired innovations in AI Integrated automotive systems, automation and robotics, AI-driven Bio materials discovery and manufacturing, AI Driven predictive modelling, digital twins, and sustainable product design for addressing environmental and industrial challenges.					
Case Study	Survey on Bio inspired Innovations, design, applications and case studies of the same.				
Text Book	Text Book 2: 12.1 to 12.10				
CIE Assessment Pattern (50 Marks – Theory) –					
RBT Levels		Marks Distribution			
		Test (s)	AAT1	AAT2	
		25	15	10	
L1	Remember	5	-	-	
L2	Understand	5	5	-	
L3	Apply	10	5	5	
L4	Analyze	5	5	5	
L5	Evaluate	-	-	-	
L6	Create	-	-	-	

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:**Text Books:**

- 1) Helena Hashemi Farzaneh, Udo Lindemann, "A Practical Guide to Bio-inspired Design", Springer Vieweg, 1st edition 2019, ISBN-10: 366257683X, ISBN-13: 978-3662576830.
- 2) Torben A. Lenau, Akhlesh Lakhtakia, "Biologically Inspired Design: A Primer (Synthesis Lectures on Engineering, Science, and Technology)", Publisher: Morgan & Claypool Publishers, 2021, ISBN-10:1636390471, ISBN-13: 978-1636390475

Reference Books:

- 1) French M, "Invention and evolution: Design in nature and engineering", Publisher: Cambridge University Press, 2020, ISBN-13: 978-1108492263.
- 2) Pan L., Pang S., Song T. and Gong F. eds, "Bio-Inspired Computing: Theories and Applications", 15th International Conference, BIC-TA 2020, Qingdao, China, October 23-25, 2021, Revised Selected Papers (Vol. 1363). Springer Nature, 2021, ISBN: 978-981-16-1820-1.

Web links and Video Lectures (e-Resources)

- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- <https://biodesign.berkeley.edu/bioinspired-design-course/>
- https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design20Workshop%20Report_2232327_October%202022_Final.508.pdf

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Bio Materials printing using 3D Printing
- Flipped class room
- Organizing Group wise discussions on sub topics
- Student presentations

COMMUNITY PROJECT USING INNOVATION AND DESIGN THINKING			
Course Code	25CPD37	Credits	02
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	-	SEE Marks	50
TW & SL / Sem	30	Total Marks	100
Total Hours /Sem	30	Exam Hours	03

Course outcomes: At the end of the course, the student will be able to:

25CPD37.1	Identify environmental issues and their impact on ecosystems, natural resources, and sustainable development.
25CPD37.2	Evaluate environmental conditions using data obtained through field surveys, case studies, environmental audits, and related investigations
25CPD37.3	Develop skills in project planning, field survey, data collection, implementation, documentation and reporting
25CPD37.4	Formulate feasible environmental problem statements and solutions considering practical constraints and sustainability aspects

Community Project using Innovation and Design Thinking helps students to understand community problems, develop innovative solutions, and create sustainable positive impact through a structured problem-solving approach. Rapid urbanization, population growth, environmental concerns, energy demand, water scarcity, waste management, transportation issues and rural development challenges have created practical problems affecting communities and public welfare. This course aims to integrate technical knowledge, field exposure and societal engagement so that students identify real community issues, frame problem statements and attempt appropriate, feasible and sustainable engineering responses.

Methods for project identification: Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

Restrictions and professional conduct:

Community / Societal Projects shall remain academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation.

CIE Assessment Pattern (50 Marks)

RBT Levels		Periodical Evaluation	Reviews and
		50	
L1	Remember	-	
L2	Understand	05	
L3	Apply	15	
L4	Analyze	10	
L5	Evaluate	10	
L6	Create	10	

SEE Assessment Pattern (50 Marks)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

Suggested Learning Resources:

Textbooks:

1. Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3. Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: <https://sdgs.un.org>
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2. NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3. Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): <https://vlab.co.in>
4. Geological Survey of India (GSI) – Maps, reports, and publications: <https://www.gsi.gov.in>
5. YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments).
6. American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

BASIC APPLIED MATHEMATICS - I (Common for All Branches)			
Course Code	25DMAT31	Credits	0
L:T:P:S	0:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	15	SEE Marks	--
TW & SL / Sem	15	Total Marks	50
Total Hours /Sem	30	Exam Hours	--
Course outcomes: At the end of the course, the student will be able to:			
25DMAT31.1	Understand the concepts of elementary transformations to the rank of a matrix, and apply the consistency and solutions of systems of linear equations		
25DMAT31.2	Apply eigenvalues and eigenvectors of square matrices for matrix diagonalization, and compute the powers of matrices for engineering and computational applications		
25DMAT31.3	Analyze curves represented in Cartesian, polar coordinate systems, determine tangents, angles between polar curves, and derive pedal equations for scientific modeling.		
25DMAT31.4	Apply techniques of partial differentiation, chain rule, Euler's theorem for homogeneous functions, Jacobians of functions to solve multivariable engineering problems		
25DMAT31.5	Analyze the motion of particles using velocity and acceleration vectors, and evaluate gradient and directional derivatives to interpret rates of change in scalar fields.		
25DMAT31.6	Apply vector differential operators—gradient, divergence, and curl—to investigate scalar and vector fields		
MODULE-1	LINEAR ALGEBRA - 1	25DMAT31.1	3 Hours
Elementary transformations, Reduction of the given matrix to echelon form, Rank of a Matrix, Consistency of a system of linear equations, Solution of a system of non-homogeneous linear equations.			
Self-study	Rank of a matrix by normal form, Solution of a system of homogeneous linear equations		
Text Book	Text Book 1: 2.7, 28.6, Text Book 2: 7.3, 7.4		
MODULE-2	LINEAR ALGEBRA - 2	25DMAT31.2	3 Hours
Linear transform, Eigen values and Eigen vectors of a square matrix, Diagonalization of a square matrix and Power of matrices using Diagonalization.			
Self-study	Reduction of quadratic expression to canonical form.		
Text Book	Text Book 1: 2.11, 2.13, Text Book 2: 7.9, 8.1.		
MODULE-3	DIFFERENTIAL CALCULUS	25DMAT31.3	3 Hours
Importance of cartesian and polar coordinate systems, Angle between the radius vector and tangent to a polar curve, angle between two polar curves, Pedal equation of a polar curve.			
Self-study	Radius of curvature in cartesian, parametric, polar forms		
Text Book	Text Book 1: 4.4, 4.7, 4.8		
MODULE-4	MULTIVARIABLE CALCULUS	25DMAT31.4	3 Hours
Introduction to partial differentiation, total differentiation, chain rule, Euler's theorem for Homogeneous functions, Jacobians, Extreme values of the functions with two variables.			
Self-study	Basic problems on partial differentiation		
Text Book	Text Book 1: 5.4, 5.7		
MODULE-5	VECTOR CALCULUS	25DMAT31.5 25DMAT31.6	3 Hours
Velocity and Acceleration of a particle, Gradient of scalar function, directional derivative, Divergence and Curl of vector functions, Solenoidal and Irrotational vector fields.			
Self-study	Vector identities		
Text Book	Text Book 1: 8.3, 8.5, 8.7, 8.18 Text Book 2: 9.7, 9.8, 9.9		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create			-

Suggested Learning Resources:**Text Books:**

- 1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
- 2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2013, ISBN: 9788126554232.

Reference Books:

- 1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236
- 2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition, 2016, ISBN: 9780070634190
- 3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831
- 4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Edition, 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://youtu.be/IUV0_Nj4d1s?si=eO3s7keCbCO1_jcz
- <https://youtu.be/VzUcs7aiqgg?si=YLtTUGr4Xp88KGY3>
- <https://youtu.be/LDBnS4c7YbA?si=udUOdJ-u0ZxFmBAW>
- https://youtu.be/palSdK9P-ns?si=7A8_VSxEI4lGvksB
- <https://youtu.be/Bw5yEqwMjQU?si=jzbklZmVev1w8K2S>
- https://youtu.be/LBqdGn1r_fQ?si=DWcAliFnosT7zikY
- <https://youtu.be/N5YCGOyTSuU?si=Wsf75V5fkUpfVVxr>
- <https://youtu.be/gd1FYn86P0c?si=7drzBEqVFSv6sQeZ>
- <https://youtu.be/cSj82GG6MX4?si=4QN1DFXEqaJoUBn7>
- <https://youtu.be/0c3yq9btr3A?si=jIoz8eu5TgV7mh8G>
- <https://youtu.be/PhfbEr2btGQ?si=HVK1uk65oHph0t8G>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

NATIONAL SERVICE SCHEME			
Course Code	25NSS30	Credits	00
L:T:P:S	0:0:0:0	CIE Marks (each Semester)	50
TLP Contact Hours/Sem	15	SEE Marks	--
TW & SL/Sem	10	Total Marks	50 x 2 = 100
Total Hours / Sem	30	Exam Hours	02
Course outcomes: At the end of the course, the student will be able to:			
25NSS30.1	Understand the importance of his / her responsibilities towards society.		
25NSS30.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.		
25NSS30.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.		
25NSS30.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.		
Semester / Course Code	CONTENT	COs	HRS
3 RD 25NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Developing Sustainable Water management system for rural areas and implementation approaches. 4. Setting of the information imparting club for women leading to contribution in social and economic issues. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Participation in Institution NSS Unit Cell campaigns.	25NSS30.1 25NSS30.2 25NSS30.3 25NSS30.4	26
4 TH 25NSS40	1. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 2. Contribution to any national level initiative of Government of India. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs). 4. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 5. Govt. school Rejuvenation and helping them to achieve good infrastructure. 6. Participation in Institution NSS Unit Cell campaigns.	25NSS40.1 25NSS40.2 25NSS40.3 25NSS40.4	26
CIE Assessment Pattern (50 Marks – Activity based) –			
CIE component for every semester			Marks
Presentation – 1 : Selection of topic, PHASE – 1			10
Commencement of activity and its progress - PHASE – 2			10
Case study-based Assessment Individual performance			10
Sector wise study and its consolidation			10
Video based seminar for 10 minutes by each student at the end of semester with Report.			10
Total marks for the course in each semester			50
- Implementation strategies of the project (NSS work). - The last report should be signed by NSS Officer, the HOD and Principal. - At last report should be evaluated by the NSS officer of the Institute. - Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.			
Suggested Learning Resources:			
Reference Books:			
1. NSS Course Manual, Published by NSS Cell, VTU Belagavi. 2. Government of Karnataka, NSS cell, activities reports and its manual.			

3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
 - Lecture session by NSS Officer
 - Students Presentation on Topics
 - Presentation - 1, Selection of topic, PHASE – 1
 - Commencement of activity and its progress - PHASE – 2
 - Execution of Activity
 - Case study-based Assessment, Individual performance
 - Sector/ Team wise study and its consolidation
 - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management- Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Setting of the information imparting club for	May be individual or team	Women empowerment groups/	Group selection/proper consultation/	Report should be submitted by individual	Evaluation as per the rubrics of

	women leading to contribution in social and economic issues.		Consulting NGOs & Govt Teams / College campus	Continuous monitoring/ Information board	to the concerned evaluation authority	scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
1.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/ Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Spreading public awareness under rural outreach programs. (minimum 5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Organize National integration and social harmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS			
Course Code	25PED30	Credits	00
L:T:P:S	0:0:0:0	CIE Marks (each semester)	50
TLP Contact Hours / Sem	15	SEE Marks	--
TW & SL / Sem	15	Total Marks	50 x 2= 100
Total Hours /Sem	30	Exam Hours	02
Course outcomes: At the end of the course, the student will be able to:			
25PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness		
25PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle		
25PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.		
25PEDX0.4	Understand the roles and responsibilities of organization and administration of sports and games		
Semester	CONTENT	COs	HOURS
3 RD 25PED30	Module 1: Orientation A. Lifestyle B. Food & Nutrition C. Health & Wellness D. Pre-Fitness test.	25PED30.1, 25PED30.2, 25PED30.3, 25PED30.4	26 HRS
	Module 2: General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash		
	Module 3: Specific games (Any one to be selected by the student) 1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.		
4 TH 25PED40	Module 1: Ethics and Moral Values A. Ethics in Sports B. Moral Values in Sports and Games	25PED40.1, 25PED40.2, 25PED40.3, 25PED40.4	26 HRS
	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration		
CIE Assessment Pattern (50 Marks – Practical) – CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.			
CIE		Marks	
Participation of student in all the modules		10	
Quizzes – 2, each of 7.5 marks		15	
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students		25	
Total		50	
Suggested Learning Resources: Reference Books: 1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani. 2. Bandonadhyav, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.			

