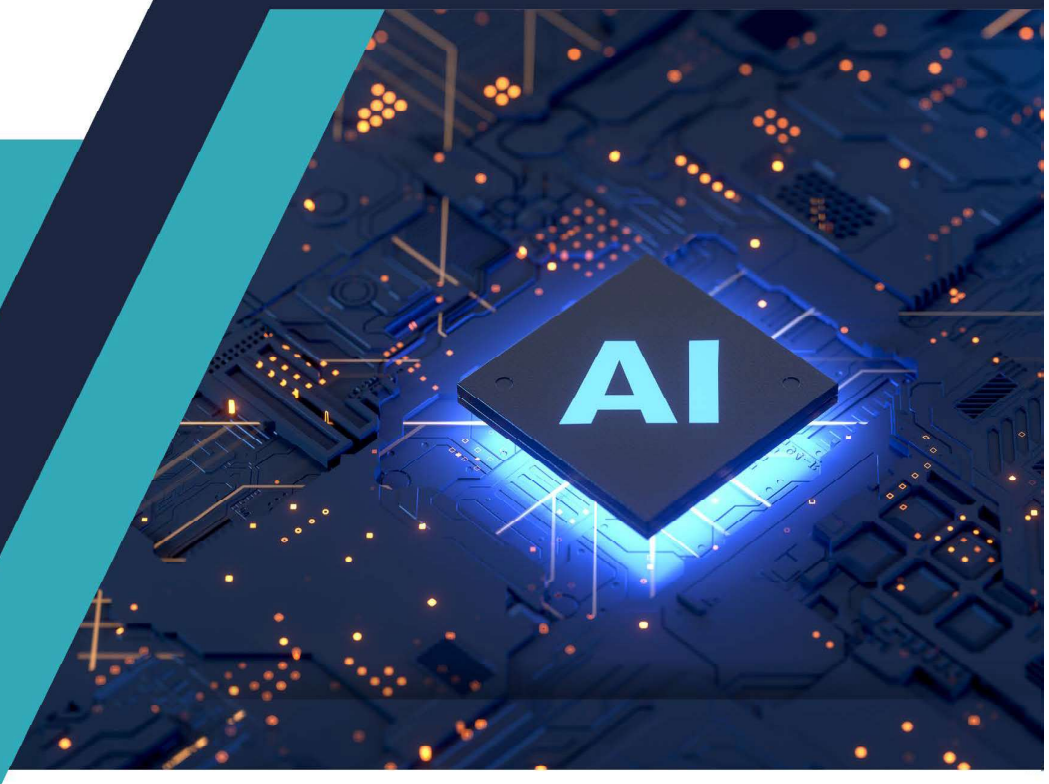
NEW HORIZON COLLEGE OF ENGINEERING

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Academic Year 2026 - 2027



5th and 6th Semesters Scheme & Syllabus

BATCH: 2024 - 2028
CREDITS: 160
[2024 Scheme]

NEW HORIZON
COLLEGE OF ENGINEERING
Autonomous College, Affiliated to VTU | Approved by AICTE New Delhi & UGC
Accredited by NAAC with 'A' Grade & Accredited by NBA

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Academic Year: 2026-27

Fifth (5th) and Sixth (6th) Semesters
Scheme & Syllabus

CREDITS:160

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[2024 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 ARTIFICIAL INTELLIGENCE AND MACHINE LERNING

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)

PO1: 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.

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

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.

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.

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.

PO6: 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.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: 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

PO10: 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.

PO11: 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:

PSO1: 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.

PSO2: 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 2024- 2028 BATCH (2024 Scheme)

V Semester													
Sl. No	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**Contact Hours**	**Marks**		
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	PCC	24AIM51	Operating Systems	AIML	3	0	0	0	3	4	50	50	**100**
2	PCC	24CSK52	Design and Analysis of Algorithms	AIML	3	0	0	0	3	4	50	50	**100**
3	PCCL	24CSLK52	Design and Analysis of Algorithms Lab	AIML	0	0	1	0	1	3	50	50	**100**
4	PCC	24AIM53	Deep Learning	AIML	3	0	0	0	3	4	50	50	**100**
5	PCCL	24AIL53	Deep Learning Lab	AIML	0	0	1	0	1	3	50	50	**100**
6	AEC*	24AIM54	Machine Learning Operations	AIML	3	0	0	0	3	3	50	50	**100**
7	AEC	24RMK55	Research Methodology and IPR	EEE	1	0	0	0	1	1	50	50	**100**
8	AEC	24SDK56	Problem Solving Methodologies	AIML	0	0	1	0	1	2	50	-	**50**
9	PROJ**	24AIM57	Societal Based Mini Project	AIML	0	0	1	0	1	2	50	50	**100**
10	OEC*	26NHOP5XX	Industrial Open Elective Course-I	Offering Dept	3	0	0	0	3	3	50	50	**100**
11	NCMC	24NSS50	National Service Scheme	-	0	0	0	0	0	2	50	--	**50**
		24PED50	Physical Education and Sports	-									
		24YOG50	Yoga	-									
								Total	**20**	**31**	**550**	**450**	**1000**

AEC* (Skill Based Core Course):
Credit for AEC* with 03 (L: T: P: S) credits can be considered as (3: 0: 0: 0). The teaching and learning of these Courses will be based on hands-on. The Course content will be from Industry Certification Course Content. The Course Assessment will be based on CIE and SEE in practical mode.

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **PROJ**: Mini Project work **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation

Societal Based Mini Project **:

The Mini project can be done in any lab across college. A common slot in time table can be allotted across all departments.

Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor. A student can do mini project as

(i) A group of 2 if mini project work is single discipline (applicable to all IT allied branches)

(ii) A group of 3- 4 if mini project work is single discipline (applicable to all Core Branches)

(iii) A group of 3 - 4 students if the Mini Project work is a multidisciplinary (Applicable to all Branches)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(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 Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

Industrial Open Elective Courses-I:

Credit for OEC is 03 (L: T: P: S) can be considered as (3: 0: 0: 0). The teaching and learning of these Courses will be based on hands-on. The Course Assessment will be based on CIE and SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 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, and Yoga 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.

Credit Definition:	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session
1-hour Lecture (L) per week=1Credit	02- Credits courses are to be designed for 25 hours of Teaching-Learning Session
2-hoursTutorial(T) per week=1Credit	01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions
2-hours Practical / Drawing (P) per week=1Credit	
2-hous Self Study for Skill Development (SDA) per week = 1 Credit	

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VI Semester														
S. No	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	Contact Hours	Marks			
					L	T	P	S			CIE	SEE	Total	
1	PCC	24AIM61	Natural Language Processing	AIML	3	0	0	0	3	4	50	50	**100**	
2	PCCL	24AIL61	Natural Language Processing Lab	AIML	0	0	1	0	1	3	50	50	**100**	
3	PCC	24AIM62	Big Data Technologies	AIML	3	0	0	0	3	4	50	50	**100**	
4	PCCL	24AIL62	Big Data Technologies Lab	AIML	0	0	1	0	1	3	50	50	**100**	
5	PCC	24AIM63	Full Stack Development for AI Applications	AIML	3	0	0	0	3	3	50	50	**100**	
6	PEC	24AIM64X	Professional Elective Course-II	AIML	3	0	0	0	3	4	50	50	**100**	
7	AEC	24AIM65X	Ability Enhancement Course – V	AIML	0	0	1	0	1	2	50	50	**100**	
8	NCMC	24SDK66	Advanced Problem Solving Methodologies	-	0	0	0	0	0	2	50	--	**50**	
9	PROJ	24AIM67	Capstone Project	AIML	0	0	2	0	2	4	50	50	**100**	
10	PCC	26NHOP6XX	Industrial Open Elective Course-II	Offering Dept.	3	0	0	0	3	3	50	50	**100**	
11	NCMC	24NSS60	National Service Scheme	-	0	0	0	0	0	2	50	--	**50**	
		24PED60	Physical Education and Sports	-										
		24YOG60	Yoga	-										
Total									**20**	**34**	**550**	**450**	**1000**	

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **OEC**: Open Elective Course, **PROJ**: Project work**, L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, C**IE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

Professional Elective Course-II			
24AIM641	AI in Information Retrieval	24AIM644	IoT for Intelligent Computing
24AIM642	Cryptography and Network Security	24AIM645	Augmented and Virtual Reality
24AIM643	Finite Automata and Formal Languages		

Ability Enhancement Course – V			
24AIM651	Mobile Application Development	24AIM654	IoT Application Development
24AIM652	Cyber Security Practices	24AIM655	Intelligent Test Automation
24AIM653	API and Microservices		

Industrial Open Elective Courses-II:
Credit for OEC is 03 (L: T: P: S) can be considered as (3: 0: 0: 0). The teaching and learning of these Courses will be based on hands-on. The Course Assessment will be based on CIE and SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses can be added to supplement the latest trend and advanced technology in the selected stream of engineering.

Capstone Project

Students have to discuss with the mentor /guide and with their help he/she has to define the problem statement for the project.

The objective of the Project is

- To encourage independent learning and the innovative attitude of the students.
- To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire team working.
- To expand intellectual capacity, credibility, judgment and intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To install responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project:

1. **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.
   The CIE marks awarded for the project, shall be based on the evaluation of the project Report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
2. **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project Report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

   SEE procedure for Project: SEE for project will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project shall be based on the evaluation of project Report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 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, and Yoga 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.

Credit Definition: 1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hous Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

V SEMESTER

OPERATING SYSTEMS			
Course Code	**24AIM51**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24AIM51.1	Apply knowledge of operating system architectures, core functions, and system services to solve resource management and execution problems in traditional and contemporary environments
24AIM51.2	Analyze process management techniques and CPU scheduling algorithms to determine system performance and throughput
24AIM51.3	Develop process synchronization mechanisms and deadlock handling techniques.
24AIM51.4	Compare contiguous and non-contiguous memory management strategies, including paging and segmentation, to optimize system resource allocation
24AIM51.5	Examine file system organization and management strategies to evaluate design trade-offs regarding access speed, security, and fault tolerance.
24AIM51.6	Justify mass storage configurations and disk scheduling choices to recommend system-level enhancements that optimize critical I/O performance metrics.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM51.1	3	-	-	-	-	-	-	-	-	-	2	-	2
24AIM51.2	3	3	-	-	-	-	-	-	-	-	2	-	2
24AIM51.3	3	3	3	2	2	-	-	-	-	-	2	-	2
24AIM51.4	3	3	3	2	2	-	-	-	-	-	2	-	2
24AIM51.5	3	3	3	2	2	-	-	-	-	-	2	-	2
24AIM51.6	3	3	3	-	2	-	-	-	-	-	2	-	2

MODULE-1	**INTRODUCTION TO OPERATING SYSTEM**	**24AIM51.1**	**8 Hours**

Introduction and Operating System Services: Basics of Operating Systems: Definition - Operating System structure; Operating System operations; Computing Environments

Operating system structures: Operating System Services; System Calls; Types of System Calls; Operating System Design and Implementation, Design Goals, Mechanisms and Policies, Implementation; Operating System structure: Layered Structure, Microkernels, Modules, Hybrid Systems

Self-study	Comparison of Modern Operating Systems (Windows, Linux, Android, and iOS) with respect to architecture, system services, kernel design, and computing environments.
Text Book	Text Book 1: 1.1, 1.3, 1.4, 1.9, 1.10, 2.1, 2.3, 2.7, 2.8

MODULE-2	**PROCESS MANAGEMENT AND CPU SCHEDULING**	**24AIM51.2**	**8 Hours**

Process Management: Process: Process Concept–The Processes, Process States, PCB; Process Scheduling: Scheduling Queues, Schedulers, Context Switch Operation; Operation on Process; Inter-Process Communication.

Threads & Concurrency: Multithreading Models, Thread Libraries, Threading Issues**.**

CPU Scheduling: Basic Concepts, CPU-I/O Burst Cycle; CPU Scheduler: Pre-emptive Scheduling, Dispatcher; Scheduling Criteria; Scheduling Algorithms: FCFS Scheduling, SJF Scheduling, Round-Robin Scheduling, Priority Scheduling.

Applications	Study how multiple applications such as web browsers, media players, and editors run concurrently using process scheduling and inter-process communication mechanisms.
Text Book	Text Book 1: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 4.3,4.4,4.6,5.1, 5.2, 5.3

MODULE-3	**PROCESS SYNCHRONIZATION AND DEADLOCK**	**24AIM51.3**	**8 Hours**

Process Synchronization: Background; The Critical Section Problem; Peterson's Solution; Synchronization Hardware; Mutex Locks; Semaphores –Semaphore Usage, Semaphore Implementation,
Synchronization Examples: Classical Problems of Synchronization – The Reader- Writer Problem, Dining-Philosopher Problem.
Deadlocks: System Model; Deadlock Characterization; Methods for Handling Deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery.

Case Study	Study how Chrome uses paging, virtual memory, demand paging, copy-on-write, and page replacement techniques to manage multiple browser tabs efficiently.
Text Book	Text Book 1: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 7.1, 8.1, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8

MODULE-4	**MEMORY MANAGEMENT**	**24AIM51.4**	**8 Hours**

Memory Management: Main Memory: Background; Contiguous Memory Allocation; Paging; Structure of Page Table; Swapping. Segmentation.
Virtual Memory: Background; Demand Paging; Copy-on-Write; Page Replacement: Basic Page Replacement, FIFO Page Replacement, Optimal Page Replacement, LRU Page Replacement; Allocation of Frames; Thrashing; Memory Compression.

Self-study	Memory Compression and Kernel Memory Allocation in modern operating systems.
Text Book	Text Book 1: 9.1,9.2,9.3,9.4,9.5,10.1,10.2,10.3,10.4,10.5,10.6,10.7,10.8

MODULE-5	**FILE SYSTEM INTERFACE**	**24AIM51.5, 24AIM51.6**	**8 Hours**

File System Interface: File Concept; Access methods: Sequential Access, Direct Access, Directory Structure.
File-system Implementation: File system Structure; File system Operations, Directory Implementation; Allocation Methods; Free Space Management
Mass Storage Structures: HDD Scheduling: FCFS, SSTF, SCAN Scheduling, CSCAN Scheduling, LOOK Scheduling

Applications	Analyze how a video streaming service (e.g., Netflix-like platform) stores, accesses, and manages large video files efficiently.
Text Book	Text Book 1: 13.1,13.2,13.3 14.1,14.2,14.3,14.4,14.5, 11.2

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	10	5

L4	**Analyze**	10	**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**	**20**
L5	**Evaluate**	**--**
L6	**Create**	**--**

Suggested Learning Resources:

Text Book:

1) Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons, Inc., 10th Edition, 2021, ISBN:9781119800361.

Reference Books:

1) Andrew S. Tanenbaum and Herbert Bos, Modern Operating Systems, 5th Edition, Pearson, 2022, ISBN: 9780137618873.
2) William Stallings, Operating Systems: Internals and Design Principles, 9th Edition, Pearson, 2021, ISBN: 9780137516742.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=lmlLdGMrdGU
- https://onlinecourses.nptel.ac.in/noc24_cs108/preview
- https://www.youtube.com/watch?v=mXw9ruZaxzQ
- https://www.coursera.org/courses?query=operating%20system
- https://www.geeksforgeeks.org/operating-systems/operating-systems/
- https://www.tutorialspoint.com/operating_system/index.htm
- https://www.studytonight.com/operating-system/
- https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O

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

- Explore a Linux operating system in a virtual machine
- Organizing Group wise discussions on issues
- Data Driven Case studies
- Cross Platform Comparative Learning
- Presentations on operating system concepts used in Android, Windows, or cloud platforms.

