



**DEPARTMENT OF
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**

Academic Year 2025-26



**3rd and 4th Semester
Scheme & Syllabus**

BATCH: 2024-28

CREDITS: 160



**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: 2025-26**

**Third (3rd) and Fourth (4th) Semesters
Scheme & Syllabus**

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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.

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 the academia and industry through their involvement in the design of curriculum and its hands-on implementation.

To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

Quality Policy

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

Values

- | | |
|--------------------|-------------------------|
| ❖ Academic Freedom | ❖ Professionalism |
| ❖ Innovation | ❖ Inclusiveness |
| ❖ Integrity | ❖ Social Responsibility |

DEPARTMENT OF AI & ML

Vision

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

Mission

To provide strong theoretical foundations and hands-on competence in Artificial Intelligence and Machine Learning, fostering research, innovation, and technical excellence in alignment with industry and national needs.

To establish sustainable academia–industry collaboration for curriculum enrichment, real-time problem solving, internships, and emerging AI technology implementation.

To develop ethically responsible, socially conscious, and environmentally aware AI professionals through holistic learning and active participation in co-curricular and professional activities.

Program Educational Objectives (PEOs)

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

PEO to Mission Statement Mapping

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

Knowledge and Attitude Profile (WK)

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

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

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

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

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

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

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

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

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

Program Outcomes (POs)

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)

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)

III 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	BSC*	24MAC31	Numerical Methods and Probability	BS	2	1	0	0	3	4	50	50	100
2	PCC*	24CSK32	Advanced Data Structures	CSE	3	0	0	0	3	3	50	50	100
3	PCCL*	24CSLK32	Advanced Data Structures Lab	CSE	0	0	1	0	1	2	50	50	100
4	PCC	24AIM33	Data Science	AIML	3	0	0	0	3	3	50	50	100
5	PCCL	24AIL33	Data Science Lab	AIML	0	0	1	0	1	2	50	50	100
6	PCC	24AIM34	Introduction to Artificial Intelligence	AIML	3	0	0	0	3	3	50	50	100
7	HSMS*	24CSK35	Software Engineering and Project Management	CSE	3	0	0	0	3	3	50	50	100
8	AEC	24AIM36X	Ability Enhancement Course – III	AIML	0	0	1	0	1	2	50	50	100
9	UHV*	24DTK37	Design Thinking and Fabrication	AIML	1	0	0	0	1	1	50	50	100
10	NCMC*	24NSS30	National Service Scheme	-	0	0	0	0	0	2	50	--	50
		24PED30	Physical Education and Sports	-									
		24YOG30	Yoga	-									
Total									19	25	500	450	950

11	NCMC*	24DMAT31	Basic Applied Mathematics -I	BS	0	0	0	0	0	2	50	--	50
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BSC: Basic Science Course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC:** Ability Enhancement Course, **L:** Lecture, **T:** Tutorial, **P:** Practical **S:** **SDA:** Self Study for Skill Development, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC:** Emerging Technology Course, **PLC:** Programming Language Course, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation

24DMAT31*: This non-credit mandatory course to be offered to Lateral entry students.

Ability Enhancement Course – III (0-0-1-0)

24AIM361	Introduction to OpenCV	24AIM364	Data Visualization with Power BI
24AIM362	GoLang Programming	24AIM365	Bio-Inspired Design and Innovation (1-0-0-0)
24AIM363	Project Management with Git		

24CSK35(HSMS)- This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management. **For IT allied Branches:** Software Product Management

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

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-hours Tutorial(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

NEW HORIZON COLLEGE OF ENGINEERING
B. E. in Artificial Intelligence and Machine Learning
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IV 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	BSC*	24MAC41	Discrete Mathematics and Graph Theory	BS	2	1	0	0	3	4	50	50	100
2	PCC*	24CSK42	Object Oriented Programming using Java	CSE	3	0	0	0	3	3	50	50	100
3	PCCL*	24CSLK42	Object Oriented Programming using Java Lab	CSE	0	0	1	0	1	2	50	50	100
4	PCC	24AIM43	Machine Learning	AIML	3	0	0	0	3	3	50	50	100
5	PCCL	24AIL43	Machine Learning Lab	AIML	0	0	1	0	1	2	50	50	100
6	PCC*	24CSK44	Database Management System	CSE	3	0	0	0	3	3	50	50	100
7	PCCL*	24CSLK44	Database Management System Lab	CSE	0	0	1	0	1	2	50	50	100
8	PEC	24AIM45X	Professional Elective Course-I	AIML	3	0	0	0	3	3	50	50	100
9	AEC	24AIM46X	Ability Enhancement Course – IV	AIML	0	0	1	0	1	2	50	50	100
10	UHV*	24UHK47	Universal Human Values and Life Skills	Any Dept	1	0	0	0	1	2	50	50	100
11	PROJ	24AIM48	Mini Project	AIML	0	0	1	0	1	2	50	50	100
12	NCMC*	24NSS40	National Service Scheme	-	0	0	0	0	0	2	50	--	50
		24PED40	Physical Education and Sports	-									
		24YOG40	Yoga	-									
Total									21	30	600	550	1150

13	NCMC*	24DMAT41	Basic Applied Mathematics-II	BS	0	0	0	0	0	2	50	--	50
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BSC: Basic Science Course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC:** Ability Enhancement Course, **PROJ:** Mini Project work, **L:** Lecture, **T:** Tutorial, **P:** Practical **S:** SDA: Self Study for Skill Development, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC:** Emerging Technology Course, **PLC:** Programming Language Course, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation.

24DMAT41*: This non-credit mandatory course to be offered to Lateral entry students.

Professional Elective Course-I

24AIM451	AI Ethics for AIML Engineers	24AIM454	Introduction to Embedded Systems
24AIM452	Computer Networks	24AIM455	Fundamentals of Sensor Technology
24AIM453	Computer Architecture		

Ability Enhancement Course – IV

24AIM461	Exploratory Data Analysis	24AIM464	Typescript Programming
24AIM462	Cloud Service Management	24AIM465	Problem Solving using Scala
24AIM463	Digital Electronics using HDL		

Mini-project: 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 2- 4 if mini project work is single discipline (applicable to all Core Branches)
- (iii) A group of 2 - 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

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-hours Tutorial(T) per week=1Credit
2-hours Practical / Drawing (P) per week=1Credit
2-hous Self Study for Skill Development (SDA)
per week = 1 Credit

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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

III SEMESTER

NUMERICAL METHODS AND PROBABILITY												
Course Code	24MAC31						CIE Marks	50				
L:T:P:S	2:1:0:0						SEE Marks	50				
Hrs. / Week	4						Total Marks	100				
Credits	3						Exam Hours	3				
Course outcomes: At the end of the course, the student will be able to:												
24MAC31.1	Use appropriate numerical methods to solve algebraic equations and transcendental equations.											
24MAC31.2	Solve initial value problems using appropriate numerical methods and also Evaluate definite integrals numerically.											
24MAC31.3	Demonstrate the idea of Linear Dependence and Independence of sets in the vector space.											
24MAC31.4	Gain ability to use probability distributions to analyze and solve real time problems											
24MAC31.5	Justify the concept of sampling distribution to solve the engineering problems and use the large/small samples to analyse the data to make decision about the hypothesis.											
Mapping of Course Outcomes to Program Outcomes:												
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	
24MAC31.1	3	3	-	-	-	-	-	-	-	-	-	-
24MAC31.2	3	3	-	-	-	-	-	-	-	-	-	-
24MAC31.3	3	3	-	-	-	-	-	-	-	-	-	-
24MAC31.4	3	3	-	-	-	-	-	-	-	-	-	-
24MAC31.5	3	3	-	-	-	-	-	-	-	-	-	-
MODULE-1	NUMERICAL SOLUTIONS AND INTERPOLATION									24MAC31.1	8 Hours	
Numerical solution of algebraic and transcendental equations: Newton-Raphson Method-Problems. Interpolation: Newton's forward and backward formulae for equal intervals, Newton divided difference, Lagrange's formula and Lagrange's inverse interpolation for unequal intervals (without proofs)-Problems.												
Text Book	Text Book 1: 28.2, 28.3, 29.6, 29.10, 29.11, 29.13, Text Book 2: 19.2, 19.3.											
MODULE-2	NUMERICAL SOLUTIONS TO DIFFERENTIAL EQUATIONS, INTEGRATION									24MAC31.2	8 Hours	
Numerical solution of ordinary differential equations of first order and of first degree: Taylor's series method, Modified Euler's method and Runge-Kutta method of fourth-order-Problems. Milne's predictor and corrector methods-Problems. Numerical integration: Simpson's 1/3 rd rule, Simpson's 3/8 th rule, Weddle's rule (without proofs)-Problems. Application of numerical integration to velocity of a particle and volume of solids.												
Text Book	Text Book 1: 32.3, 32.5, 32.7, 32.9, 30.7, 30.8, 30.10, Text Book 2: 19.5, 21.1.											
MODULE-3	VECTOR SPACES									24MAC31.3	8 Hours	
Vector Space definition and examples, Subspaces and Spanning sets, Linear Dependence and Independence, Linear Independence and Spanning Sets, Bases: Orthogonal and Orthonormal bases and Dimension.												
Text Book	Text Book 3: 4.1, 4.2, 4.3, 4.4, 4.5.											
MODULE-4	PROBABILITY AND JOINT PROBABILITY DISTRIBUTIONS									24MAC31.4	8 Hours	
Random variables (discrete and continuous), probability density functions; Expectation and Standard Deviation. Discrete Probability distributions: Binomial and Poisson Distributions-Problems. Continuous Probability distribution: Normal Distributions-Problems. Concept of joint probability-Joint probability distribution, Dependent and Independent random variables. Covariance, Correlation coefficient.												
Text Book	Text Book 1: 25.12, 25.13, 26.8, 26.9, 26.10, 26.11, 26.12, 26.14, 26.15, 26.16.											
MODULE-5	SAMPLING THEORY									24MAC31.5	8 Hours	
Sampling, Sampling distributions, test of hypothesis of large samples for means and proportions, Inferences for variance and proportion. Central limit theorem (without proof), confidence limits for means, Student's t-distribution, F-distribution and Chi-square distribution for test of goodness of fit for small samples.												
Text Book	Text Book 1: 27.2, 27.3, 27.4, 27.5, 27.6, 27.7, 27.8, 27.9, 27.10, 27.11, 27.12, 27.14, 27.15, 27.16, 27.17, 27.18, 27.19,											
List of Tutorial Contents												
Sl. No.	Contents										COs	
1.	Use Newton's forward formula for equal interval problems.										24MAC31.1	
2.	Use Newton's backward formula for equal interval problems.										24MAC31.1	
3.	Uses of Simpson's 1/3 rd rule problems										24MAC31.2	
4.	Uses of Simpson's 3/8 th rule problems										24MAC31.2	
5.	Use Wronskian to test a set of solutions of a linear homogeneous differential equation for linear independence.										24MAC31.3	
6.	Identify and sketch the graph of a conic section and perform a rotation of axes.										24MAC31.3	

7.	Use of Binomial Distribution in real life problems.	24MAC31.4
8.	Use of Normal Distribution in real life problems.	24MAC31.4
9.	Use Student's t-distribution to test goodness of fit for small samples.	24MAC31.5
10.	Use Chi-square distribution to test goodness of fit for small samples.	24MAC31.5

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

- 1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
- 2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.
- 3) David C Lay, Linear Algebra and its applications, Addison-Wesley Publishers, Fourth Edition, 2012, ISBN: 9780321385178.