3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

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YOGA			
Course Code	25YOG30	Credits	00
L:T:P:S	0:0:0:0	CIE Marks (each Semester)	50
TLP Contact Hours / Sem	15	SEE Marks	--
TW & SL / Sem	15	Total Marks	50 x 4 = 200
Total Hours /Sem	30	Exam Hours	02
Course outcomes: At the end of the course, the student will be able to:			
25YOG30.1	Understanding the origin, history, aim and objectives of Yoga		
25YOG30.2	Become familiar with an authentic foundation of Yogic practices		
25YOG30.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat		
25YOG30.4	Use the teachings of Patanjali in daily life.		
Sem	CONTENT	COs	HRS
25YOG30 3 rd	Introduction of Yoga: Aim and Objectives of Yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of Yoga, importance of prayer Brief introduction of yogic practices for common man: Yogic practices for common man to promote positive health Rules and regulations: Rules to be followed during yogic practices by practitioner Misconceptions of Yoga: Yoga its misconceptions, Difference between yogic and non-yogic practices. Suryanamaskara: 1. Suryanamaskar prayer and its meaning, Need, importance and benefits of 2. Suryanamaskar 12 count,2rounds Kapalabhati: 40strokes/min 3rounds Different types of Asanas with Brief introduction and importance: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supinline: Utthitadvipadasana, Ardhalasana	25YOG30.1 25YOG30.2 25YOG30.3 25YOG30.4	26
25YOG40 4 th	Suryanamaskara: Suryanamaskar 12 count,4rounds Brahmari Pranayama Different types of Asanas with Brief introduction and importance: 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Sarvangasana, Chakraasana 5. Balancing: Sheershasana Patanjali's Ashtanga Yoga: Asana, Pranayama Pranayama: Chandra Bhedana, Nadishodhana, Surya Bhedana Shat Kriyas: Jalaneti and sutraneti, Sheetkarma Kapalabhati	25YOG40.1 25YOG40.2 25YOG40.3 25YOG40.4	26
CIE Assessment Pattern (50 Marks – Practical) CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)			
CIE		Marks	
Avg of Test 1 and Test 2		25	
Demonstration of Yogasana		25	
Total		50	
Suggested Learning Resources:			
Reference Books:			
1. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)			

2. Tiwari, O P: Asana Why and How
3. Ajitkumar: Yoga Pravesha (Kannada)
4. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
5. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
6. Nagendra H R: The art and science of Pranayama
7. Tiruka: Shatkriyegalu (Kannada)
8. Iyengar B K S: Yoga Pradipika (Kannada)
9. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- <https://youtu.be/KB-TYlgd1wE>
- <https://youtu.be/aa-TG0Wg1Ls>

MUSIC			
Course Code	25MUS30	Credits	00
L:T:P:S	0:0:0:0	CIE Marks (each Semester)	50
TLP Contact Hours / Sem	15	SEE Marks	--
TW & SL / Sem	15	Total Marks	50 x 2 = 100
Total Hours /Sem	30	Exam Hours	02
Course outcomes: At the end of the course, the student will be able to:			
25MUS30.1	Identify and understand the origins and evolution of the Indian music system and its fundamental concepts		
25MUS30.2	Analyze and practice various types of compositions in Carnatic music and relate to different musical traditions		
25MUS30.3	Demonstrate knowledge of major composers and their contributions to Indian classical music		
25MUS30.4	Classify and understand various musical instruments and their construction		
Sem	CONTENT	COs	HRS
3 rd 25MUS30	Origin of Indian Music - Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Taya, Raga, Tala, and Mla. Study of the fundamental concepts that form the foundation of Carnatic music. Compositions in Carnatic Music - Introduction to types of compositions including Geethe, Jathi, Swara, Swarajathi, Varna, Krithi, and Thillana. Understanding of notation systems and their application in musical compositions. Composers and Their Contributions - Biography and musical contributions of Purandaradasa (founder of Carnatic music pedagogy), Thyagaraja (prolific composer and saint), and Mysoro Vasudevacharya. Study of their impact on Indian classical music traditions. Abhyasa Gana - Practical Training - Singing of Sarale Varase exercises and notation writing. Introduction to Suladi Saphthatala. Singing of 2 Geethe in Malahiri. Foundation for practical music experience.	25MUS30.1 25MUS30.2 25MUS30.3 25MUS30.4	26
4 th 25MUS40	Classification of Musical Instruments - Classification and construction of string instruments (Veena, Sitar), wind instruments (Flute, Shehnai), percussion instruments (Mridangam, Tabla), and Idiophones (Ghana Vaadya - Gongs, Cymbals). Examples and characteristics of each class of instruments. Abhyasa Gana - Practical Training - Continuation of singing exercises including Sarale Varase at varying speeds. Complete notation writing for Sarale Varase and Suladi Saphthatala in Mayamalavagowla Raga. Singing of 2 additional Geethe in Malahiri, one Jathi Swara, and one Krithi in a Mela raga. Advanced practical music training.	25MUS40.1 25MUS40.2 25MUS40.3 25MUS40.4	26
CIE Assessment Pattern (50 Marks – Practical)			
CIE to be evaluated every semester based on practical demonstration of Singing/Playing learnt in the semester and internal tests (MCQ type)			
	CIE	Mark	
	Avg of Test 1 and Test 2	20	
	Practical test on:		
	a. Recite one Sarale Varase mentioned by the examiner in three speeds.	30	
	b. Sing/Play the Geethe in Malahari.		
	c. Singing/Playing Jathi Swara/Krithi.		
	Total	50	
Textbooks:			
1. Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007.			
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana - Vol.1 (English), Shreenivaas Prakaashana, 2018.			
References:			
1. Lakshminarayana Subramiam, Viji Subramaniam, "Classical Music of India: A Practical Guide", Tranqueber 2018.			
Web links and Video Lectures (e-Resources):			
• https://www.youtube.com/watch?v=ihFDT8ZBPxE			
• https://www.youtube.com/watch?v=4XXI5tTXa0I			

- <https://www.youtube.com/watch?v=n-60gfzGa1E>
- https://www.youtube.com/watch?v=Vv_K7J7gx6M
- <https://www.youtube.com/watch?v=BovAAPumYUo>
- https://www.youtube.com/watch?v=F_aWPATb8V4
- <https://www.youtube.com/watch?v=DPPCRWA3hXo>
- <https://www.youtube.com/watch?v=TUP00NK9eTM>
- <https://www.youtube.com/watch?v=LlolyBzZtdg>

IV SEMESTER

DISCRETE MATHEMATICS AND GRAPH THEORY (Common for AIML & CSE)			
Course Code	25MAC41	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25MAC41.1	Apply propositional logic to construct truth tables and analyze the validity of logical statements using logical connectives.		
25MAC41.2	Analyze function composition, inverse functions, and apply the Pigeonhole Principle to solve counting and existence problems in engineering.		
25MAC41.3	Apply the Principle of Inclusion and Exclusion and its generalizations to solve counting and combinatorial problems encountered in engineering.		
25MAC41.4	Analyze graph structures by determining graph isomorphism, identifying subgraphs, and interpreting the structural properties of graphs.		
25MAC41.5	Apply the concepts of rooted trees, binary trees, spanning trees, network flows, and Kruskal's algorithm to solve optimization and network design problems.		
25MAC41.6	Analyze planar graphs and their different representations to solve graph-theoretic problems in engineering, computer science, communication networks, and circuit design.		
MODULE-1	MATHEMATICAL LOGIC	25MAC41.1	9 Hours
Basic Connectives and Truth Tables, Tautology and Contradiction, Logic Equivalence, The Laws of Logic, Converse, Inverse and Contra positive, Logical Implication, Rules of Inference. Introduction to quantifiers.			
Self-study	NAND, NOR connectives problems		
Text Book	Text Book 1: 2.1, 2.2, 2.3, 2.4, 2.5.		
MODULE-2	RELATIONS AND FUNCTIONS	25MAC41.2	9 Hours
Cartesian Products and Relations, One-to-One and onto functions. The Pigeon hole principle, Function Composition and Inverse Functions. Properties of Relations, Equivalence Relations and Partitions. Partial orders, Hasse diagram.			
Self-study	Introduction and operations on set theory.		
Text Book	Text Book 1: 5.1, 5.2, 5.3, 5.5, 5.6, 7.1, 7.3, 7.4.		
MODULE-3	THE PRINCIPLE OF INCLUSION AND EXCLUSION	25MAC41.3	9 Hours
The principle of Inclusion and Exclusion, Generalizations of the principle, Derangements, nothing is in its right place, Rook Polynomials. Recurrence relations: First order linear recurrence relation, the second order linear homogeneous recurrence relation with constant coefficients.			
Self-study	Permutations and combinations		
Text Book	Text Book 1: 8.1, 8.2, 8.3, 8.4, 10.1, 10.2.		
MODULE-4	GRAPH THEORY	25MAC41.4	9 Hours
Introduction, Basic definition, Application of graphs, finite, infinite and bipartite graphs, incidence and degree, isolated vertex, pendant vertex and null graph. Isomorphism of graphs. Introduction to sub-graphs, walks, paths, circuits and cycles.			
Self-study	Graph coloring, chromatic polynomials.		
Text Book	Text Book 1: 11.1, 11.2, 11.3, 11.4, Text Book 2: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9.		
MODULE-5	CONNECTIVITY AND PLANARITY	25MAC41.5 25MAC41.6	9 Hours
Eulers graphs, Hamiltonian paths, circuits and cycles, Rooted and Binary trees, spanning trees, Network flows, Kruskal algorithm, Vertex connectivity, edge connectivity, cut set and cut vertices, fundamental circuits. Planar graphs, Different representation of a planar graph			
Self-study	Directed graphs, Huffman code		
Text Book	Text Book 1: 11.5, 12.1, 12.2, 12.3, Text Book 2: 3.1, 3.5, 4.1, 4.2, 4.3, 4.4, 5.2, 5.4, 5.6		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create			-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:**Text Books:**

- 1) Ralph P. Grimaldi, Discrete and Combinatorial Mathematics-an applied introduction, Pearson Education, Fifth Edition, 2019, ISBN: 9789353433055.
- 2) Narsingh Deo, Graph Theory with Application to Engineering and Computer Science, Dover Publications Inc., First Edition, 2016, ISBN: 978-0486807935.

Reference Books:

- 1) Basavaraj S. Anami and Venkanna S. Madalli, Discrete Mathematics – A Concept based approach, Universities Press, 2016, ISBN: 9788173719998
- 2) Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, McGraw Hill Education, Seventh Edition, 2017, ISBN: 9780070681880
- 3) D.S. Malik and M.K. Sen, Discrete Mathematical Structures: Theory and Applications, Thomson, 2004. ISBN: 9780619212858
- 4) Thomas Koshy, Discrete Mathematics with Applications, Elsevier, First Edition 2005, ISBN: 9788181478870.

Web links and Video Lectures (e-Resources):

- <https://youtu.be/O4Qf0SQKkZw?si=1r9joVe2-rP04fCH>
- https://youtu.be/Hbyj6vEi7fY?si=_GaCjUHBndV2MArP
- https://youtu.be/7hLvm_4DNqs?si=viYHH_fZDZQ9Fmdw
- https://youtu.be/7hLvm_4DNqs?si=viYHH_fZDZQ9Fmdw
- https://youtu.be/6Z_eengdMVE?si=-ZlPy2xl18oMUwFR
- <https://youtu.be/fwSiTaCs8KM?si=wpZcCEG-pNDuIPkS>
- <https://youtu.be/iHC1ZdLdKjw?si=tuN-6pLqhMWPn4Mb>
- https://youtu.be/auvGQCoYdu4?si=3ELSyG5g-475AN1_
- https://youtu.be/GLHWih_RB38?si=FuoNQAzNR2IIYpU0

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

OBJECT ORIENTED PROGRAMMING USING JAVA			
Course Code	25CSK42	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25CSK42.1	Model the real-world entities using Object Oriented Programming concepts.		
25CSK42.2	Identify the importance of inheritance and interface concepts and apply to model relationships		
25CSK42.3	Analyze the importance of file handling and string handling operations		
25CSK42.4	Apply the concept of Exception handling and Multithreading in concurrent programming		
25CSK42.5	Develop applications using collections framework for managing user defined types		
25CSK42.6	Solve the real-world problems using Object Oriented concepts and collection Framework in Java		
MODULE-1	INTRODUCTION TO JAVA	25CSK42.1	9 Hours
The Java Language, Java Development Kit (JDK); Java Buzzwords, Byte Code, JVM, JRE and Java environment, Data types, variables and Arrays, Operators, Control statement, command line Arguments, Object Oriented concepts, Classes, Objects and Methods, Access specifiers, Method Overloading, Constructor, Implicit this.			
Case Study	JavaDoc report generation		
Text Book	Text Book 1: Part 1 Chapter 1 to 7		
MODULE-2	INHERITANCE AND INTERFACING	25CSK42.2	9 Hours
Inheritance, Method Overriding, Annotations, Static members, Inner Classes, Abstract Classes, Final members and classes, The Object Class, Interfaces, Package Fundamentals, Reflections			
Case Study	Real world scenario and application of interface and abstract classes		
Text Book	Text Book 1: Part 1 Chapter 8,9,12		
MODULE-3	STRING MANIPULATION AND FILE HANDLING	25CSK42.3	9 Hours
String Constructors, Length Operations, Character Extraction, Comparison, Searching, Modifying, String Buffer, StringBuilder, Basic file I/O: File Input Stream, File Output Stream, File Reader, File Writer			
Case Study	Serialization of java objects		
Text Book	Text Book 1: Part 2 Chapter 16, Part 1 Chapter 13		
MODULE-4	EXCEPTION HANDLING AND MULTI-THREADING	25CSK42.4	9 Hours
Exception handling: Fundamentals, Types, Using try, catch, throw, throws, finally, multiple catch, User Defined Exceptions, Thread Concept, Java Thread Model, The main method, Creating Threads, Daemon Threads, Thread Pool, Thread Priorities, Synchronization, join.			
Case Study	Solving Java based UI hanging due to deadlock issues		
Text Book	Text Book 1: Part 1 Chapter 10, 11		
MODULE-5	COLLECTION FRAMEWORK	25CSK42.5&25CSK42.6	9 Hours
Collections Overview, Collection Interfaces, Set, List, Map, Queue, Collection Classes, Generics, Type Wrappers,			
accessing a collection using an Iterator, Sorting collections, equals ().			
Case Study	Lambda expressions in Java		
Text Book	Text Book 1: Part 1 Chapter 14		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	AAT1	AAT2
		25	10	15
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	10
L5	Evaluate		-	
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:**Text Book:**

1. Herbert Schildt, “Java: The Complete Reference”, 13th Edition, McGraw-Hill, 2025. ISBN: 978-9355326478

Reference Books:

1. Kathy Sierra, Bert Bates & Trisha Gee, Head First Java, 3rd Edition, O'Reilly Media, 2022. ISBN-13: 9781491910771, ISBN-10: 1491910771.
2. Y. Daniel Liang, Introduction to Java Programming and Data Structures, Comprehensive Version, 13th Edition, Pearson, 2023. ISBN-13: 9780138092832.
3. Herbert Schildt & Danny Coward, Java: The Complete Reference, 13th Edition, McGraw-Hill Education, 2024. ISBN-13: 9781265058432.
4. Cay S. Horstmann, Core Java, Volume I: Fundamentals, 13th Edition, Pearson, 2025. ISBN-13: 9789367130735.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=bm0OyhwFDuY&list=PLsyebzWxl7pe_IiTfNyr55kwJPWbgxB5
- <https://www.youtube.com/watch?v=CFD9EFcNZTQ>
- <https://www.youtube.com/watch?v=r59xYe3Vyks&list=PLS1QulWo1RIbfTjQvTdj8Y6yyq4R7g-Al>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Hands-on with coding platforms like Codetrantra.