DESIGN AND ANALYSIS OF ALGORITHMS			
Course Code	**24CSK52**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24CSK52.1	Apply algorithmic design to solve simple to complex problems using various approaches for algorithm design
24CSK52.2	Analyze both brute force and divide-and-conquer design strategies to compute an algorithm's effectiveness in devising a solution.
24CSK52.3	Design and deploy from a variety of techniques to address searching and sorting challenges.
24CSK52.4	Implement both greedy and dynamic programming strategies for solving intricate problems
24CSK52.5	Evaluate backtracking and branch & bound methods for crafting solutions to real-time problems
24CSK52.6	Interpret the P, NP, and NP-complete complexity classes to scrutinize the constraints and boundaries of an algorithm's performance

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CSK52.1	3	-	-	-	-	-	-	-	-	-	1	-	-
24CSK52.2	-	3	2	-	-	-	-	-	-	-	1	-	-
24CSK52.3	-	3	3	-	3	-	-	-	-	-	1	-	2
24CSK52.4	-	-	3	-	3	-	-	-	-	-	1	-	2
24CSK52.5	-	-	-	3	2	1	-	-	-	-	2	-	-
24CSK52.6	-	. -	-	3	-	1	-	-	-	-	2	-	2

MODULE-1	**Exploring Algorithms and Analyzing Function Growth**	**24CSK52.1**	**8 Hours**
Algorithm introduction, Fundamentals of Algorithmic problem solving, fundamentals of analysis of algorithm efficiency, analysis framework, Asymptotic notations, Important problem types, Mathematical Analysis of Recursive Algorithms-factorial function, Tower of Hanoi, Binary Recursion, and Mathematical Analysis of Non-Recursive Algorithms-Maximum Element, Element uniqueness problem.			
Self-study	Evaluate a real-world problem where the algorithm is applied and discuss its efficiency.		
Text Book	Text Book 2: 1.1,1.2,1.3,2.2,2.3,2.4		
MODULE-2	**Methods for Evaluating an Algorithm in Order to Devise a Solution**	**24CSK52.2**	**8 Hours**
Brute Force String matching algorithms − Naive string matching, Rabin Karp Knuth Morris Pratt. Exhaustive Search, Travelling Salesman problem and Knapsack problem. Divide & Conquer: Merge Sort, Quick sort, selection sort and their performance analysis.			
Case Study	Read the algorithm, write its pseudocode, implement and analyze its time and space complexity.		
Text Book	Text Book 1:32.1,32.2,32.4 Text Book 2: 3.4,4.1,4.2		
MODULE-3	**Exploring Search Algorithms and Balanced Trees**	**24CSK52.3**	**8 Hours**
Decrease and Conquer: Decrease by constant, Decrease by constant factor-Russian Peasant Multiplication, Fake-Coin Problem, variable size decrease- Breadth First search traversal, Depth First search traversal, Topological sorting. Transform & Conquer: AVL trees, Heap sort.			
Case Study	Solve a practical problem using the algorithm and compare it with alternative methods.		
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10		
MODULE-4	**Optimizing Algorithms for Efficient Problem Solving**	**24CSK52.4**	**8 Hours**
Greedy Technique: Job sequence with deadlines, Minimum Spanning tree algorithms – Kruskal's & Prim's, Shortest Path algorithm – Dijkstra's, Huffman Trees and codes, Dynamic Programming: 0/1 Knapsack problems, Warshall's Algorithm, Floyd's algorithm			
Case Study	Explore a case study on "Optimizing Algorithms for Efficient Problem Solving" in the context of job scheduling in a manufacturing facility.		
Text Book	Text Book 3: 4.1,4.2.4.4 Text Book 2:8.1,8.2,8.4,9.1,9.2,9.3,9.4		
MODULE-5	**Algorithmic Frontiers and Strategies**	**24CSK52.5, 24CSK52.6**	**8 Hours**

Backtracking: N Queens problem, subset sum problem, graph coloring, Hamiltonian Circuit Problem,Branch & Bound: Travelling Salesman problem, Assignment problem, Limitations of Algorithm Power: Decision Trees, Deterministic Polynomial (P), Non-Deterministic Polynomial (NP) , NP complete & NP Hard.

Self-study	Study reductions between NP-Complete problems and distinguish NP-Hard problems.
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	-	-	-
L2	Understand	-	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	5	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. Thomas H Cormen, Charles E Leiserson, Ronald R Rivest & Clifford Stein, "Introduction to Algorithms", fourth edition, 2022, MIT Press, ISBN:9780262367509.
2. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Third Edition, 2022, Pearson Education, ISBN: 978-9332585485.
3. Ellis Horowitz, Satraj Sahni and Rajasekaran, "Computer Algorithms/C++ ", fourth Edition, 2023, The Orient Blackswan, ISBN: 978-9386235145.

Reference Books:

1. Anuradha A. Puntambekar, "Analysis and Design of Algorithms", 2022, Technical Publications, ISBN: 978-9333223867.
2. Design and Analysis of Algorithms, S. Sridhar, 2023, Oxford University Press, ISBN: 9789354977886.

Web links and Video Lectures (e-Resources):

https://rcet.org.in/uploads/academics/rohini_20313798233.pdf

- **https://www.javatpoint.com/daa-rabin-karp-algorithm**
- **https://www.javatpoint.com/daa-knuth-morris-pratt-algorithm**
- **https://www.javatpoint.com/greedy-algorithms**
- **https://www.javatpoint.com/dynamic-programming**
- **https://www.javatpoint.com/backtracking-introduction**
- **https://www.youtube.com/playlist?list=PLdo5W4Nhv31ZTn2P9vF02bkb3SC8uiUUn**

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

- Algorithmic Problem-Solving Sessions: conducting regular problem-solving sessions where students work in groups to solve algorithmic problems from basic to advance to devise solutions collaboratively.
- Algorithm Visualization and Simulation: Practice interactive algorithm visualization and simulation tools to visually observe how algorithms work in real-time. Modify algorithms by changing the input parameters, and analyze the effects on algorithm performance. This approach promotes active engagement and allows to gain insights into algorithm behavior through experimentation.

DESIGN AND ANALYSIS OF ALGORITHMS LAB			
Course Code	**24CSLK52**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24CSLK52.1	Apply the divide-and-conquer design strategies to compute an algorithm's effectiveness in devising a solution. And string-matching problems through application of various algorithmic methods.
24CSLK52.2	Analyze decrease and conquer techniques to address graph traversal problems.
24CSLK52.3	Develop both greedy and dynamic programming strategies for solving intricate problems
24CSLK52.4	Implement backtracking and branch & bound methods for crafting solutions to real-time problems

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CSLK52.1	3	-	-	-	1	-	-	-	1	-	1	2	2
24CSLK52.2	-	3	-	-	1	-	-	-	1	-	1	-	-
24CSLK52.3	-	-	3	-	1	-	-	-	1	-	1	-	-
24CSLK52.4	-	-	3	-	2	-	-	-	1	-	1	2	2

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	Demo of programming language tool Installation with Simple Programs. Design, develop, and implement the specified algorithms for the following problems using programming language under LINUX /Windows environment.	2	NA
	PART-A		
1	Develop a program to perform string matching using the Rabin-Karp Algorithm.	2	24CSLK52.1
2	Examine the time complexity of Merge Sort through the application of the divide and conquer technique	2	24CSLK52.1
3	Examine the time complexity of Quick Sort employing the divide and conquer technique.	2	24CSLK52.1
4	Develop a program for implementing the heap sort algorithm.	2	24CSLK52.2
5	A. Implement the **Breadth-First Search (BFS)** algorithm to traverse a graph from a given source vertex. The algorithm should visit all vertices level by level using a queue and display the order of traversal. B. Implement the **Depth-First Search (DFS)** algorithm to traverse a graph from a given source vertex. The algorithm should visit vertices by exploring as far as possible along each branch before backtracking using recursion or a stack.	2	24CSLK52.2
6	Given a connected Graph of some number of vertices, develop a program to find Minimum Spanning Tree of graph by applying Kruskal's algorithm	2	24CSLK52.3
	PART-B		
7	Design a program that utilizes Prim's Algorithm to determine the minimum cost spanning tree within a given graph. This algorithm systematically selects edges while ensuring that the resulting tree remains connected and has the lowest possible total edge weight	2	24CSLK52.3
8	Develop a program to find shortest paths from source vertex to other vertices in a weighted connected graph, using Dijkstra's algorithm.	2	24CSLK52.3
9	Develop a program to implement the 0/1 Knapsack problem using Dynamic Programming.	2	24CSLK52.3
10	Develop a program to (a) Implement All-Pairs Shortest Paths problem using Floyd's algorithm. (b) Find transitive closure of a graph using Warshall's algorithm.	2	24CSLK52.3

11	Write a program to color the nodes in the graph such that no two adjacent can have the same color using backtracking.	2	24CSLK52.4
12	Develop a comprehensive program that employs the Backtracking technique to solve the N Queens problem. This classic problem involves placing 'N' chess queens on an 'N x N' chessboard in such a way that no two queens threaten each other, ensuring that no queen can attack any other queen horizontally, vertically, or diagonally.	2	24CSLK52.4

PART-C

Beyond Syllabus Virtual Lab Content

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

- https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html
- https://daa-dei.vlabs.ac.in/exp/divide-conquer-sorting/html
- https://daa-dei.vlabs.ac.in/exp/greedy-coinchange/greehtml
- https://daa-dei.vlabs.ac.in/exp/dp-lcs/Dynamic Progra/html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	--	-
L2	Understand	--	-
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	5	10
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) Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Third Edition, 2022, Pearson Education, ISBN: 978-9332585485.

2) Design and Analysis of Algorithms, S. Sridhar, 2023 Oxford University Press, ISBN: 9780198093695.

DEEP LEARNING			
Course Code	**24AIM53**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24AIM53.1	Summarize the fundamental principles of deep learning, neural network architectures and and backpropagation algorithms.
24AIM53.2	Apply neural network training methodologies, including sequential and batch learning modes, while selecting appropriate stopping criteria to optimize model performance.
24AIM53.3	Analyze the challenges in neural network optimization and compare the performance of various optimization algorithms.
24AIM53.4	Utilize convolutional neural network architectures to implement solutions for key image-processing tasks such as classification, object detection, and image segmentation
24AIM53.5	Design LSTM and GRU architectures for sequence modelling data.
24AIM53.6	Formulate novel generative frameworks by synthesizing advanced autoencoder and Generative Adversarial Network (GAN) architectures to solve complex domain-specific tasks.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM53.1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
24AIM53.2	3	**-**	-	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
24AIM53.3	3	**3**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
24AIM53.4	**3**	**-**	**-**	**-**	2	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
24AIM53.5	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
24AIM53.6	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**

MODULE-1	**FUNDAMENTALS OF NEURAL NETWORKS AND DEEP LEARNING**	**24AIM53.1, 24AIM53.2**	**8 Hours**

Introduction to Deep Learning, Perceptron: Single layer perceptron, The Perceptron Convergence Theorem, XOR problem, Multilayer Perceptron, Feedforward Neural Networks (FNN), Activation Functions, Training Neural Network, Back propagation algorithm, Modes of training: Sequential and batch modes of training, stopping criteria.

Text Book	Text Book 1: Ch 3,4 Text Book 2: Ch:1,2,3,4,5

MODULE-2	**NEURAL NETWORK OPTIMIZATION**	**24AIM53.3**	**8 Hours**

Challenges in Neural Network Optimization, Gradient Descent Optimization, Type of Gradient Descent: Batch, Stochastic, Mini-batch. Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.

Text Book	Text Book 1: Ch:3, 6 Text Book 3: Ch:3

MODULE-3	**CONVOLUTIONAL NEURAL NETWORKS (CNNS) AND APPLICATIONS**	**24AIM53.4**	**8 Hours**

Convolutional Neural Networks (CNNs): Understanding Convolutional Layers-Pooling Layers and Fully Connected Layers-CNN Architectures (LeNet, AlexNet, VGG, ResNet). Types of CNNs. Applications of CNNs: Image Classification-Object Detection-Image Segmentation.

Text Book	Text Book 1: Ch 5,8 Text Book 2: Ch 7,8,13,14 Text Book 3: Ch:10

MODULE-4	**RECURRENT ARCHITECTURES FOR SEQUENCE MODELING**	**24AIM53.5**	**8 Hours**

Introduction to Sequential Data, Recurrent Neural Networks (RNNs): Introduction to RNNs-Architecture, Applications of RNNs, Variants of RNN, Limitation. Long Short-Term Memory (LSTM) Networks and Gated Recurrent Units (GRUs): Architecture of LSTM Networks, GRU vs. LSTM: Comparative Analysis.

Text Book	Text Book 1: Ch 7 Text Book 2: Ch 9,20 Text Book:3: Ch 9

MODULE-5	**AUTOENCODERS AND ADVERSARIAL NETWORKS**	**24AIM53.6**	**8 Hours**

Introduction to Representation Learning, Autoencoders: Encoder-Decoder Architecture, Latent Space Representation, Reconstruction Loss. Types: Denoising Autoencoders, Sparse Autoencoders. Applications.

Generative Adversarial Networks (GANs): Introduction to GANs-Architecture: Generator and Discriminator-Training GANs, Applications (Image Generation, Style Transfer).	
Case Study	Anamoly Detection in banking sector for credit card fraud
Text Book	Text Book 1: Ch 6,9 Text Book 2: Ch 10.6 Text Book 3: Ch 9

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	10	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 Books:

1. Nithin Buduma, Nikhil Buduma, and Joe Papa," Fundamentals of Deep Learning Designing Next-Generation Machine Intelligence Algorithms" O'Reilly Media, Inc,2022, ISBN:9781492082187.
2. Dive into Deep Learning, Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Amazon Senior Scientists –Cambridge University Press, 2024. ISBN:978-1-009-38943-3.
3. Neural Networks and Deep Learning, Charu C. Aggarwal, Springer Cha, ISBN: 978-3-031-29641-3, 2023

Reference Books:

1) Understanding Deep Learning, Simon J. D. Prince, MIT Press 2023, ISBN: 978-0262048644

2) Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurélien Géron, 2022, ISBN: 978-1098125974.

Web links and Video Lectures (e-Resources):

- https://www.cse.iitm.ac.in/~miteshk/CS7015_2018.html
- https://ocw.mit.edu/courses/15-773-hands-on-deep-learning-spring-2024/lists/lecture-notes/
- https://ocw.mit.edu/courses/15-773-hands-on-deep-learning-spring-2024/video_galleries/lecture-videos/
- https://course.fast.ai/
- www.iitp.ac.in/~arijit

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

- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)
- Organizing Group discussions on real-world problems
- Seminars

DEEP LEARNING LAB			
Course Code	**24AIL53**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24AIL53.1	Apply deep learning algorithms in Python to solve real-world problems using complex datasets
24AIL53.2	Analyze convolutional neural network (CNN) architectures, including classic and modern variants, for image processing tasks
24AIL53.3	Develop deep learning models using TensorFlow and interpret their performance metrics.
24AIL53.4	Assess deep learning frameworks, such as Keras, and PyTorch, for specific model development tasks.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIL53.1	3	-	-	2	3	-	-	-	-	-	2	3	3
24AIL53.2	3	3	-	3	2	-	-	-	-	-	2	3	3
24AIL53.3	3	3	**3**	3	3	-	-	-	-	-	2	3	3
24AIL53.4	3	3	3	3	3	-	-	-	-	-	3	3	3

Pgm. No.	List of Programs	Hours	
	Prerequisite		
	Basics of Machine learning Concepts and Python Programming	2	NA
	PART-A		
1	Write a python program to implement XOR function using multi-layer Neural Network.	2	24AIL53.1 24AIL53.3
2	Use different hyperparameter and activation functions to find an optimal solution in the implementation of classifier model for given dataset using 3- layer neural network	2	24AIL53.2
3	Develop a program for recognizing handwritten digits using Convolutional Neural Network (CNN).	2	24AIL53.1 24AIL53.2 24AIL53.3
4	Write a program to implement 1D CNN for given time series data.	2	24AIL53.2 24AIL53.3
5	Train two identical neural networks on suitable dataset, one with batch normalization and one without. Compare their performance metrics (accuracy, loss curves) on the test set and show the effect of batch normalization and drop out in neural network classifier.	2	24AIL53.4
6	Develop a python code to implement Convolution Neural Network, visualize the feature maps generated and generalize the model using regularization.	2	24AIL53.2 24AIL53.3
	PART-B		
7	Develop a program for language modeling using RNN	2	24AIL53.3 24AIL53.4
8	Write a program for Text generation using LSTM.	2	24AIL53.1 24AIL53.3 24AIL53.4
9	Develop a LSTM-based model for an open-source dataset. Describe the architecture of LSTM model, including the number of LSTM	2	24AIL53.1 24AIL53.3 24AIL53.4

	layers, embedding dimensions. Also handle the sequence length variability in input texts.		
10	Consider the task of annotating images for autonomous vehicle detection systems. Write a program to implement an approach labeling complex objects such as pedestrians, cyclists, and various types of vehicles using an image labeling tool, also export the annotations in JSON or CSV formats.	2	24AIL53.1 24AIL53.2 24AIL53.3 24AIL53.4
11	Write a program to implement the steps to preprocess the images and augment the data for training a UNet model, also do necessary adjustment in the architecture design to handle different datasets. Collect image dataset for performing U-Net segmentation	2	24AIL53.1 24AIL53.2 24AIL53.3 24AIL53.4
12	Develop a python code to implement autoencoder and visualize the generated images. Experiment the key hyperparameters learning rate, batch size and number of epochs.	2	24AIL53.1 24AIL53.2 24AIL53.3 24AIL53.4

PART-C

Beyond Syllabus Virtual Lab Content

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

- Demonstrate the working of Back propagation: https://vlab.spit.ac.in/ai/#/experiments/1
- YOLO CNN for Object Detection: https://vlab.spit.ac.in/ai/#/experiments/6
- Handwritten Digit Recognition Using CNN: https://vlab.spit.ac.in/ai/#/experiments/2

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test(s) (20)	Weekly Assessment (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) A. Zhang, Z. C. Lipton, M. Li, and A. J. Smola, *Dive into Deep Learning*. Cambridge, UK: Cambridge University Press, 2023. ISBN: 978-1009389433

2) F. Chollet and M. Watson, *Deep Learning with Python*, 3rd ed. Shelter Island, NY, USA: Manning Publications, 2025. ISBN: 978-1633436589.