Reference Books:

- 1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236.
- 2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
- 3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
- 4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

- 1) https://youtu.be/IgoJV4g_0LM?si=JO1_bkIvMR8xlC0V
- 2) <https://youtu.be/mIFwzgj11uO4?si=Xd13dh0eNlmIswPS>
- 3) https://youtu.be/74g5_3TC-tQ?si=yB2PHVGr4hxllqPo
- 4) <https://youtu.be/QQFIWwDA9NM?si=3wJrtlm1NdPSbXmB>
- 5) <https://youtu.be/5817fLmsTGE?si=Y7ORyV2ETSCxZRAZ>
- 6) <https://youtu.be/q3xj16shDuw?si=ewdlKAC8UEc6oRQV>
- 7) <https://youtu.be/89Z0tOvHjNU?si=3jT-orjZaC1kSzx>
- 8) <https://youtu.be/dOrONKyD31Q?si=dMBU-BXGdGL6jIZy>
- 9) <https://youtu.be/BR1nN8DW2Vg?si=melzz97SqhK3wr-->
- 10) https://youtu.be/ugd4k3dC_8Y?si=xF5U2gjlP0woDQt
- 11) https://youtu.be/z0Ry_3_qhDw?si=6IG2a65BZgdbaKsn
- 12) https://youtu.be/36cAE10vpq4?si=jfR8gkFmMOckWNZ_
- 13) <https://youtu.be/vFz2FG65HBc?si=SCHi3Y1XuHWg-pPT>
- 14) <https://youtu.be/2Dsz1ZBJ3Y?si=8ATLUE-mkJSMewO3>

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

- Contents related activities (Activity-based discussions)
 - Problem solving Approach
 - Organizing Group wise discussions on related topics
 - Seminars

ADVANCED DATA STRUCTURES													
Course Code	24CSK32							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:													
24CSK32.1	Understand the fundamentals of data structures and their applications essential for Programming/Problem Solving.												
24CSK32.2	Examine the operational aspects of linear data structures: stacks, queues.												
24CSK32.3	Analyze the behavior and performance of linked lists to address data organization challenges.												
24CSK32.4	Demonstrate the operational aspects of Tree data structures for optimized data hierarchy and retrieval.												
24CSK32.5	Demonstrate the operational aspects of Graph data structures for modeling and traversing.												
24CSK32.6	Investigate the sorting methods and hashing techniques for optimizing data access, storage, and retrieval.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CSK32.1	3	3	3	3	2	-	-	-	-	-	2	-	2
24CSK32.2	3	3	3	3	2	-	-	-	-	-	2	-	2
24CSK32.3	3	3	3	3	2	-	-	-	-	-	2	-	2
24CSK32.4	3	3	3	3	2	-	-	-	-	-	2	-	2
24CSK32.5	3	3	3	3	2	-	-	-	-	-	2	-	2
24CSK32.6	3	3	3	3	2	-	-	-	-	-	2	-	2
MODULE-1	INTRODUCTION							24CSK32.1			8 Hours		
Data Structures, Classifications, Data Structure Operations, Array Operations: Traversing, inserting, deleting, Multidimensional Arrays, Strings, Structures, Self- Referential Structures, Unions. Pointers -Pointer as function arguments, Dynamic Memory Allocation Functions.													
Text Book	Text Book 1: 2.1, 2.2,2.3 & Text Book 2:1.1-1.5,2.1-2.3												
MODULE-2	STACKS AND QUEUES							24CSK32.2			8 Hours		
Stacks, Applications of stacks: Recursion - Factorial, Fibonacci Sequence, Tower of Hanoi, Evaluation of Expressions, Multiple Stacks. Queues: Queue representation, Primitive operations, Circular queue, Priority queue, Double ended queue, Applications of queues.													
Text Book	Text Book 1:3.1,3.3,3.4, Text Book 2: 4.5.1,4.5.3,4.5.4,4.5.6,5.1-5.4,6.4.1,6.4.3,6.4.4												
MODULE-3	LINKED LISTS							24CSK32.3			8 Hours		
Introduction to Linked List, Representation of linked list in memory, Single Linked List, Doubly linked list, Header linked list, Linked representation of stack, Linked representation of queue, Circular linked list, Operations on linked lists, Applications of Linked List – Polynomials Representation, Addition of two polynomials.													
Text Book	Text Book 1: 4.1,4.2,4.4,4.5,4.8												
MODULE-4	TREES							24CSK32.4			8 Hours		
Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees, Heaps. Binary Search Trees, Selection Trees, Forests, Balanced Trees, AVL Trees, Single rotation, Double rotation, Red-Black Trees, Application of Trees- Evaluation of Expression													
Text Book	Text Book 1: 5.1,5.2,5.3,5.4,5.5,5.6, Text Book 2: 10.1, 10.3, 10.5, 10.7												
MODULE-5	GRAPHS, SORTING & HASHING							24CSK32.5, 24CSK32.6			8 Hours		
Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search. Sorting- Quick Sort, Merge Sort, Stable vs. Unstable sort, Hashing: The symbol table, Hashing Functions, Collision Resolution Techniques.													
Text Book	Text Book 1:6.1,6.2,7.1,8.1,8.2 & Text Book 2:10.1,10.2												

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution			
		Test (s)	AAT1	AAT2	AAT3
		25	7.5	7.5	10
L1	Remember	5	-	-	-
L2	Understand	5	2.5	2.5	-
L3	Apply	5	2.5	2.5	5
L4	Analyze	5	2.5	2.5	5
L5	Evaluate	5	-	-	-
L6	Create	-	-	-	-

*Alternate Assessment-1 &2: MCQs= 5 marks; Problem solving based question= 2.5 marks (Coding Platform)

*Alternate Assessment-3: MCQs= 5 marks; Problem solving based question= 5 marks (Coding Platform)

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. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structures in C. University Press, 2012, **ISBN:** 978-0716782506
2. Debasis Samanta: Classic Data Structures, 2nd Edition, PHI, 2009, **ISBN:** 978-8120337312

Reference Books:

1. Yedidyah, Augenstein, Tannenbaum: "Data Structures using C and C++, 2nd Edition, Pearson Education, 2003, ISBN :8131702294, 788131702291.
2. Richard F. Gilberg and Behrouz A. Forouzan: Data Structures A Pseudocode Approach with C, Cengage Learning, 2005, **ISBN-13:** 978-8131503140.
3. K.V. Sambasivarao, *Data Structures*. S. Chand Publishing, 2024. ISBN-13: 978-9358704730.
4. Reema Thareja, *Data Structures Using C*. Oxford University Press, 3rd Edition, 2023. ISBN-13: 978-0199491689.

Web links and Video Lectures (e-Resources):

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

Activity-Based Learning (Suggested Activities in Class)

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

ADVANCED DATA STRUCTURES LAB													
Course Code	24CSLK32					CIE Marks			50				
L:T:P:S	0:0:1:0					SEE Marks			50				
Hrs / Week	2					Total Marks			100				
Credits	03					Exam Hours			03				
Course outcomes: At the end of the course, the student will be able to:													
24CSLK32.1	Apply the concepts of Arrays and Structures for Programming and Problem Solving.												
24CSLK32.2	Examine the operational aspects of linear data structures: stacks, queues for efficient data management.												
24CSLK32.3	Analyze the behavior and performance of linked lists to address data organization challenges.												
24CSLK32.4	Demonstrate the operational aspects of non-linear data structures: Trees, Graphs in Programming.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CSLK32.1	3	3	3	3	3	-	-	-	-	-	3	-	2
24CSLK32.2	3	3	3	3	3	-	-	-	-	-	3	-	2
24CSLK32.3	3	3	3	3	3	-	-	-	-	-	3	-	2
24CSLK32.4	3	3	3	3	3	-	-	-	-	-	3	-	2
List of Programs													
Pgm. No.	List of Programs										Hours	Cos	
Prerequisite Programs													
	<ul style="list-style-type: none"> Basic C Programs (Arrays, User defined Functions, Structures, Pointers) Basic Commands in Linux 										2	NA	
PART-A													
1a.	Design, Develop and Implement a menu driven Program in C for the following array operations. a. Creating an array of N Integer Elements b. Display of array Elements with Suitable Headings c. Inserting an Element (ELEM) at a given valid Position (POS) d. Deleting an Element at a given valid Position (POS) e.Exit. Support the program with functions for each of the above operations.										2	24CSLK32.1	
2a.	Design, Develop and Implement a Program in C to create a structure to store the name, account number and balance of 3 and store their information. a. Write a function to print the names of all the customers having balance less than MINIMUM_AMOUNT . b. Write a function to add BONUS_AMOUNT in the balance of all the customers having more than \$1000 in their balance and then print the incremented value of their balance										2	24CSLK32.1	
3a	Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations										2	24CSLK32.2	
4a.	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.										2	24CSLK32.2	

5a.	Design, Develop and Implement a Program in C for the following Stack Application: Evaluation of Postfix expression with single digit operands and operators: +, -, *, /, %, ^.	2	24CSLK32.2
6a.	Design, Develop and Implement a Program in C for the following Stack Application: Solving Tower of Hanoi problem with n disks.	2	24CSLK32.2
PART-B			
1b.	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above Operations.	2	24CSLK32.2
2b.	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, PhNo a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. Exit	2	24CSLK32.3
3b.	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit	2	24CSLK32.3
4b.	Using circular representation for a polynomial, design, develop, and execute a program in C to accept two polynomials, add them, and then print the resulting polynomial.	2	24CSLK32.3
5b.	Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers. a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit	2	24CSLK32.4
6b.	Demonstrate the Binary Search algorithm by first sorting the list of elements using any one of the standard sorting techniques. a. The program should accept a list of elements, sort them in ascending order, and then perform a Binary Search to find a given target element. b. Display appropriate messages indicating whether the element was found and its position.	2	24CSLK32.4
PART-C			
Beyond Syllabus Virtual Lab Content			
(To be done during Lab but not to be included for CIE or SEE)			
1. https://ds1-iiith.vlabs.ac.in/exp/poly-arithmetic/polynomial-arithmetic-linked-list/multiplication-of-polynomials.html : Implement polynomial multiplication using linked lists.			
2. https://ds1-iiith.vlabs.ac.in/exp/depth-first-search/dfs/dfs-demo.html Implement Depth First Search in Graphs.			
3. https://ds1-iiith.vlabs.ac.in/exp/hash-tables/hash-tables/hash-tables-operations.html Demonstrate Hash Table			

CIE Assessment Pattern (50 Marks – Lab)			
RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	5	5
L6	Create	-	-

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

*** SEE EXAM:** Students will be assigned one program from Part A and one program from Part B.

Suggested Learning Resources:

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structures in C. University Press, 2012, **ISBN-13:** 978-0716782506
2. Debasis Samanta: Classic Data Structures, 2nd Edition, PHI, 2009, **ISBN-13:** 978-8120337312
3. Yedidyah, Augenstein, Tannenbaum: “Data Structures using C and C++, 2nd Edition, Pearson Education, 2003, ISBN:8131702294, 788131702291.
4. Richard F. Gilberg and Behrouz A. Forouzan: Data Structures A Pseudocode Approach with C, Cengage Learning, 2005, **ISBN-13:** 978-8131503140.
5. K.V. Sambasivarao, *Data Structures*. S. Chand Publishing, 2024. ISBN-13: 978-9358704730.
6. Reema Thareja, *Data Structures Using C*. Oxford University Press, 3rd Edition, 2023. ISBN-13: 978-0199491689.