OBJECT ORIENTED PROGRAMMING USING JAVA LAB			
Course Code	25CSLK42	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25CSLK42.1	Understand the real-world applications using Object Oriented Programming concepts.		
25CSLK42.2	Develop applications using String concept in Java.		
25CSLK42.3	Apply the concept of Multithreading and exception handling in java programming		
25CSLK42.4	Solve the real-world problems using Object Oriented concepts and collection framework in Java.		
Pgm. No.	List of Programs	Hours	COs
Prerequisite Programs / Demo			
	Expected Prior Knowledge and Skills: Proficiency in C programming language, basic program design concepts (e.g, pseudo code).	2	NA
PART-A			
1	Create a Java program for the following task: - Define a class named Book with four attributes: - title (String) - author (String) - isbn (int) - price (double) - Provide a constructor that initializes all four attributes when a Book object is created. - In the main method, create two Book objects using the constructor. Print the details of each Book object in a clear, well formatted manner.	2	25CSLK42.1
2	A courier company must calculate the volume of shipping cartons that come in different shapes and require optional padding. Create a Java class Box and a driver program that meet the following requirements: Constructor Overloading - Box () → creates a default carton of 1 cm × 1 cm × 1 cm. - Box (double side) → creates a cube-shaped carton whose three edges are all side cm. - Box (double length, double breadth, double height) → creates a rectangular carton with the given dimensions in centimetres. Method Overloading (all named volume) - double volume () → returns the carton's raw volume in cm³. - double volume (double scaleFactor) → returns the volume after being multiplied by scaleFactor (e.g., 1.05 for 5 % padding). - static double volume (double l, double b, double h) → static helper that calculates the volume of any block without creating a Box object. In a driver class (BoxDemo): - Construct one object with each constructor. - Display the dimensions of every box. - Demonstrate each overloaded volume method, clearly labelling the output.	2	25CSLK42.1
3	Design and implement a Java program to demonstrate both multilevel inheritance and hierarchical inheritance .	2	25CSLK42.1

	1. Create a base class Person with attributes name and age. 2. Derive a class Employee from Person with an additional field empId 3. From Employee, derive two separate classes: - o Manager with an additional field department - o Clerk with an additional field typingSpeed		
4	Write a Java program that models different kinds of musical instruments and shows runtime (dynamic) polymorphism through method overriding. 1. Base class • Create an abstract class Instrument containing a method void playNote(). 2. Subclasses (hierarchical inheritance) • Piano overrides playNote() to print "Piano: C-E-G chord". • Guitar overrides playNote() to print "Guitar: Strum on E minor". • Flute overrides playNote() to print "Flute: Sustained A note". 3. Driver code (OrchestraDemo) • Declare an Instrument [] array that holds one object of each subclass. • Iterate through the array and invoke playNote() on every element. • Show that the correct subclass version executes at runtime, proving dynamic dispatch.	2	25CSLK42.1
5	Design and develop Java program to compute area and perimeter for different shapes using abstract classes and interfaces.	2	25CSLK42.1
6	Create a class in Java called "Calculator" which contains the following: 1. A static method called powerInt(int num1, int num2) that accepts two integers and returns num1 to the power of num2 (num1 power num2). 2. A static method called powerDouble(double num1,int num2) that accepts one double and one integer and returns num1 to the power of num2 (num1 power num2). 3. Call your method from another class without instantiating the class (i.e. call it like Calculator.powerInt(12,10) since your methods are defined to be static). Hint: Use Math.pow(double,double) to calculate the power.	2	25CSLK42.1
PART-B			
7	Develop a simple Java program to find the longest substring without repeating characters in a given string. Accept the input string through command-line arguments. If no command-line argument is provided, accept the input interactively using the Scanner class. Display the longest substring and its length.	2	25CSLK42.2
8	Design and Develop a simple Java program to • Instantiate a StringBuffer with the text "Hello". • Append " World", insert "Java " after the first space, and then delete the word "World". • After each operation, print the buffer content and its current capacity.	2	25CSLK42.2
9	Develop a Program to take care of Number Format Exception if user enters values other than integer for calculating average marks of 2 students. The name of the students and marks in 3 subjects are taken from the user while executing the program. • In the same Program write your own Exception classes to take care of Negative values and values out of range (i.e. other than in the range of 0-100) • Include finally to output the statement "Program terminated".	2	25CSLK42.3
10	Design and implement a Java program to solve the classic Producer-Consumer problem with a fixed-size shared buffer. Program must include Producer threads that add items and Consumer threads that remove items. Crucially, producers should wait if the buffer is full, and consumers should	2	25CSLK42.3

	wait if its empty, ensuring proper synchronization using synchronized , wait () , and notifyAll() .		
11	Create a Student Attendance Management System using a HashMap Collection type. Perform the following operations: Add the key-value pair. Retrieve the value associated with a given key Check whether a particular key/value exist. replace a value associated with a given key in the HashMap	2	25CSLK42.4
12	Write a Java program that creates a new ArrayList<Integer> , adds several exam marks, and then performs the following operations: 1. Add all elements of another List<Integer> to the original ArrayList. 2. Copy the ArrayList to a plain int [] array. 3. Reverse the contents of the ArrayList. 4. Extract a sub-list (e.g., marks from index 2 to index 5). 5. Sort the ArrayList in ascending order. 6. Clone the ArrayList into another ArrayList<Integer>.	2	25CSLK42.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

- <https://java-iitd.vlabs.ac.in/exp/method-overloading>
- <https://java-iitd.vlabs.ac.in/exp/inheritance>
- <https://java-iitd.vlabs.ac.in/exp/exceptions>
- <https://java-iitd.vlabs.ac.in/exp/threading>
- <https://java-iitd.vlabs.ac.in/exp/collections>

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	10	5
L3	Apply	10	5
L4	Analyze	10	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books

- 1.Y. Daniel Liang, "Introduction to Java Programming and Data Structures", 13th Edition, Pearson Education, 2023, ISBN: 978-0138092832.
2. Herbert Schildt and Danny Coward, "Java: The Complete Reference", 13th Edition, McGraw-Hill Education, 2025, ISBN: 978-9355326478.
3. Kathy Sierra, Bert Bates, and Trisha Gee, "Head First Java", 3rd Edition, O'Reilly Media, 2022, ISBN: 978-1491910771.

MACHINE LEARNING			
Course Code	25AIM43	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes:			
At the end of the course, the student will be able to:			
25AIM43.1	Understand the fundamental concepts, terminologies, types, challenges, and workflow of Machine Learning.		
25AIM43.2	Apply supervised classification techniques to evaluate model performance using appropriate classification metrics.		
25AIM43.3	Analyze regression models and ensemble learning techniques for prediction and risk assessment problems using suitable performance measures.		
25AIM43.4	Implement clustering and association rule mining algorithms on unlabeled datasets to discover hidden patterns and relationships		
25AIM43.5	Examine the probabilistic machine learning models for uncertainty-based decision-making applications.		
25AIM43.6	Compare the performance of different probabilistic graphical models to select the most effective approach for inference and prediction in complex systems.		
MODULE-1	INTRODUCTION	25AIM43.1	9 Hours
Understanding Machine Learning: Definition, Terminologies in machine learning, Applications, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Hypothesis Space and Generalization, Bias-variance trade off, Find-S Algorithm, Candidate Elimination Algorithm.			
Case Study	Determine the Hypothesis space and generalization for Loan Approval Automation system.		
Text Book	Text Book 1: Ch 1.1, 1.2,1.5, 1.6, 2.8, 3.4, 3.5, 3.7		
MODULE-2	SUPERVISED LEARNING-I	25AIM43.2	9 Hours
Linear Classification model, Performance Evaluation-Confusion Matrix, Accuracy, Precision, Recall, F-Measure, AUC-ROC Curves. Support Vector Machine, Decision Trees- Introduction, Tree Construction Algorithms:ID3, C4.5, CART,, Splitting Criteria, Tree Pruning.			
Case Study	Predicting customer loan default for a retail bank using Decision Tree.		
Text Book	Text Book 1: Ch 6.1,6.2,6.3 Text Book 2: Ch 3,8		
MODULE-3	SUPERVISED LEARNING-II	25AIM43.3	9 Hours
Introduction to Regression- Linear Regression, Ranking and Ordinal Regression, Cost Functions: MSE, MAE, R-Square, Performance Evaluation, Shrinkage methods- Lasso Regression and Ridge Regression, Ensemble Learning Techniques, Parallel Ensemble Models.			
Case Study	Financial Risk Assessment using Regression Technique		
Text Book	Text Book 1: Ch 5.1 to 5.8, 12.1, 12.2		
MODULE-4	UNSUPERVISED LEARNING	25AIM43.4	9 Hours
Distance Based Models: Distance Metrics-Euclidean, Manhattan, Hamming, Minkowski, Clustering: K-means Clustering, Hierarchical Clustering – Agglomerative and Divisive methods, Introduction to Rule Based learning, Association rule mining- Apriori Algorithm, FP-Growth.			
Case Study	Market Basket Analysis using Apriori Algorithm		
Text Book	Text Book 1: Ch 7.1,7.2,7.3, 7.8,13.2		
MODULE-5	PROBABILISTIC MODELS	25AIM43.5,25AIM43.6	9 Hours
Probabilistic Generative Model-Naive Bayes: -Bayes' Theorem and Conditional Probability-Maximum Likelihood-Gaussian, Multinomial, and Bernoulli Naive Bayes. Inference in Bayesian Belief Network, Markov Models.			
Case Study	Check received mail is spam or not using Bayes Theorem using given data.		
Text Book	Text Book 1: Ch 8.1,8.2,8.3,9.1,9.2,9.3,9.4		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	10	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	--

Suggested Learning Resources:**Text Books:**

- 1) S. Sridhar & M. Vijayalakshmi, “Machine Learning”, Oxford University Press, 2021, ISBN:978-9391050504
- 2) M N Murty and Ananthanarayana V S, “Machine Learning: Theory and Practice”, Universities Press (India) Pvt. Limited, 2024, ISBN: 9789393330697

Reference Books:

1. Machine Learning for Engineers: Using Data to Solve Problems for Physical Systems by Ryan G. Mc Clarren, 2021, Springer Nature, ISBN: 978-3030703875
2. Tom Mitchell, “Machine Learning”, McGraw Hill, 2026. 2nd Edition, ISBN: 9364446038, 9789364446037.

Web links and Video Lectures (e-Resources):

- <https://towardsdatascience.com/the-fp-growth-algorithm-1ffa20e839b8>
- <https://www.analyticsvidhya.com/blog/2021/08/decision-tree-algorithm>
- <https://ocw.mit.edu/courses/15-097-prediction-machine-learning-and-statistics>
- <https://www.analyticsvidhya.com/blog/2021/10/everything-you-need-to-know-about-linear-regression/>
- <https://www.appliedaicourse.com/blog/classification-in-machine-learning/>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group discussion on real-world problems
- Seminars
- Problem Solving
- Case Study

MACHINE LEARNING LAB			
Course Code	25AIL43	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes:			
At the end of the course, the student will be able to:			
25AIL43.1	Apply supervised machine learning models, such as Linear Classifiers, SVM, Decision Trees, and Bayesian Networks, to solve classification problems using Python.		
25AIL43.2	Develop machine learning models using regularization, ensemble learning, and ordinal regression techniques, and compare their performance.		
25AIL43.3	Analyze the performance of K-Means and Hierarchical Clustering algorithms in partitioning complex datasets to interpret structural patterns and cluster validity		
25AIL43.4	Implement association rule mining algorithms and evaluate machine learning models using appropriate performance measures and visualization tools.		
Pgm No.	List of Experiments / Programs	Hours	Cos
Prerequisite Experiments / Programs / Demo			
	- Basic Python program using libraries - Read and write a CSV file using python	2	NA
PART-A			
1	a). Implement and demonstrate the FIND-S algorithm to find the most specific hypothesis from a given set of training data samples. (Read the training data from a .CSV file). b). Implement and demonstrate the Candidate Elimination algorithm to determine the specific and general boundaries of the version space from a given set of training data samples. (Read the training data from a .CSV file).	2	25AIL43.1
2	Develop a program to implement the Support Vector Machine (SVM) algorithm on the given dataset and analyze its classification performance using Confusion matrix, ROC Curve, Precision, Recall and F1 Score for any given dataset.	2	25AIL43.1
3	Construct Decision Tree classifiers using the CART and ID3 approaches, train them on an appropriate dataset, and perform classification on an unseen instance.	2	25AIL43.1
4	Develop ML models using L1 (Lasso) and L2 (Ridge) regularization techniques for the given dataset. Evaluate their performance and compare the effectiveness of both methods.	2	25AIL43.2
5	Apply Bagging and Boosting algorithms to a selected dataset, analyze the results, and assess the effectiveness of each ensemble method.	2	25AIL43.2
6	Develop and evaluate a ranking-based prediction model using Ordinal Regression for a given dataset and analyze the quality of the generated rankings.	2	25AIL43.2
PART-B			
7	Construct a K-Means clustering solution for a given dataset, determine the most suitable number of clusters, and visualize the formed clusters.	2	25AIL43.3
8	Design a Python program to perform Hierarchical Clustering using Agglomerative and Divisive techniques, generate dendrograms, and analyze cluster relationships.	2	25AIL43.3
9	Write a program to demonstrate the working of the Apriori Algorithm using a suitable dataset and identify frequent item sets based on a specified minimum support threshold.	2	25AIL43.4
10	Apply the FP-Growth algorithm to a given dataset and identify frequent item sets without candidate generation, then generate association rules.	2	25AIL43.4

11	Implement a Naïve Bayes classifier in Python to classify documents from a text corpus. Measure the classifier's performance using accuracy, precision, and recall metrics.	2	25AIL43.4
12	Write a Python program to create a Bayesian Belief Network, estimate conditional probability tables, and infer outcomes for new instances.	2	25AIL43.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. <https://vlab.spit.ac.in/ai/#/experiments/3>
2. <https://vlab.spit.ac.in/ai/#/experiments/5>
3. <https://vlab.spit.ac.in/ai/#/experiments/10>
4. <https://vlab.spit.ac.in/ai/#/experiments/11>

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Tom Mitchell, "Machine Learning", McGraw Hill, 2nd Edition, 2026, ISBN:978-9364446037
2. Manaranjan Pradhan and U. Dinesh Kumar, Machine Learning Using Python, 2nd Edition, 2024 Wiley India Pvt. Ltd., ISBN:978-9370609167