Machine Learning Operations			
Course Code	**24AIM54**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**03**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24AIM54.1	Apply the core principles, lifecycle, and cultural practices of DevOps, emphasizing version control and continuous integration workflows.
24AIM54.2	Apply containerization and orchestration techniques using Docker and Kubernetes for application deployment and management.
24AIM54.3	Analyze the machine learning lifecycle and identify the role of MLOps in developing reliable and scalable ML systems.
24AIM54.4	Implement MLOps practices for data management, experiment tracking, model training and validation.
24AIM54.5	Develop automated machine learning pipelines using CI/CD, workflow orchestration and cloud-based MLOps platforms.
24AIM54.6	Construct scalable MLOps pipelines to deploy, monitor, and sustain machine learning models in production environments using AWS services.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM54.1	3	-	-	-	2	-	-	-	-	-	2	3	2
24AIM54.2	3	-	-	2	3	-	-	-	-	-	2	3	3
24AIM54.3	3	3	-	2	3	-	-	-	-	-	2	2	2
24AIM54.4	3	3	3	2	3	-	-	-	-	-	2	2	3
24AIM54.5	3	3	3	2	3	-	-	-	-	-	2	2	2
24AIM54.6	3	3	3	3	3	-	-	-	-	-	2	3	3

MODULE-1	DEVOPS FUNDAMENTALS AND VERSION CONTROL	24AIM54.1	8 Hours

Introduction to DevOps, Software Development Life Cycle (SDLC), Agile and DevOps, Version Control Concepts, Installation and Configuration of Git, Git Commands (init, add, commit, push, pull, clone, merge, branch), Git hub actions for workflow automations

Hands on:

1. You have been assigned to develop a simple portfolio website for a client. Before writing code, prepare your development environment following DevOps practices and maintain the project using Git version control.
2. Publish a local Git repository to GitHub and synchronize project versions between the local system and the remote repository.
3. Demonstrate collaborative development by publishing your project to GitHub and implement a feature using branching and merge multiple features into a common project.
4. Automate Continuous integration (CI) using GitHub Actions whenever code is pushed to GitHub.

MODULE-2	CONTAINERIZATION AND ORCHESTRATION	24AIM54.2	8 Hours

Docker Fundamentals, Docker Architecture, Docker Installation and Configuration, Docker Images and Containers, Dockerfile Creation, Docker Hub and Container Registry, Deployment of Python Flask Applications using Docker, Introduction to Kubernetes, Container Orchestration Concepts.

Hands on:

1. Develop a simple Student Management REST API using Python Flask that allows users to retrieve and add student records. Test the implemented APIs using Postman.
2. Explore the advantages of containerization by creating a Docker image and executing a Python Flask application inside a Docker container.
3. Store the application as a Docker image and distribute it using Docker Hub.
4. Pull a docker image from dockerhub repository and run it locally.

MODULE-3	**MLOPS FOUNDATIONS**	**24AIM54.3, 24AIM54.4**	**8 Hours**

Introduction to Machine Learning Operations (MLOps), DevOps vs MLOps, Machine Learning Lifecycle, Challenges in Production ML Systems, Introduction to MLflow, Experiment Tracking, Model Registry and Versioning, Experiment Comparison, Experiment Retrieval and Reproducibility.

Hands on:

1. Develop a machine learning model to predict house prices based on property features. Configure MLflow and explore its experiment tracking interface.
2. Train a machine learning model with different hyperparameters and preprocessing techniques. Use MLflow to track all experiments systematically.
3. Execute several experiments on a ML model. Identify the best model based on evaluation metrics and maintain it using the MLflow Model Registry.
4. Use MLflow to retrieve a saved experiment details and reproduce the model execution.

Case Study	Build a Continuous Training (CT) pipeline that automatically retrains a machine learning model when the training dataset is updated using Github Actions.

MODULE-4	**AUTOMATED ML PIPELINES**	**24AIM54.5**	**8 Hours**

Building REST APIs for Machine Learning using Flask, Streamlit and Docker for Machine Learning Models, Introduction to MLOps Pipelines, Automated Model Validation, Automated Docker Image Build and Deployment Workflow, Model Deployment Strategies, Continuous Integration/Continuous Deployment (CI/CD) for Machine Learning using GitHub Actions.

Hands on:

1. Develop a Flask-based REST API to expose a trained ML model for prediction requests through external applications like postman.
2. Develop a Streamlit-based user-friendly web interface for a ML model that accepts user inputs, displays prediction results, and package the complete application using Docker for portable deployment.
3. Implement direct deployment strategy by replacing an existing Docker container with an updated version of a machine learning application.
4. Configure a GitHub Actions workflow to automate the process of building and validation of the Docker image of a ML project whenever changes are pushed to the repository.

Case Study	Study of Different model deployment strategies.

MODULE-5	**MODEL DEPLOYMENT & MONITORING**	**24AIM54.5 24AIM54.6**	**8 Hours**

Introduction to Cloud-Based Machine Learning Deployment, AWS EC2 servers, Creating and Configuring Virtual Machine Instances, Configuring Docker on Cloud Servers, Deploying Containerized Machine Learning Applications on AWS, Batch and Real-Time Inference, Overview of Kubernetes for Machine Learning Workloads, Model Drift Detection, Data Drift Monitoring.

CIE Assessment Pattern (50 Marks – Hands On) –

RBT Levels		Marks Distribution	
		Test (s)	Online Learning / Certification
		25	25
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	10	15
L4	Analyze	10	5
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	--

Web links and Video Lectures (e-Resources):

- IIT Kharagpur: https://www.youtube.com/@MLOpsIITMBSDegree
- Great Learning: https://www.youtube.com/watch?v=PMRIXTmeXDc
- IBM: https://www.youtube.com/watch?v=OejCJL2EC3k

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

- Online classes using Jeopardy Lab
- Contents related activities (Activity-based discussions)
- Presentations

RESEARCH METHODOLOGY AND IPR			
Course Code	**24RMK55**	**CIE Marks**	**50**
L: T: P: S	**1:0:0:0**	**SEE Marks**	**50**
Hours / Week	**01**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

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

24RMK55.1	Define research problems and formulate research questions and research objectives.
24RMK55.2	Demonstrate research processes, critical thinking, and academic writing skills.
24RMK55.3	Understand the statutory provisions and different forms of Intellectual Property Rights (IPRs).
24RMK55.4	Identify the significance and procedures of patents, including patent filing and protection.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24RMK55.1	3	3	2	2	2	–	–	1	2	–	2	-	**2**
24RMK55.2	3	3	2	2	2	–	–	1	2	–	2	-	**3**
24RMK55.3	3	3	2	1	1	–	1	1	2	–	2	-	**2**
24RMK55.4	3	3	2	1	–	–	1	1	2	–	2	-	**2**

MODULE-1	**FORMULATION OF RESEARCH PROBLEM**	**24RMK55.1**	**3 Hours**
Research– Meaning and Objectives–Types of Research–Research Approaches-Research Process–Literature Review–Research Problem– Identification and Defining the Research Problem.			
Text Book	Text Book 1: Ch. 1, 2		
MODULE-2	**RESEARCH DESIGN PROCEDURES**	**24RMK55.2**	**3 Hours**
Meaning of Research Design – Features of a Good Design –Concepts Related to Research Design– Different Research Designs – Basic Principles of Experimental Designs.			
Case Study	To find the solution for the given research problem using different types of research Methods		
Text Book	Text Book 1: Ch. 3		
MODULE-3	**INTERPRETATION AND REPORT WRITING**	**24RMK55.1 24RMK55.2**	**3 Hours**
Meaning and Technique of Interpretation – Precautions in interpretation – Different Steps in Report Writing – Layout of a Research Report– Types of Report – Mechanics of Writing a Research Report –Conclusion-Referencing in Academic Writing –Bibliography.			
Text Book	Text Book 2: Ch. 14		
MODULE-4	**INTRODUCTION TO IPR**	**24RMK55.3**	**3 Hours**
Introduction and Significance of Intellectual Property Rights –Types of Intellectual Property Rights–Rationale for Protection of IPR–IPR in India and Abroad–Forms of IPR – Royalty – Copyright – Trademark – Patents – Industrial Designs –Application of Different Forms of IPR– Future Aspects of IPR– Some Examples of IPR.			
Text Book	Text Book 2: Ch. 1 and 2		

MODULE-5	BASICS OF PATENTS	24RMK55.3, 24RMK55.4	3 Hours

Patents and its Basics – Patentable and Non-Patentable Inventions–Patent Application Process (National and International level) –Drafting and Filing a Patent –Types of Patent Applications–Patent Documents–Specification and Claims–Assignment, Licensing, Infringement–Different Layers of International Patent System

Case Study	Analyze different domains of filed patents
Text Book	Text Book 2: Ch. 1 and 2

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Patent drafting	Review paper writing
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	-	-
L4	Analyze	5	5	5
L5	Evaluate	5	5	5
L6	Create	-	5	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Kothari, C.R., Research Methodology: Methods and Techniques, New Age International, 2024, ISBN-9789389802559
2) Ramakrishna Chintakunta, A Text book of Intellectual Property rights, Blue Hill Publication, ASIN: B09T6YDB5N, 2022

Reference Books:

1) Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K, An Introduction to Research Methodology, RBSA Publishers. 2022, ISBN-13:978-8176111652
2) Ranjith Kumar, Research methodology, Saga publications,5th edition, 2024, ISBN- 9781529788785.
3) Sinha, S.C. and Dhiman, A.K., Research Methodology, EssEss Publications. 2 volumes, 2022. ISBN: 81-7000-324-5(Vol-I), 81-7000-334-2 (Vol-II)
4) Asha Vijay Durafe, Dhanashree K. Toradmalle , Intellectual Property Rights, Dreamtech Press,2024, ISBN: 9789351195191.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=GSeeyJVD0JU
- https://www.youtube.com/watch?v=nv7MOoHMM2k
- https://www.youtube.com/watch?v=BGSgZ1J8-yQ
- https://onlinecourses.nptel.ac.in/noc22_ge08/preview
- https://www.coursera.org/learn/research-methods
- https://www.wipo.int/academy/en/

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

- Video Sessions
- Organizing Group Wise Discussions
- Paper Presentation
- Review paper writing
- Patent drafting

PROBLEM SOLVING METHODOLOGIES			
Course Code	**24SDK56**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**02**

Course outcomes:
Upon successful completion of this course, the student will be able to:

24SDK56.1	Demonstrate proficiency in solving quantitative aptitude problems using fundamental concepts
24SDK56.2	Apply advanced quantitative techniques to address and solve complex real-world problems.
24SDK56.3	Develop and enhance logical reasoning skills essential for problem-solving in various competitive examinations.
24SDK56.4	Cultivate critical and creative thinking skills necessary for analytical reasoning and problem-solving.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24SDK56.1	3	3	-	-	2	-	-	-	-	-	-
24SDK56.2	3	3	-	-	2	-	-	-	-	-	-
24SDK56.3	3	3	-	-	2	-	-	-	-	-	-
24SDK56.4	3	3	-	-	2	-	-	-	-	-	-

MODULE-1	**Critical Thinking through Quantitative Analysis**	**24SDK56.1 , 24SDK56.2**	**6 Hours**

Number systems: LCM and HCF of numbers, Squaring and Cubing Techniques, Multiplication Tricks, Divisibility rules, Digit sum method, Speed Math, Simplifications, Approximations.
Percentages: Conversion of Fraction to Percentage Table, Percentage Change, Net percentage change/Effective percentage change, Successive Percentage, Concept of more/less percentage, Percentage of percentage, Product constancy, Increased/decreased by P%, Percentage Changes in Numerator and Denominator, Successive Percentage.
Averages: Basic concept, Consecutive Numbers, Non-Consecutive Numbers, Equation Concept, True/False concept, Including/Excluding concept, Replacement concept, Average Speed concept.

MODULE-2	**Numerical Techniques for Problem Solving**	**24SDK56.1, 24SDK56.2**	**6 Hours**

Profit and Loss: Basic concept, Profit Percentage, Loss Percentage, Profit/Loss Percentage, Overall Profit/Loss, Dishonest shopkeeper, More/less loss concept, Discounts
Ratio and Proportion: Concept Explanation, Duplicate Ratio, Triplicate Ratio, Direct Proportion, Indirect Proportion, Double rule of three or compound proportion, Ratio in investment, Ratio in partnership, Ratio in averages, Ratio in profit and loss, Ratio in interest rates.
Ages: Ratio and sum of ages, Ratio and Product of Ages, Ratio of Present and Future Ages, Ratio of Past and Present Ages.
Partnership: Simple Partnership, Compound Partnership, Partnership at Will, Partnership for a Fixed Term, Particular Partnership, General Partnership, Limited Partnership, Limited Liability Partnership.

MODULE-3	**Quantitative Techniques**	**24SDK56.1 , 24SDK56.2**	**6 Hours**

Time and Work: Unit work, Combined work, Individual efficiency, Group efficiencies, Time taken by an individual or a group, Work done by an individual or a group, Total work done, Chain Rule Concept, Pipes and Cisterns, 4 Rules of Pipes and Cistern.
Gamification: Switch Grid, Geo Sudoku, Grid Lock, Number Challenge, Cognitive reasoning games.

Cognitive Ability: Statements & Conclusions, Statements & Assertions, Statements & Assumptions, Causes & Effects and Flow Charts.

MODULE-4	**Analytical Reasoning and Creative Problem Solving**	**24SDK56.3 , 24SDK56.4**	**6 Hours**

Number Series - Missing numbers, Incomplete series **-** Odd**-**even series, primes, Fibonacci series, Arithmetic progression, Geometric progression, Harmonic progression, Squares and cubes, Operations on digits, Exponential series, Increasing multiplication, Hybrid series**.**

Alphabetical Series- Missing alphabets, incomplete letter series **-** series of words, series of letters, arrangement of words/letters, letters marked with corresponding numbers sequence, positions of letters, ranking of the word in dictionary; Mixed Series **-** Missing numbers and words/letters, complete the series**. Analogies:** Alphabet Classification, Word Classification, Number Classification**.**

Coding and Decoding: Coding based on order, Letter to Letter Mapping, Letter to number mapping, Letter to digit mapping, Re**-**ordering sequences; Word sequencing, Match the word to code, Symbol Coding**.**

MODULE-5	**Problem Solving through Logical Analysis**	**24SDK56.3** **24SDK56.4**	**6 Hours**

Directions: Eight Directions, Distance, Displacement, Starting and ending points, Referential directions, Directions of shadows, Axis based problems, Actual and conditional directions**.**

Seating Arrangements: Linear arrangement, Square Arrangement, Rectangular Arrangement, Circular arrangement, Vertical arrangement, Seating arrangement in a photograph, Tabular arrangement, Hexagonal Seating Arrangement, Complex arrangement, Miscellaneous arrangements**.**

Blood Relations: Relations defined, Generation Verticals, Family Tree, Single Person Blood Relations, Mixed/Chain Blood Relations, Symbol based Blood Relation**.**

CIE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Quantitative Aptitude for Competitive Examinations — R**.**S**.** Aggarwal
2. How to Prepare for Quantitative Aptitude for CAT — Arun Sharma

Reference Books:

1. Quantum CAT — Sarvesh K**.** Verma
2. Fast Track Objective Arithmetic — Rajesh Verma
3. Quantitative Aptitude for Placements — Dinesh Khattar

Web links and Video Lectures (e-Resources):

- Freshersworld: Aptitude & Reasoning
  https://www.youtube.com/results?search_query=Freshersworld+Aptitude+Reasoning
- Adda24/7: Aptitude & Reasoning
  https://www.youtube.com/results?search_query=Adda247+Quantitative+Aptitude+Reasoning

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

Activity	**Aptitude Topic**	**Description**
Math Relay Race	Percentages, Profit & Loss, Time & Work	• Divide students into teams. Each student solves one question and passes the sheet to the next teammate. The first team to finish wit the most correct answers wins.
Puzzle & Seating Challenge	Seating Arrangements, Logical Reasoning	• Give each team a seating arrangement or logic puzzle. Teams com to solve it within a fixed time.
DI Detective	Data Interpretation	• Provide charts, graphs, or tables. Students answer questions individually or in groups, explaining how they arrived at their answers.
Human Number Line	Number System, Averages, Ratio & Proportion	• Students hold number cards and physically arrange themselves to solve ordering, averages, ratios, or sequence-based problems.
Aptitude Quiz Bowl	Mixed Aptitude Topics	• Conduct a quiz with multiple rounds (MCQs, rapid fire, visual reasoning, puzzles, and calculation challenges). Award points to teams and maintain a leaderboard.

SOCIETAL BASED MINI PROJECT			
Course Code	**24AIM57**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**-**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

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

24AIM57.1	Demonstrate the technological needs and/or societal needs and sustainability of the environment.
24AIM57.2	Apply practical knowledge and the latest tools usage along with project development.
24AIM57.3	Analyze the outcome of the project.
24AIM57.4	Construct end-to-end machine learning and deep learning systems using MLOps practices for model versioning, continuous deployment, and automated monitoring in domain-specific contexts.
24AIM57.5	Implement the project and provide solutions within the context of the Legel framework, addressing social concerns and upholding ethical issues.
24AIM57.6	Present the Report for the implemented problem and its solutions as a team.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM57.1	3	-	-	-	-	-	--		-	-	-	3	3
24AIM57.2	3	-	-	3	3	-	-	-	-	-	-	3	3
24AIM57.3	3	3	-	-	3	-	-	-	-	-	-	3	3
24AIM57.4	3	3	3	3	2	2	2	3	2	2	2	3	3
24AIM57.5	3	3	3	3	3	2	2	3	3	3	-	3	3
24AIM57.6	3	3	3	3	3	2	3	3	3	3	3	3	3

Each team capable of identifying a problem and carry out a mini project on the problem defined. A panel of experts will review the code developed towards the project during the course of the semester. Plagiarized projects will automatically get an **"F" GRADE** and the student will be liable for further disciplinary action. At the completion of a project, the team will submit a project report, which will be evaluated by duly appointed examiner(s).