Web links and Video Lectures (e-Resources):

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

DATA SCIENCE														
Course Code	24AIM33							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:														
24AIM33.1	Apply the predictive modeling techniques for different dataset using necessary python packages													
24AIM33.2	Utilize various statistical concepts and transformation techniques to effectively process and prepare datasets													
24AIM33.3	Design appropriate data wrangling techniques to transform diverse datasets into a clean and usable format													
24AIM33.4	Analyze the performance and suitability of diverse strategies for handling and processing multi-source data													
24AIM33.5	Evaluate the effectiveness of various data transformation and dimension reduction techniques for specific data sources													
24AIM33.6	Make data science-driven solutions to address real-world challenges, with proficiency assessed through evaluations													
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
24AIM33.1	3	-	-	-	-	-	-	-	-	-	-	3	3	
24AIM33.2	3	-	-	-	-	-	-	-	-	-	-	3	3	
24AIM33.3	-	-	3	-	3	-	-	-	-	-	-	3	3	
24AIM33.4	-	3	-	-	-	-	-	-	-	-	-	3	3	
24AIM33.5	-	-	-	3	2	-	-	-	-	-	-	3	3	
24AIM33.6	-	-	-	-	2	2	-	-	-	-	2	3	3	
MODULE-1	BASIC CONCEPTS AND PYTHON PACKAGES							24AIM33.1,24AIM33.6				8 Hours		
Basic Concepts: Predictive Modelling, Data preparation, Importance of Data preparation, Data Cleaning, Feature selection, Data Transform, Dimensionality reduction, K-fold cross validation, Data Leakage and avoidance measure. Python Packages: Numpy, Matplotlib, pandas, Scipy, scikit, Dataframe, Loading Machine Learning data.														
Text Book			Textbook1: Chapter:1,2,3, 4											
MODULE-2	DESCRIPTIVE STATISTICS AND DATA PREPARATION							24AIM33.1, 24AIM33.2, 24AIM33.4				8 Hours		
Descriptive Statistics: Reasons to study Statistics, Sampling, Data Analysis Process, Mean, Median, Standard Deviation, Skewness, Kurtosis, Graphical Representation-Box Plots, Pivot Table, Heat Map Correlation, Statistics-ANOVA. Data Preparation: Need for Data Pre-processing, Data Transforms, and Rescale Data Standardize Data, Normalize Data, Binarize Data, Univariate and Bivariate Data.														
Text Book			Textbook 2: Chapter:1, 2,4, 5, 8, 10,11, 12,13,14,15											
MODULE-3	DATA CLEANING AND FEATURE SELECTION							24AIM33.3, 24AIM33.4,24AIM33.6				8 Hours		
Data Cleaning: Basic data cleaning, Outlier Identification and Removal, Identifying and Removing Missing Data,, Statistical Imputation, KNN Imputation, Iterative Imputation. Feature Selection: Statistics for feature selection, Methods for categorical input, Methods for Numerical input, Select Features for Numerical Output, RFE for Feature Selection, Significance of feature selection.														
Text Book			Text Book1: Chapter:5, 6,7, 8,9, 10,11, 12,13, 14,15, 16.											
MODULE-4	DATA TRANSFORM AND DIMENSIONALITY REDUCTION							24AIM33.4, 24AIM33.5, 24AIM33.6				8 Hours		
Data Transforms: Scaling data source, min-max scalar and standard scaler, Scale data with outliers, encode categorical data, Make Distributions More Gaussian, Approach for Numerical Data Distributions, Deriving new input variables. Dimensionality reduction: Techniques for Dimensionality Reduction, Linear Discriminant Analysis, PCA Dimensionality Reduction, SVD Dimensionality Reduction														
Text Book			Text Book1: Chapter:17,18, 19,20,21,23,27, 28,29, 30.											
MODULE-5	OTHER TRANSFORMS							24AIM33.4, 24AIM33.5, 24AIM33.6				8 Hours		

Transform numerical to categorical, Transform Numerical and Categorical, Introduction to Regression: Linear Regression, Transform the Target in Regression, Save and load the transformation, case studies for Binary classification, Regression

Case Study Big Mart Sales Prediction Data Science Project – Learn about Supervised Learning, Feature Engineering, and Sales Forecasting, Healthcare (Pfizer) Data Science Project – Learn about Classification, Imbalanced Data Handling, and Patient Risk Prediction, Boston House Pricing Prediction Data Science Project – Learn about Regression Techniques and Real Estate Analytics

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

CIE Assessment Pattern (50 Marks - Theory)

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

Suggested Learning Resources:

Text Books:

- 1) Jason Brownlee, “Data Preparation for Machine Learning: Data Cleaning, Feature Selection, and Data Transforms in Python”, Machine Learning Mastery, 2020. ISBN:
- 2) Roxy Peck, Chris Olsen and Jay Devore, “Introduction to Statistics & Data Analysis ”3rd Edition Thomson Higher Education,2015. ISBN: 1305445961, 9781305445963

Reference Books:

- 1) Andrew Park, “Data Science for Beginners”, Andrew Park ,2021. ISBN: 9781914167997
- 2) Norman Matloff, “Probability and Statistics for Data Science”, CRC Press,2019. ISBN: 9780429687112

Web links and Video Lectures (e-Resources):

- 1) Data Science for Engineers: <https://digimat.in/nptel/courses/video/106106179/L01.html>
- 2) Statistics for Data Science: <https://www.youtube.com/watch?v=V5fqShLVpoI>

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

- Online Class using Jeopardy Lab
- Seminar for Solving immediate problem
- Class Presentation.

	c. Perform ANOVA to compare the means of the numerical features across different neighborhoods or zones in Boston		
PART-B			
1b	i. Implement the following for a given set of training data examples stored in a .CSV file a. Load data set b. Convert into Dataframe c. Apply Scaler method d. Fit the Scaler Data into PCA e. Plot the visualization diagram for PCA ii. Evaluate the Dimensionality Reduction: a. Compare the performance of a machine learning algorithm (e.g., logistic regression or k-nearest neighbours) on the original dataset versus the reduced dimensional dataset using cross-validation or another suitable evaluation metric.	2	24AIL33.1 24AIL33.2 24AIL33.3
2b	Implement the following Imputation for a given set of training data examples stored in a CSV file: a. Statistical Imputation b. KNN Imputation c. Iterative Imputation	2	24AIL33.3 24AIL33.4
3b	Implement the following Encoding methods for a given set of training data: a. Ordinal Encoding b. One Hot Encoding c. Dummy Variable Encoding	2	24AIL33.3 24AIL33.4
4b	Implement the following Transform methods on a numerical dataset: Uniform Discretization Transform, K-Means Discretization Transform	2	24AIL33.1 24AIL33.3 24AIL33.4
5b	Write a program to implement Linear Regression for a given dataset.	2	24AIL33.1 24AIL33.3
6b	Write a program to implement Binary classification and Multi - Classification for a given dataset	2	24AIL33.1 24AIL33.4
PART-C Beyond Syllabus Virtual Lab Content (To be done during Lab but not to be included for CIE or SEE)			
Data Science Concepts: https://iitmdatascience.com/notes.html https://cse.iitm.ac.in/~pratyush/cs6741.html https://archive.nptel.ac.in/courses/106/106/106106179/ Regression Models: http://www.r-bloggers.com/how-to-perform-a-logistic-regression-in-r/ http://www.coastal.edu/kingw/statistics/R-tutorials/logistic.html Classification: http://www.ats.ucla.edu/stat/r/data/binary.csv			
CIE Assessment Pattern (50 Marks - Lab)			
	RBT Levels	Test (s) - 20	Weekly Assessment - 30
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	10
L4	Analyse	5	10
L5	Evaluate	5	5
L6	Create	-	-
SEE Assessment Pattern (50 Marks - Lab)			
	RBT Levels	Exam Marks Distribution (50)	
L1	Remember	-	
L2	Understand	10	
L3	Apply	10	
L4	Analyse	20	
L5	Evaluate	10	
L6	Create		
Suggested Learning Resources:			
Reference Books:			
1)Yanchang Zhao, "R and DataMining: Examples and Case Studies", Elsevier,1stEdition,2012, ISBN: 9780123972712			
2) Han, Kamber, "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kaufmann Publishers,2016. ISBN: 9780123814807			

INTRODUCTION TO ARTIFICIAL INTELLIGENCE														
Course Code	24AIM34							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:														
24AIM34.1	Apply basic Artificial Intelligence methods for knowledge representation, problem-solving, and learning													
24AIM34.2	Analyze different search and reasoning techniques for real-time Artificial Intelligence problem-solving.													
24AIM34.3	Design intelligent systems using different algorithms or techniques to address real-world challenges													
24AIM34.4	Examine the complexities that arise when attempting to represent knowledge.													
24AIM34.5	Optimize the solutions for an AI problem by strategically employing various techniques													
24AIM34.6	Develop AI solutions that incorporate analytical reasoning to resolve complex logical issues.													
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	PS01	PS02	
24AIM34.1	3	-	-	-	-	-	-	-	-	-	-	3	2	
24AIM34.2	-	3	-	-	2	-	-	-	-	-	-	3	2	
24AIM34.3	-	-	3	-	2	-	-	-	-	-	-	3	2	
24AIM34.4	-	-	3	-	-	-	-	-	-	-	-	3	2	
24AIM34.5	-	-	-	3	2	-	-	-	-	-	-	3	3	
24AIM34.6	-	-	3	-	2	-	-	-	-	-	-	3	3	
MODULE-1 INTRODUCTION TO PROBLEMS & PROBLEM SEARCH														
Basics of AI, Applications of AI, Artificial Intelligence Problems and Techniques, Problem Spaces and Search: Defining the problem as a state space search, Production systems and its characteristics, Problem characteristics, Issues in the design of search programs. Good behaviour: the concept of rationality, the nature of environments, simple reflex programs.														
Self-study	Investigate the different types of Artificial Intelligence Techniques.													
Text Book	Text Book 1: Ch:1 and 2 Text Book 3:Ch 2													
MODULE-2	HEURISTIC SEARCH TECHNIQUES										24AIM34.2, 24AIM34.3	8 Hours		
Informed Search Strategies: Heuristic functions, Generate and Test, Hill Climbing, Best first search, A* algorithm, Constraint satisfaction, Means end analysis.														
Self-study	Investigate the Performance Comparison of Hill Climbing with other Optimization Techniques.													
Text Book	Text Book 1: Ch: 3													
MODULE-3	Logical Agents										24AIM34.4	8 Hours		
Introduction to Agents, the structure of Agents and Agents Programs, knowledge-based Agents, The Wumpus world, Propositional logic, Predicate logic, Procedural versus declarative Knowledge														
Self-study	Build a Rule-Based Expert System for Disease Diagnosis													
Text Book	Text Book 1: Ch: 4,5,6													
MODULE-4	KNOWLEDGE REPRESENTATION										24AIM34.4, 24AIM34.5	8 Hours		
Knowledge Representation: Representations & mappings, Approaches in knowledge representation, Issues in knowledge representation. Statistical reasoning: Certainty factors & rule-based systems. Weak slot and filler structures: Semantic nets, Frames: Strong slot and filler structures, conceptual dependency.														
Text Book	Text Book 1: Ch 8,9,10													
MODULE-5	AI PROGRAMMING LANGUAGES										24AIM34.6	8 Hours		
Introduction to LISP, Syntax and Numeric Functions, Basic List, Manipulation Functions in LISP, Functions, Predicate and Conditionals, Input, Output and Local Variables, Iteration and Recursion.														
Case Study	Solving the 8-Puzzle using Best-First Search in LISP													
Text Book	Text Book 2: Ch 3													

CIE Assessment Pattern (50 Marks - Theory)

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

SEE Assessment Pattern (50 Marks - Theory)

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

Suggested Learning Resources:**Text Books:**

- 1) E. Rich, K. Knight & Shivashankar B. Nair, "Artificial Intelligence", 3rd Edition, McGraw Hill, 2017. ISBN: 978-0070087705
- 2) Dan W. Patterson, "Introduction to Artificial intelligence and Expert systems", Prentice Hall of India Private Limited, 2006. ISBN: 978-8120307773
- 3). Stuart Russell and Peter Norvig, "Artificial Intelligence, A Modern Approach", Prentice Hall of India Private Limited, 2020. ISBN: 978-0136042594.