DATABASE MANAGEMENT SYSTEMS			
Course Code	25CSK44	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes:			
At the end of the course, the student will be able to:			
25CSK44.1	Apply relational database concepts, database design principles, relational algebra and SQL to develop database applications		
25CSK44.2	Analyze query processing, indexing techniques, and database programming methods for efficient data retrieval and performance optimization		
25CSK44.3	Design relational database schemas and data models based on database management principles and application requirements		
25CSK44.4	Implement database solutions using relational database management systems and SQL for effective data storage, manipulation, and retrieval		
25CSK44.5	Evaluate normalization, transaction processing, concurrency control, and recovery techniques to ensure reliable and consistent database management		
25CSK44.6	Create database applications using modern relational and NoSQL database technologies to address real-world data management requirements		
MODULE-1	DATABASE FUNDAMENTALS AND DATABASE DESIGN	25CSK44.1,25CSK44.2	9 Hours
Database Concepts: Definitions, Characteristics, Advantages of DBMS, Three-schema architecture, Data Abstraction & Independence, DBMS Components: Database Designers, Administrators, Users. Entity-Relationship Model: Entity types, attributes, keys (super key, primary, candidate), Relationship types, structural constraints, Reduction of ER schema to relational schema, Relational Model Concepts: Schema, Tuples, Domains, Keys, Integrity Constraints: Entity, Referential.			
Self-Study	Explore different real-world databases (e.g., railway reservation systems, hospital management systems) and identify the advantages of DBMS over traditional file systems.		
Text Book	Text Book 1: 1.1,1.2, 1.3, 1.4, 1.6, 2.2, 2.4, 3.3, 3.4, 3.5, 5.1, 5.2		
MODULE-2	RELATIONAL DATABASES AND SQL	25CSK44.2,25CSK44.3	9 Hours
Relational Algebra: Select, Project, Join, Union, Intersection, Difference, Rename, Division. SQL Basics: DDL: Create, Drop, Alter, Truncate; DML: Insert, Delete, Update; SQL Clauses: Where, Order By, Group By; Constraints: Not Null, Unique, Primary, Foreign Key; Aggregate functions: SUM, AVG, COUNT, MIN, MAX.			
Case Study	Consider three related tables representing entities and their associations. Design relational algebra queries to: Retrieve records that meet specific conditions. Identify records not associated with certain data (using difference). Write SQL statements to: Create tables and define their structures (DDL). Insert sample data (DML). Retrieve and summarize data using SELECT with various clauses (WHERE, GROUP BY, ORDER BY).		
Text Book	Text Book 1: 8.1, 8.2, 8.3, 6.1, 6.2, 6.3, 6.4.4 to 2.15		
MODULE-3	QUERY PROCESSING & INDEXING	25CSK44.3,25CSK44.4	9 Hours
Advanced SQL: Union, Intersect and Except; Nested Queries; Correlated Queries; Joins; Introduction to Views; Triggers; Dynamic SQL, ODBC/JDBC. Indexing: Tree Structured Indexing: Indexed sequential access method, B+ Trees, Format of a node, Search, Insert, Delete, Duplicates, Hash based indexing: Static Hashing, Extendible Hashing, Linear Hashing			
Self-study	Explore different types of joins (inner, outer, left, right, natural) by creating simple tables and writing example queries to understand how results differ.		
Text Book	Text Book 2: 3.5, 3.8,4.2,14.1 to 14.7		
MODULE-4	NORMAL FORMS & TRANSACTION PROCESSING	25CSK44.4,25CSK44.5	9 Hours
Normalization: Functional Dependencies; Normal Forms: 1NF, 2NF, 3NF, BCNF; Transaction Management: ACID Properties; Distributed Transactions, Schedules: Recoverability, Serializability; Concurrency Control: 2PL-Two-Phase Locking, Time-stamp based & Optimistic Concurrency; Database Recovery concepts.			
Case Study	Start with a large unnormalized relation containing redundant and repeating groups. Identify all functional dependencies. Normalize the relation step by step to achieve 3NF or BCNF, clearly explaining the design decisions.		

Text Book	Text Book 1: 20.1, 20.3, 20.4, 20.5, 21.1, 21.2, 21.4, 22.1		
MODULE-5	NoSQL & MODERN DATABASE SYSTEMS	25CSK44.5,25CSK44.6	9 Hours
NoSQL: Introduction to NoSQL: Need, Features, ACID vs BASE, CAP Theorem; Types: Key-Value, Document, Column, Graph. Modern Database Systems: Cassandra DB: Architecture, Data Centers and Racks, Gossip Protocol, Snitches vs Nodes, Replication, Read/Write Operations, Caching, Compaction, Tombstones. Mongo DB: Overview.			
Self-study	Compare different NoSQL database types: Key-Value, Document, Column, Graph, focusing on their data models and use cases.		
Text Book	Text Book 1: 24.1 - 24.6, Text Book 3: 6.1, 6.2, 6.3, 6.5, 6.7, 6.15,6.16, 6.17, 9.1, 9.2		
CIE Assessment Pattern (50 Marks – Theory) –			
RBT Levels		Marks Distribution	
		Test (s)	AAT1
		25	15
L1	Remember	-	-
L2	Understand	5	-
L3	Apply	10	5
L4	Analyze	5	5
L5	Evaluate	5	-
L6	Create	-	-
SEE Assessment Pattern (50 Marks – Theory)			
RBT Levels		Exam Marks Distribution (50)	
L1	Remember	-	
L2	Understand	10	
L3	Apply	20	
L4	Analyze	10	
L5	Evaluate	10	
L6	Create	--	
Suggested Learning Resources:			
Text Books:			
1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 8th Edition, Pearson / Addison-Wesley, 2025, ISBN-13: 978-0133970777			
2. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, 7th Edition, Tata McGraw-Hill, 2024, ISBN-13: 978-9390727506			
3. Jeff Carpenter and Eben Hewitt, Cassandra: The Definitive Guide, 2nd Edition, O'Reilly Media, 2020, ISBN-13: 978-1492097143			
Reference Books:			
1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw-Hill, 2022 (Reprint), ISBN-13: 978-0072465631			
Web links and Video Lectures (e-Resources)			
• https://onlinecourses.nptel.ac.in/noc23_cs79/preview			
• https://www.youtube.com/watch?v=DRSog3SA4-Y&list=PLIwC9bZ0rmjSkM1VRJROX4vP2YMIf4EbH			
• https://www.youtube.com/watch?v=f1oV46r69YM			
• https://dev.mysql.com/doc/workbench/en/ (MySQL Workbench -- ER modelling)			
• https://dbdiagram.io/ (Quick ER-diagramming tool used in industry)			
• https://university.mongodb.com/ (MongoDB University -- free NoSQL courses)			
• https://cassandra.apache.org/doc/latest/ (Apache Cassandra documentation)			
• https://aws.amazon.com/rds/ and https://aws.amazon.com/dynamodb/ (Managed cloud databases used in industry)			
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning			
• Qualitative Assessment -- Explore a live database application.			
• Case Study -- Designing a relational database for a given scenario.			
• Qualitative Assessment -- Explore a live database application.			
• Case Study -- Designing a relational database for a given scenario.			
• Mock technical-interview rounds on SQL query writing, normalization and transactions -- common database rounds in placement drives. Mock technical-interview rounds on SQL query writing, normalization and transactions -- common database rounds in placement drives.			

DATABASE MANAGEMENT SYSTEMS LAB			
Course Code	25CSLK44	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25CSLK44.1	Apply relational database design principles, DDL, DML, integrity constraints and normalization techniques for database applications		
25CSLK44.2	Analyze SQL queries using relational operators, aggregate functions, joins and subqueries for data retrieval and manipulation.		
25CSLK44.3	Evaluate database programming techniques using views, triggers and JDBC/ODBC connectivity for database-driven applications.		
25CSLK44.4	Create database applications using relational and NoSQL database technologies for modern data management solutions.		
Pgm. No.	List of Programs	Hours	COs
Prerequisite			
	Demonstration on installation and configuration of an RDBMS platform (MySQL / PostgreSQL / Oracle) and a NoSQL platform (MongoDB Compass / Cassandra), and an overview of SQL client tools and ER-modeling tools used in industry (MySQL Workbench, google drawing).	2	NA
PART-A			
1	Identify the possible entities, attributes and relationships for a given real-world case study (e.g., Online Food Delivery / Hospital Management System) and design an ER/EER diagram using an industry ER-modeling tool such as MySQL Workbench or google drawing; map the diagram to a relational schema.	2	25CSLK44.1
2	Demonstrate various DDL and DML commands to create, modify, and manipulate a Student Database, applying appropriate primary key, foreign key, unique, check, not null and default constraints while creating tables.	2	25CSLK44.1
3	Demonstrate the use of various SQL operators (arithmetic, comparison, logical and special operators such as BETWEEN, IN, LIKE) on a Library Management database.	2	25CSLK44.2
4	Apply aggregate functions along with GROUP BY, HAVING, and ORDER BY clauses on a Sales/Library database to summarize and rank data.	2	25CSLK44.2
5	Demonstrate the use of nested and correlated subqueries to retrieve details of all customers who have ordered more than a given number of items, from an Order Database.	2	25CSLK44.2
6	Start with a large unnormalized relation containing redundant and repeating groups (e.g., an e-commerce order table): identify all functional dependencies and normalize the relation step by step to achieve 3NF, BCNF and 4NF, clearly explaining the design decisions and any controlled denormalization trade-off for read performance.	2	25CSLK44.1
7	Analyze various types of joins (inner, outer, left, right, self and cross joins) to perform multi-table queries relating to Student and Course tables enrolled in each course.	2	25CSLK44.2
PART-B			
8	Create/replace a single-table view and a multi-table view, update and drop views for the given relations; compare tables and views and demonstrate an update-through-view scenario.	2	25CSLK44.3

9	Create and drop triggers for various events such as insert, update and delete transactions (e.g., maintaining an audit log on a BOOK table); demonstrate a trigger that enforces a business rule.	2	25CSLK44.3
10	Develop a Python application to connect to a database using ODBC, perform CRUD (Create, Read, Update, Delete) operations and integrate JSON data handling for data serialization, storage, retrieval and API-style data exchange, simulating a real-world backend application.	2	25CSLK44.3
11	Design and implement a relation using Cassandra and perform basic CRUD operations within the Cassandra database.	2	25CSLK44.4
12	Demonstrate creating and dropping a database/collection in MongoDB and perform basic CRUD operations using JavaScript/Python query syntax.	2	25CSLK44.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. <https://vlab.iitr.ac.in/assets/explorelabs/Database%20management%20system%20lab/labs/index.html>
2. <https://www.programiz.com/sql/online-compiler>
3. <https://www.db-fiddle.com/>
4. <https://leetcode.com/problemset/database/>

CIE Assessment Pattern (50 Marks - Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	5
L4	Analyze	15	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks - Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 8th Edition, Pearson / Addison-Wesley, 2025, ISBN-13: 978-0133970777.
2. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, 7th Edition, Tata McGraw-Hill, 2024, ISBN-13: 978-9390727506.
3. Jeff Carpenter and Eben Hewitt, Cassandra: The Definitive Guide, 2nd Edition, O'Reilly Media, 2020, ISBN-13: 978-1492097143.
4. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw-Hill, 2023 (Reprint), ISBN-13: 978-0072465631.

PRINCIPLES OF ARTIFICIAL INTELLIGENCE			
Course Code	25AIM451	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM451.1	Apply fundamental Artificial Intelligence concepts, intelligent agents, and problem-solving techniques to formulate AI solutions.		
25AIM451.2	Analyze different search and reasoning techniques for real-time Artificial Intelligence problem-solving.		
25AIM451.3	Design intelligent systems utilizing multiple algorithms or techniques to address practical real-world challenges.		
25AIM451.4	Examine logical reasoning and knowledge representation techniques for developing knowledge-based systems.		
25AIM451.5	Optimize the performance of AI systems using appropriate knowledge representation frameworks and automated reasoning techniques.		
25AIM451.6	Analyze the ethical, societal, and governance aspects of Artificial Intelligence to apply Responsible AI principles in designing and deploying AI systems. .		
MODULE-1	INTRODUCTION TO PROBLEMS & PROBLEM SEARCH	25AIM451.1	9 Hours
Basics of AI, Applications of AI, Artificial Intelligence Problems and Techniques, Problem Spaces and Search: Defining the problem as a state space search, Problem characteristics, Issues in the design of search programs, good behavior: the concept of rationality, the nature of environments, simple reflex programs, model based reflex agents, goal based and utility-based agents.			
Self-Study	Investigate the different types of Artificial Intelligence Techniques.		
Text Book	Text Book 1: Ch 1 and 2, Text Book 3: Ch 2		
MODULE-2	HEURISTIC SEARCH TECHNIQUES	25AIM451.2, 25AIM451.3	9 Hours
Informed Search Strategies: Heuristic functions, Generate and Test, Hill Climbing, Best First Search, A* algorithm, Constraint satisfaction, Means end analysis, Uninformed Search Strategies, Breadth-first search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search.			
Case Study	Investigate the Performance Comparison of Hill Climbing with other Optimization Techniques.		
Text Book	Text Book 1: Ch 2, 4, Text Book 3: Chapter 3		
MODULE-3	LOGICAL AGENTS	25AIM451.4	9 Hours
Introduction to Agents, the structure of agent programs, knowledge-based Agents, The Wumpus world, Propositional logic, Predicate logic, Procedural versus declarative knowledge.			
Case Study	Build a Rule-Based Expert System for Disease Diagnosis		
Text Book	Text Book 1: Ch 3,5, Textbook 3: Ch 7		
MODULE-4	KNOWLEDGE REPRESENTATION	25AIM451.4, 25AIM451.5	9 Hours
Knowledge Representation: Representations & mappings, Approaches in knowledge representation, Issues in knowledge representation. Statistical reasoning: Certainty factors & rule-based systems. Weak slot and filler structures: Semantic nets, Frames: Strong slot and filler structures, conceptual dependency.			
Case Study	Semantic networks in E-Commerce		
Text Book	Text Book 1: Ch 5, 6.		
MODULE-5	RESPONSIBLE AI	25AIM451.6	9 Hours
Introduction to responsible AI, Ethical Theories, Values, Ethics in Practice, Implementing Ethical Reasoning, Responsible Research and Innovation, The ART of AI: Accountability, Responsibility, Transparency, Design for Values, Approaches to Ethical Reasoning by AI, Governance for Responsible AI, Codes of Conduct.			
Case Study	Solving the 8-Puzzle using Best-First Search.		
Text Book	Text Book 2: Chapter 3, 4, 6		
CIE Assessment Pattern (50 Marks – Theory)			

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	10	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	--

Suggested Learning Resources:

Text Books:

- 1) Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Artificial Intelligence, 4th Revised Edition, MedTech Science Press, 2024.ISBN: 978-8196544577.
- 2) Virginia Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer, 1st ed. (2019), ISBN: 978-3-030-30371-6
- 3)Stuart Russell and Peter Norvig, Artificial Intelligence, A Modern Approach, Pearson Education, 4th Edition, 2022, ISBN: 978-9356063570.

Reference Book:

- 1)N. P. Padhy, S. P. Simon, and M. Senthil Kumar, Artificial Intelligence, Oxford University Press, 2025, ISBN: 9789361032752.