CIE Assessment Pattern (50 Marks)

RBT Levels		Review (50 marks)
		50
L1	**Remember**	**-**
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	-

SEE Assessment Pattern (50 Marks)

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

NATIONAL SERVICE SCHEME			
Course Code	**24NSS50**	**CIE Marks (each Semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

24NSS50.1	Understand the importance of his / her responsibilities towards society.
24NSS50.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
24NSS50.3	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.
24NSS50.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24NSS50.1	-	-	-	-	-	3	3	2	-	-	1
24NSS50.2	-	-	-	-	-	3	3	2	-	-	1
24NSS50.3	-	-	-	-	-	3	3	2	-	-	1
24NSS50.4	-	-	-	-	-	3	3	2	-	-	1

Sem/ Code	CONTENT	COs	HRS
3RD 24NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.	24NSS30.1 24NSS30.2 24NSS30.3 24NSS30.4	30
4TH 24NSS40	4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	24NSS40.1 24NSS40.2 24NSS40.3 24NSS40.4	30
5TH 24NSS50	7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 9. Spreading public awareness under rural outreach programs. (minimum 5 programs).	24NSS50.1 24NSS50.2 24NSS50.3 24NSS50.4	30
6TH 24NSS60	10. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 11. Govt. school Rejuvenation and helping them to achieve good infrastructure.	24NSS60.1 24NSS60.2 24NSS60.3 24NSS60.4	30

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 6th 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.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- 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.	Setting of the information imparting club for women leading to contributionin 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
4.	Water conservation techniques – Role of different stakeholders– Implementation.	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

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
6.	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
7.	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
8.	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
9.	Spreading public awareness under rural outreach programs. (minimum5 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
10.	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
11.	Govt. school Rejuvenation andhelping 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	**24PED50**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4= 200**
Credits	**00**	**Exam Hours**	**02**

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

24PED50.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
24PED50.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
24PED50.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
24PED50.4	Understand the roles and responsibilities of organization and administration of sports and games

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
24PED50.1	-	-	-	-	-	2	-	3	3	-	-	2
24PED50.2	-	-	-	-	-	2	-	3	3	-	-	2
24PED50.3	-	-	-	-	-	2	-	3	3	-	-	2
24PED50.4	-	-	-	-	-	2	-	3	3	-	-	2

Sem	CONTENT	COs	HRS
3RD 24PED30	**Module 1: Orientation** A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.	24PED30.1 24PED30.2	5
	Module 2: General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash D. Agility – Shuttle Run E. Flexibility – Sit and Reach F. Cardiovascular Endurance – Harvard step Test	24PED30.2 24PED30.3	15
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.	24PED30.3 24PED30.4	10
4TH 24PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	24PED40.1 24PED40.2	5
	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw. C. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. D. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up. E. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash. F. Athletics (Track / Field Events) – Any event as per availability of Ground.	24PED40.3	20
	Module 3: Role of Organization and administration	24PED40.4	5

5TH 24PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 1. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** A. Fundamental Skills 1. Catching, Throwing and Ball control, 2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 3. Dribbling: High and low. 4. Attack and counter attack, simple counter attack, counter attack from two wings and center. 5. Blocking, Goal Keeping and Defensive skills. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of officials **Ball badminton:** A. Fundamental Skills 1. Basic Knowledge: Various parts of the Racket and Grip. 2. Service: Short service, Long service, Long-high service. 3. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	24PED50.1 24PED50.2 24PED50.3 24PED50.4	Total 30 Hrs / Semester 2 Hrs/ week
6TH 24PED60	**Athletics**: 1. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations) use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Football OR Hockey** **Football:** A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. 2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 4. Heading: In standing, running and jumping condition. 5. Throw-in: Standing throw-in and Running throw-in. 6. Feinting: With the lower limb and upper part of the body. 7. Tackling: Simple Tackling, Slide Tackling. 8. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting. 9. Game practice with application of Rules and Regulations. A. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing	24PED60.1, 24PED60.2, 24PED60.3, 24PED60.4	Total 30 Hrs/ Sem 2 Hrs/ week

	4. Penalty stroke practice. 5. Penalty corner practice. 6. Tackling: Simple Tackling, Slide Tackling. 7. Goal Keeping, Ball clearance- kicking, and deflecting. 8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials		

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 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.

YOGA			
Course Code	**24YOG50**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

24YOG50.1	Understanding the origin, history, aim and objectives of Yoga
24YOG50.2	Become familiar with an authentic foundation of Yogic practices
24YOG50.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat Kriyas
24YOG50.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24YOG50.1	-	-	-	-	-	3	-	-	-	-	1
24YOG50.2	-	-	-	-	-	3	-	-	-	-	1
24YOG50.3	-	-	-	-	-	3	-	-	-	-	1
24YOG50.4	-	-	-	-	-	3	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HRS
3rd 24YOG30	**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 Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	24YOG30.1 24YOG30.2 24YOG30.3 24YOG30.4	Total 32 Hrs/ Sem 2 Hrs/week
4TH 24YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	24YOG40.1 24YOG40.2 24YOG40.3 24YOG40.	Total 32 Hrs/ Semester 2 Hrs/week

5TH 24YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvangasana **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	24YOG50.1 24YOG50.2 24YOG50.3 24YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 24YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 4. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	24YOG60.1 24YOG60.2 24YOG60.3 24YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

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**

VI SEMESTER

NATURAL LANGUAGE PROCESSING			
Course Code	**24AIM61**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24AIM61.1	Describe basics of linguistics, probability and statistics associated with NLP.
24AIM61.2	Analyze language modeling techniques and semantic representations in natural language processing.
24AIM61.3	Design an end-to-end NLP application by integrating preprocessing, feature extraction, and model-building techniques.
24AIM61.4	Assess the performance of advanced transformer models in various NLP tasks such as text classification, summarization, and topic modeling.
24AIM61.5	Construct transformer-based deep learning pipelines incorporating multi-head attention mechanisms for domain-specific text generation and classification tasks.
24AIM61.6	Implement the NLP applications on emerging trends with ethical implications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM61.1	2	-	-	-	-	-	-	-	-	-	-	-	-
24AIM61.2	3	3	-	-	-	-	-	-	-	-	2	3	2
24AIM61.3	3	3	3	-	-	-	-	-	-	-	2	3	2
24AIM61.4	3	3	3	3	3	-	-	-	-	-	2	3	2
24AIM61.5	3	3	3	3	-	-	-	-	-	-	2	3	2
24AIM61.6	3	3	2	-	3	-	2	3	-	-	2	3	2

MODULE-1	**FUNDAMENTALS OF NATURAL LANGUAGE PROCESSING**	**24AIM61.1**	**8 Hours**

Introduction to NLP, Components of NLP, Ambiguity in Natural language, Basics of Linguistics, Probability and Statistics for NLP, Words and Corpora, Regular Expressions, Simple Unix Tools for Word Tokenization, Text Normalisation, Rule-based Tokenization, Morphology: Inflectional Morphology and Derivational Morphology, Finite-State Morphological Parsing, Porter Stemmer, Minimum edit distance

Case Study	NLP applications in various industries.
Text Book	Text Book 1: Ch 2

MODULE-2	**STATISTICAL LANGUAGE MODELS AND SEMANTICS**	**24AIM61.2**	**8 Hours**

N-Gram Language Models, Building Unigram, Bigram and Trigram Language Models, Evaluating Language Models, Smoothing Techniques, Perplexity, Representing Meaning, First-Order Predicate Calculus, Semantic Roles, and Word Sense Disambiguation.

Text Book	Text Book 1: Ch 3,21

MODULE-3	**VECTOR SEMANTICS AND WORD EMBEDDINGS**	**24AIM61.2, 24AIM61.3**	**8 Hours**

Lexical Semantics, Vector Semantics, Word Vector Representations, Cosine Similarity, TF-IDF (Term Frequency–Inverse Document Frequency), Pointwise Mutual Information (PMI), Applications of TF-IDF and PPMI, Word2Vec (CBOW and Skip-gram), GloVe, FastText, Contextual Word Embeddings, Evaluation of Vector Models, Part-of-Speech Tagging, Hidden Markov Models (HMM), Named Entity Recognition (NER), and Conditional Random Fields (CRFs).

Text Book	Text Book 1: Ch 5,17

MODULE-4	**TRANSFORMER AND TOPIC MODELS**	**24AIM61.4, 24AIM61.5**	**8 Hours**

Sequence-to-Sequence models, Attention mechanism, Transformer architecture, Self-Attention and Multi-head Attention, Positional Encoding, Encoder- Decoder Architecture, BERT (Bidirectional Encoder Representations from Transformers), GPT Models, T5(Text-to-Text Transfer Transformer), Fine-tuning transformer models for NLP tasks. Topic Modeling: Latent Dirichlet Allocation (LDA) and Non-NegativeMatrix Factorization (NMF).

Text Book	Text Book 1: Ch 8,9

MODULE-5	**APPLICATIONS AND FUTURE DIRECTIONS IN NLP**	**24AIM61.5, 24AIM61.6**	**8Hours**

Text Classification, Sentiment Analysis, Information Extraction, Named Entity Recognition applications, machine translation, Question Answering Systems, Text Summarization, Dialogue systems, Chatbots, GPT-based Applications, Ethical and Responsible NLP, Future Trends in NLP: Emerging trends and AI-driven NLP tools and services.

Case Study	Using NLP for Healthcare summaries
Text Book	Text Book 1: Ch-12 Text Book 2: Ch 23,24

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	10	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:

Textbooks:

1) Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models, 3rd Edition, Online Manuscript, Stanford University, January 2026. Available at: https://web.stanford.edu/~jurafsky/slp3/
2) Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 3rd Edition (Online Draft), Stanford University, January 2022.

Reference Books:

1) Lewis Tunstall, Leandro von Werra, Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media, 2022. ISBN: 9781098103248.
2) Hobson Lane and Maria Dyshel, Natural Language Processing in Action, 2nd Edition, Manning Publications, 2025. ISBN: 978-1617299445

Web links and Video Lectures (e-Resources):

- http://www.digimat.in/nptel/courses/video/106101007/L01.html
- https://www.youtube.com/playlist?list=PLzJaFd3A7DZutMK8fFxZx_mhmFQgzijGE
- https://nptel.ac.in/courses/106101007

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

- Online Class using Jeopardy
- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to read research topics on NLP
- Class Presentation

NATURAL LANGUAGE PROCESSING LAB			
Course Code	**24AIL61**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24AIL61.1	Analyze textual data by applying Natural Language Processing (NLP) algorithms with NLTK
24AIL61.2	Apply tokenization, stemming, and lemmatization techniques to process and visualize text corpora
24AIL61.3	Utilize word embedding models (e.g., Word2Vec, GloVe), part-of-speech tagging, named entity recognition to capture linguistic features and semantic relationships in text.
24AIL61.4	Construct end-to-end NLP applications by integrating fine-tuned transformer models, topic discovery algorithms, and text classification workflows

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIL61.1	3	3	-	-	-	-	-	-	-	-	2	3	**2**
24AIL61.2	3	-	-	-	-	-	-	-	-	-	2	3	2
24AIL61.3	**3**	**3**	**3**	-	3	-	-	-	-	-	2	3	2
24AIL61.4	3	3	**3**	3	3	-	-	-	-	-	2	3	2

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Python Programming/ Basic Packages • Basics of Automata Theory concepts	2	NA
	PART-A		
1	Choose an English word from a text corpus and analyze its usage by generating concordances. Extract and display all words longer than four characters from the corpus.	2	24AIL61.1 24AIL61.2
2	Counting Vocabulary: a) Identify the total number of words (tokens) in the given text. b) Identifythe total number of unique words (types) in the given text. c) Analyze the frequency of occurrence of the word "the" in the given text. d) Analyze the percentage of occurrences of the word "the" with respect to the total number of words in the text	2	24AIL61.1 24AIL61.2
3	Write a Python program to perform tokenization and stemming on a text corpus and display the resulting tokens and stems.	2	24AIL61.1 24AIL61.2
4	Develop a Python program to remove stop words using NLTK and extract email IDs, phone numbers, and dates from text using regular expressions.	2	24AIL61.1 24AIL61.2
5	a. Write a program for N-gram model with NLTK in Python b. Implement Wordnet Lemmatizer with appropriate POS tag.	2	24AIL61.1 24AIL61.2
6	Build a Bag-of-Words (BoW) model for a collection of text documents. Generate the document-term matrix, identify the most frequent terms, and visualize the top terms using bar charts.	2	24AIL61.1 24AIL61.2 24AIL61.3
	PART-B		
7	Develop a Python program to implement Named Entity Recognition on a text corpus. Visualize the frequency distribution of different entity types using bar chart.	2	24AIL61.2 24AIL61.3

8	Develop a Python program to classify a given sentence as positive, negative, or neutral using NLTK's VADER sentiment analyzer	2	24AIL61.2 24AIL61.3
9	Develop a Python program to implement Word2Vec and FastText word embedding models for a given text corpus and compare their performance.	2	24AIL61.4
10	Develop a Python program to fine-tune a BERT model for a text classification task. Evaluate the trained model using Accuracy, Precision, Recall, F1-Score, and Confusion Matrix and analyze the performance.	2	24AIL61.4
11	Develop a Python program to implement abstractive text summarization for a given document. Compare the original and summarized texts by analyzing word count and sentence count	2	24AIL61.2 24AIL61.3
12	Develop a Python program to implement a language translator using transformer-based models. Perform back-translation and analyze the consistency between the original and translated texts.	2	24AIL61.4

PART-C

Beyond Syllabus Virtual Lab Content

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

- Word Analysis : https://nlp-iiith.vlabs.ac.in/exp/word-analysis/
- Word Generation: https://nlp-iiith.vlabs.ac.in/exp/word-generation/
- Morphology : https://nlp-iiith.vlabs.ac.in/exp/morphology/
- N-grams: https://nlp-iiith.vlabs.ac.in/exp/n-grams/
- N-grams smoothing: https://nlp-iiith.vlabs.ac.in/exp/n-grams-smoothing/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		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) Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models, 3rd Edition, Online Manuscript, Stanford University, January 2026.

BIG DATA TECHNOLOGIES			
Course Code	**24AIM62**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24AIM62.1	Understand the fundamental concepts, architecture, and components of Big Data technologies including HDFS and related frameworks.
24AIM62.2	Apply MapReduce programming concepts to solve real-world Big Data processing problems.
24AIM62.3	Analyze and evaluate the performance of iterative data processing algorithms using Apache Spark.
24AIM62.4	Design models for data transformation, processing, and analytics in Big Data environments.
24AIM62.5	Execute Big Data algorithms on Spark RDDs to solve problem statements.
24AIM62.6	Use Hadoop ecosystem tools such as Pig and Hive for large-scale data storage, querying, and analysis.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM62.1	3	-	-	-	-	-	-	-	-	-	-	-	-
24AIM62.2	3	-	-	-	3	-	-	-	-	-	-	3	2
24AIM62.3	3	3	-	-	3	-	-	-	-	-	-	3	2
24AIM62.4	3	3	3	-	3	-	-	-	-	-	-	3	2
24AIM62.5	3	3	3	-	3	-	-	-	-	-	-	3	2
24AIM62.6	3	3	3	-	3	-	-	-	-	-	**2**	3	2

MODULE-1	**INTRODUCTION TO BIG DATA AND HADOOP**	**24AIM62.1**	**8 Hours**

Introduction to Big Data, Data Storage and Analysis, Comparison with other Systems, A brief History of Hadoop, Hadoop Releases, Apache Hadoop and Eco System, Hadoop 2 (YARN): Architecture – Interacting with Hadoop Eco systems, Hadoop Streaming, Hadoop Pipes

Text Book	Text Book 1: Ch 1,2,5 Text Book 2: Ch 38,39

MODULE-2	**HDFS AND MAP REDUCE**	**24AIM62.2**	**8 Hours**

HDFS Concepts, Command Line Interface, Hadoop file system, interfaces, Data flow, Hadoop Archives, Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression, Failures, Job Scheduling, Task Execution, Map Reduce Types and Input and Output Formats, Map Reduce Features

Text Book	Text Book 1: Ch 5,6 Text Book 2: Ch 39

MODULE-3	**APACHE SPARK**	**24AIM62.3**	**8 Hours**

Spark's Basic Architecture, Spark's API, Data Frames, Spark's Toolset, Structures API – Data sets, Data Frames, SQL tables and views, Basic Structured operations, Different types of Data, Aggregations, Joins.

Text Book	Text Book 1: Ch 3, 5 Text Book 2: Ch 39.2

MODULE-4	**SPARK RDDs**	**24AIM62.4, 24AIM62.5**	**8 Hours**

Creating RDDs, Manipulating RDDs, Advanced RDDs-Key-value Basics, Aggregations, Co Groups, Joins, Controlling Partitions, Custom Serialization, Distributed Shared Variables, how spark Runs on a cluster, Streaming- Stream Processing Design Points, Spark's Streaming APIs.

Text Book	Text Book 1: Ch 5 Text Book 2: Ch 39.2

MODULE-5	**APACHE PIG AND APACHE HIVE**	**24AIM62.6**	**8 Hours**

Apache Pig: Introduction to PIG, Pig on Hadoop, Installing and Running Pig, Grunt, Pig's Data Model, Introduction to Pig Latin, Developing and Testing Pig Latin Scripts.
Apache Hive: Introduction, Hive in Hadoop Ecosystem, Data Types and File Formats, HiveQL-Data Definition, Data Manipulation, Queries, Views, Indexes.