Reference Books:

- 1) N. P. Padhy, "Artificial Intelligence and Intelligent System", Oxford University Press, 2005. ISBN: 978-0195671544

Web links and Video Lectures (e-Resources):

1. <https://nptel.ac.in/courses/106102220>
2. <https://nptel.ac.in/courses/106105077>
3. <https://archive.nptel.ac.in/courses/106/105/106105158/>
4. <https://archive.nptel.ac.in/courses/106/106/106106140/>

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

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

SOFTWARE ENGINEERING AND PROJECT MANAGEMENT														
Course Code	24CSK35							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:														
24CSK35.1	Apply appropriate software process models to solve real-world software engineering problems using the principles of the SDLC													
24CSK35.2	Use standard SRS templates to prepare clear and testable requirement documents for the given project.													
24CSK35.3	Analyze modeling techniques such as DFDs and UML diagrams for effective software design.													
24CSK35.4	Analyze how people, products, processes, and projects interact to guide software management strategies.													
24CSK35.5	Analyze reactive and proactive risk strategies to evaluate their impact on the software project outcome													
24CSK35.6	Evaluate software risk factors by systematically identifying, projecting, refining, and prioritizing mitigation strategies within a coherent RMMM plan													
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
24CSK35.1	2	-	2	-	2	2	-	2	-	-	2	-	2	
24CSK35.2	2	-	2	-	2	2	-	2	-	-	2	-	2	
24CSK35.3	2	2	2	2	2	2	-	2	-	-	2	-	2	
24CSK35.4	2	2	2	2	2	2	-	2	-	2	2	-	2	
24CSK35.5	2	2	2	2	2	2	-	2	-	2	2	-	2	
24CSK35.6	2	2	2	2	2	2	-	2	-	2	2	-	2	
MODULE-1	INTRODUCTION TO SOFTWARE ENGINEERING AND PROCESS MODELS										24CSK35.1	8 Hours		
Introduction: Software Engineering, Software Process, Software Development Life Cycle. Process models: Waterfall model, Prototype model, Evolutionary process models, Unified Process model, iterative waterfall model, Incremental process models, Spiral model, Agile Development Model.														
Case study	Software Process Models (Waterfall, Prototyping, Evolutionary, Spiral, Unified, Agile): <ul style="list-style-type: none"> Select one or more process models to study in depth. Analyze case studies of projects that successfully used each model to understand their practical applications. 													
Text Books	Text Book 1: Chapter 1.1 to 1.4, and 2.1 to 2.6, 4.1 Text book 2: Chapter 1.1,2.2,2.4													
MODULE-2	REQUIREMENTS ENGINEERING							24CSK35.2				8 Hours		
Types of requirements, User requirements, System requirements, Functional and Non-functional requirements, Software requirements document, requirements specifications, requirement engineering process, Feasibility study, Requirements elicitation and analysis, Requirements validation, Requirements management.														
Applications	Identify a simple software project or system and draw SRS for the same													
Text Book3	Text Book 3: Chapter 4.1 to 4.7													
MODULE-3	SOFTWARE DESIGN							24CSK35.3				8 Hours		
Approaches to Software Design: Developing the Data Flow Diagram, UML diagram, Use case diagrams, Class diagram, interaction diagram, activity diagram, and state chart diagrams.														
Applications	Identify a simple software project or system and draw the corresponding DFD, UML, Class, interaction, activity and state chart diagrams													
Text Book	Text Book 2: 6.2, 7.2 to 7.8													
MODULE-4	MANAGING SOFTWARE PROJECTS							24CSK35.4				8 Hours		
Project Management Concepts: The Management Spectrum, People, Product, Process and Project. Project Planning: Creating a viable Software plan, Project planning process, Resources, data analytics and software project estimation, decomposition and estimation techniques														
Applications	You are part of a software team tasked with developing a Campus Placement Portal for a consortium of engineering colleges. The portal must support student registration, company onboarding, automated scheduling, and analytics. <ul style="list-style-type: none"> Apply the Management Spectrum: Understand how people, product, process, and project dynamics influence outcomes. 													

	<ul style="list-style-type: none"> • Create a viable software plan including scope, deliverables, timeline, and risk considerations. • Execute project decomposition and resource estimation using industry techniques. 																																						
Text Book	Text Book 1: Chapter 24.1 to 24.6, Chapter 25.1 to 25.6																																						
MODULE-5	RISK MANAGEMENT																																						
	24CSK35.5, 24CSK35.6																																						
	8 Hours																																						
Reactive versus proactive Risk Strategies, software Risks, Risk Identification, Risk Projection, Risk refinement, Risk mitigation, monitoring and management, The RMMM plan.																																							
Case Study	<p>Risk Strategy in E-Ticketing System Upgrade</p> <p>Key Risks to be Identified:</p> <ul style="list-style-type: none"> • Technical: API failures with third-party payment gateways • Operational: Lack of mobile testing resources • External: New regulatory compliance for digital ticketing • Proactive Steps: <ol style="list-style-type: none"> 1. Identified key risks using brainstorming and past incident logs 2. Created a mitigation list and incorporated it into a unified RMMM plan • Reactive Handling: <ol style="list-style-type: none"> a. A payment service disruption was resolved via backup gateway integration b. Emergency testing sprint addressed mobile app crashes 																																						
Text book 1	Text Book 1: Chapter 26: 26.1 to 26.7																																						
CIE Assessment Pattern (50 Marks - Theory)																																							
<table border="1"> <thead> <tr> <th colspan="2" rowspan="2">RBT Levels</th> <th colspan="3">Marks Distribution</th> </tr> <tr> <th>Test (s) (25)</th> <th>AAT1* (15)</th> <th>AAT2* (10)</th> </tr> </thead> <tbody> <tr> <td>L1</td> <td>Remember</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>L2</td> <td>Understand</td> <td>5</td> <td>-</td> <td>-</td> </tr> <tr> <td>L3</td> <td>Apply</td> <td>10</td> <td>5</td> <td>5</td> </tr> <tr> <td>L4</td> <td>Analyze</td> <td>5</td> <td>5</td> <td>5</td> </tr> <tr> <td>L5</td> <td>Evaluate</td> <td>5</td> <td>5</td> <td>-</td> </tr> <tr> <td>L6</td> <td>Create</td> <td>-</td> <td>-</td> <td>-</td> </tr> </tbody> </table>		RBT Levels		Marks Distribution			Test (s) (25)	AAT1* (15)	AAT2* (10)	L1	Remember	-	-	-	L2	Understand	5	-	-	L3	Apply	10	5	5	L4	Analyze	5	5	5	L5	Evaluate	5	5	-	L6	Create	-	-	-
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L6	Create	-	-	-																																			
* AAT1: Case Study with Report																																							
*AAT2: Online certification course(free)																																							
SEE Assessment Pattern (50 Marks - Theory)																																							
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Suggested Learning Resources:																																							
Text Books:																																							
<ol style="list-style-type: none"> 1. R. S. Pressman and Bruce Maxim, Software Engineering: A Practitioner's Approach, 9/e, McGraw-Hill, 2020, ISBN-13: 9781259872976 2. Rajib Mall, Fundamentals of software engineering, 5th edition, PHI Learning Private Limited 2018, ISBN-13: 9788120351658 3. Software Engineering, Ian Sommerville, Pearson Education, Tenth Edition, 2016, ISBN-13: 978-0-13-394303-0 																																							
Reference Books:																																							
<ol style="list-style-type: none"> 1. Software Engineering, Chandramouli, Pearson Education, first edition, 2015, ISBN-13: 9789332537293 2. Software Project Management: A Unified Framework, Walker Royce, first edition, 1998, ISBN-13: 9788177583786 3. Managing Global Software Projects, McGraw-Hill Education (India), Gopaldaswamy Ramesh, Fourteenth Reprint 2013, ISBN-13: 9780070598973 4. Effective Software Project Management. Robert K. Wysocki – Wiley Publication, 2011, ISBN-13: 978-0-470-12107-8 																																							

Web links and Video Lectures (e-Resources):

- <https://www.coursera.org/learn/introduction-to-software-engineering>
- https://www.udemy.com/courses/development/software-engineering/?srsltid=AfmB0or5x5ldCizp1dXfnY9RvF7fYyhshBGixnAxyR7XM3Q1iYg4tD_2
- <https://www.edx.org/learn/software-engineering>
- https://onlinecourses.nptel.ac.in/noc20_cs68/preview
- <https://alison.com/course/project-management-s-fundamentals>
- <https://www.coursera.org/courses?query=software%20project%20management&msockid=336a577a6ec56ab12f9546416f686b63>
- <https://software-engineering-book.com/slides/>

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

- PPT presentation on case studies with a team of students
- Role Play

INTRODUCTION TO OPENCV													
Course Code	24AIM361					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:													
24AIM361.1	Apply the essential OpenCV operations for image and video processing.												
24AIM361.2	Analyze image pixel manipulation tasks with OpenCV												
24AIM361.3	Design a new method for processing and extracting image features using the OpenCV library												
24AIM361.4	Evaluate real-time video and image analysis techniques such as color detection, channel splitting, and panorama creation using OpenCV.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM361.1	3	-	-	-	-	-	-	-	-	-	-	3	3
24AIM361.2	-	3	-	-	-	-	-	-	-	-	-	3	3
24AIM361.3	-	-	3	-	2	-	-	-	-	-	2	3	3
24AIM361.4	-	-	-	3	2	-	-	-	-	-	2	3	3
Pgm. No	List of Experiments / Programs											Hours	COs
Prerequisite Experiments / Programs / Demo													
	Basic Python Programming, Basic image processing concepts.											2	NA
PART-A													
1a	Read a color image using OpenCV, display the original image, resize it to 300×300 pixels, and display both the original and resized images in separate windows.											2	24AIM361.1 24AIM361.2
2a	Convert the color image to grayscale, save the grayscale image to disk, and print the original image's: <ul style="list-style-type: none"> • Height • Width • Number of Channels • Data Type 											2	24AIM361.1 24AIM361.2
3a	Create a blank white image using OpenCV and perform the following: <ol style="list-style-type: none"> Draw a line, rectangle, and circle on the image. Draw an ellipse with specified axis lengths and angle. 											2	24AIM361.1 24AIM361.2
4a	Read a color image using OpenCV, access the pixel value at coordinate (x, y), print its original value, modify it to red, and display the modified image.											2	24AIM361.1 24AIM361.2
5a	Using OpenCV to access the pixel value at a given coordinate (x, y) in a color image and modify it to red. Display the modified image.											2	24AIM361.1 24AIM361.2
6a	Load a mp4 video file using OpenCV and play each frame in a window until the video ends or the user presses a key to stop.											2	24AIM361.1 24AIM361.2
PART-B													
1b	Write a Python program using OpenCV to split a color image into its Blue, Green, and Red (B, G, R) channels and display each channel separately.											2	24AIM361.3
2b	Apply a Gaussian Blur filter to a color image using OpenCV and display both the original and blurred images side by side.											2	24AIM361.3
3b	Write a Python program using OpenCV to perform automatic image thresholding using Otsu's method on a grayscale image. Display the original grayscale image and the thresholded binary image											2	24AIM361.3
4b	Using OpenCV detect and draw contours of shapes present in a binary image. Display the original image with contours outlined.											2	24AIM361.3
5b	Write a Python program using OpenCV to detect and display only the red color in an image using HSV color space and masking. Display both the original image and the red-masked result.											2	24AIM361.3 24AIM361.4
6b	Write a Python program using OpenCV to stitch two or more overlapping images to create a panoramic image.											2	24AIM361.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1) Real-Time Face Detection using Webcam:

<https://realpython.com/face-recognition-with-python/>

<https://www.datacamp.com/tutorial/face-detection-python-opencv?>

2) Real-Time Color Tracking Using HSV : <https://codewithcurious.com/projects/realtime-colour-detection-python/>

3) Real-Time Edge Detection Using Canny Filter: -[https://docs.opencv.org/3.4/da/d22/tutorial_py_canny.html?](https://docs.opencv.org/3.4/da/d22/tutorial_py_canny.html)

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

- 1) Gary Bradski, "Learning OpenCV: Computer Vision with OpenCV Library", O'Reilly, 2008. ISBN: 978-0596516130
- 2) Prateek Joshi, "OpenCV with Python by Example", Packt Publishing, 2015. ISBN: 978-1785283932

Web links and Video Lectures(e-Resources):

- <https://www.geeksforgeeks.org/python/opencv-python>
- <https://www.kaggle.com/code/talhabu/opencv-tutorial-from-basic-to-advanced>
- https://docs.opencv.org/4.x/d9/df8/tutorial_root.html

Activity-Based Learning/Practical Based learning

- Organizing Group wise discussions on issues
- Group projects

GOLANG PROGRAMMING														
Course Code	24AIM362							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:														
24AIM362.1	Understand the basic Go Language syntax and features.													
24AIM362.2	Apply the concept of Go Programming to solve real world problem.													
24AIM362.3	Analyze the concept of arrays and pointer sin Go Language programming													
24AIM362.4	Examine the concept of functions & Strings in Go programming.													
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
24AIM362.1	2	-	-	-	-	-	-	-	-	-	-	3	3	
24AIM362.2	3	-	-	-	-	-	-	-	-	-	-	3	3	
24AIM362.3	-	3	-	-	-	-	-	-	-	-	-	3	3	
24AIM362.4	-	-	-	3	-	-	-	-	-	-	2	3	3	
Pgm. No.	List of Experiments / Programs										Hours	COs		
Prerequisite Experiments / Programs / Demo														
	Basic Programming concepts using any language C, Python, C++.										2	NA		
PART-A														
1a	Write a GoLang program to find LCM and GCD of three numbers using explicit type casting and demonstrate the basic standard arithmetic operations.										2	24AIM362.1, 24AIM362.2		
2a	a. Write a Golang program to print Floyd's Triangle. b. Write a Golang program to swap two numbers without using third variable.										2	24AIM362.1, 24AIM362.2		
3a	a. Write a Golang program to generate Fibonacci sequence up to a given number. b. Write a program for sine and cosine series using Golang.										2	24AIM362.1, 24AIM362.2		
4a	Write a Golang program to check whether given numbers are palindrome or not. Note: Discuss the loop and decision-making statements syntax and working methods.										2	24AIM362.1, 24AIM362.2		
5a	a. Write a Golang program to print Pyramid of numbers. b. Write a program to sum of natural numbers all divisible by odd numbers.										2	24AIM362.2 24AIM362.3,		
6a	Write a program to demonstrate the string manipulation using functions; a. creation of string b. Find string length c. concatenation of strings and other string operations. Note: Discuss the functions and string.										2	24AIM362.2 24AIM362.4		
PART-B														
1b	a. Write a Golang program to illustrate comparison of two arrays. b. Write a Golang program to merge two arrays without using library function.										2	24AIM362.1, 24AIM362.2		
2b	Demonstrate the Working of Pointers in Golang with examples. Note: Discuss the pointer in Golang.										2	24AIM362.1, 24AIM362.2		
3b	a. Write a Golang program to show how to declare and define the structure. b. Write a Golang program using setter and getter functions. Note: Discuss the structure in Golang.										2	24AIM362.1, 24AIM362.3, 24AIM362.4		
4b	Write a Golang program to demonstrate the Structure as Functions Arguments.										2	24AIM362.1, 24AIM362.2 24AIM362.3		
5b	Write a Golang program for Struct Embedding concepts.										2	24AIM362.3, 24AIM362.4		
6b	Write a Golang program using Pointers to Structures.										2	24AIM362.3, 24AIM362.4		

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

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

CIE Assessment Pattern (50 Marks - Lab)

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

SEE Assessment Pattern (50 Marks - Lab)

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

Suggested Learning Resources:

Reference Books:

1 Alan A. A. Donovan , Brian W. Kernighan, "The Go Programming Language", Pearson Education, 2016. ISBN: 978-9332569713.

Web links and Video Lectures(e-Resources):

- <https://www.freecodecamp.org/news/learn-golang-handbook>
- <https://go.dev/ref/spec>

Activity-Based Learning/Practical Based learning

- Prepare Flowcharts and Handouts
- Organizing Group wise discussions on issues
- Project Presentation

PROJECT MANAGEMENT WITH GIT													
Course Code	24AIM363					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:													
24AIM363.1	Understand the fundamental concepts of Git to perform version control tasks.												
24AIM363.2	Apply Git commands to create and manage branches.												
24AIM363.3	Analyze the concept of collaboration and working with remote repositories.												
24AIM363.4	Examine Git history to manage various versions of codebase.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM363.1	2	-	-	-	2	-	-	-	-	-	-	3	3
24AIM363.2	3	-	-	-	2	-	-	-	-	-	-	3	3
24AIM363.3	-	3	-	-	2	-	-	-	-	-	-	3	3
24AIM363.4	-	-	3	-	2	-	-	-	-	-	-	3	3
Pgm. No.	List of Experiments / Programs										Hours	COs	
Prerequisite Experiments / Programs / Demo													
	<ul style="list-style-type: none"> Basic Command Line Interface skills Knowledge about file systems A Github/ Gitlab account. 										2	NA	
PART-A													
1a	Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message. Also add files that need not be tracked in to gitignore.										2	24AIM363.1	
2a	Create a new branch named "feature-branch." Switch to the "main" branch. Merge the "feature-branch" into "main."										2	24AIM363.1 24AIM363.2	
3a	a. Make some changes to a tracked file in your repository. Use the appropriate Git command to view the changes made to the file before staging. b. Write the commands to stash your changes, switch branches, and then apply the stashed changes.										2	24AIM363.1 24AIM363.2	
4a	Write the command to merge "feature-branch" into "main" while providing a custom commit message for the merge.										2	24AIM363.1 24AIM363.2	
5a	a. Connect your local repository to a remote repository hosted on GitHub and push your local commits to it. b. Make a change in your GitHub repository online and then sync those changes to your local machine.										2	24AIM363.2 24AIM363.3	
6a	Clone a remote GitHub repository, verify its setup, make a small change to a file and commit it. Pull the latest updates from the remote to this cloned repository.										2	24AIM363.2 24AIM363.3	
PART-B													
1b	Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository.										2	24AIM363.1 24AIM363.2 24AIM363.4	
2b	Write the command to display the last five commits in the repository's history.										2	24AIM363.1 24AIM363.2 24AIM363.4	
3b	Write the command to cherry-pick a range of commits from "source-branch" to the current branch.										2	24AIM363.1 24AIM363.2	

4b	Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message?	2	24AIM363.2 24AIM363.4
5b	Write the command to list all commits made by a specific author between a specific range of dates. (e.g., Author John between 2024-01-01 to 2024-12-31)	2	24AIM363.2 24AIM363.3 24AIM363.4
6b	Write the command to undo the changes introduced by the commit from a specific ID.	2	24AIM363.1 24AIM363.2 24AIM363.4

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

- Learn Git branching: <https://learngitbranching.js.org/>
- Git reset and relog commands usage: <https://www.datacamp.com/tutorial/git-reflog>
- Git GUI using GitGUI /GitKraken/ SourceTree

CIE Assessment Pattern (50 Marks - Lab)

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

SEE Assessment Pattern (50 Marks - Lab)

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

Suggested Learning Resources:

Reference Books:

1. Scott Chacon, Ben Straub, "Pro Git", Second Edition, Apress (Springer Nature), 2014. ISBN: 978-1484200773.

Web links and Video Lectures(e-Resources):

- Git documentation: <https://git-scm.com/doc>
- Github documentation: <https://docs.github.com>
- GitGUI using SourceTree: <https://www.sourcetreeapp.com>

Activity-Based Learning/Practical Based learning

- Project Presentation (Team/ Individual)

DATA VISUALIZATION USING POWER BI													
Course Code	24AIM364					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:													
24AIM364.1	Understand basic concepts and terminology of the Power BI service.												
24AIM364.2	Apply the concept of data importing, charts and data cleaning.												
24AIM364.3	Analyze the concept of View and export data from dashboards and reports.												
24AIM364.4	Design the relationship between dashboards and reports, visualizations, and tiles.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM364.1	2	-	-	-	-	-	-	-	-	-	-	3	3
24AIM364.2	3	-	-	-	-	-	-	-	-	-	-	3	3
24AIM364.3	-	3	-	-	-	-	-	-	-	-	-	3	3
24AIM364.4	-	-	3	-	3	-	-	-	-	-	3	3	3
Pgm. No.	List of Experiments / Programs										Hours	COs	
Prerequisite Experiments / Programs / Demo													
	Basic of Data Science Algorithms and Python										2	NA	
PART-A													
1a	Visualize different groups of data using bar chart, stacked bar charts to show the composition of each item. Note: Discuss the different types of data and choosing appropriate chart type.										2	24AIM364.1 24AIM364.2	
2a	a. Load a dataset of monthly sales by region and product category. Create a clustered bar chart comparing total sales across regions. b. Create a line chart to visualize sales trends over time. Add data labels and customize the line colors. Note: Discuss the Design principles for effective visualizations										2	24AIM364.1 24AIM364.2	
3a	Import an excel file that has multiple sheets. Combine all the sheets in to a single table using Power query. Note: Discuss the Importing different data sources in Power BI										2	24AIM364.1 24AIM364.2	
4a	Handle data errors, duplicate records, missing values and data type mismatches on the imported data Note: Discuss the Dealing with errors and in consistent data										2	24AIM364.2 24AIM364.3	
5a	Create interactive report with filters Note: Discuss the inking visualizations through interactions										2	24AIM364.2 24AIM364.3	
6a	Create a dashboard report for the given dataset Note: Discuss the arranging visuals in dashboards										2	24AIM364.3 24AIM364.4	
PART-B													
1b	Design and visualize business KPIs using calculated DAX measures (e.g., profit margin, growth%). Note: Discuss advanced DAX expressions and their use in deriving insights.										2	24AIM364.3 24AIM364.4	
2b	Develop a dynamic report using What-if Parameters for user-driven business analysis. Note: Discuss how parameterization supports simulation and scenario planning.										2	24AIM364.3 24AIM364.4	
3b	Use conditional formatting to highlight performance metrics and thresholds across visuals Note: Discuss how visual formatting aids quick interpretation of critical metrics.										2	24AIM364.3 24AIM364.4	
4b	Generate and analyze spatial or categorical heatmaps to identify patterns in dense data Note: Discuss color gradients and layout techniques for intuitive heat maps.										2	24AIM364.3 24AIM364.4	
5b	Create an interactive multi-level drill through report with contextual navigation Note: Discuss navigation workflows and how to retain analysis focus across pages.										2	24AIM364.4	
6b	Design a professional-grade analytical report for a real-world dataset with storytelling. Note: Encourage domain-driven insight reporting with layout design, slicers, and										2	24AIM364.4	

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

Charts for visualization: <https://windsor.ai/power-bi-visualization-charts/>
Heatmaps: <https://intellipaat.com/blog/power-bi-heatmap/>
Colour conditional Formatting: <https://intellipaat.com/blog/power-bi-heatmap/>
[https:// databear.com/changing-colours-using-dax-and-conditional-formatting-in-power-bi/](https://databear.com/changing-colours-using-dax-and-conditional-formatting-in-power-bi/)

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1) Alberto Ferrari and Marco Russo, “Introducing Microsoft PowerBI “, Microsoft Press, 2016. ISBN: 9781509302758.