Web links and Video Lectures (e-Resources):

1. <https://nptel.ac.in/courses/106102220>
2. <https://cs50.harvard.edu/ai/weeks/>
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_cs42
4. <https://www.coursera.org/learn/introduction-to-ai>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Inquiry based learning
- AI Bias and Ethics Debate
- AI Algorithm Demonstration Using Scratch/Pseudocode
- AI Real life Use-Case Investigation

COMPUTER NETWORKS			
Course Code	25AIM452	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Mark	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM452.1	Apply the principles of layered network architectures (OSI and TCP/IP) to simulate end-to-end data transmission using core network components.		
25AIM452.2	Analyze data link layer protocols for error control, flow control, and medium access to evaluate reliable data transmission efficiency.		
25AIM452.3	Implement IP addressing and routing protocols for efficient packet forwarding in computer networks.		
25AIM452.4	Design custom transport layer mechanisms for reliable data transfer in socket-based network applications.		
25AIM452.5	Illustrate the working of application layer protocols and socket programming for network-based applications and multimedia service		
25AIM452.6	Assess network security mechanisms, attacks, and countermeasures for secure network communication.		
MODULE-1	INTRODUCTION	25AIM452.1	9 Hours
TCP/IP Protocol Suite: Layered Architecture, Layers in the TCP/IP Protocol Suite, Encapsulation and Decapsulation. THE OSI MODEL: OSI Versus TCP/IP comparison, Types of Networks, Types of Network Topologies, Transmission Media Types, Wireless Transmission, Networking Devices, Multiplexing and De-Multiplexing			
Case Study	College Campus Network Design and Analysis using OSI/TCP-IP Models, Network Devices, Topologies, and Transmission Media.		
Text Book	Text Book 1: 1.3, 1.5,1.6,2.5,2.6 Text Book 2: 4.8.4		
MODULE-2	DATALINK LAYER	25AIM452.2	9 Hours
Data Link Layer services: Framing, Error Detection and Correction, Flow Control. Media Access Control: Random Access: CSMA, CSMA/CD, CSMA/CA. Sliding Window Protocol: Stop and Wait, Go-back-N ARQ, Selective Repeat ARQ. Data Link Layer Addressing: MAC addresses, ARP, RARP, DHCP, Ethernet standards, Wireless LANS, High Level Data Link Control, Asynchronous Transfer Mode			
Case Study	Study and analysis of Ethernet and Wi-Fi communication in a Local Area Network (LAN) using MAC addressing, ARP, DHCP, and CSMA/CA mechanisms.		
Text Book	Text Book 1: 3.2, 3.3,4.2 Text Book 2: 3.1,3.2,4.1-4.4		
MODULE-3	NETWORK LAYER	25AIM452.3	9 Hours
Network Layer: Internet Protocol (IP)- IPv4 and IPv6, Comparison of IPV4 and IPV6. IP Addresses: Types of IP address, Subnetting and Super-netting, ICMP. Routing Algorithms: Link State Routing, Distance Vector Routing, Broadcast Routing, Multicast Routing, Anycast Routing. Routing Protocols: RIP, OSPF, BGP. Mobile IP, IPSec			
Case Study	<i>Implementation and Performance Analysis of IPv4/IPv6 Addressing and Routing Protocols (RIP, OSPF, BGP) in Enterprise Networks</i>		
Text Book	Text Book 1: Ch 7.4, 7.5,8.2,8.4,8.5 Text Book 2: Ch 5.2,5.6,8.6		
MODULE-4	TRANSPORT LAYER	25AIM452.4	9 Hours
Transport Layer Services: Connectionless Protocols: UDP services, UDP Header, Reliable Data Transfer, Connection-Oriented Protocols: TCP Header, TCP Connection establishment and release, RTT estimation, TCP Flow Control, Connection Management, Congestion Control, Integrated and Differentiated Services: Intserv, Diffserv.			
Case Study	Study of TCP/UDP Communication and QoS Mechanisms in Real-Time Network Applications		
Text Book	Text Book 1: Ch 9.1, 9.2, 9.3 Text Book 2: 5.4.5,5.4.6		

MODULE-5		APPLICATION LAYER		25AIM452.5,25AIM452.6		9 Hours	
Principles of Network Applications: The Web and HTTP, FTP, Electronic Mail, SMTP, Mail Message Formats and MIME, DNS, Socket Programming with TCP and UDP. Multimedia Networking, Network Security: Principles of Cryptography, Firewalls, Attacks and Counter measures.							
Case Study		Design and Analysis of Secure Client–Server Network Applications Using HTTP, DNS, Socket Programming, and Firewall Technologies Understanding the comparison of HTTP, HTTPS, FTP, and SFTP Protocols					
Text Book		Text Book 1: Ch 10.3.1, 10.4,10.5, 11.4, Text Book 2: 6.1.3,8.1					
CIE Assessment Pattern (50 Marks – Theory) –							
RBT Levels		Marks Distribution					
		Test (s)	AAT1		AAT2		
		25	15		10		
L1	Remember	5	-		-		
L2	Understand	5	-		-		
L3	Apply	10	10		5		
L4	Analyze	5	5		5		
L5	Evaluate	-	-		-		
L6	Create	-	-		-		
SEE Assessment Pattern (50 Marks – Theory)							
RBT Levels		Exam Marks Distribution (50)					
L1	Remember	10					
L2	Understand	10					
L3	Apply	20					
L4	Analyze	10					
L5	Evaluate	--					
L6	Create	--					
Suggested Learning Resources: Text Books: 1) Data Communications and Networking–Behrouz A. Forouzan,6 th Edition 2025, ISBN-13: 9780078022098 2) Computer Networks—Andrew S Tanenbaum, 6 th Edition. Pearson,2021, ISBN-13: 9780136764052 . Reference Book: 1) James F. Kurose and Keith W. Ross <i>Computer Networking: A Top-Down Approach</i> , 9th Edition, Pearson Education, 2025, ISBN-13: 978-0135429334.							
Web links and Video Lectures (e-Resources): - https://nptel.ac.in/courses/106106091 - http://acl.digimat.in/nptel/courses/video/106105183/L01.html - https://cn-iitr.vlabs.ac.in/List%20of%20experiments.html - https://www.youtube.com/@JimKurose/videos - https://www.youtube.com/watch?v=frUQMhXhnvs&list=PLBlnK6fEyqRgMoNjXQxrIIKRpSrVBuTlK							
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning - Design a campus network using different network topologies and map the communication process through OSI and TCP/IP layers. - Simulate Ethernet and Wi-Fi communication using Packet Tracer/Wireshark and analyze MAC addressing, ARP requests, and CSMA/CD or CSMA/CA operations. - Perform IPv4 subnetting and configure static and dynamic routing (RIP/OSPF) in a network simulator to observe packet forwarding. - Capture and analyze TCP and UDP packets using Wireshark to study three-way handshake, flow control, and congestion control mechanisms. - Develop a simple client-server chat application using TCP/UDP sockets and examine HTTP, DNS, and firewall operations in the communication process.							

FINITE AUTOMATA AND FORMAL LANGUAGES			
Course Code	25AIM453	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM453.1	Apply and construct finite automata for recognizing regular languages.		
25AIM453.2	Analyze regular languages using regular expressions, pumping lemma, closure properties, and decision algorithms.		
25AIM453.3	Design context-free grammars and derive strings for context-free languages.		
25AIM453.4	Construct Pushdown Automata, Context-Free Grammars, and Turing Machines for formal language problems.		
25AIM453.5	Analyze computability, decidability, and complexity issues in formal language and computation models.		
25AIM453.6	Evaluate whether a given language is regular by analyzing the limits of finite computational models.		
MODULE-1	The Theory of Automata	25AIM453.1	9
Introduction to automata theory, Examples of automata machine, Finite automata as a language acceptor and translator, Deterministic finite automata. Non-deterministic finite automata, finite automata with output (Mealy Machine. Moore machine), Finite automata with ϵ -moves, Minimizing number of states of a DFA, Properties and limitation of FSM, Application of finite automata.			
Case Study	Implementing Tokenizers like for valid C-identifiers, Keywords, e-mail validators, phone number etc.		
Text Book	Text Book 1: Ch 2		
MODULE-2	Regular Expressions	25AIM453.2,25AIM453.6	9
Alphabet, String and Languages, Regular expression, Properties of Regular Expression, Finite automata and Regular expressions, Arden's Theorem, Regular Expression to DFA conversion & vice versa Pumping lemma for regular sets, Application of pumping lemma, Regular sets and Regular grammar, Closure properties of regular sets.			
Case Study	Discuss the challenges and limitations of relying solely on regular expressions for text processing in NLP tasks.		
Text Book	Text Book 1: Ch 2		
MODULE-3	Grammars	25AIM453.3	9
Definition and types of grammar, Chomsky hierarchy of grammar, Relation between types of grammars, Context free grammar, Left most & right most derivation trees, Ambiguity in grammar, Simplification of context free grammar, Chomsky Normal Form, Greibach Normal Form, properties of context free language, Pumping lemma for context free language			
Case Study	Analyze the impact of grammar simplification on language recognition and parsing algorithms.		
Text Book	Text Book 1: Ch 3		
MODULE-4	Push Down Automata and Turing Machine	25AIM453.4	9
Basic definitions, Deterministic push down automata and non-deterministic push down automata, Acceptance of push down automata, push down automata and context free language, Turing machine model, Representation of Turing Machine, Construction of Turing Machine for simple problem's, Universal Turing machine and other modifications, Halting problem of Turing Machine.			
Case Study	Program for simulation of Leftmost/Rightmost Derivations.		
Text Book	Text Book 1: Ch 4,5		
MODULE-5	Computability	25AIM453.5,25AIM453.6	9
Introduction and Basic concepts, Recursive function, Partial recursive function, Initial functions, Composition of functions, Ackerman's function, Recursively Enumerable and Recursive languages, Decidable and undecidable problem, Post correspondence problem, Space and time complexity			

Case Study	Ackermann's function and explain its significance in computability theory.
Text Book	Text Book 2: Ch 3(PP: 99 to 180)

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	10	10	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Alberto Pettorossi, Automata Theory and Formal Languages: Fundamental Notions, Theorems, and Techniques, Springer, 2022. ISBN: 978-3031119644.
2. George Tourlakis, Computability, 1st Edition, Springer, 2022. ISBN: 978-3030832018.

Reference Books:

1. Pallavi Vijay Chavan and Ashish Jadhav, Automata Theory and Formal Languages, 1st Edition, Elsevier, 2023, ISBN: 978-0-323-91784-1.
2. Marco T. Morazán, Programming-Based Formal Languages and Automata Theory: Design, Implement, Validate, and Prove, 1st Edition, Springer, 2023/2024, ISBN: 978-3-031-43972-8.
3. K. R. Chowdhary, Theory of Computation: Automata, Formal Languages, Computation and Complexity, 1st Edition, Springer, 2025, ISBN: 978-981-97-6233-0.

Web links and Video Lectures (e-Resources):

- https://youtu.be/_2w9UX17m_k?si=moreG8VmNd4UXzUD
- <https://archive.nptel.ac.in/courses/106/106/106106049/>
- <https://sites.google.com/vivekanand.du.ac.in/vivekananda-college-library/library-services/library-resources/e-resources>
- <https://www.udemy.com/course/theory-of-computation-online-course/?couponCode=IND21PM>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assign tasks where students need to solve problems or design algorithms collaboratively, incorporating flowcharts to visualize their solutions.
- Showcase videos illustrating the latest trends in computational fields such as artificial intelligence, quantum computing, or machine learning applications
- Contents related activities (Activity-based discussions)
 - For active participation of students, instruct the students to prepare Flowcharts and Handouts
 - Organizing Group wise discussions on issues
- Seminars

INTRODUCTION TO EMBEDDED SYSTEMS			
Course Code	25AIM454	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes:			
At the end of the course, the student will be able to:			
25AIM454.1	Understand the fundamentals, architecture, components, and applications of embedded systems.		
25AIM454.2	Apply embedded system design methodologies and hardware-software concepts to solve real-world problems.		
25AIM454.3	Apply RTOS concepts for embedded software design and development		
25AIM454.4	Illustrate the architecture, organization, and operational principles of ARM-based embedded systems.		
25AIM454.5	Analyze ARM processor features, instruction execution mechanisms, and performance enhancement techniques.		
25AIM454.6	Analyze ARM instruction-based embedded solutions for practical applications through self-learning and modern technologies.		
MODULE-1	INTRODUCTION TO EMBEDDED SYSTEM	25AIM454.1, 25AIM454.2	9 Hours
Introduction to Embedded System, Embedded systems Vs General computing systems, Classification of Embedded systems, Major Application Areas of Embedded Systems. Microprocessor Vs Microcontroller, Differences between RISC and CISC, Harvard V/s Von Neumann Processor/Controller Architecture, Memory (ROM and RAM types). Introduction to Edge AI, AI-enabled Embedded Systems, Embedded AI Applications.			
Case Study	Smart Traffic Management system using Embedded AI		
Text Book	Text Book 1: Ch-1, Ch-2, Ch-3		
MODULE-2	EMBEDDED SYSTEM DESIGN	25AIM454.2	9 Hours
Characteristics and Quality Attributes of Embedded Systems, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling, Embedded firmware design and development, AI Model Optimization for Embedded Devices.			
Case Study	AI based Smart Health Monitoring Wearable device		
Text Book	Text Book 1: Ch -4, Ch-5, Ch-6		
MODULE-3	RTOS FOR EMBEDDED AI SYSTEM	25AIM454.3	9 Hours
Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread pre-emption, Pre-emptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Selection of RTOS, RTOS in Edge AI and ML Applications.			
Case Study	Autonomous Warehouse Robot Using RTOS		
Text Book	Text Book 1: Ch -8, Ch-9		
MODULE-4	ARM EMBEDDED SYSTEMS	25AIM454.4,25AIM454.5	9 Hours
Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. ARM Processor Fundamentals, ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions.			
Self-study	ARM architecture overview (Cortex-M0/M3/M4/M7, A, R series)		
Text Book	Text Book 2: Ch- 1, 2,3.		
MODULE-5	INTRODUCTION TO THE ARM INSTRUCTION SET	25AIM454.5, 25AIM454.6	9 Hours
Introduction to the ARM Instruction set: Introduction, Data processing instructions, Load – Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution.			
Case Study	Smart Home Automation Using ARM Cortex-M, IoT Weather Monitoring Station		

Text Book

Text Book 2: Ch-4,5,6,7

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1

Tim Wilmshurst, Rob Toulson, Tom Spink, Fast and Effective Embedded Systems Design: From Bits and Bytes to IoT with Arm Mbed, 3rd Edition, Elsevier, 2024. ISBN: 9780323951975.

2

Jason D. Bakos, Embedded Systems: ARM Programming and Optimization, 2nd Edition, Elsevier, 2024. ISBN: 9780128225752.

Reference Book:

1.

Elecia White, Making Embedded Systems, 2nd Edition, O'Reilly Media, 2024.ISBN:978-1098151508.