Text Book	Text Book 1: Ch 5

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.Ümit Demirbaga, Gagangeet Singh Aujla, Anish Jindal, and Oğuzhan Kalyon, "Big Data Analytics: Theory, Techniques, Platforms, and Applications", Springer Nature Switzerland, 2025, ISBN: 9783031566981 (Print), 9783031566998 (eBook).

2.Philippe J. S. De Brouwer, The Big R-Book: From Data Science to Learning Machines and Big Data, John Wiley & Sons, First Edition, 2020, ISBN: 978-1119632771.

Reference Books:

1. Arip Basuki, Masria Rambe, and Sahat Parulian Sitorus, Big Data Analytics: Concepts, Implementation, and the Latest Application, Serasi Media Teknologi, First Edition, 2026, ISBN: 978-6347531261.

2.Rob Botwright, Big Data: Statistics, Data Mining, Analytics, and Pattern Learning, First Edition, Rob Botwright Publications, 2024, ISBN: 978-1839386824.

Web links and Video Lectures (e-Resources):

- IIT Kharagpur: https://www.youtube.com/watch?v=rvJgArru8dI
- IIT Kharagpur: https://www.youtube.com/watch?v=cTZVK7CK1gs
- IIT Kharagpur: https://www.youtube.com/watch?v=mNP44rZYiAU
- MIT: https://www.youtube.com/watch?v=mzIoSW-cInA

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

- Online classes using Jeopardy Lab
- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to read research papers on Big Data Analytics and have a discussion.
- Presentations

BIG DATA TECHNOLOGIES LAB			
Course Code	**24AIL62**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24AIL62.1	Apply the Hadoop MapReduce framework and HDFS to develop distributed data processing and file management applications.
24AIL62.2	Design data processing workflows using Apache Pig for analyzing large-scale datasets.
24AIL62.3	Develop data warehouse applications using Apache Hive, including table partitioning and query optimization.
24AIL62.4	Implement Big Data analytics applications using Apache Spark for data processing, integration with NoSQL databases, and real-time analytics.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIL62.1	3	-	-	-	3	-	-	-	-	-	-	3	3
24AIL62.2	3	3	3	-	3	-	-	-	-	-	-	3	3
24AIL62.3	3	3	3	-	3	-	-	-	-	-	-	3	3
24AIL62.4	3	3	3	-	3	-	-	-	-	-	-	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	• Basic knowledge of computer programming (Python or Java). • Basic understanding of databases and SQL • Basic knowledge of Linux command-line operations	2	NA
	PART-A		
1	Develop and execute a Word Count application using the Hadoop MapReduce framework to count the frequency of each word in a given text file.	2	24AIL62.1
2	Perform data materialization on a publicly available dataset using the Hadoop framework and verify the generated materialized data.	2	24AIL62.1
3	Develop and execute an Apache Pig script to identify the most frequently occurring initial letter from the words in a given dataset.	2	24AIL62.2
4	Implement partitioning in Apache Hive by creating a partitioned table, loading data into partitions, and analyzing query performance.	2	24AIL62.3
5	Implement Hadoop Distributed File System file management operations, including creating directories, uploading files, retrieving files, and deleting files and directories.	2	24AIL62.1
6	Implement matrix multiplication using the Hadoop MapReduce framework.	2	24AIL62.1
	PART-B		
7	Implement an Apache Spark program to read data from a CSV file into a DataFrame and write the DataFrame to a CSV file.	2	24AIL62.4
8	Develop and execute an Apache Spark application to convert a Resilient Distributed Dataset into a DataFrame and a Dataset.	2	24AIL62.4
9	Develop and execute an Apache Spark application to read a dataset and load the processed data into a MongoDB database.	2	24AIL62.4
10	Develop and execute an Apache Spark application to load a given dataset into a Neo4j graph database and verify the successful creation and retrieval of graph data.	2	24AIL62.4
11	Develop and execute an Apache Spark application to load a given dataset into an Apache Cassandra database and verify the successful insertion and retrieval of the data.	2	24AIL62.4
12	Design and implement a real-time health monitoring system using Hadoop/Spark to process and analyze patient health data for continuous monitoring.	2	24AIL62.4

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

1. Spark and RDD Program: https://sparkbyexamples.com/spark/spark-rdd-transformations-2/ https://sparkbyexamples.com/pyspark-rdd/ https://www.bing.com/videos/search?q=spark+rdd+experiments+video&view=detail&mid=395879D64250FA3C2B47395879D64250FA3C2B47&FORM=VIRE
2. Hive-Program: https://www.bing.com/videos/search?q=video+for+spark+RDD+programs+using+python&&view=detail&mi

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	**30**
L1	**Remember**	**-**	**-**
L2	**Understand**	-	5
L3	**Apply**	10	15
L4	**Analyze**	10	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) Arip Basuki, Masria Rambe, and Sahat Parulian Sitorus, Big Data Analytics: Concepts, Implementation, and the Latest Application, Serasi Media Teknologi, First Edition, 2026, ISBN: 978-6347531261.
2).Rob Botwright, Big Data: Statistics, Data Mining, Analytics, and Pattern Learning, First Edition, Rob Botwright Publications, 2024, ISBN: 978-1839386824.

FULL STACK DEVELOPMENT FOR AI APPLICATIONS			
Course Code	**24AIM63**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**03**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24AIM63.1	Describe the core components of front-end web development, focusing on HTML5 semantics, CSS3 styling, and responsive design principles.
24AIM63.2	Develop interactive client-side web applications using JavaScript, DOM manipulation, asynchronous programming, and APIs.
24AIM63.3	Design and implement reusable front-end applications using React.js components, state management, hooks, and routing.
24AIM63.4	Develop RESTful backend services using Node.js and Express.js with routing, middleware, validation, and error handling.
24AIM63.5	Build secure full-stack applications using MongoDB, authentication, file uploads, and deployment techniques.
24AIM63.6	Integrate front-end, back-end, databases, and AI/ML services to develop and deploy secure full-stack AI applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM63.1	3	-	-	-	2	-	-	-	-	-	2	3	-
24AIM63.2	3	3	2	1	3	-	-	-	-	-	2	3	-
24AIM63.3	2	2	3	2	3	-	-	-	-	-	2	3	-
24AIM63.4	2	3	3	2	3	-	-	-	-	-	2	3	-
24AIM63.5	2	2	3	2	3	-	-	-	-	-	2	3	-
24AIM63.6	3	3	3	3	3	-	-	-	-	-	2	3	3

MODULE-1	WEB FUNDAMENTALS WITH HTML5 AND CSS3	24AIM63.1	8 Hours

Introduction to full stack development; web application architecture; client-server model; HTTP request and response basics; HTML5 document structure; semantic tags; lists, tables, forms, media elements; CSS3 selectors; box model; typography; colors; Flexbox and Grid; responsive design; and basic accessibility practices.

Hands on:

1. Create a semantic web page using HTML5 tags.
2. Design forms with labels, inputs, and validation hints.
3. Apply CSS selectors, box model, and typography.
4. Build a responsive layout using Flexbox and Grid.
5. Develop a landing page for an AI-enabled application or intelligent service.

Applications	AI Chatbot Landing Page or dashboard for ML predictions

MODULE-2	JAVASCRIPT ESSENTIALS FOR INTERACTIVE WEB APPS	24AIM63.2	8 Hours

JavaScript syntax and program structure; variables, data types, operators, and control statements; functions; arrays and objects; ES6 features; DOM manipulation; event handling; JSON; asynchronous JavaScript; fetch API; Consuming REST APIs for AI services; and client-side form validation.

Hands on:

1. Write programs using variables, functions, arrays, and objects.
2. Manipulate DOM elements and handle browser events.
3. Create a calculator using JavaScript.
4. Validate a form before submission.
5. Fetch weather prediction API/ text classification API

Applications	Interactive Student Career Recommendation Interface

MODULE-3	REACT.JS FRONT-END DEVELOPMENT	24AIM63.3 24AIM63.6	8 Hours

Introduction to React.js; project setup; JSX; components; props; state; hooks such as useState and useEffect; conditional rendering; lists and keys; event handling; forms; lifting state; React Router; and reusable component design. Calling backend AI APIs from React, Loading indicators while AI predicts, Display confidence scores

Hands on:

1. Create a React project and organize components.
2. Pass data using props and manage local state.
3. Build a form component with controlled inputs.
4. Implement page navigation using React Router.
5. Develop a small single-page application with reusable components.

Case Study	Disease Prediction Dashboard

MODULE-4	**NODE.JS AND EXPRESS.JS BACK-END DEVELOPMENT**	**24AIM63.4 24AIM63.6**	**8 Hours**

Node.js runtime environment; npm and package management; modules; Express.js server setup; routing; middleware; request and response objects; REST API design; controller-based structure; input validation; centralized error handling; and API testing using Postman. REST APIs serving ML predictions, Backend integration with Python ML model

Hands on:

1. Set up a Node.js server with Express.js.
2. Create REST endpoints for CRUD operations.
3. Add middleware for logging and validation.
4. Handle errors using a consistent response format.
5. Test API routes using Postman.

Applications	ML Prediction Service Backend / Student Performance Prediction API

MODULE-5	**MONGODB AUTHENTICATION, FILE UPLOAD AND DEPLOYMENT**	**24AIM63.5 24AIM63.6**	**8 Hours**

MongoDB collections and documents; MongoDB Atlas setup; Mongoose schemas and models; CRUD operations; basic relationships between documents; password hashing using bcrypt; JWT-based authentication; file upload using Multer; environment variables; CORS; and deployment of the MERN application using Render. Storage of prediction history and uploaded datasets using MongoDB

Hands on:

1. Connect the backend to MongoDB Atlas.
2. Create schemas, models, and CRUD operations with Mongoose.
3. Add user registration and login with JWT.
4. Upload and serve image files using Multer.
5. Deploy the complete MERN application on Render.

Applications	AI Image Classification Portal/ Resume Screening Application

CIE Assessment Pattern (50 Marks – Hands On)

RBT Levels		**Marks Distribution**	
		Test (s)	**Online Learning / Certification**
		25	**25**
L1	**Remember**	**-**	**-**
L2	**Understand**	**5**	**5**
L3	**Apply**	10	15
L4	**Analyze**	10	5
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**	**--**

Reference Books:

1. Robin Nixon, HTML5 and CSS3 Masterclass, BPB Publisher, ISBN-13: 978-9355511218, 2022.
2. Yanko Belov, JavaScript Masterclass: A comprehensive guide to mastering JavaScript programming, BPB Publisher,2024, ISBN-13: 978-9355517074.
3. Anthony Onyekachukwu Okonta, React.js Design Patterns, BPB Online,2023, ISBN 13: 978-9355513649.
4. Prem Kumar, Full Stack Development with MERN, Notion Press, ISBN 13: 979-8904316280, 2026: ISBN:978-8904316280.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=h_RftxdJTzs
- https://www.youtube.com/watch?v=vmpPKBwhWd0&list=PL2U8BLk0YRjAWuF47s5tXqFPYL3ct9QY6
- https://www.youtube.com/watch?v=SqcY0GlETPk
- https://www.youtube.com/watch?v=KOutPbKc9UM
- https://www.youtube.com/watch?v=pqVo0OnA2No&list=PL-qmWjtEKf7jklvrbHSL8v9D64JvUsQCo

AI IN INFORMATION RETRIEVAL			
Course Code	**24AIM641**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24AIM641.1	Describe the core architecture of Information Retrieval systems, including text preprocessing pipelines and indexing methodologies.
24AIM641.2	Apply classical retrieval models and document ranking methods for effective information retrieval.
24AIM641.3	Analyze retrieval performance using standard evaluation metrics and user-centric measures.
24AIM641.4	Implement AI-based retrieval techniques including semantic search and neural retrieval models.
24AIM641.5	Design distributed, multimedia, and web-scale information retrieval systems.
24AIM641.6	Develop intelligent search applications using web search algorithms.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM641.1	3	-	-	-	-	-	-	-	-	-	-	2	3
24AIM641.2	3	-	-		-	-	-	-	-	-	-	2	3
24AIM641.3	3	3	-	3	2	-	-	-	-	-	2	2	2
24AIM641.4	3	3	2	2	3	-	-	-	-	-	2	3	3
24AIM641.5	3	3	3	2	3	-	-	-	-	-	2	3	3
24AIM641.6	3	3	3	2	3	-	-	-	-	-	3	3	3

MODULE-1	**FUNDAMENTALS OF INFORMATION RETRIEVAL**	**24AIM641.1**	**8 Hours**

Introduction to Information Retrieval, Data Retrieval vs Information Retrieval, Components of IR Systems, Architecture of IR Systems, Text Mining and Information Retrieval. Text Preprocessing: Tokenization, Stop-word Removal, Stemming, Lemmatization.
Indexing and Term Weighting: TF, IDF, TF-IDF, Inverted Index, Signature Files, Hash-Based Indexing, Suffix Trees and Suffix Arrays. Introduction to Semantic Representation and Word Embeddings.

Text Book	Text Book 1: Ch 1, 2, 3, 4

MODULE-2	**RETRIEVAL MODELS AND AI TECHNIQUES**	**24AIM641.2**	**8 Hours**

Boolean Retrieval Model, Vector Space Model, Probabilistic Retrieval Model, Language Models, Inference Networks. Relevance Feedback, Query Expansion, Cluster Hypothesis.
Latent Semantic Indexing (LSI), Learning to Rank Concepts, Neural Information Retrieval, Dense Retrieval Models, Semantic Search, Bi-Encoder and Cross-Encoder Architectures.
Clustering Algorithms: Single Pass Algorithm, Single Link Algorithm.

Text Book	Text Book 1: Ch 5, 6, 7, 8, 9

MODULE-3	**EVALUATION OF INFORMATION RETRIEVAL SYSTEMS**	**24AIM641.3**	**8 Hours**

Evaluation Metrics: Precision, Recall, F-Measure, Mean Reciprocal Rank (MRR), Mean Average Precision (MAP), Normalized Discounted Cumulative Gain (NDCG).
Cross Validation and Experimental Design. User-Oriented Evaluation Measures, Click-through Analysis, A/B Testing.
Visualization in Information Systems: User Relevance Judgments, Document Context Visualization, Interface Support for Search Processes, Explainable and Fair Search Systems.

Text Book	Text Book 1: Ch 10, 11, 12

MODULE-4	**DISTRIBUTED AND MULTIMEDIA INFORMATION RETRIEVAL**	**24AIM641.5, 24AIM641.6**	**8 Hours**

Distributed Information Retrieval: Collection Partitioning, Source Selection, Query Processing, Federated Search, Web Issues.
Multimedia Information Retrieval: Multimedia Data Models, Query Languages, Multimedia Indexing Approaches, Image Retrieval, Video Retrieval, Audio Retrieval, Automatic Feature Extraction.
Vector Databases and Similarity Search: Introduction to FAISS, ChromaDB, Pinecone, Approximate Nearest Neighbor (ANN) Search.

Case Study	Automatic feature extraction in Multimedia IR
Text Book	Text Book 1: Ch 13, 14, 15

MODULE-5	**WEB SEARCH**	**24 AIM641.4, 24AIM641.5, 24AIM641.6**	**8 Hours**

Challenges in Web Search, Characteristics of the Web, Search Engine Architecture, Web Crawlers, Web Data Mining. Hyperlink Analysis, Web Graph, PageRank Algorithm, HITS Algorithm.
Knowledge Graphs, Question Answering Systems, Conversational Search.

Text Book	Text Book 1: Ch 16, 17, 18, 19

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	10	5
L4	Analyze	10	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	20
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Textbook:

1) Hybrid Intelligent Systems for Information Retrieval, Anuradha D Thakare, Shilpa Laddha, Ambika Pawar, Chapman & Hall,2024, ISBN:978-1032035703

Reference Books:

1) Neural Approaches to Conversational Information Retrieval, Jianfeng Gao, Chenyan Xiong, Paul Bennett, Nick Craswell et al., Springer, 2023, ISBN: 978-3031230806.
2) Knowledge Graph-Enhanced RAG Tomaž Bratanič, Oskar Hane, Manning Pubns Co,2025, ISBN: 978-1633436268.

Web links and Video Lectures (e-Resources):

- https://www.geeksforgeeks.org/what-is-information-retrieval/
- https://nlp.stanford.edu/IR-book/?utm_source=chatgpt.com
- https://www.youtube.com/watch?v=z0kLmriffyg&list=PLpwnR8mPhhf8m7L_b9cSRLdjPW2soerAd

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

- Demonstration of various image retrieval algorithms.
- Content-related activities (Activity-based discussions)
    - For active participation of students, instruct the students to prepare the model for various IR algorithms.
    - Research paper presentations on recent advancements in Neural Information Retrieval and Generative Search.
    - Case study analysis of search engines and recommendation systems.

CRYPTOGRAPHY AND NETWORK SECURITY			
Course Code	**24AIM642**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24AIM642.1	Apply standard cryptographic algorithms and network security principles to protect data integrity and secure transmission pathways.
24AIM642.2	Analyze different cryptographic algorithms to assess their vulnerability to common security attacks and cryptanalysis techniques
24AIM642.3	Compare the architectures of symmetric (private key) and asymmetric (public key) cryptography to determine their suitability for secure data exchange
24AIM642.4	Design secure key management and distribution architectures using digital certificates and trust hierarchies.
24AIM642.5	Implement network protection mechanisms, including firewalls, intrusion detection systems, and access controls, to mitigate security threats.
24AIM642.6	Formulate risk mitigation strategies and security controls by analyzing network protocols, data transmission methods, and system vulnerabilities..