Web links and Video Lectures (e-Resources):

- <https://www.datacamp.com/tutorial/tutorial-power-bi-for-beginners>
- <https://www.bing.com/videos/search?q=power+bi+tutorial+for+beginners&docid=603533498868517438&mid=D73791A4A441F7A262C4D73791A4A441F7A262C4&view=detail&FORM=VIRE>
- <https://www.geeksforgeeks.org/power-bi-tutorial>

Activity-Based Learning/Practical Based learning

- Prepare Flowcharts and Handouts
- Project Presentation

BIO INSPIRED DESIGN AND INNOVATION														
Course Code	24AIM365								CIE Marks	50				
L:T:P:S	1:0:0:0								SEE Marks	50				
Hrs / Week	01								Total Marks	100				
Credits	01								Exam Hours	02				
Course outcomes: At the end of the course, the student will be able to:														
24AIM365.1	Apply the biomimetics principles for real life challenges													
24AIM365.2	Investigate novel bioengineering initiatives by evaluating design and development principles													
24AIM365.3	Apply the bio computing optimization through research and experiential learning.													
24AIM365.4	Review the fundamental biological ideas through pertinent industrial applications and case studies													
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
24AIM365.1	3	3	3	3	2	-	-	-	1	1	-	3	3	
24AIM365.2	3	3	3	3	2	-	-	-	1	1	-	3	3	
24AIM365.3	3	3	3	3	2	-	-	-	1	1	-	3	3	
24AIM365.4	3	3	3	3	2	-	-	-	1	1	-	3	3	
MODULE-1 BIO-INSPIRED DESIGN AND ENGINEERING 24AIM365.1 3 Hours														
Bio-Inspired Engineering and design, History, Need for Bio-Inspired Designs. Bio inspired Additive manufacturing techniques, (self-healing, self-assembly).														
Self-study	Investigate the Challenges of Bio inspired design, Compare with traditional areas of science and engineering.													
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16													
MODULE-2 BIO MATERIALS AND BIO HEALTHCARE DESIGN 24AIM365.2 3 Hours														
Biomaterials, Design of Forms- (Hexagonal unit cells, Intrinsic disorder, anisotropy), Bio- Mechanics, Applications of Biomaterials and Bio systems in Health care design (Human Prosthetics, Parasitic, Wasp-Inspired Needle)														
Case Study	Investigate Bio-Compatible and health care applications.													
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15													
MODULE-3 BIO SUSTAINABLE DEVELOPMENT 24AIM365.3,24AIM365.4 3 Hours														
Innovations in Energy (Termite mound inspired shopping malls), Innovations in Resource-Air purification, filtration), Dew water collection systems, water purification, desalination.														
Self-study / Case Study /Applications	Explore the Bio inspired environmental constructions and development.													
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10													
MODULE-4 BIO COMPUTING AND OPTIMISATION 24AIM365.5 3 Hours														
No Free Lunch Theorem, Bat Algorithm, Flower Pollination Algorithm, Genetic Algorithm, Ant Colony Optimisation (ACO), Swam Intelligence- Particle Swam Optimisation (PSO).														
Self-study / Case Study /Applications	Scrutinize the Different types of Optimization techniques, genetic research.													
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7													
MODULE-5 APPLICATIONS OF BIO-INSPIRED INNOVATIONS 24AIM365.6 3 Hours														
Bioinspired innovations in- Automotive, Automation, Materials and Manufacturing, Carbon Neutral Solutions (Coral Reefs, Eco-cements), Carbon Free Solutions (Lotus leaf inspired paints), Eco-restorations (Eco-friendly pesticide).														
Self-study / Case Study /Applications	Survey on Bio inspired Innovations, design, applications and case studies of the same.													
Text Book	Text Book 2: 12.1 to 12.10													
CIE Assessment Pattern (50 Marks - Theory) -														
RBT Levels		Marks Distribution												
		Test (s) - 25	AAT1 - 15	AAT2 - 10										
L1	Remember	5	-	-										
L2	Understand	5	-	-										
L3	Apply	5	5	5										
L4	Analyze	5	5	5										
L5	Evaluate	5	5	-										
L6	Create	-	-	-										

SEE Assessment Pattern (50 Marks - Theory)

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

Suggested Learning Resources:**Text Books:**

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

Reference Books:

- 1) French M, "Invention and evolution: Design in nature and engineering", Publisher: Cambridge University Press, 2020
- 2) Pan L., Pang S., Song T. and Gong F. eds, "Bio-Inspired Computing: Theories and Applications", 15th International Conference, BIC-TA 2020, Qingdao, China, October 23-25, 2020, Revised Selected Papers (Vol. 1363). Springer Nature, 2021
- 3) Wann D, "Bio Logic: Designing with nature to protect the environment", Wiley Publisher, 1994

Web links and Video Lectures (e-Resources-:

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

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

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

DESIGN THINKING AND FABRICATION													
Course Code	24DTK37							CIE Marks	50				
L:T:P:S	1:0:0:0							SEE Marks	50				
Hrs / Week	01							Total Marks	100				
Credits	01							Exam Hours	02				
Course outcomes: At the end of the course, the student will be able to:													
24DTK37.1	Identify innovation opportunities through real-world problem analysis and observation.												
24DTK37.2	Propose a product or service idea using technical knowledge and feasibility insights.												
24DTK37.3	Demonstrate empathy and creative thinking in the ideation and concept generation stages.												
24DTK37.4	Design, prototype, and test functional models using appropriate tools and fabrication												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24DTK37.1	3	-	-	-	-	-	-	-	-	-	-	2	2
24DTK37.2	3	3	2	-	-	-	-	-	-	-	-	2	2
24DTK37.3	3	3	2	-	-	-	-	-	-	-	-	-	1
24DTK37.4	3	3	2	1	2	-	-	-	-	-	2	2	2
MODULE-1	INTRODUCTION TO DESIGN THINKING							24DTK37.1 24DTK37.3			3 Hours		
Definition, origin, and key features of Design Thinking. Role of a Design Thinker in organisations. Core principles and stages of the Design Thinking process. Collaborative design thinking with examples of MVPS or prototyping													
Self-study	Smart Agricultural Monitoring System												
Text Book:	Text Book 1: 2.1,2.2,2.4,2.5,2.6,2.7 Text Book 2: Page No. 1-90												
MODULE-2	DESIGN THINKING METHODOLOGY							24DTK37.3			3 Hours		
Design Thinking Methodology: The 5 Stages of the Design Thinking Process- Empathise, define (the problem), Ideate, Prototype, and Test.													
Self-study	Autonomous Drone for Aerial Surveillance												
Text Book	Text Book 1:5.1,5.2,5.3 Text Book 2: Page No.100-124												
MODULE-3	TOOLS FOR DESIGN THINKING							24DTK37.1			3 Hours		
Ideation tools & exercises. Sample Design Challenge, Introduction to the Design Challenge Themes, Storytelling and Tools for Innovation.													
Self-study	Smart Home Automation System												
Text Book	Text Book 1:4.1,4.2,4.6,4.8,6.1,6.2,6.3 Text Book 2: Page No.125-138												
MODULE-4	EMPATHY MAPS							24DTK37.3			3 Hours		
Empathise-Understand customers, Empathy Maps, Empathise-Step into customers' shoes, Customer Journey Maps, Define- Analysis & Drawing Inferences from Research.													
Self-study	Custom Drone with Payload Integration for Search and Rescue												
Text Book	Text Book 1: 9.1,9.2,9.3,10.1,10.2,10.3,10.4 Text Book 2: Page No.139-146												
MODULE-5	DESIGN CHALLENGE AND PROTOTYPING							24DTK37.2 24DTK37.4			3 Hours		
The Design Challenge: Define the Design Challenge, Prototyping & Iteration- Feasibility Study, Testing, Documentation, and the Pitching.													
Self-study	Automated PCB Inspection System												
Text Book	Text Book 1:3.1,3.2 Text Book 2: Page No.147 and 189												

CIE Assessment Pattern (50 Marks - Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	-	-
L4	Analyze	5	5	-
L5	Evaluate	-	5	5
L6	Create	-	5	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) Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking. ISBN-13: 978-1790435371
- 2) John. R. Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013. ISBN-13: 978-1111645823

Reference Books:

- 1) Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009. ISBN-13: 978-1422177808
- 2) Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand - Improve - Apply", Springer, 2011, ISBN-13: 978-3-642-13756-3
- 3) Yousef Haik and Tamer M. Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011. 48 , ISBN-13: 978-0495668145
- 4) Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover - 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author), ISBN-13: 978-0231163569

Web links and Video Lectures (e-Resources)

- <https://www.ibm.com/design/thinking/>
- <https://www.ideo.com/pages/design-thinking>

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

- Ergonomic Kitchen Tool Handle: Reverse Engineering and Redesign
- Customizable Modular Furniture System: From Concept to Prototype
- Rapid PCB Prototyping for Bluetooth Applications
- CNC Milling for Custom Circuit Board Fabrication
- Smart Motion Detection System Using Microprocessor
- IoT-Based Smart Home Automation System Using Microprocessor
- Design and Fabrication of Rotary Milling Fixture
- Design and Fabrication of Milling Vise Attachment on Lathe Machine
- AI-Driven Drone for Search and Rescue Operations
- Autonomous Drone for Wildfire Detection and Monitoring
- Drone-Based Delivery System for Emergency Medical Supplies