Web links and Video Lectures (e-Resources):

•

<https://archive.nptel.ac.in/courses/106/105/106105193/>

•

<https://developer.arm.com/documentation/dui0068/b/ARM-Instruction-Reference>

•

<https://www.udemy.com/course/introduction-to-arm-cortex-m3-and-m4-processors/>

•

www.Nuvoton.com/websites on Advanced ARM Cortex Processors

•

<https://alison.com/tag/embedded-systems>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

•

Group Discussion

•

Flipped Class

•

Seminar

FUNDAMENTALS OF SENSOR TECHNOLOGY			
Course Code	25AIM455	Credits	03
L:T:P:S	3:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	45	SEE Marks	50
TW & SL / Sem	45	Total Marks	100
Total Hours /Sem	90	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM455.1	Understand the basic concepts, classification, and working principles of sensors and explain their key performance characteristics.		
25AIM455.2	Apply signal conditioning, data acquisition systems, and sensor interfacing techniques to prepare and collect accurate data.		
25AIM455.3	Analyze the performance of different sensors for various applications.		
25AIM455.4	Evaluate the characteristics of embedded sensor platforms and the methods used in fabricating MEMS and nanoscale sensors.		
25AIM455.5	Illustrate the real-time solutions for practical problems by integrating sensor technology		
25AIM455.6	Examine the practical applications, ethical considerations, and AI-integrated advancements in smart sensor technology		
MODULE-1	INTRODUCTION TO SENSORS	25AIM455.1	9 Hours
Introduction to sensors: Basic concepts, Classification of Sensors, and working principles. characteristics: Sensitivity, Resolution, Accuracy, Precision, Linearity, Hysteresis. Measurement systems: Functional elements, Transducers and Sensors			
Case Study	Sensors used in autonomous vehicles		
Text Book	Text Book 1: Ch -1,2		
MODULE-2	SIGNAL CONDITIONING AND DATA ACQUISITION	25AIM455.2	9 Hours
Signal conditioning circuits: Amplifiers, filters, and analog-to digital conversion, Noise reduction and signal Amplification techniques. Calibration and linearization of sensor outputs. Data acquisition systems and their components. Interfacing sensors with microcontrollers and processors.			
Self-study	Self-study on Sensor interfacing with Arduino		
Text Book	Text Book 1: Ch 3,4		
MODULE-3	SMART SENSORS	25AIM455.3	9 Hours
Principle of operation: Moisture sensor, humidity sensors, gas sensors, IMU sensors, camera sensors, LiDAR sensors, Biomedical Sensors.			
Case Study	Breath analyzer using temperature sensors.		
Text Book	Text Book 1: Ch- 5,6,7 Text Book 2: Ch- 2,3,5,7		
MODULE-4	MEMS AND EMBEDDED PLATORM	25AIM455.4,25AIM455.5	9 Hours
Sensor software: firmware, drivers, calibration, data processing, edge/cloud integration. Sensor platforms: Arduino, Raspberry Pi, ESP32. Definition and classification of MEMS and nanoscale sensors. Structure and working principles of MEMS-based sensors, Smart Sensors, Intelligent Sensor Nodes.			

Case Study	Smart Air Monitoring System using MEMS Sensors and Arduino			
Text Book	Text Book 1: Ch-7,8,9 Text Book 2: Ch -1,4,8			
MODULE-5	APPLICATIONS, CHALLENGES, AND FUTURE TRENDS		25AIM455.5,25AIM455.6	9 Hours
Applications in robotics, automotive systems, healthcare, and agriculture. Environmental monitoring and smart cities. Ethical considerations and challenges in smart sensor Implementation. Emerging trends: AI and machine learning in sensor systems. Case studies on innovative smart sensor solutions				
Case Study	Identify current challenges in deployment or scalability and finally propose future trends or innovative ideas to overcome those challenges.			
Textbook	Textbook 2: Ch- 9,10			
CIE Assessment Pattern (50 Marks – Theory)				
RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	5	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-
SEE Assessment Pattern (50 Marks – Theory)				
RBT Levels		Exam Marks Distribution (50)		
L1	Remember	-		
L2	Understand	10		
L3	Apply	20		
L4	Analyze	10		
L5	Evaluate	10		
L6	Create	--		
Suggested Learning Resources:				
Text Books:				
1) Ahmed Barhoum and Zeynep Altintas, Fundamentals of Sensor Technology: Principles and Novel Designs, Woodhead Publishing,2023, ISBN-10 0323884318.				
2) Krzysztof Iniewski (Ed.), Smart Sensors for Industrial Internet of Things, CRC Press, 2022.ISBN:978-1466568112.				
Reference Books:				
1) John G. Webster and Halit Eren, Measurement, Instrumentation, and Sensors Handbook, 3rd Edition, CRC Press, 2023.ISBN:978-1439848838				
2) Jan Korvink and Oliver Paul, MEMS: A Practical Guide of Design, Analysis, and Applications, updated Edition, Springer, 2022.ISBN:978-3540211174				
Web links and Video Lectures (e-Resources):				
• IIoT Fundamentals: Smart Sensors & Actuators in Automation,				
• https://www.realpars.com/courses/iiotsensors-actuators?utm				
• Introduction to Sensors, https://online.stanford.edu/courses/me220-introduction-sensors?utm				
• Concept of Smart Sensors and Their Important Features.				
• https://www.youtube.com/watch?v=aUe1251TxS8&utm				
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning				
• Group Discussion				
• Flipped Class				
• Seminar				

ADVANCED PYTHON PROGRAMMING			
Course Code	25AIM461	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM461.1	Implement Python libraries and software techniques to build domain-specific applications		
25AIM461.2	Apply regular expressions and concept of threads and date for developing efficient program		
25AIM461.3	Analyze the exception handling and objected Oriented Concepts to solve given problem		
25AIM461.4	Develop integrated databases and Python GUIs to solve real-world application problems		
Pgm No	List of Experiments / Programs	Hrs	COs
Prerequisite Experiments / Programs / Demo			
	• Basic concepts in python programming language	2	NA
PART-A			
1	Write a Python program to implement various file operations.	2	25AIM461.1
2	Write a Python program to demonstrate use of regular expression for suitable Application.	2	25AIM461.1, 25AIM461.2
3	Write a program to retrieve the information from an html file.	2	25AIM461.2
4	Write a Program to demonstrate concept of threading and multitasking.	2	25AIM461.2
5	Write a Python Program to create application which uses date and time.	2	25AIM461.1, 25AIM461.2
6	Write a program to stop execution temporarily using python.	2	25AIM461.1, 25AIM461.2
PART-B			
7	Write a program to Python program to implement concepts of OOP such as a. Types of Methods b. Inheritance c. Polymorphism	2	25AIM461.1, 25AIM461.3
8	Write a program to Python program to implement concepts of OOP such as a. Abstract methods and classes b. Interfaces c. Inner classes	2	25AIM461.1, 25AIM461.3
9	Write a program to demonstrate different types of exception handing.	2	25AIM461.1, 25AIM461.3
10	Write a Python Program to work with databases in Python to perform operations such as Connecting to database.	2	25AIM461.1, 25AIM461.4
11	Creating and dropping tables Inserting and updating into tables.	2	25AIM461.1, 25AIM461.4
12	Write a GUI based application using python	2	25AIM461.1, 25AIM461.4
PART-C			
Beyond Syllabus Virtual Lab Content (4 Hours)			
(To be done during Lab but not to be included for CIE or SEE)			
1. https://python-iitk.vlabs.ac.in/exp/classes-and-objects/			
2. https://python-iiith.vlabs.ac.in/exp/sacrificial-electrodes-mfc/			
CIE Assessment Pattern (50 Marks - Lab)			
	RBT Levels	Weekly Assessment - 20	Test (s) - 30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	-	-
L6	Create	-	-
SEE Assessment Pattern (50 Marks - Lab)			
	RBT Levels	Exam Marks Distribution (50)	
L1	Remember	-	
L2	Understand	10	
L3	Apply	20	
L4	Analyze	20	
L5	Evaluate	-	
L6	Create	-	

Suggested Learning Resources:**Reference Books:**

- 1) Reema Thareja, "Python Programming using Problem-solving Approach", Publisher: Oxford University Press, 3rd Edition, 2025, ISBN: 9789367257654
- 2) John Hunt, "Advanced Guide to Python 3 Programming", Publisher: Springer, 2nd Edition, 2023, ISBN: 978-3031403354
- 3) Fabrizio Romano, Heinrich Kruger, "Learn Python Programming: A comprehensive, up-to-date, and definitive guide to learning Python", Publisher: Packt Publishing, 4th Edition, 2024, ISBN: 978-1835882948

CLOUD SERVICE MANAGEMENT			
Course Code	25AIM462	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM462.1	Apply role-based policies, multi-factor authentication (MFA), and secure network protocols to provision and connect to Linux and Windows virtual servers via console and command-line interfaces.		
25AIM462.2	Analyze cloud data architectures by formatting block storage devices for persistence and manipulating object storage spaces.		
25AIM462.3	Deconstruct and integrate serverless application code layers, backend proxy links, and host web servers to publish live application services.		
25AIM462.4	Examine and automate cloud architectures using bash backup routines, automated scheduling engines, system log filters, and diagnostic tracking boards.		
Pgm. No.	List of Programs	Hrs	COs
Prerequisite Experiments / Programs / Demo			
	Basics of Cloud Computing and Unix commands	2	NA
PART-A			
1	Create an IAM user, group, and role. Attach permission policies and enable MFA. Explore access control from the AWS Management Console.	2	25AIM462.1
2	a. Launch a Linux EC2 instance using AWS Console and connect using SSH. b. Launch a Linux EC2 instance using AWS CLI and verify connections.	2	25AIM462.1
3	Launch a Windows EC2 instance and connect using RDP. Explore basic app installation on the Windows instance.	2	25AIM462.1
4	Create and attach an EBS volume to a Linux EC2 instance. Format, mount and verify the volume persistence.	2	25AIM462.2
5	a. Create an S3 bucket using AWS Console and upload/download files. b. Perform the same operations using AWS CLI.	2	25AIM462.2
6	Write a script to back up a file from an EC2 instance to S3 bucket and automate it using cron jobs.	2	25AIM462.4
PART-B			
7	Create a basic AWS Lambda function in Python or Node.js. Invoke the function with test events and explore the output.	2	25AIM462.3
8	Build a REST API using API Gateway connected to a Lambda function. Test it using Postman.	2	25AIM462.3
9	Monitor an EC2 instance using Amazon CloudWatch. Create alarms for CPU usage and configure email alerts via SNS.	2	25AIM462.4
10	Enable logs for EC2 and set up metric filters and composite alarms in CloudWatch. Create a CloudWatch Dashboard for monitoring.	2	25AIM462.4
11	Monitor Lambda and API Gateway metrics using CloudWatch. Visualize function invocations and errors in the dashboard.	2	25AIM462.4
12	Deploy a static website on an EC2 instance using Free Tier services. Include all necessary configuration steps such as installing web servers, copying files, modifying inbound rules, and testing accessibility.	2	25AIM462.1 25AIM462.2 25AIM462.3 25AIM462.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

- <https://aws.amazon.com/console/>
- https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs29
- https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs150

CIE Assessment Pattern (50 Marks - Lab)

RBT Levels		Weekly Assessment - 20	Test (s)- 30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	10	15
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks - Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	
L6	Create	-

Suggested Learning Resources:

Reference Books:

- 1 E. Haque, Cloud Service Management and Governance: Smart Service Management in Cloud Era. Boca Raton, FL, USA: CRC Press, 2023. ISBN: 978-1447850588.
- 2) J. Mulder, Multi-Cloud Administration Guide: Manage and optimize cloud resources across Azure, AWS, GCP, and Alibaba Cloud. Birmingham, UK: Packt Publishing, 2023. ISBN: 978-1804616734.
- 3)R. Miles, Learning AWS: Design, build, and deploy production-ready applications. Sebastopol, CA, USA: O'Reilly Media, 2024. ISBN: 978-1098149178.

DIGITAL ELECTRONICS USING HDL			
Course Code	25AIM463	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM463.1	Understand basic logic gates and combinational circuit design.		
25AIM463.2	Apply design rules to write Verilog code for the applications		
25AIM463.3	Develop sequential logic circuits using flip-flops and finite state machines		
25AIM463.4	Construct and simulate complex combinational logic modules using HDL-based design workflows		
Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	- Knowledge of Basic Electronics Components - Familiar with Basic electronic circuit connections - Basic knowledge of using a computer	2	NA
PART-A			
1	Logic Gates using Verilog: To implement basic logic gates (AND, OR, NOT, NAND, NOR, EXOR) in Verilog. (To understand how fundamental Boolean operations (AND, OR, NOT) form the basis of all digital logic circuits.)	2	25AIM463.1 25AIM463.2
2	Adder and Subtractor: To design a 3-bit binary adder & subtractor using HDL. (To understand binary arithmetic works and how multiple-bit numbers can be added using logic gates. Adders are foundational for ALUs, digital counters, and various computing elements.)	2	25AIM463.1 25AIM463.2
3	4-bit Comparator: To design a 4-bit comparator using HDL (To learn how binary numbers can be compared using digital logic. This knowledge is necessary for decision-making circuits, such as ALUs, digital sorters, and processors that evaluate conditions)	2	25AIM463.1 25AIM463.2
4	Converter: Write an HDL program for a 4-bit Binary to Gray converter	2	25AIM463.1 25AIM463.2
5	MUX/DEMUX: To design and simulate a 4:1 MUX and a 1:4 DEMUX using HDL (To understand the role of a multiplexer in selecting one of many input signals based on control lines. MUXes & DEMUXes are key components in routing data within digital systems and optimizing logic implementation.)	2	25AIM463.1 25AIM463.2
6	Encoder/Decoder: To design and simulate an Encoder/Decoder using HDL	2	25AIM463.1 25AIM463.2
PART-B			
7	Flip-Flop: To develop the HDL code for the following flip flops: T, D, S K, J K (To study memory elements that store binary data. Understanding flip-flops helps in designing registers, pipelines, and state machines that require synchronization with a clock signal.)	2	25AIM463.3 25AIM463.4
8	Register: To develop the HDL code for the Registers SISO, SIPO, PISO, PIPO.	2	25AIM463.3 25AIM463.4

9	Synchronous 4-bit Counter: To design a 4-bit synchronous up counter. (To understand how counters operate with a common clock signal. Synchronous counters are essential in time-based applications like clocks, digital timers, and frequency dividers.)	2	25AIM463.3 25AIM463.4
10	Asynchronous 4-bit Counter: To design a ripple counter using HDL. (To analyze the ripple effect of flip-flops clocked at different times. The concept of propagation delay and the importance of synchronization in digital systems.)	2	25AIM463.3 25AIM463.4
11	Design 4-bit Binary and BCD counters (Synchronous reset and Asynchronous reset, and “any sequence” counters).	2	25AIM463.3 25AIM463.4
12	Write an HDL code to display messages on the given seven-segment display. (To study how binary values are decoded into human-readable decimal digits using combinational logic. This is useful for displaying numerical output in embedded systems, counters, and digital displays.)	2	25AIM463.3 25AIM463.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours) (To be done during Lab but not to be included for CIE or SEE)

- <https://de-iitr.vlabs.ac.in/exp/truth-table-gates/>
- <https://de-iitr.vlabs.ac.in/exp/half-full-adder/>
- <https://de-iitr.vlabs.ac.in/exp/realization-of-logic-functions/>

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. R P Jain and Kishor Sarawadekar, Modern Digital Electronics, McGraw Hill, 2022, ISBN: 9355321775.