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM642.1	3	-	-	-	-	-	-	-	-	-	-	2	3
24AIM642.2	3	3	-	-	2	-	-	-	-	-	-	2	3
24AIM642.3	3	3	3	2	2	-	-	-	-	-	2	2	3
24AIM642.4	3	3	3	2	3	-	3	-	-	-	2	2	3
24AIM642.5	3	3	3	2	3	2	3		-	-	2	2	3
24AIM642.6	3	3	3	3	2	2	2	-	-	-	3	2	3

MODULE-1	**Classical Encryption Techniques and Block Ciphers**	**24AIM642.1**	**8 Hours**

Cryptography, Network Security, **Substitution Techniques:** Caesar Cipher, Monoalphabetic Cipher, Hill Cipher, One Time Pad.

The data encryption standard: DES encryption, DES decryption, **A DES example**: Results, The Avalanche effect, **The strength of DES**: The use of 56-Bit Keys, The nature of the DES algorithm, Timing Attacks.

Case Study	Investigate the Challenges of DES to encrypt customer data. An attacker obtains the ciphertext and launches a brute force attack by testing all possible keys.
Text Book	Text Book 1: Ch 1: 1.6,1.7, Ch 3: 3.2, Ch 4: 4.2, 4.3, 4.4.

MODULE-2	**Public-Key Cryptography and RSA**	**24AIM642.2**	**8 Hours**

Principles of public-key cryptosystems: Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems, public-key cryptanalysis. **The RSA algorithm**: description of the algorithm, computational aspects, the security of RSA.

Other Public-Key Cryptosystems: Diffie-Hellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems.

Case Study	To understand how public-key cryptography secures online banking transactions using RSA and Diffie–Hellman key exchange.
Text Book	Text Book 1: Ch 9: 9.1, 9.2, Ch 10: 10.1,10.2

MODULE-3	**Key Management and Distribution**	**24AIM642.3**	**8 Hours**

Symmetric key distribution using Symmetric encryption: Key distribution options, Third-Party key distribution options, Key hierarchy

Symmetric key distribution using asymmetric encryption: simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme,

Distribution of public keys: public announcement of public keys, publicly available directory, public key authority, public keys certificates.

Case Study	To understand how symmetric and asymmetric key distribution techniques are used in a real-world banking environment for secure communication.
Text Book	Text Book 1: Ch 15: 15.1 – 15.3

MODULE-4	**User Authentication and Kerberos**	**24AIM642.4**	**8 Hours**

X-509 certificates: Certificates, X-509 version 3

Remote user Authentication principles: Mutual Authentication, one-way authentication, **Remote user Authentication using Symmetric encryption**: Mutual Authentication, one-way Authentication,

Kerberos: Motivation, Kerberos version 4, Kerberos version 5. **Remote user Authentication using Asymmetric encryption:** Mutual Authentication, one-way Authentication.			
Case Study	To study how an organization uses **X.509 certificates, Public Key Infrastructure (PKI), and Kerberos** for secure user authentication.		
Text Book	Text Book 1: Ch 15: 15.4. Ch 16: 16.1 - 16.4		
MODULE-5	**E-Mail and IP Security**	**24AIM642.5, 24AIM642.6**	**8 Hours**
Electronic Mail Security: Internet mail Architecture, Email Formats, Email threats and comprehensive Email Security, S/MIME 609. **IP Security overview:** IP Security policy, Encapsulating Security payload, Combining security associations, Internet key exchange.			
Case Study	To understand how organizations secure email communication and network traffic using **PGP, S/MIME, and IPSec** technologies.		
Text Book	Text Book 1: Ch 19: 19.1 – 19.4, Ch 20: 20.1 – 20.5		

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	10	5
L4	Analyze	10	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	20
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Textbook:

1. Cryptography and network Security Principles and Practice eighth edition global edition, William Stallings, Pearson Education Limited 2023, ISBN: 978-1-292-43748-4.

Reference:

1.Zoubir Mammeri, "Cryptography: Algorithms, Protocols, and Standards for Computer Security", Wiley, 2024. ISBN: 978-1394207480.

2. Charlie Kaufman, Radia Perlman & Mike Speciner, *Network Security: Private Communication in a Public World*, 3rd Edition, Pearson Education,2024. ISBN: 978-8196874339.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105031
- https://onlinecourses.nptel.ac.in/noc21_cs16
- https://www.digimat.in/nptel/courses/video/106105031
- https://www.youtube.com/watch?v=DEqjC0G5KwU
- https://www.youtube.com/watch?v=FqQ7TWvOaus
- https://www.youtube.com/watch?v=PHsa_Ddgx6w

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

- Implement classical, symmetric and asymmetric algorithms in any preferred language
- Evaluate network security protocol using any simulator available
- Conduct a comprehensive literature survey on the protocols and algorithms
- Identify the security threats and models of security threats
- Implement factorization algorithms and evaluate their complexity, identify a technology to factorize a large prime number.

FINITE AUTOMATA AND FORMAL LANGUAGES			
Course Code	**24AIM643**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24AIM643.1	Demonstrate the recognition of regular languages by executing deterministic and non-deterministic finite state machine transitions.
24AIM643.2	Analyze regular languages using regular expressions, pumping lemma, closure properties, and decision algorithms.
24AIM643.3	Design context-free grammars and derive strings for context-free languages.
24AIM643.4	Construct Pushdown Automata, Context-Free Grammars, and Turing Machines for formal language problems.
24AIM643.5	Analyze computability, decidability, and complexity issues in formal language and computation models.
24AIM643.6	Assess the capabilities and limitations of regular languages and computational models in solving language recognition problems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM643.1	3	-	-		-	-	-	-	-	-	-	-	-
24AIM643.2	3	3	-	3	-	-	-	-	-	-	-	-	-
24AIM643.3	3	3	3	2	-	-	-	-	-	-	-	2	2
24AIM643.4	3	3	3	3	2	-	-	-	-	-	-	2	2
24AIM643.5	3	3	-	3	-	-	-	-	-	-	-	2	2
24AIM643.6	3	3	3	3	2	-	-	-	-	-	-	2	2

MODULE-1	**The Theory of Automata**	24AIM643.1	**8 Hours**

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**	24AIM643.2, 24AIM643.6	**8 Hours**

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.

Self-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**	24AIM643.3	**8 Hours**

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 From, Greibach Normal From, 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**	24AIM643.4	**8 Hours**

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

Applications	Program for simulation of Leftmost/Rightmost Derivations.
Text Book	Text Book 1: Ch 4,5

MODULE-5	**Computability**	24AIM643.5, 24AIM643.6	**8 Hours**

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 -180)

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s) - 25	AAT 1 15	AAT2 10
L1	Remember	-	-	-
L2	Understand	5	5	-
L3	Apply	10	5	5
L4	Analyze	10	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	20
L5	Evaluate	--
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://www.udemy.com/course/theory-of-computation-online-course/?couponCode=IND21PM

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

- Demonstration of working principle of Turing machine.
- 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)
    - Organizing Group wise discussions on issues
    - Seminars

IOT FOR INTELLIGENT COMPUTING

Course Code	**24AIM644**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**03**

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

24AIM644.1	Describe the architectural layers, historical evolution, and key enabling technologies
24AIM644.2	Implement appropriate sensing, actuation, and device management protocols for real-time IoT applications
24AIM644.3	Apply design principles and communication technologies for developing connected IoT systems.
24AIM644.4	Analyze data acquisition, organization, processing, storage, and analytics mechanisms in IoT environments.
24AIM644.5	Classify IoT communication technologies into Infrastructure, Discovery, Data, Identification, Device Management, and Semantic protocols.
24AIM644.6	Assess IoT system architectures and communication protocols to identify security vulnerabilities, attack vectors, and mitigation requirements.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM644.1	3	-	-	-	-	-	-	-	-	-	-	-	-
24AIM644.2	3	3	-	-	-	-	-	-	-	-	-	2	2
24AIM644.3	3	-	-	-	-	-	-	-	-	-	-	2	3
24AIM644.4	3	3	-	-	-	-	-	-	-	-	-	3	3
24AIM644.5	3	3	2	-	2	-	-	-	-	-	-	3	3
24AIM644.6	3	3	3	3	3	-	-	-	-	-	2	2	2

MODULE-1	**INTRODUCTION**	**24AIM644.1, 24AIM644.6**	**8 Hrs**

An Overview: IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, Examples of IoT. Emergence of IoT: Evolution of IoT, Enabling IoT and Complex Interdependence Technologies, IoT Networking Components, Addressing Strategies in IoT.

Text Book	Text Book 1: Ch-1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7. Text Book 2: Ch-4.1, 4.2, 4.3, 4.4, 4.5.

MODULE-2	**DESIGN PRINCIPLES FOR CONNECTED DEVICES**	**24AIM644.2, 24AIM644.3**	**8 Hs**

IoT Sensing and Actuation: Sensors, Sensor Characteristics, Sensing Types, Actuators, Actuator types, Actuator Characteristics. IoT/M2M System Layers and Design Standardisation, Communication Technologies, Data Enrichment, Data consolidation and Device management at Gateway, Ease of designing and affordability.

Text Book	Text Book 1: Ch-2.1, 2.2, 2.3, 2.4, 2.5 Text Book 2: Ch-5.2, 5.3, 5.5, 5.6, 5.7, 5.8, 5.9

MODULE-3	**DATA ACQUIRING, ORGANISING, PROCESSING AND ANALYTICS**	**24AIM644.4**	**8 Hrs**

Introduction, Data acquiring and storage, Organising the data, Transactions, business process, Integration and Enterprise Systems, Analytics, Knowledge acquiring, Managing and Storing Process.

Text Book	Text Book 1: Ch-5.1, 5.2, 5.3, 5.4, 5.5, 5.6

MODULE-4	**IoT COMMUNICATION TECHNOLOGIES**	**24AIM644.5**	**8Hrs**

Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols.

Text Book	Text Book 2: Ch-8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7

MODULE-5	**IoT SECURITY AND CASE STUDIES**	**24AIM644.6**	**8 Hrs**

Introduction, Vulnerabilities, Security Requirements and Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT.

Case Study	IoT/ IIoT Applications in the premises, supply chain and customer monitoring, Connected Car and its applications and services, Smart city streetlights control and monitoring.
Text Book	Text Book 1: Ch-10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 12.3, 12.4, 12.6

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	10	5
L4	Analyze	10	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

*Assessments are to be selected from the assessment list attached to **Appendix A.**

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) Dr. Raj Kamal, "Internet of Things: Architecture and Design Principles," McGraw Hill, 2022, ISBN:978-9390727384

2) Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press, 2022, ISBN:978-1108959742.

Reference Books:

1. Ammar Rayes and Samer Salam, Internet of Things from Hype to Reality: The Road to Digitization, 3rd Edition, Springer, 2022, ISBN: 978-3-030-90157-8.
2. Valentina E. Balas, Vijender Kumar Solanki and Raghvendra Kumar (Eds.), Recent Advances in Internet of Things and Machine Learning: Real-World Applications, 1st Edition, Springer, 2022, ISBN: 978-3-030-90118-9.
3. Nidhi Sindhwani, Rohit Anand, M. Niranjanamurthy, Dinesh Chander Verma and Emilia Balas Valentina (Eds.), IoT Based Smart Applications, 1st Edition, Springer, 2023, ISBN: 978-3-031-04523-3.

Web links and Video Lectures (e-Resources):

- https://www.educba.com/introduction-to-iot/
- https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
- https://onlinecourses.nptel.ac.in/noc22_cs53/preview
- https://www.simplilearn.com/iot-devices-article

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

- Visit to any open source IOT lab
- Demonstration of Thermal sensors
- Demonstration of chemical characterization
- Demonstration of strain gauge sensors
- Video demonstration of the latest IOT applications
- Contents-related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare various sensors and its description
  - Organizing Group discussions on real-time issues
  - Seminars

AUGMENTED AND VIRTUAL REALITY			
Course Code	**24AIM645**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24AIM645.1	Describe the core concepts, foundational technologies, and practical applications of Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR).
24AIM645.2	Analyze tracking systems, sensors, and calibration techniques used in AR/VR systems
24AIM645.3	Apply computer vision techniques and AI-based methods for AR applications.
24AIM645.4	Evaluate rendering pipelines and interaction mechanics across different VR hardware architectures to identify bottlenecks in immersive simulations
24AIM645.5	Design basic AR/VR applications using modern development tools and frameworks.
24AIM645.6	Assess immersive technologies based on user experience, ethical responsibility, and future technological evolution.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PSO1	PSO2
24AIM645.1	3	-	-	-	-	-	-	-	-	-	-	-	-
24AIM645.2	3	3	-	2	3	-	-	-	-	-	-	2	2
24AIM645.3	3	-	-	-	3	-	-	-	-	-	2	2	2
24AIM645.4	3	**3**	3	3	3	-	-	-	-	-	2	2	2
24AIM645.5	3	3	3	**-**	3	-	-	-	-	-	2	2	2
24AIM645.6	3	3	3	3	3	-	2	-	-	-	2	2	2

MODULE-1	**Introduction to Augmented Reality**	**24AIM645.1,24AIM645.2**	**8 Hours**

Definition and history of Augmented Reality, Examples and Applications, Displays-Multimodal Displays, Visual perception and spatial display models, Requirements and Characteristics of AR Systems, Introduction to Mixed Reality (MR), Extended Reality (XR), and Metaverse concepts.

Case Study	Understanding AR Fundamentals and investigate visual perception and spatial display model.
Text Book	Text Book 1: Ch 1,2,12

MODULE-2	**Tracking**	**24AIM645.2,24AIM645.3**	**8 Hours**

Tracking, Calibration, and Registration techniques, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion, Advantages and limitations of different tracking methods

Case Study	Explore tracking method along with advantages and limitations, and the choice of tracking technology depends on factors such as the type of AR/VR application, device capabilities, user experience requirements, and environmental conditions.
Text Book	Text Book 1: Ch 7,13

MODULE-3	**Computer Vision for Augmented Reality**	**24AIM645.2, 24AIM645.3**	**8 Hours**

Marker tracking and natural feature tracking, Multiple camera infrared tracking, Incremental tracking techniques, Simultaneous Localization and Mapping (SLAM), Outdoor tracking calibration and registration, Camera calibration and display calibration, Introduction to AI-based object detection and pose estimation in AR.

Text Book	Text Book 1: Ch 14

MODULE-4	**Introduction to Virtual Reality**	**24AIM645.4, 24AIM645.5**	**8 Hours**

Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Multiple Models of Input and Output Interface in Virtual Reality: Input -Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, Challenges in VR: motion sickness, latency, and user interaction.

Case Study	Investigate and explore Mastering VR Development Skills, Understanding Virtual Reality Fundamentals
Text Book	Text Book 1: Ch 4,5,6,8,10

MODULE-5	**Visual Computation in Virtual Reality**	**24AIM645.5, 24AIM645.6**	**8 Hours**

Fundamentals of computer graphics for VR, Software and hardware technologies in stereoscopic display, Real-time rendering techniques, Management of large-scale virtual environments,
Interactive techniques in VR, Body tracking, hand gesture recognition, and object grasp development tools, Ethical considerations and future trends in AR/VR technologies

Case Study	Survey on Visual Computation and understanding object grasp development tools.
Text Book	Text Book 1:9,10,11,15,16

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	10	5
L4	Analyze	5	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. Doerner, R., Broll, W., Grimm, P., and Jung, B., *Virtual and Augmented Reality (VR/AR): Foundations and Methods of Extended Realities (XR)*, 2nd Edition, Springer, 2022, ISBN:978-3030790615.
2. Gutiérrez, M.A., Vexo, F., and Thalmann, D., *Stepping into Virtual Reality*, Springer, 2023, ISBN:978-3031364864.

Reference Books:

1. Badotra, S., Tanwar, S., Rana, A., Sindhwani, N., and Kannan, R., *Handbook of Augmented and Virtual Reality*, De Gruyter, 2023. ISBN:978-3310785319.
2. Ivanov, V., Pavlenko, I., Evtuhov, A., and Trojanowska, J., *Augmented Reality for Engineering Graphics*, Springer, 2024.ISBN:978-3031446412

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs03
- https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs87
- https://www.youtube.com/watch?v=lzXfv-Iq85c
- https://www.youtube.com/watch?v=vz0UUVDt2ps

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

- Contents related activities (Activity-based discussions)
- **AR Scavenger Hunts**: Create scavenger hunts where students use AR-enabled devices to find and interact with virtual objects or landmarks overlaid onto the real-world environment.
- **Simulated Experiments:** Enable students to conduct science experiments or simulations in VR environments where they can manipulate variables, observe outcomes, and learn through hands-on exploration.