BASIC APPLIED MATHEMATICS-I											
Course Code	24DMAT31					CIE Marks			50		
L:T:P:S	0:0:0:0					SEE Marks			--		
Hrs. / Week	2					Total Marks			50		
Credits	0					Exam Hours			--		
Course outcomes: At the end of the course, the student will be able to:											
24DMAT31.1	Know the principles of engineering mathematics through calculus										
24DMAT31.2	Determine the power series expansion of a function										
24DMAT31.3	Find the definite integrals with standard limits and also develop the ability to solve different types of differential equations										
24DMAT31.4	Apply ideas from linear algebra in solving systems of linear equations and determine the Eigen values and Eigen vectors of a matrix										
Mapping of Course Outcomes to Program Outcomes:											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24DMAT31.1	3	3	-	-	-	-	-	-	-	-	--
24DMAT31.2	3	3	-	-	-	-	-	-	-	-	--
24DMAT31.3	3	3	-	-	-	-	-	-	-	-	-
24DMAT31.4	3	3	-	-	-	-	-	-	-	-	-
MODULE-1	DIFFERENTIAL CALCULUS								24DMAT31.1 24DMAT31.2	8 Hours	
Polar Curves-Problems on angle between the radius vector and tangent, Angle between two curves-Problems, Pedal equation for polar curves-Problems. Maclaurin's theorem for function of one variable (statement only)-Problems.											
Text Book	Text Book 1: 4.4, 4.7, 4.8, Text Book 2: 15.4										
MODULE-2	PARTIAL DIFFERENTIATION								24DMAT31.1	8 Hours	
Definition and Simple problems, Euler's theorem for Homogeneous function (NO Derivation and NO extended theorem)-Problems, Jacobians of order two - definition and problems.											
Text Book	Text Book 1: 5.4, 5.7,										
MODULE-3	INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS								24DMAT31.3	8 Hours	
Problems on evaluation of $\sin n x$ and $\cos n x$ integrals with standard limits (0 to $\pi/2$). Solution of first order and first-degree differential equations-Variable separable, Linear and Exact differential equations.											
Text Book	Text Book 1: 6.2, 11.6, 11.9, 11.11, Text Book 2: 1.3, 1.4, 1.5										
MODULE-4	LINEAR ALGEBRA-1								24DMAT31.4	8 Hours	
Problems on rank of a matrix by elementary transformations, Solution of system of linear equations by Gauss elimination method-Problems.											
Text Book	Text Book 1: 2.7, 28.6, Text Book 2: 7.3, 7.4										
MODULE-5	LINEAR ALGEBRA-2								24DMAT31.4	8 Hours	
Linear transformation, Eigen values and Eigen Vectors of square matrix-Problems.											
Text Book	Text Book 1: 2.11, 2.13, Text Book 2: 7.9, 8.1.										
CIE Assessment Pattern (50 X 2=100 Marks - Theory)											
RBT Levels		Marks Distribution									
		Theory - Tests	AAT1	AAT2							
		25	15	10							
L1	Remember	5	-	-							
L2	Understand	5	-	-							
L3	Apply	5	5	5							
L4	Analyze	5	5	5							
L5	Evaluate	5	5	-							
L6	Create	-	-	-							
Suggested Learning Resources:											
Text Books:											
1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.											
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.											
Reference Books:											
1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition,											

2015, ISBN: 9780273719236.

- 2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
- 3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
- 4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

- 1)https://youtu.be/IUV0_Nj4d1s?si=eO3s7keCbCO1_jcz
- 2)<https://youtu.be/VzUcs7aiqgg?si=YLtTUGr4Xp88KGY3>
- 3)<https://youtu.be/LDBnS4c7YbA?si=udUOdJ-u0ZxFmBAW>
- 4)https://youtu.be/palSdK9P-ns?si=7A8_VSxEI4lGvksB
- 5)<https://youtu.be/Bw5yEqwMjQU?si=jzbklZmVev1w8K2S>
- 6)https://youtu.be/LBqdGn1r_fQ?si=DWcAliFnosT7zikY
- 7)<https://youtu.be/N5YCGOyTSuU?si=Wsf75V5fkUpfVVxr>
- 8)<https://youtu.be/gd1FYn86P0c?si=7drzBEqVFSv6sQeZ>
- 9)<https://youtu.be/cSj82GG6MX4?si=4QN1DFXEqJoUBn7>
- 10)<https://youtu.be/0c3yq9btr3A?si=jloz8eu5TgV7mh8G>
- 11)<https://youtu.be/PhfbEr2btGQ?si=HVK1uk65oHph0t8G>

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

- Contents related activities (Activity-based discussions)
 - Problem solving Approach
 - Organizing Group wise discussions on related topics
 - Seminars

NATIONAL SERVICE SCHEME											
Course Code	24NSS30					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:											
24NSS30.1	Understand the importance of his / her responsibilities towards society.										
24NSS30.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.										
24NSS30.3	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.										
24NSS30.4	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
24NSS30.1	-	-	-	-	-	3	3	2	-	-	1
24NSS30.2	-	-	-	-	-	3	3	2	-	-	1
24NSS30.3	-	-	-	-	-	3	3	2	-	-	1
24NSS30.4	-	-	-	-	-	3	3	2	-	-	1
Semester/ Course Code											
CONTENT											
COs											
HOURS											
3 RD 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 HRS
4 TH 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 HRS
5 TH 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 development programs etc. 9. Spreading public awareness under rural outreach programs. (minimum 5 programs).								24NSS50.1, 24NSS50.2, 24NSS50.3, 24NSS50.4		30 HRS
6 TH 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 HRS
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	
<ul style="list-style-type: none"> 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	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management- Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/C ontinuous 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 contribution in social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams /College campus	Group selection/ proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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. (minimum 5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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 and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS												
Course Code	24PED30						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:												
24PED30.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness											
24PED30.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle											
24PED30.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.											
24PED30.4	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
24PED30.1	-	-	-	-	-	2	-	3	3	-	-	2
24PED30.2	-	-	-	-	-	2	-	3	3	-	-	2
24PED30.3	-	-	-	-	-	2	-	3	3	-	-	2
24PED30.4	-	-	-	-	-	2	-	3	3	-	-	2
Semester	CONTENT									COs		HOURS
3 RD 24PED30	Module 1: Orientation A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.									24PED30.1, 24PED30.2		5 HRS
	Module 2: General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash D. Agility – Shuttle Run E. Flexibility – Sit and Reach F. Cardiovascular Endurance – Harvard step Test									24PED30.2, 24PED30.3		15 HRS
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.									24PED30.3, 24PED30.4		10 HRS
4 TH 24PED40	Module 1: Ethics and Moral Values A. Ethics in Sports B. Moral Values in Sports and Games									24PED40.1, 24PED40.2		5 HRS
	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. 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 HRS
	Module 3: Role of Organization and administration									24PED40.4		5 HRS
5 TH 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:									24PED50.1, 24PED50.2, 24PED50.3, 24PED50.4		Total 30 Hrs/ Semest er

	<ul style="list-style-type: none"> • 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. <p>2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing</p> <p>3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O’Brien Technique)</p> <p style="text-align: center;">Handball OR Ball Badminton</p> <p>Handball:</p> <p>A. Fundamental Skills</p> <ol style="list-style-type: none"> 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. <p>B. Rules and their interpretations and duties of officials</p> <p>Ball badminton:</p> <p>A. Fundamental Skills</p> <ol style="list-style-type: none"> 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. <p>B. Rules and their interpretation and duties of officials.</p>		<p>2 Hrs/we ek</p>
<p>6TH 24PED60</p>	<p>Athletics:</p> <ol style="list-style-type: none"> 1. Track -110 Mtrs and 400Mtrs: <ul style="list-style-type: none"> • 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). <p style="text-align: center;">Football OR Hockey</p> <p>Football:</p> <p>A. Fundamental Skills</p> <ol style="list-style-type: none"> 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. 	<p>24PED60.1, 24PED60.2, 24PED60.3, 24PED60.4</p>	<p>Total 30 Hrs/ Semest er 2 Hrs/we ek</p>

	<p>A. Rules and their interpretation and duties of officials.</p> <p>Hockey:</p> <p>A. Fundamental Skills</p> <ol style="list-style-type: none"> 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing 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. <p>B. Rules and their interpretation and duties of officials</p>		
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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	24YOG30						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:											
24YOG30.1	Understanding the origin, history, aim and objectives of Yoga										
24YOG30.2	Become familiar with an authentic foundation of Yogic practices										
24YOG30.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat Kriyas										
24YOG30.4	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
24YOG30.1	-	-	-	-	-	3	-	-	-	-	1
24YOG30.2	-	-	-	-	-	3	-	-	-	-	1
24YOG30.3	-	-	-	-	-	3	-	-	-	-	1
24YOG30.4	-	-	-	-	-	3	-	-	-	-	1
Semester / Course Code	CONTENT									COs	HOURS
3 rd 24YOG30	<p>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</p> <p>Brief introduction of yogic practices for common man: Yogic practices for common man to promote positive health</p> <p>Rules and regulations: Rules to be followed during yogic practices by practitioner</p> <p>Misconceptions of yoga: Yoga its misconceptions, Difference between yogic and non-yogic practices.</p> <p>Suryanamaskara:</p> <ol style="list-style-type: none"> 1. Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds <p>Different types of Asanas:</p> <ol style="list-style-type: none"> 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supine line: Utthitadvipadasana, Ardhalasana, Halasana 									24YOG30.1, 24YOG30.2, 24YOG30.3, 24YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4 TH 24YOG40	<p>Suryanamaskara: Suryanamaskar 12 count,4rounds</p> <p>Brief introduction and importance of:</p> <p>Kapalabhati: Revision of Kapalabhati -40strokes/min3rounds</p> <p>Different types of Asanas:</p> <ol style="list-style-type: none"> 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 <p>Patanjali's Ashtanga Yoga: Asana, Pranayama</p> <p>Pranayama: Chandra Bhedana, Nadishodhana, Surya Bhedana</p>									24YOG40.1, 24YOG40.2, 24YOG40.3, 24YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

<p>5TH 24YOG50</p>	<p>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</p>	<p>24YOG50.1, 24YOG50.2, 24YOG50.3, 24YOG50.4</p>	<p>Total 32 Hrs/Sem 2 Hrs/week</p>								
<p>6TH 24YOG60</p>	<p>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</p>	<p>24YOG60.1, 24YOG60.2, 24YOG60.3, 24YOG60.4</p>	<p>Total 32 Hrs/Sem 2Hrs/w eek</p>								
<p>CIE Assessment Pattern (50 Marks – Practical)</p>											
<p>CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)</p>											
<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="width: 50%;">CIE</th> <th style="width: 50%;">Marks</th> </tr> </thead> <tbody> <tr> <td>Avg of Test 1 and Test 2</td> <td>25</td> </tr> <tr> <td>Demonstration of Yogasana</td> <td>25</td> </tr> <tr> <td style="text-align: right;">Total</td> <td>50</td> </tr> </tbody> </table>				CIE	Marks	Avg of Test 1 and Test 2	25	Demonstration of Yogasana	25	Total	50
CIE	Marks										
Avg of Test 1 and Test 2	25										
Demonstration of Yogasana	25										
Total	50										
<p>Suggested Learning Resources:</p>											
<p>Reference Books:</p>											
<ol style="list-style-type: none"> 4. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala) 5. Tiwari, O P: Asana Why and How 6. Ajitkumar: Yoga Pravesha (Kannada) 7. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger) 8. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger) 9. Nagendra H R: The art and science of Pranayama 10. Tiruka: Shatkriyegalu (Kannada) 11. Iyengar B K S: Yoga Pradipika (Kannada) 12. Iyengar B K S: Light on Yoga (English) 											
<p>Web links and Video Lectures (e-Resources):</p>											
<ul style="list-style-type: none"> • https://youtu.be/KB-TYlgd1wE • https://youtu.be/aa-TG0Wg1Ls 											