IOT SYSTEMS DESIGN AND PROGRAMMING			
Course Code	25AIM464	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM464.1	Examine the architecture and core functionalities of various single-board embedded computing platforms.		
25AIM464.2	Analyze communication protocols and interfacing standards for IoT device connectivity using Arduino		
25AIM464.3	Build functional embedded applications using Arduino hardware and software interfacing		
25AIM464.4	Integrate various sensors and actuators with Arduino microcontrollers to capture and process real-world data.		
Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	Not Required	2	NA
PART-A			
1	To interface LED / Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED / Buzzer for 1 sec after every 2 seconds.	2	25AIM464.1
2	To interface Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED at sensor detection.	2	25AIM464.1
3	To interface smoke sensor with Arduino/Raspberry Pi and write a program to turn on alarm when smoke is detected.	2	25AIM464.1
4	To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.	2	25AIM464.2
5	To interface TCS3200 Color Sensor with Arduino to detect the colors and display the same.	2	25AIM464.2
6	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smart phone using Bluetooth.	2	25AIM464.2
PART-B			
7	To interface ultrasonic sensor with Arduino/Raspberry Pi and write a program to display the distance of the obstacle.	2	25AIM464.3
8	To interface float sensor to detect water level in over head tanks and warn the overflow using Arduino/Raspberry PI with an LED	2	25AIM464.3
9	To interface ADXL335 accelerometer with Arduino/RaspberryPI to detect the various orientation and display it on serial monitor.	2	25AIM464.3
10	Create an application that has three LEDs (Red, Green and white). The LEDs should follow the cycle (All Off, Red On, GreenOn, WhiteOn) for each hand movement (use Ultrasonic sensor).	2	25AIM464.3

11	To interface soil moisture sensor to display the quality of soil moisture values using Arduino/RaspberryPI	2	25AIM464.3
12	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to cloud.	2	25AIM464.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Develop a native application that uses GPS location information.
2. <https://gr-solution.blogspot.com/2015/12/develop-native-application-that-uses.html>
3. Develop a mobile application to send an email. <https://www.geeksforgeeks.org/how-to-send-an-email-from-your-android-app/>
4. Develop a simple application with one Edit Text so that the user can write some text in it. Create a button called "Convert Text to Speech" that converts the user input text into voice.
5. <https://www.geeksforgeeks.org/edittext-widget-in-android-using-java-with-examples/>

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books

1. R. Kanagachidambaresan, Internet of Things Using Single Board Computers: Principles of IoT and Python Programming, Apress, 2022, ISBN: 978-1-4842-8107-9.
2. Anand Tamboli, Build Your Own IoT Platform: Develop a Flexible and Scalable Internet of Things Platform, Apress, 2022, ISBN: 978-1-4842-8072-0.
3. Rohit Sharma and Dilip Sharma (Eds.), New Trends and Applications in Internet of Things (IoT) and Big Data Analytics, Springer, 2022, ISBN: 978-3-030-99328-3.
4. Nidhi Sindhwani, Rohit Anand, M. Niranjanamurthy, Dinesh Chander Verma and Emilia Balas Valentina (Eds.), IoT Based Smart Applications, Springer, 2023, ISBN: 978-3-031-04523-3.

PROBLEM SOLVING USING SCALA			
Course Code	25AIM465	Credits	01
L:T:P:S	0:0:1:0	CIE Marks	50
TLP Contact Hours / Sem	30	SEE Marks	50
TW & SL / Sem	-	Total Marks	100
Total Hours /Sem	30	Exam Hours	03
Course outcomes: At the end of the course, the student will be able to:			
25AIM465.1	Design data models using Scala's sealed traits and case classes to create algebraic data types		
25AIM465.2	Apply structural recursion and pattern matching to navigate and modify data		
25AIM465.3	Develop programs that effectively utilize Scala's built-in data structures		
25AIM465.4	Utilize object-oriented programming concepts and file I/O mechanisms in Scala to build structured applications.		
Pgm. No.	List of Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	Basics Python programming concepts	2	NA
PART-A			
1	a. Write a Scala program to compute the sum of the two given integer values. If the two values are the same, then return triples their sum. b. Write a Scala program to check two given integers, and return true if one of them is 22 or if their sum is 32.	2	25AIM465.1
2	a. Write a Scala program to remove the character in a given position of a given string. The given position will be in the range 0...string length -1 inclusive. b. Write a Scala program to create a new string taking the first 5 characters of a given string and return the string with the 5 characters added at both the front and back.	2	25AIM465.1
3	a. Write a Scala program to print the multiplication table of a given number using a for loop. b. Write a Scala program to find the largest element in an array using pattern matching	2	25AIM465.1
4	a. Write a Scala function to calculate the product of digits in a given number. b. Write a Scala function to check if a given number is a perfect square	2	25AIM465.1
5	a. Write a Scala program that creates a subclass Student that extends the Person class. Add a property called grade and implement methods to get and set it. b. Write a Scala program that creates a class Triangle with properties side1, side2, and side3. Implement a method is Equilateral to check if the triangle is equilateral.	2	25AIM465.4
6	a. Write a Scala program that creates an enum class Color with values for different colors. Use the enum class to represent an object's color. b. Write a Scala program that creates a class ContactInfo with properties name, email, and address. Create a class Customer that includes a ContactInfo object.	2	25AIM465.4
PART-B			
7	a. Write a Scala program to create a set and find the difference and intersection between two sets. b. Write a Scala program to create a set and find the second largest element in the set.	2	25AIM465.3
8	a. Write a Scala program to create a list in different ways. Note: Use Lisp style, Java style, Range list, Uniform list, Tabulate list b. Write a Scala program to flatten a given List of Lists, nested list structure.	2	25AIM465.3

9	a. Write a Scala program to add each element n times to a given list of integers. b. Write a Scala program to split a given list into two lists.	2	25AIM465.3
10	a. Write a Scala program to swap the elements of a tuple Further print no swapping required if elements are same. b. Write a Scala program to find non-unique elements in a tuple	2	25AIM465.3
11	a. Write a recursive Scala function to calculate the factorial of a number. b. Implement a tail-recursive function to compute the greatest common divisor (GCD) of two integers.	2	25AIM465.2
12	a. Write a Scala program to read a text file and count the number of lines, words, and characters. b. Write a Scala program to write a list of names to a file, one per line.	2	25AIM465.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. <https://docs.scala-lang.org/tutorials/scala-for-java-programmers.html>
2. <https://www.tutorialspoint.com/scala/index.htm>
3. <https://www.coursera.org/learn/scala-functional-programming>

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books:

- 1) Martin Odersky, Lex Spoon, Bill Venner, and Frank Sommers, “Programming in Scala”, Artima Inc, 2021. ISBN:978-0997148008
- 2) Alvin Alexander, “Scala Cookbook: Recipes for Object-Oriented and Functional Programming”, O'Reilly, 2021, ISBN: 978-1492051503

ENVIRONMENTAL SCIENCE PROJECT			
Course Code	25EPP47	Credits	02
L:T:P:S	0:0:2:0	CIE Marks	50
TLP Contact Hours / Sem	-	SEE Marks	50
TW & SL / Sem	60	Total Marks	100
Total Hours /Sem	60	Exam Hours	03

Course outcomes: At the end of the course, the student will be able to:

25EPP47.1	Identify environmental issues and their impact on ecosystems, natural resources, and sustainable development.
25EPP47.2	Evaluate environmental conditions using data obtained through field surveys, case studies, environmental audits, and related investigations
25EPP47.3	Develop skills in project planning, field survey, data collection, implementation, documentation and reporting
25EPP47.4	Design sustainable solutions to mitigate identified environmental problems using scientific and engineering principles.

The Environmental Science Project is a practical, applied-learning course that builds students' environmental awareness and responsibility. It focuses on real issues such as climate change, pollution, biodiversity, resource use, soil erosion, and thermal comfort, using field surveys, case studies, data collection, audits, and analysis to develop feasible and sustainable solutions. Students are encouraged to propose feasible, sustainable, and technically sound solutions based on scientific principles and engineering practices.

The project may be undertaken **individually or in groups of up to four students**, including interdisciplinary teams wherever appropriate. Student performance shall be evaluated based on the prescribed project assessment rubrics.

Methods for project identification: Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

Restrictions and professional conduct:

Environmental Science Projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation

CIE Assessment Pattern (50 Marks)

RBT Levels		Periodical Reviews and Evaluation
		50
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

SEE Assessment Pattern (50 Marks)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

Suggested Learning Resources:

Textbooks:

1. Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3. Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: <https://sdgs.un.org>
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2. NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3. Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): <https://vlab.co.in>
4. Geological Survey of India (GSI) – Maps, reports, and publications: <https://www.gsi.gov.in>
5. YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments).
6. American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

BASIC APPLIED MATHEMATICS - II (Common for All Branches)			
Course Code	25DMAT41	Credits	0
L:T:P:S	0:0:0:0	CIE Marks	50
TLP Contact Hours / Sem	15	SEE Marks	--
TW & SL / Sem	15	Total Marks	50
Total Hours /Sem	30	Exam Hours	--
Course outcomes: At the end of the course, the student will be able to:			
25DMAT41.1	Understand the least squares method to fit linear, quadratic, and exponential curves to experimental data.		
25DMAT41.2	Solve first-order and first-degree differential equations and interpret their solutions in engineering and scientific applications.		
25DMAT41.3	Analyze higher-order linear differential equations solutions encountered in engineering systems.		
25DMAT41.4	Apply the double and triple integrals concepts to compute the areas and volumes of engineering domains.		
25DMAT41.5	Analyze the Laplace transforms and apply their properties to simplify mathematical models of engineering systems.		
25DMAT41.6	Apply Laplace transform techniques to solve linear differential equations arising in the engineering applications.		
MODULE-1	STATISTICAL ANALYSIS	25DMAT41.1	3 Hours
Fitting of the linear curves, quadratic curves and exponential curves by least square method. Correlation, Coefficient of correlation and Lines of Regression.			
Self-study	Fitting of the geometric curves.		
Text Book	Text Book 1: 24.5, 25.12, 25.13, 25.14		
MODULE-2	ORDINARY DIFFERENTIAL EQUATIONS	25DMAT41.2 25DMAT41.3	3 Hours
Solution of first order and first-degree differential equations – Exact differential equations. Solution of second and higher order homogeneous and non-homogeneous (e^{ax} , $\sin ax$, $\cos ax$) linear differential equations.			
Self-study	Solution of first order linear differential equations		
Text Book	Text Book 1: 11.11, 11.12, 13.5		
MODULE-3	INTEGRAL CALCULUS	25DMAT41.4	3 Hours
Evaluation of double integrals, evaluation of double integrals by change of order of integration, double integrals in polar coordinates, Area enclosed by plane curves, Evaluation of triple integrals.			
Self-study	Evaluation of double integrals over the region of integration.		
Text Book	Text Book 1: 7.1, 7.2, 7.3.		
MODULE-4	LAPLACE TRANSFORMS	25DMAT41.5	3 Hours
Definition and Laplace transform of simple functions, Properties of Laplace transforms -Shifting property problems, Laplace transform of Periodic functions problems.			
Self-study	Laplace transform of elementary functions		
Text Book	Text Book 1: 21.3, 21.4, 21.5, Text Book 2: 6.1.		
MODULE-5	INVERSE LAPLACE TRANSFORMS	25DMAT41.6	3 Hours
Inverse Laplace Transform by partial fractions and completing square forms. Solution of linear differential equations using Laplace Transform techniques.			
Self-study	Inverse Laplace transform of simple functions		
Text Book	Text Book 1: 21.12, 21.15, Text Book 2: 6.4		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create			-

Suggested Learning Resources:**Text Books:**

- 1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
- 2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.

Reference Books:

- 1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
- 2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
- 3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
- 4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- <https://youtu.be/SaNDPSk1UVM?si=FRxMnRi1btCUIscK>
- <https://youtu.be/HxrLu-qRJKc?si=pKc9XOCllBx-H4Wp>
- https://youtu.be/ma1QmE1SH3I?si=Hoo3_cjiIlds203os
- <https://youtu.be/TKBXey91Gc4?si=JjZfQvJxdxN8I6YQ>
- https://youtu.be/1THkFmuIPXM?si=pc9VvmZ-9cQe_Wr_
- <https://youtu.be/m7jH0jfRf2I?si=OOEWttfQhieJ9wih>
- <https://youtu.be/qFnoRfZknBY?si=BeMrhMF3LML4hBGa>
- <https://youtu.be/n9XP6pljtw8?si=3gU-XKgt5JlZe9LE>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

NATIONAL SERVICE SCHEME			
Course Code	25NSS40	Credits	00
L:T:P:S	0:0:0:0	CIE Marks (each Semester)	50
TLP Contact Hours / Sem	15	SEE Marks	--
TW & SL / Sem	15	Total Marks	50 x 2 = 100
Total Hours /Sem	30	Exam Hours	02
Course outcomes: At the end of the course, the student will be able to:			
25NSS40.1	Understand the importance of his / her responsibilities towards society.		
25NSS40.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.		
25NSS40.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.		
25NSS40.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.		
Sem/ Code	CONTENT	COs	HRS
25NSS30 3 RD	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Developing Sustainable Water management system for rural areas and implementation approaches. 4. Setting of the information imparting club for women leading to contribution in social and economic issues. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Participation in Institution NSS Unit Cell campaigns.	25NSS30.1 25NSS30.2 25NSS30.3 25NSS30.4	26
25NSS40 4 TH	1. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 2. Contribution to any national level initiative of Government of India. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs). 4. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 5. Govt. school Rejuvenation and helping them to achieve good infrastructure. 6. Participation in Institution NSS Unit Cell campaigns.	25NSS40.1 25NSS40.2 25NSS40.3 25NSS40.4	26
CIE Assessment Pattern (50 Marks – Activity based) –			
CIE component for every semester			Marks
Presentation – 1 : Selection of topic, PHASE - 1			10
Commencement of activity and its progress - PHASE - 2			10
Case study-based Assessment Individual performance			10
Sector wise study and its consolidation			10
Video based seminar for 10 minutes by each student at the end of semester with Report.			10
Total marks for the course in each semester			50
- Implementation strategies of the project (NSS work). - The last report should be signed by NSS Officer, the HOD and Principal. - At last report should be evaluated by the NSS officer of the Institute. - Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.			
Suggested Learning Resources:			
Reference Books:			
1. NSS Course Manual, Published by NSS Cell, VTU Belagavi. 2. Government of Karnataka, NSS cell, activities reports and its manual. 3. Government of India, NSS cell, Activities reports and its manual.			
Pre-requisites to take this Course:			
1. Students should have a service-oriented mindset and social concern.			