MOBILE APPLICATION DEVELOPMENT			
Course Code	**24AIM651**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24AIM651.1	Build an application using Flutter development environment.
24AIM651.2	Experiment with the method of storing, sharing and retrieving the data in applications.
24AIM651.3	Examine responsive user interface across wide range of devices.
24AIM651.4	Develop a mobile application incorporating various android components, including activities, views, services, content providers, and broadcast receivers.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM651.1	**3**	3	3	-	-	-	-	-	**-**	**-**	-	3	-
24AIM651.2	3	3	-	-	-	-	-	-	**-**	**-**	-	2	-
24AIM651.3	3	3	**-**	-	3	-	-	-	**-**	**-**	-	2	-
24AIM651.4	**3**	**3**	3	-	3		-	-	**-**	**-**	-	2	-

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	Basic of HTML, CSS, and JavaScript	2	NA
	PART-A		
1	Write a Flutter program to display college and course information using variables. **Note:** Introduction to Flutter, Dart, architecture, create project	2	24AIM651.1 24AIM651.2 24AIM651.3 24AIM651.4
2	Create a personal portfolio page using basic Flutter widgets such as Text, Container, Row, and Column**.**	2	24AIM651.1 24AIM651.2 24AIM651.3 24AIM651.4
3	Develop a Flutter application to display a student's profile card using Card, CircleAvatar, Icon, Text, and Container widgets.	2	24AIM651.1 24AIM651.2 24AIM651.3
4	Write a Flutter program to perform basic arithmetic operations (Addition, Subtraction, Multiplication, and Division) using TextField, Buttons, and setState().	2	24AIM651.1 24AIM651.2 24AIM651.3
5	Develop a Flutter application containing TextFields, Buttons, and Sliders to collect user information.	2	24AIM651.1 24AIM651.2 24AIM651.3 24AIM651.4
6	Create a Flutter application with two screens and implement navigation using Navigator**.**	2	24AIM651.1 24AIM651.2 24AIM651.3 24AIM651.4
	PART-B		
7	Develop a Flutter application using ListView.builder() to display a shopping list.	2	24AIM651.1 24AIM651.2 24AIM651.3

8	Develop a simple To-Do List application where users can add and remove tasks and also changes displayed text dynamically using setState().	2	24AIM651.1 24AIM651.2 24AIM651.3
9	Develop a Flutter application that stores and retrieves a username using Shared Preferences.	2	24AIM651.1 24AIM651.2 24AIM651.3 24AIM651.4
10	Develop a Flutter application that fetches and displays weather information from an API.	2	24AIM651.2 24AIM651.3 24AIM651.4
11	Develop a Flutter application that allows users to customize the app theme by selecting primary and accent colors. Persist the selected theme using SharedPreferences so that the chosen colors are retained even after the app is closed and reopened.	2	24AIM651.2 24AIM651.3 24AIM651.4
12	Build a small standalone app that collects user data in a form- Validate inputs and stores them using local persistence. E.g., Feedback Form App, Survey App	2	24AIM651.1 24AIM651.2 24AIM651.3 24AIM651.4

PART-C

Beyond Syllabus/ Virtual Lab Content

- https://www.scaler.com/topics/deeplink-flutter/
- https://www.fullstack.com/labs/resources/blog/an-introduction-to-flutters-world

CIE Assessment Pattern (50 Marks–Lab)

RBT Levels		Test(s) - 20 marks	Weekly Assessments- 30 marks
L1	**Remember**	**-**	**-**
L2	**Understand**	05	10
L3	**Apply**	05	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. Ultimate Flutter Handbook: Learn Cross-Platform App Development with Visually Stunning UIs and Real-World Projects, by Lahiru Rajeendra Mahagamage, 2023. ISBN: 978- 9388590860
2. Flutter & Dart: Up & Running: Build native apps for both iOS and Android using a single codebase, by Deepti Chopra, Roopal Khurana,2023. ISBN: 978-9355513816
3. Flutter for Beginners, by Alessandro Biessek, Packt Publishing, 2021. ISBN: 978-1800565999

Weblinks and Video Lectures(e-Resources):

- https://alison.com/course/introduction-to-mobile-app-development-with-flutter
- https://youtu.be/F3JuuYuOUK4?si=nn81DgwP5htUsM-E
- https://alison.com/topic/learn/125818/getting-started-with-flutter-learning-outcomes.

CYBER SECURITY PRACTICES			
Course Code	**24AIM652**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24AIM652.1	Apply Linux and networking tools for cybersecurity tasks.
24AIM652.2	Perform reconnaissance, network analysis, and vulnerability assessment using open-source tools.
24AIM652.3	Analyze common web application vulnerabilities in a controlled environment.
24AIM652.4	Apply system hardening, log analysis, and security auditing techniques.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM652.1	3	-	-	-	3		-	-	-	-	-	-	-
24AIM652.2	3	-	-	-	3			-	-	-	-	2	2
24AIM652.3	3	3	-	-	3	2	2	-	-	-	-	2	2
24AIM652.4	3	-		3	2	2	2	-	-	-	-	2	2

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	Basics of Networks, Tools	2	-
	PART-A		
1	Install Kali Linux in VirtualBox and configure an isolated virtual network with Metasploitable and explore the Linux file system and essential security commands.	2	24AIM652.1
2	Perform foot printing and OSINT using WHOIS, dig, nslookup, theHarvester, and DNSRecon to gather publicly available information.	2	24AIM652.1
3	Perform host discovery, port scanning, service enumeration, and operating system detection on a virtual network using Nmap, Zenmap	2	24AIM652.1
4	Capture and analyze network traffic including ARP, ICMP, DNS, TCP, HTTP, and HTTPS packets.	2	24AIM652.2
5	Perform vulnerability assessment of an intentionally vulnerable virtual Machine and interpret the identified vulnerabilities using Greenbone Community Edition(OpenVAS).	2	24AIM652.2
6	Perform password auditing using sample password hashes and demonstrate secure password practices.	2	24AIM652.2
	PART-B		
7	Demonstrate common web application vulnerabilities such as SQL Injection using an intentionally vulnerable web application. (John the Ripper)	2	24AIM652.3
8	Demonstrate Cross-Site Scripting (XSS) and Command Injection attacks in a controlled environment and recommend mitigation techniques.	2	24AIM652.3
9	Perform basic exploitation of known vulnerabilities on Metasploitable 2 using the Metasploit Framework in an isolated lab environment.	2	24AIM652.3
10	Configure Linux firewall rules, user permissions, SSH security settings, and perform basic system hardening.	2	24AIM652.3
11	Analyze Linux authentication and system logs to identify suspicious activities and security incidents.	2	24AIM652.3

12	Conduct a comprehensive security audit of a Linux system and prepare a vulnerability assessment and mitigation report	2	24AIM652.4

PART-C

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

1. Explore the **OWASP Juice Shop** virtual lab to understand advanced web application security vulnerabilities https://www.scaler.com/topics/cyber-security/owasp-juice-shop/
2. Perform Capture-the-Flag (CTF) challenges on beginner-friendly platforms such as **OverTheWire** and **PicoCTF**. : https://www.youtube.com/watch?v=t_jMl7afitA
3. Perform Linux privilege escalation techniques using intentionally vulnerable virtual machines in a controlled environment.: https://www.youtube.com/watch?v=VpNaPAh93vE

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		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. Nitul Dutta, Nilesh Jadav, Sudeep Tanwar, Hiren Kumar Deva Sarma and Emil Pricop, Cyber Security: Issues and Current Trends, Springer, 2022, ISBN: 978-981-16-6599-8.
2. Jacob G. Oakley, Michael Butler, Wayne York, Matthew Puckett and J. Louis Sewell, Theoretical Cybersecurity: Principles and Advanced Concepts, 1st Edition, Apress, 2022, ISBN: 978-1-4842-8299-1.
3. Martti Lehto and Pekka Neittaanmäki (Eds.), Cyber Security: Critical Infrastructure Protection, 1st Edition, Springer, 2022, ISBN: 978-3-030-91292-5.
4. Tünde Anna Kovács, Zoltán Nyikes and Igor Fürstner (Eds.), Security-Related Advanced Technologies in Critical Infrastructure Protection: Theoretical and Practical Approach, 1st Edition, Springer, 2022, ISBN: 978-94-024-2173-6.

Reference URLs

1. Kali Linux Documentation: https://www.kali.org/docs/
2. Nmap Reference Guide: https://nmap.org/book/
3. Wireshark User Guide: https://www.wireshark.org/docs/
4. OWASP Juice Shop Documentation: https://owasp.org/www-project-juice-shop/
5. Metasploit Framework Documentation: https://docs.metasploit.com/
6. Greenbone Community Edition Documentation: https://greenbone.github.io/docs/latest/
7. Lynis Documentation: https://cisofy.com/documentation/lynis/

API & MICROSERVICES			
Course Code	**24AIM653**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24AIM653.1	Design RESTful APIs using Node.js and Express by implementing resource-oriented services and HTTP-based communication.
24AIM653.2	Implement secure and persistent microservices by integrating databases, performing CRUD operations, and applying JWT-based authentication and authorization mechanisms.
24AIM653.3	Develop and manage distributed applications by implementing inter-service communication, API Gateway patterns, and environment-based service configurations.
24AIM653.4	Deploy, containerize, and monitor microservices using Docker, Docker Compose, and logging mechanisms to support scalable and maintainable applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM653.1	3	3	3	-	3	-	-	-	-	-	**2**	3	2
24AIM653.2	3	3	2	2	3	-	-	-	-	-	**2**	3	3
24AIM653.3	3	**2**	3	2	3	-	-	-	-	-	**2**	3	3
24AIM653.4	2	2	3	2	3	-	-	-	-	2	**2**	2	3

Pgm. No.	List of Programs	Hours	Cos
	Prerequisite		
	Basic Java Programming/C Programming	2	NA
	PART-A		
1	Build a Simple REST API using Node.js and Express. **(Tasks:** Set up a Node.js project, install Express, create GET and POST routes for a student resource, and test the API endpoints using Postman.)	2	24AIM653.1
2	Implement CRUD Operations for a Product API using an In-Memory Data Store. **(Tasks:** Create a Product API, implement GET, POST, PUT, and DELETE routes, store data in an in-memory array, and test all CRUD operations using Postman.)	2	24AIM653.1
3	Develop a REST API with Database Integration for Book Management **(Tasks:** Create a Book API, connect it to MongoDB or SQLite, implement CRUD operations using the database, and verify data persistence.)	2	24AIM653.1
4	Design a secure REST API in Python (or your preferred language framework) that uses JSON Web Tokens (JWT) for user authentication.	2	24AIM653.1
5	Implement Inter-Service Communication between Microservices. **(Tasks:** Create Order and Payment services, invoke the Payment service from the Order service using HTTP requests, and verify successful communication between services.	2	24AIM653.2
6	Design and Implement an API Gateway for Multiple Microservices. **(Tasks:** Create multiple backend services, develop an API Gateway using Express, route incoming requests to appropriate services, and validate request forwarding.)	2	24AIM653.2

PART-B			
7	Containerize a Node.js Microservice using Docker. **(Tasks:** Create a Dockerfile, build a Docker image, run the microservice inside a Docker container, and verify containerized application execution.)	2	24AIM653.2
8	Deploy Multiple Microservices using Docker Compose. **(Tasks:** Create a docker-compose.yml file, configure multiple services, launch containers simultaneously, and verify communication among the deployed services.)	2	24AIM653.2
9	Write a Configure a Microservice using Environment Variables. **(Tasks:** Create a Greeting Service, read the application name and port number from environment variables, execute the service with different configurations, and verify configuration changes.)	2	24AIM653.3
10	Implement Logging in a Microservice for Improved Observability. **(Tasks:** Create an Inventory Service, log incoming requests, capture application errors, record service startup events, and analyze generated logs.)	2	24AIM653.3
11	Implement Service Discovery for Microservices using Consul. **(Tasks:** Install and configure Consul, register multiple microservices, configure health checks, discover service instances dynamically, and verify service-to-service communication using Consul.)	2	24AIM653.4
12	Design a Centralized Logging and Monitoring for Microservices using the ELK Stack. **(Tasks:** Install and configure Elasticsearch, Logstash, and Kibana components, collect logs from multiple microservices, visualize logs using Kibana dashboards, and configure basic monitoring and observability dashboards.)	2	24AIM653.3

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

1. https://kinsta.com/blog/microservices-vs-api/
2. https://docs.docker.com/get-started/
3. https://labs.play-with-docker.com/
4. https://www.nginx.com/resources/library/
5. https://www.elastic.co/training

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	10
L3	Apply	10	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. **Ashley Davis**, *Bootstrapping Microservices, Second Edition: With Docker, Kubernetes, GitHub Actions, and Terraform*, Manning Publications, 2024**,** ISBN-13**: 978-1633438569.**
2. Sourabh Sharma, *Modern API Development with Spring and Spring Boot*, Packt Publishing, 2021, ISBN: **9781800562875**.
3. James Gough, Daniel Bryant, Matthew Auburn, *Mastering API Architecture*, O'Reilly Media,2022, ISBN: **9781492090632**.

IoT Application Development			
Course Code	**24AIM654**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24AIM654.1	Analyze the fundamental architectures and functionalities of various single-board embedded platforms.
24AIM654.2	Implement hardware interfacing between various IoT devices and the Arduino platform
24AIM654.3	Apply Arduino interfacing concepts to build a simple hardware application
24AIM654.4	Integrate various sensors with the Arduino platform to build functional circuits.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM654.1	3	3	-	-	-	-	-	-	-	-	-	2	2
24AIM654.2	3	3	3	-	3			-	-	-	-	3	3
24AIM654.3	3	3	3	3	3	-	-	-	-	-	-	3	3
24AIM654.4	3	3	3	3	3	-	2	-	-	-	-	3	3

Exp. No.	List of Experiments	Hrs	COs
	Prerequisite		
	Electronics circuit basics, Gates, Sensors	2	-
	PART-A		
1	Interface an LED and Buzzer with Arduino/Raspberry Pi and write a program to control their operation using timer interrupts, where the LED blinks every 2 seconds and the buzzer sounds for 1 second simultaneously.	2	24AIM654.1
2	To interface a Digital Sensor (IR/LDR) with Arduino/Raspberry Pi and develop a program to activate an LED and a buzzer upon sensor detection, and deactivate them when no object is detected.	2	24AIM654.1
3	To interface a Smoke Sensor with Arduino/Raspberry Pi and write a program to continuously monitor smoke concentration, activate an LED and buzzer when the smoke level exceeds a predefined threshold, and deactivate them when the environment is safe.	2	24AIM654.1
4	To interface a DHT11 Temperature and Humidity Sensor with Arduino/Raspberry Pi and implement an environmental monitoring system that continuously measures and displays temperature and humidity readings, generating an alert when the temperature exceeds the specified threshold.	2	24AIM654.2
5	To interface a TCS3200 Color Sensor with Arduino/Raspberry Pi and implement a color detection system that identifies object colors, displays the detected color on the Serial Monitor, and activates a buzzer when a predefined target color is detected.	2	24AIM654.2
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	24AIM654.2
	PART-B		
7	To interface an Ultrasonic Sensor with Arduino/Raspberry Pi and implement an obstacle detection system that measures the distance, displays it on the Serial Monitor, and classifies the obstacle as Safe, Warning, or Danger based on predefined distance thresholds.	2	24AIM654.3
8	To interface a Float Sensor, LED, and Buzzer with Arduino/Raspberry Pi and develop a water level monitoring and overflow warning system that continuously monitors the tank level, displays the tank status on the Serial Monitor, and activates visual	2	24AIM654.3

	(LED) and audible (buzzer) alerts when the water reaches the overflow level.		
9	To interface an ADXL335 Accelerometer with Arduino/Raspberry Pi and develop a program to detect the orientation and tilt of the sensor, display the X, Y, and Z axis acceleration values on the Serial Monitor, and identify the corresponding orientation.	2	24AIM654.3
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	24AIM654.3
11	To interface a Soil Moisture Sensor with Arduino/Raspberry Pi and develop a program to measure soil moisture levels, classify the soil condition (Dry, Moist, or Wet), and display the readings and soil status on the Serial Monitor.	2	24AIM654.3
12	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to cloud.	2	24AIM654.4

PART-C

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

- Develop a native application that uses GPS location information: https://gr-solution.blogspot.com/2015/12/develop-native-application-that-uses.html
- Develop a mobile application to send an email: https://www.geeksforgeeks.org/how-to-send-an-email-from-your-android-app/
- Create a button called "Convert Text to Speech" that converts the user's input text into voice: https://www.geeksforgeeks.org/edittext-widget-in-android-using-java-with-examples/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		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. G. R. Kanagachidambaresan, Internet of Things Using Single Board Computers: Principles of IoT and Python Programming, 1st Edition, 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, 2nd Edition, Apress, 2022, ISBN: 978-1-4842-8072-0.
3. Nidhi Sindhwani, Rohit Anand, M. Niranjanamurthy, Dinesh Chander Verma and Emilia Balas Valentina (Eds.), IoT Based Smart Applications, 1st Edition, Springer, 2023, ISBN: 978-3-031-04523-3.
4. Ammar Rayes and Samer Salam, Internet of Things from Hype to Reality: The Road to Digitization, 3rd Edition, Springer, 2022, ISBN: 978-3-030-90157-8.

INTELLIGENT TEST AUTOMATION			
Course Code	**24AIM655**	**CIE Marks**	**50**
L:T:P:S	**0:0:2:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24AIM655.1	Apply Selenium WebDriver concepts to automate browser operations and test various functionalities of web applications.
24AIM655.2	Develop automated test scripts using Selenium for cross-browser, data-driven, and web form testing.
24AIM655.3	Implement automated software testing using JUnit and Cucumber BDD for unit, database, and behavior-driven testing.
24AIM655.4	Create automated test cases using Tricentis Tosca for functional and data-driven testing of web applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM655.1	3	2	-	-	3	-	-	-	-	-	-	2	2
24AIM655.2	3	3	3	3	3	-	-	-	-	-	-	3	2
24AIM655.3	3	3	3	2	3	-	-	-	-	-	-	3	3
24AIM655.4	3	3	3	2	3	-	-	-	-	-	-	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite		
	Knowledge about Software Testing fundamentals (STLC), Manual and Automation Testing, and basic HTML concepts.	2	NA
	PART-A		
1	Develop a Selenium WebDriver-based automation program to open a browser, navigate to a given website, maximize the window, display the page title and URL, and close the browser.	2	24AIM655.1
2	Write an automated test case using Selenium to perform tests on login web pages.	2	24AIM655.1
3	Write a program to perform cross-browser testing in Selenium and make use of TestNG to specify different browsers for your test executions.	2	24AIM655.2
4	Write a test program to display the total number of different objects present on a web page using Selenium.	2	24AIM655.1
5	Use Selenium to test a program that updates 10 student records in a table from an Excel file.	2	24AIM655.2
6	Develop a Selenium WebDriver program to automate a web form by entering data into text fields, selecting radio buttons and checkboxes, choosing an option from a drop-down list, submitting the form, and verifying the successful submission message.	2	24AIM655.2
	PART-B		
7	Write a JUnit test for evaluating a standalone Java application.	2	24AIM655.3
8	Write a JUnit test suite for checking the database connection.	2	24AIM655.3
9	Develop and execute a Cucumber BDD test to validate valid and invalid login scenarios using Gherkin feature files, step definitions, and a test runner.	2	24AIM655.3
10	Develop a Selenium – Cucumber test to automate a web registration		24AIM655.3

	form and verify the successful submission of user details.	2	
11	Create and execute a Tricentis Tosca test case to automate valid and invalid login scenarios for a web application by scanning the required controls using Tosca XScan and verifying the login result.	2	24AIM655.4
12	Create and execute a data-driven Tricentis Tosca test case to automate a web registration form using multiple sets of input data and verify the successful submission message.	2	24AIM655.4

PART-C

Beyond Syllabus /Virtual Lab Content

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

1. Develop an automated Selenium WebDriver test suite using the Page Object Model (POM) design pattern to automate and validate multiple functionalities of a sample web application.
   https://www.youtube.com/watch?v=-0F-YBAQdGE
2. Configure and execute Selenium automated test cases using GitHub Actions to demonstrate Continuous Integration (CI) and analyze the test execution results.
   https://www.youtube.com/watch?v=0YRzXYZWPb4

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		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. Panagiotis Leloudas, Introduction to Software Testing: A Practical Guide to Testing, Design, Automation, and Execution, 1st Edition, Apress, 2023, ISBN: 978-1-4842-9513-7.
2. István Forgács and Attila Kovács, Modern Software Testing Techniques: A Practical Guide for Developers and Testers, 1st Edition, Apress, 2024, ISBN: 978-1-4842-9892-3.
3. Mark Winteringham, Testing Web APIs, 1st Edition, Manning Publications, 2022, ISBN: 978-1-61729-953-7.
4. Matthew Heusser and Michael Larsen, Software Testing Strategies: A Testing Guide for the 2020, 1st Edition, Packt Publishing, 2023, ISBN: 978-1-83763-802-4.

ADVANCED PROBLEM SOLVING METHODOLOGIES			
Course Code	**24SDK66**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**0**	**Exam Hours**	**02**

Course outcomes:
Upon successful completion of this course, the student will be able to:

24SDK66.1	Infer the complex problems using the concepts of data structures and C programming
24SDK66.2	Apply object-oriented programming concepts in C++and Java to solve real time problem statements.
24SDK66.3	Solve real-world problem using python and C#
24SDK66.4	Develop the skills of handling data base queries and procedures

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24SDK66.1	3	3	-	-	2	-	-	-	-	-	-
24SDK66.2	2	3	3	-	3	-	-	-	-	-	-
24SDK66.3	2	2	3	2	3	-	-	-	-	-	-
24SDK66.4	2	3	3	-	3	-	-	-	-	-	-

MODULE-1	**Problem Solving On Data Structures and C**	**24SDK66.1**	**6 Hours**

Data Structures using C: Stack and queues, list, graph, tree, sorting and searching, Hash functions
Advanced C programming: Pointers, Recursion, Functions, Structure, Union, C Preprocessor

MODULE-2	**Problem Solving on Object Oriented Programming Using CPP**	**24SDK66.2**	**6 Hours**

Object Oriented Programming: Inheritance, Polymorphism, Exception handling, File Handling, Predefined function, Void function, Name spaces, Input and output streams.

MODULE-3	**Problem Solving on JAVA And XML**	**24SDK66.2**	**6 Hours**

Object oriented programming using Java: Inheritance, Polymorphism, Abstract class and Interface, Collections, Exception handling, Streams, Functional Interface.
XML: DTD, Schema, Server Path, DOM, XSLT, Name Space, AJAX.

MODULE-4	**Problem Solving Using C # And Python**	**24SDK66.3**	**6 Hours**

Python: Functions, iterators, Object oriented Programming, Exception Handling, Packages, Frame works- Django, Collections.
C#: Object oriented Programming, Delegate, Collections and generic, Name space.

MODULE-5	**Scenario Based Problems On DBMS**	**24SDK66.4**	**6 Hours**

ER Model, SQL- DDL, DML, TCL, DCL, Joins, subquery, PL/SQL-Index, Sequence, procedures and functions, normalization, B tree, B+ tree, Forms.

Note:

1. **Students shall solve the programming exercises and scenario-based problems available on the designated portal as part of the prescribed boot camp.**
2. **The CIE assessment and evaluation will be as per the guidelines framed by CDC.**

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution
		Tests
		50
L1	Remember	5
L2	Understand	10
L3	Apply	20
L4	Analyze	15
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Martin C Brown, "Python-The Complete Reference", Mc Graw Hill, 4th edition, 2020
2. Reema Tharega, "Data Structures using C", Oxford University Press, 2020
3. Ullakirch-Prinz, "A complete guide to program in C++", Jonas and Bartlett Learning, 2022
4. Kathy Sierra, "Headfirst Java", O'reilly Media, 2021
5. Andrew Stellman, "Headfirst C#", O'reilly Media, 2021

Web links and Video Lectures (e-Resources):

1. https://www.learncpp.com/
2. https://www.programiz.com/dsa
3. https://code.visualstudio.com/Docs/languages/csharp
4. https://www.udemy.com/course/the-complete-java-course-from-basics-to-advanced/?couponCode=ST16MT70224
5. https://www.codecademy.com/learn/paths/c

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

- Analysis of industry relevant use cases
- Problem solving on scenario-based questions
- Placement portal practice sessions

CAPSTONE PROJECT			
Course Code	**24AIM67**	**CIE Marks**	**50**
L:T:P:S	**0:0:2:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**2**	**Exam Hours**	**03**

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

24AIM67.1	Identify a real-life engineering problem, utilize prior knowledge and conduct extensive investigation, across diverse sources, in addressing the
24AIM67.2	Applying the software engineering principles in planning, formulating an innovative design/ approach and computing the requirements
24AIM67.3	Perform professionally as a team member, accepting responsibility, taking initiative, and providing leadership necessary to ensure project success.
24AIM67.4	Use formal and informal communications with team members and guide, make presentations and prepare technical document.
24AIM67.5	Provide solution within the context of legal framework addressing the societal and environmental concerns and upholding ethical issues.
24AIM67.6	Present the Report for implemented problem and its solutions as a team.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM67.1	3	3	-	-	-	-	-	-	-	-	-	3	3
24AIM67.2	3	3	3	-	3	-	-	-	-	-	-	3	3
24AIM67.3	-	-	-	-	-	2	2	2	3	2	3	3	3
24AIM67.4	-	-	-	-	3	2	2	2	3	3	3	3	3
24AIM67.5	-	-	-	-		3	3	3	3	2	2	3	3
24AIM67.6	-	-	-	-	3	-	-	2	2	2	-	-	-

This course will be conducted largely as group of 2-4student members under the direct supervision of a member of academic staff.

Students will be required to

1. Students should form teams to carry out the project. The size of the teams can comprise of a minimum of two students and maximum of four students.
2. Each team are free to choose their Internal Guide or will be assigned an Internal Guide by the Department Coordinator.
3. Teams can carry out their project in-house or in a reputed organization (which has to be approved by the Internal Guide). Students taking up industry projects can do so with the condition that they are allowed to demonstrate their project work on the college campus.
4. Identification of a problem which is feasible and innovative based on the current state of art technology and having relevance and social impact, considering the boundaries of societal, environmental and ethical issues.
5. Survey of literature related to the identified problem to make a feasibility study and identify the project requirements. Prepare and submit a synopsis of your project to your respective Guides.
6. Based on the literature review, preparation of review paper and publishing it.
7. Evolve a high-level design/system level architecture and identify the various implementable modules with their input/output needs.
8. Preparation and submission of Project technical report.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Review (50 marks)
L1	**Remember**	**-**
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
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**	-

NATIONAL SERVICE SCHEME			
Course Code	**24NSS60**	**CIE Marks (each Semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

24NSS60.1	Understand the importance of his / her responsibilities towards society.
24NSS60.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
24NSS60.3	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.
24NSS60.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24NSS60.1	-	-	-	-	-	3	3	2	-	-	1
24NSS60.2	-	-	-	-	-	3	3	2	-	-	1
24NSS60.3	-	-	-	-	-	3	3	2	-	-	1
24NSS60.4	-	-	-	-	-	3	3	2	-	-	1

Sem/ Code	CONTENT	COs	HRS
3RD 24NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. **3.** Setting of the information imparting club for women leading to contribution in social and economic issues.	24NSS30.1 24NSS30.2 24NSS30.3 24NSS30.4	30
4TH 24NSS40	4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	24NSS40.1 24NSS40.2 24NSS40.3 24NSS40.4	30
5TH 24NSS50	6. Developing Sustainable Water management system for rural areas and implementation approaches. 7. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 8. Spreading public awareness under rural outreach programs. (minimum 5 programs).	24NSS50.1 24NSS50.2 24NSS50.3 24NSS50.4	30
6TH 24NSS60	9. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 10. Govt. school Rejuvenation and helping them to achieve good infrastructure.	24NSS60.1 24NSS60.2 24NSS60.3 24NSS60.4	30

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 6th 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.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- 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.	Setting of the information imparting club for women leading to contributionin 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
4.	Water conservation techniques – Role of different stakeholders– Implementation.	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
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
6.	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/Governmen t 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
7.	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
8.	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
9.	Spreading public awareness under rural outreach programs. (minimum5 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

10.	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
11.	Govt. school Rejuvenation andhelping 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	**24PED60**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4= 200**
Credits	**00**	**Exam Hours**	**02**

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

24PED60.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
24PED60.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
24PED60.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
24PED60.4	Understand the roles and responsibilities of organization and administration of sports and games

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
24PED60.1	-	-	-	-	-	2	-	3	3	-	-	2
24PED60.2	-	-	-	-	-	2	-	3	3	-	-	2
24PED60.3	-	-	-	-	-	2	-	3	3	-	-	2
24PED60.4	-	-	-	-	-	2	-	3	3	-	-	2

Sem	CONTENT	COs	HRS
3RD 24PED30	**Module 1: Orientation** a) Lifestyle, b) Fitness c) Food & Nutrition d) Health & Wellness e) Pre-Fitness test.	24PED30.1 24PED30.2	5
	Module 2: General Fitness & Components of Fitness a) Warming up (Free Hand exercises) b) Strength – Push-up / Pull-ups c) Speed – 30 Mtr Dash d) Agility – Shuttle Run e) Flexibility – Sit and Reach f) Cardiovascular Endurance – Harvard step Test	24PED30.2 24PED30.3	15
	Module 3: Recreational Activities a) Postural deformities. b) Stress management. c) Aerobics. d) Traditional Games.	24PED30.3 24PED30.4	10
4TH 24PED40	**Module 1: Ethics and Moral Values** a) Ethics in Sports b) Moral Values in Sports and Games	24PED40.1 24PED40.2	5
	Module 2: Specific Games (Anyone to be selected by the student) a) Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. b) Throwball – Service, Receive, Spin attack, Net Drop & Jump throw. c) Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. d) Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up. e) Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash. f) Athletics (Track / Field Events) – Any event as per availability of Ground.	24PED40.3	20
	Module 3: Role of Organization and administration	24PED40.4	5

5TH 24PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 1. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** A. Fundamental Skills a) Catching, Throwing and Ball control, b) Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. c) Dribbling: High and low. d) Attack and counter attack, simple counter attack, counter attack from two wings and center. e) Blocking, Goal Keeping and Defensive skills. f) Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of officials **Ball badminton:** C. Fundamental Skills a) Basic Knowledge: Various parts of the Racket and Grip. b) Service: Short service, Long service, Long-high service. c) Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. d) Game practice with application of Rules and Regulations. **D.** Rules and their interpretation and duties of officials.	24PED50.1 24PED50.2 24PED50.3 24PED50.4	Total 30 Hrs / Semester 2 Hrs/ week
6TH 24PED60	**Athletics**: 1. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations) use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. **3.** Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Football OR Hockey** **Football:** A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. 2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 4. Heading: In standing, running and jumping condition. 5. Throw-in: Standing throw-in and Running throw-in. 6. Feinting: With the lower limb and upper part of the body.	24PED60.1, 24PED60.2, 24PED60.3, 24PED60.4	Total 30 Hrs/ Sem 2 Hrs/ week

	7. Tackling: Simple Tackling, Slide Tackling. 8. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting. 9. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit Trapping. 2. Dribbling and Dozing 3. Penalty stroke practice. 4. Penalty corner practice. 5. Tackling: Simple Tackling, Slide Tackling. 6. Goal Keeping, Ball clearance- kicking, and deflecting. 7. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials		

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 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.

YOGA			
Course Code	**24YOG50**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

24YOG50.1	Understanding the origin, history, aim and objectives of Yoga
24YOG50.2	Become familiar with an authentic foundation of Yogic practices
24YOG50.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat Kriyas
24YOG50.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24YOG50.1	-	-	-	-	-	3	-	-	-	-	1
24YOG50.2	-	-	-	-	-	3	-	-	-	-	1
24YOG50.3	-	-	-	-	-	3	-	-	-	-	1
24YOG50.4	-	-	-	-	-	3	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HRS
3rd 24YOG30	**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 Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	24YOG30.1 24YOG30.2 24YOG30.3 24YOG30.4	Total 32 Hrs/ Sem 2 Hrs/week
4TH 24YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	24YOG40.1 24YOG40.2 24YOG40.3 24YOG40.	Total 32 Hrs/ Semester 2 Hrs/week

5TH 24YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvangasana **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	24YOG50.1 24YOG50.2 24YOG50.3 24YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 24YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 4. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	24YOG60.1 24YOG60.2 24YOG60.3 24YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

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**

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 assessmentin 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 degreeprogram are the statements that describe the expected achievements of graduate in theircareer and in particular, what the graduates are expected to perform and achieve during thefirst 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)

PO6: 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).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: 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

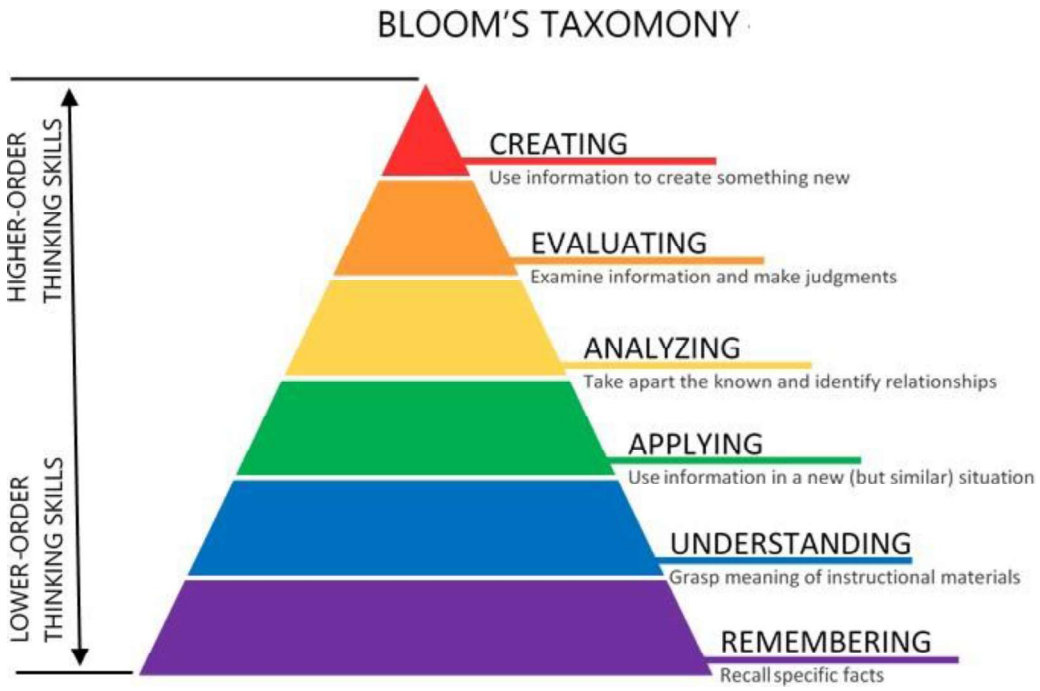
PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: 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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