2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
 - Lecture session by NSS Officer
 - Students Presentation on Topics
 - Presentation - 1, Selection of topic, PHASE - 1
 - Commencement of activity and its progress - PHASE - 2
 - Execution of Activity
 - Case study-based Assessment, Individual performance
 - Sector/ Team wise study and its consolidation
 - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management- Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

4.	Setting of the information imparting club for women leading to contribution in social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/ proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/ proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
1.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government/ private/ aided schools/ Government Schemes officers	School selection/ proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Spreading public awareness under rural outreach programs. (minimum 5 programs)	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Organize National integration and social harmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

YOGA					
Course Code		25YOG40	Credits	00	
L:T:P:S		0:0:0:0	CIE Marks	50	
TLP Contact Hours / Sem		15	SEE Marks	--	
TW & SL / Sem		15	Total Marks	50 x 4 = 200	
Total Hours /Sem		30	Exam Hours	02	
Course outcomes: At the end of the course, the student will be able to:					
25YOG40.1		Understanding the origin, history, aim and objectives of Yoga			
25YOG40.2		Become familiar with an authentic foundation of Yogic practices			
25YOG40.3		Practice different Yogic methods such as Suryanamaskara, Pranayama			
25YOG40.4		Use the teachings of Patanjali in daily life.			
Sem	CONTENT			COs	HRS
25YOG30 3 rd	Introduction of Yoga: Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer Brief introduction of yogic practices for common man: Yogic practices for common man to promote positive health Rules and regulations: Rules to be followed during yogic practices by practitioner Misconceptions of yoga: Yoga its misconceptions, Difference between yogic and non-yogic practices. Suryanamaskara: Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar. Suryanamaskar 12 count,2rounds Kapalabhati: 40strokes/min 3rounds Different types of Asanas with Brief introduction and importance: Sitting: Padmasana, Vajrasana, Sukhasana Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana Prone line: Bhujangasana, Shalabhasana Supine line: Utthitadvipadasana, Ardhalahalasana			25YOG30.1 25YOG30.2 25YOG30.3 25YOG30.4	26
25YOG40 4 th	Suryanamaskara: Suryanamaskar 12 count,4rounds Brahmari Pranayama Different types of Asanas with Brief introduction and importance: 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Sarvangasana, Chakraasana 5. Balancing: Sheershasana Patanjali's Ashtanga Yoga: Asana, Pranayama Pranayama: Chandra Bhedana, Nadishodhana, Surya Bhedana Shat Kriyas: Jalaneti and sutraneti, Sheetkarma Kapalabhati			25YOG40.1 25YOG40.2 25YOG40.3 25YOG40.4	26
CIE Assessment Pattern (50 Marks – Practical) CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)					
		CIE	Marks		
		Avg of Test 1 and Test 2	25		
		Demonstration of Yogasana	25		
		Total	50		
1. Suggested Learning Resources: 2. Reference Books: 3. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala) 4. Tiwari, O P: Asana Why and How 5. Ajitkumar: Yoga Pravesha (Kannada) 6. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)					

7. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
8. Nagendra H R: The art and science of Pranayama
9. Tiruka: Shatkriyegalu (Kannada)
10. Iyengar B K S: Yoga Pradipika (Kannada)
11. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- <https://youtu.be/KB-TYlgd1wE>
- <https://youtu.be/aa-TG0Wg1Ls>

PHYSICAL EDUCATION AND SPORTS			
Course Code	25PED40	Credits	00
L:T:P:S	0:0:0:0	CIE Marks (each semester)	50
TLP Contact Hours / Sem	15	SEE Marks	--
TW & SL / Sem	15	Total Marks	50 x 2= 100
Total Hours /Sem	30	Exam Hours	02
Course outcomes: At the end of the course, the student will be able to:			
25PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness		
25PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle		
25PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.		
25PEDX0.4	Understand the roles and responsibilities of organization and administration of sports and games		
Semester	CONTENT	COs	HOURS
3 RD 25PED30	Module 1: Orientation A. Lifestyle B. Food & Nutrition C. Health & Wellness D. Pre-Fitness test.	25PED30.1, 25PED30.2, 25PED30.3, 25PED30.4	26 HRS
	Module 2: General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash		
	Module 3: Specific games (Any one to be selected by the student) 1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.		
4 TH 25PED40	Module 1: Ethics and Moral Values A. Ethics in Sports B. Moral Values in Sports and Games	25PED40.1, 25PED40.2, 25PED40.3, 25PED40.4	26 HRS
	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration		
CIE Assessment Pattern (50 Marks – Practical) – CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.			
CIE		Marks	
Participation of student in all the modules		10	
Quizzes – 2, each of 7.5 marks		15	
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students		25	
Total		50	
Suggested Learning Resources: Reference Books: 1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani. 2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata. 3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics. 4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi. 5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi. 6. Vivek Thani. Coaching Cricket, Khel Sahitva Kendra, New Delhi.			

7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

MUSIC			
Course Code	25MUS40	Credits	00
L:T:P:S	0:0:0:0	CIE Marks	50
TLP Contact	15	SEE Marks	--
TW & SL / Sem	15	Total Marks	50 x 2 = 100
Total Hours	30	Exam Hours	02
Course outcomes: At the end of the course, the student will be able to:			
25MUS40.1	Identify and understand the origins and evolution of the Indian music system and its fundamental concepts		
25MUS40.2	Analyze and practice various types of compositions in Carnatic music and relate to different musical traditions		
25MUS40.3	Demonstrate knowledge of major composers and their contributions to Indian classical music		
25MUS40.4	Classify and understand various musical instruments and their construction		
Sem	CONTENT	COs	HRS
3 rd 25MUS30	Origin of Indian Music - Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Taya, Raga, Tala, and Mla. Study of the fundamental concepts that form the foundation of Carnatic music. Compositions in Carnatic Music - Introduction to types of compositions including Geethe, Jathi, Swara, Swarajathi, Varna, Krithi, and Thillana. Understanding of notation systems and their application in musical compositions. Composers and Their Contributions - Biography and musical contributions of Purandaradasa (founder of Carnatic music pedagogy), Thyagaraja (prolific composer and saint), and Mysoro Vasudevacharya. Study of their impact on Indian classical music traditions. Abhyasa Gana - Practical Training - Singing of Sarale Varase exercises and notation writing. Introduction to Suladi Saphthatala. Singing of 2 Geethe in Malahiri. Foundation for practical music experience.	25MUS30.1 25MUS30.2 25MUS30.3 25MUS30.4	26
4 TH 25MUS40	Classification of Musical Instruments - Classification and construction of string instruments (Veena, Sitar), wind instruments (Flute, Shehnai), percussion instruments (Mridangam, Tabla), and Idiophones (Ghana Vaadya - Gongs, Cymbals). Examples and characteristics of each class of instruments. Abhyasa Gana - Practical Training - Continuation of singing exercises including Sarale Varase at varying speeds. Complete notation writing for Sarale Varase and Suladi Saphthatala in Mayamalavagowla Raga. Singing of 2 additional Geethe in Malahiri, one Jathi Swara, and one Krithi in a Mela raga. Advanced practical music training.	25MUS40.1 25MUS40.2 25MUS40.3 25MUS40.4	26
CIE Assessment Pattern (50 Marks – Practical)			
CIE to be evaluated every semester based on practical demonstration of Singing/Playing learnt in the semester and internal tests (MCQ type)			
CIE			Ma
Avg of Test 1 and Test 2			20
Practical test on:			30
d. Recite one Sarale Varase mentioned by the examiner in three speeds.			
e. Sing/Play the Geethe in Malahari.			
f. Singing/Playing Jathi Swara/Krithi.			50
Total			
Textbooks:			
1. Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007.			
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana - Vol.1 (English), Shreenivaas Prakaashana, 2018.			
References:			
1. Lakshminarayana Subramiam, Viji Subramaniam, "Classical Music of India: A Practical Guide", Tranqueber 2018.			
Web links and Video Lectures (e-Resources):			

- <https://www.youtube.com/watch?v=ihFDT8ZBPxE>
- <https://www.youtube.com/watch?v=4XXl5tTXa0I>
- <https://www.youtube.com/watch?v=n-60gfzGa1E>
- https://www.youtube.com/watch?v=Vv_K7J7gx6M
- <https://www.youtube.com/watch?v=BovAAPumYUo>
- https://www.youtube.com/watch?v=F_aWPATb8V4
- <https://www.youtube.com/watch?v=DPPCRWA3hXo>
- <https://www.youtube.com/watch?v=TUP00NK9eTM>
- <https://www.youtube.com/watch?v=LlolyBzZtdg>

APPENDIX A

Outcome Based Education

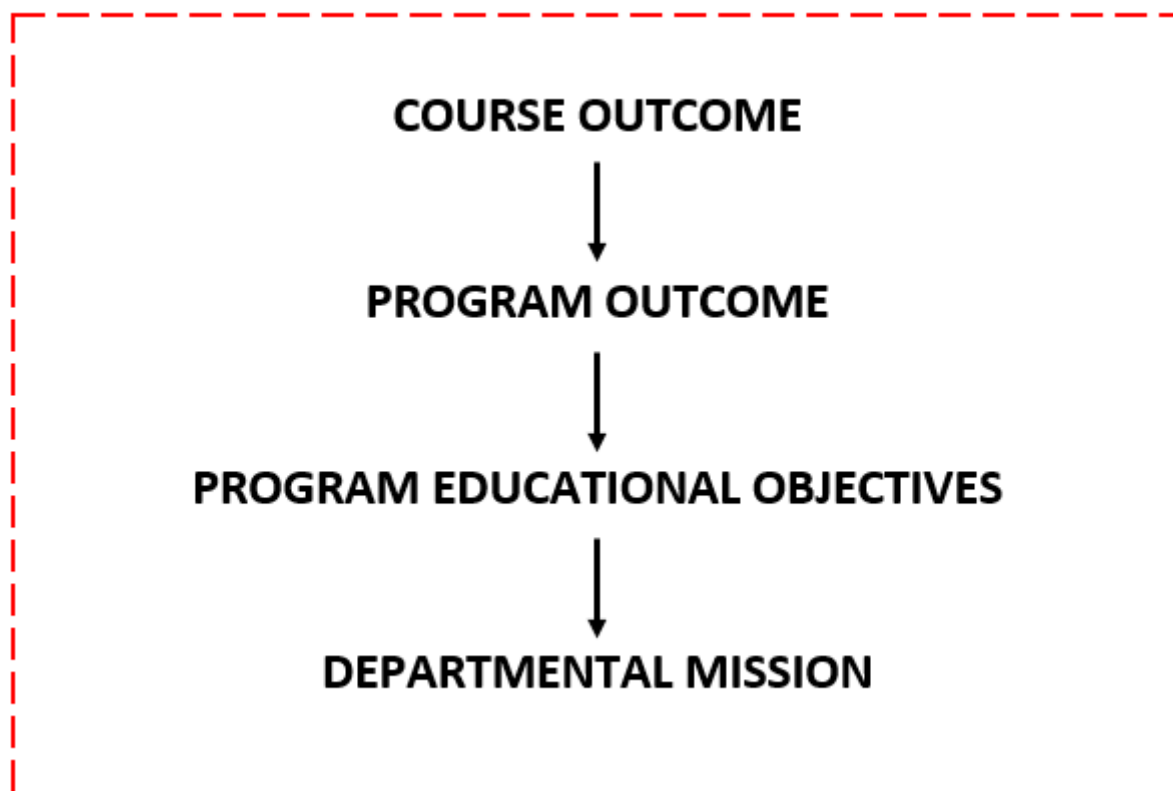
Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead, classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation: Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and in particular, what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcome:



APPENDIX B

The Graduate Attributes of NBA

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

UG – Engineering Program (August 2024)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

P06: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

P07: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

P08: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

P09: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

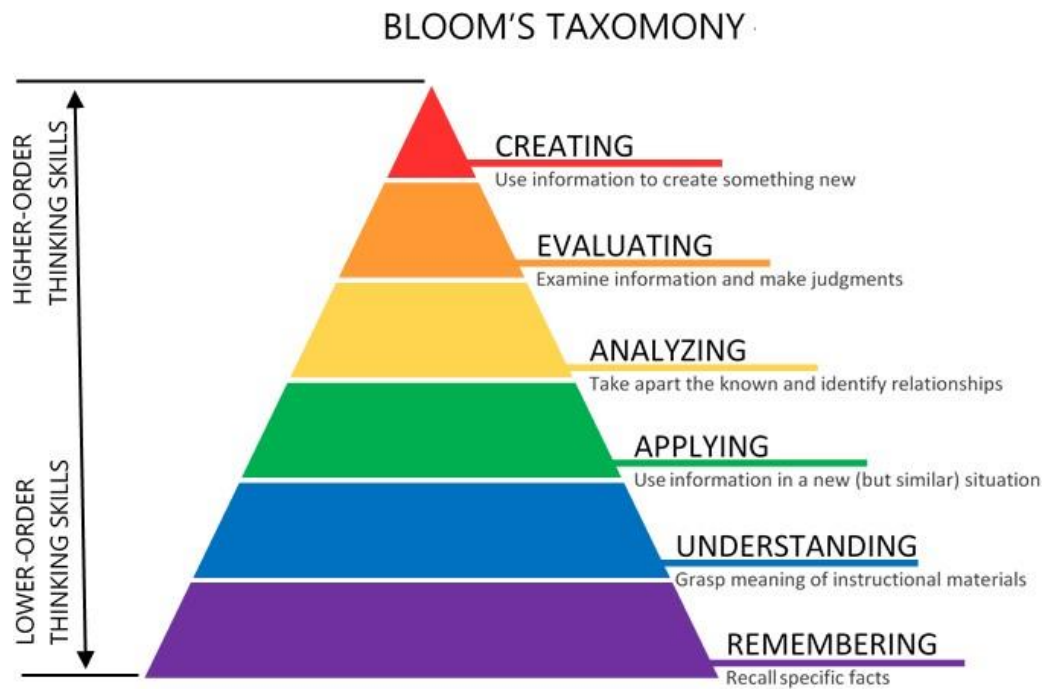
P010: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

P011: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

APPENDIX C

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



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