IV SEMESTER

DISCRETE MATHEMATICS AND GRAPH THEORY												
Course Code	24MAC41						CIE Marks			50		
L:T:P:S	2:1:0:0						SEE Marks			50		
Hrs. / Week	4						Total Marks			100		
Credits	3						Exam Hours			3		
Course outcomes: At the end of the course, the student will be able to:												
24MAC41.1	Justify the arguments with propositional and predicate logic and from truth tables.											
24MAC41.2	Solve the engineering problems involving relations and functions.											
24MAC41.3	Illustrate the principle of inclusion and exclusion.											
24MAC41.4	Analyze the computer science problems by using graph theory techniques.											
24MAC41.5	Understand and analyze graph properties related to connectedness and planarity.											
Mapping of Course Outcomes to Program Outcomes:												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	
24MAC41.1	3	3	-	-	-	-	-	-	-	-	-	-
24MAC41.2	3	3	-	-	-	-	-	-	-	-	-	-
24MAC41.3	3	3	-	-	-	-	-	-	-	-	-	-
24MAC41.4	3	3	-	-	-	-	-	-	-	-	-	-
24MAC41.5	3	3	-	-	-	-	-	-	-	-	-	-
MODULE-1 MATHEMATICAL LOGIC 24MAC41.1 8 Hours												
Basic Connectives and Truth Tables, Tautology and Contradiction, Logic Equivalence, The Laws of Logic, Converse, Inverse and Contra positive, Logical Implication, Rules of Inference, Quantifiers.												
Text Book	Text Book 1: 2.1, 2.2, 2.3, 2.4, 2.5.											
MODULE-2 RELATIONS AND FUNCTIONS 24MAC41.2 8 Hours												
Cartesian Products and Relations, One-to-One and onto functions. The Pigeon hole Principle, Function Composition and Inverse Functions. Properties of Relations, Equivalence Relations and Partitions. Partial orders-Hasse diagrams.												
Text Book	Text Book 1: 5.1, 5.2, 5.3, 5.5, 5.6, 7.1, 7.3, 7.4.											
MODULE-3 THE PRINCIPLE OF INCLUSION AND EXCLUSION 24MAC41.3 8 Hours												
The principle of Inclusion and Exclusion, Generalizations of the principle, Derangements-Nothing is in its Right Place, Rook Polynomials. Recurrence relations: First order linear recurrence relation, the second order linear homogeneous recurrence relation with constant coefficients.												
Text Book	Text Book 1: 8.1, 8.2, 8.3, 8.4, 10.1, 10.2.											
MODULE-4 GRAPH THEORY 24MAC41.4 8 Hours												
Introduction, Basic definition, Application of graphs, finite, infinite and bipartite graphs, incidence and degree, isolated vertex, pendant vertex and null graph. Isomorphism of graphs. Introduction to sub-graphs, walks, paths, circuits and cycles.												
Text Book	Text Book 1: 11.1, 11.2, 11.3, 11.4, Text Book 2: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9.											
MODULE-5 CONNECTIVITY AND PLANARITY 24MAC41.5 8 Hours												
Eulers graphs, Hamiltonian paths, circuits and cycles, Rooted and Binary trees, Huffman code, Directed graphs, Vertex connectivity, edge connectivity, cut set and cut vertices, fundamental circuits. Planar graphs, Dual of planar graphs, Different representation of a planar graph.												
Text Book	Text Book 1: 11.5, 12.1, 12.2, 12.3, Text Book 2: 3.1, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 5.2, 5.4, 5.6, 5.7.											
List of Tutorial Contents												
Sl. No.	Contents										COs	
1.	Uses of Propositional logic-problems										24MAC41.1	
2.	Boolean algebra-problems										24MAC41.1	
3.	Uses of relations and functions in Cryptography-problems										24MAC41.2	
4.	Partial orders-Hasse diagrams										24MAC41.2	
5.	Principle of Inclusion and Exclusion										24MAC41.3	
6.	Rook Polynomials										24MAC41.3	
7.	Bipartite graphs										24MAC41.4	
8.	Isomorphism of graphs										24MAC41.4	
9.	Huffman Tree and Huffman code										24MAC41.5	
10.	Representations of a planar graph										24MAC41.5	

CIE Assessment Pattern (50 Marks - Theory)				
RBT Levels		Marks Distribution		
		Theory Tests	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks - Theory)				
RBT Levels		Exam Marks Distribution (50)		
L1	Remember	5		
L2	Understand	5		
L3	Apply	15		
L4	Analyze	15		
L5	Evaluate	10		
L6	Create	-		

Suggested Learning Resources:

Text Books:

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

Reference Books:

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

Web links and Video Lectures (e-Resources):

- 1) <https://youtu.be/O4Qf0SQKkZw?si=1r9joVe2-rP04fCH>
- 2) https://youtu.be/Hbyj6vEi7fY?si=_GaCjUHBndV2MArP
- 3) https://youtu.be/7hLvm_4DNqs?si=viYHH_fZDZQ9Fmdw
- 4) https://youtu.be/7hLvm_4DNqs?si=viYHH_fZDZQ9Fmdw
- 5) https://youtu.be/6Z_eengdMVE?si=-ZlPy2xl18oMUwFR
- 6) <https://youtu.be/fwSiTaCs8KM?si=wpZcCEG-pNDuIPkS>
- 7) <https://youtu.be/iHC1ZdLdKjw?si=tuN-6pLqhMWPn4Mb>
- 8) https://youtu.be/auvGQCoYdu4?si=3ELSyG5g-475AN1_
- 9) https://youtu.be/GLHWih_RB38?si=FuoNQAzNR2IlyPU0
- 10) <https://youtu.be/hrumNRQwTV8?si=8o3hB1BbFD-MCNXS>
- 11) <https://youtu.be/sWsXBY19o8I?si=ALqpJllzrAafEVDq>

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

- Contents related activities (Activity-based discussions)
 - Problem solving Approach
 - Organizing Group wise discussions on related topics
- Seminars

OBJECT ORIENTED PROGRAMMING WITH JAVA														
Course Code	24CSK42					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:														
24CSK42.1	Model the real-world entities using Object Oriented Programming concepts.													
24CSK42.2	Identify the importance of inheritance and interface concepts and apply to model relationships													
24CSK42.3	Analyze the importance of exception handling and string handling operations													
24CSK42.4	Apply the concept of Multithreading in concurrent programming													
24CSK42.5	Develop applications using collections framework for managing user defined types													
24CSK42.6	Solve the real-world problems using Object Oriented concepts and collection Framework in Java													
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
24CSK42.1	3	3	3	3	2	-	-	-	-	-	-	-	2	
24CSK42.2	3	3	3	3	2	-	-	-	-	-	-	-	2	
24CSK42.3	3	3	3	3	2	-	-	-	-	-	-	-	2	
24CSK42.4	3	3	3	3	2	-	-	-	-	-	-	-	2	
24CSK42.5	3	3	3	3	2	-	-	-	-	-	-	-	2	
24CSK42.6	3	3	3	3	2	-	-	-	-	-	-	-	2	
MODULE-1	INTRODUCTION TO JAVA								24CSK42.1			8 Hours		
The Java Language, Java Development Kit (JDK); Java Buzzwords, Byte Code, JVM, JRE and Java environment, Data types, variables and Arrays, Operators, Control statement, command line Arguments, Object Oriented concepts, Classes, Objects and Methods, Access specifiers, Method Overloading, Constructor, Implicit this.														
Text Book	Text Book 1: Part 1 Chapter 1 to 7													
MODULE-2	INHERITANCE AND INTERFACING								24CSK42.2			8 Hours		
Inheritance, Method Overriding, Annotations, Static members, Inner Classes, Abstract Classes, Final members and classes, The Object Class, Interfaces, Package Fundamentals, Reflections														
Text Book	Text Book 1: Part 1 Chapter 8 ,9,12													
MODULE-3	STRING MANIPULATION AND FILE HANDLING								24CSK42.3, 24CSK42.4			8 Hours		
String Constructors, Length Operations, Character Extraction, Comparison, Searching, Modifying, String Buffer, StringBuilder, Basic file I/O: File Input Stream, File Output Stream, File Reader, File Writer														
Text Book	Text Book 1: Part 2 Chapter 16, Part 1 Chapter 13													
MODULE-4	EXCEPTION HANDLING AND MULTI-THREADING								24CSK42.5			8 Hours		
Exception handling: Fundamentals, Types, Using try, catch, throw, throws, finally, multiple catch, User Defined Exceptions, Thread Concept, Java Thread Model, the main method, Creating Threads, Daemon Threads, Thread Pool, Thread Priorities, Synchronization, join.														
Text Book	Text Book 1: Part 1 Chapter 10, 11													
MODULE-5	COLLECTION FRAMEWORK								24CSK42.6			8 Hours		
Collections Overview, Collection Interfaces, Set, List, Map, Queue, Collection Classes, Generics, Type Wrappers, accessing a collection using an Iterator, Sorting collections, equals ().														
Text Book	Text Book 1: Part 1 Chapter 14													
CIE Assessment Pattern (50 Marks – Theory)														
RBT Levels		Marks Distribution												
		Test (s)	AAT1	AAT2	AAT3									
		25	7.5	7.5	10									
L1	Remember	-	-	-	-									
L2	Understand	5	-	-	-									
L3	Apply	10	5	-	5									
L4	Analyze	5	2.5	2.5	5									
L5	Evaluate	5	-	5	-									
L6	Create	-	-	-	-									

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:**Text Books:**

1. Herbert Schildt & Danny Coward, Java: The Complete Reference, 13th Edition, McGraw Hill, 2024. ISBN 978-1265058432

Reference Books:

1. T. Budd, "Understanding Object-Oriented Programming with Java", Updated Edition, Pearson Education, 2018
2. J. Nino and F.A. Hosch, "An Introduction to programming and OO design using Java", John Wiley & sons, 2019 (Reprint).
3. Y. Daniel Liang, "Introduction to JAVA Programming", 10th Edition, Pearson Education.
4. R. A. Johnson, "Java Programming and Object-Oriented Application Development", Cengage Learning, 2020 (Reprint)

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=bm0OyhwFDuY&list=PLsyebzWxl7pe_IiTfNyr55kwJPWbgxB5
- <https://www.youtube.com/watch?v=CFD9EFcNzTQ>
- <https://www.youtube.com/watch?v=r59xYe3Vyks&list=PLS1QulWo1RIbfTjQvTdj8Y6yyq4R7g-Al>

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

- Hands-on with coding platforms like Codetantra.

OBJECT ORIENTED PROGRAMMING WITH JAVA LAB													
Course Code	24CSLK42					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:													
24CSLK42.1	Design solutions for real world problems using Object Oriented Programming concepts.												
24CSLK42.2	Develop applications using String concept in Java.												
24CSLK42.3	Apply the concept of Multithreading and exception handling in java programming												
24CSLK42.4	Model and manage the application data using collection framework in Java.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CSLK42.1	3	3	3	3	2	-	-	-	-	-	2	-	2
24CSLK42.2	3	3	3	3	2	-	-	-	-	-	2	-	2
24CSLK42.3	3	3	3	3	2	-	-	-	-	-	2	-	2
24CSLK42.4	3	3	3	3	2	-	-	-	-	-	2	-	2
List of Programs													
Pgm. No.	Note: Student must attempt one question from PART A and PART B each during SEE Exam.										Hours	COs	
Prerequisite Programs / Demo													
	Expected Prior Knowledge and Skills: Problem solving skill, Basic programming concepts										1	NA	
PART-A													
1a.	Design and develop a Java program for the following task: 1. Define a class named Book with four attributes: <ul style="list-style-type: none"> • title (String) • author (String) • isbn (int) • price (double) 2. Provide a constructor that initializes all four attributes when a Book object is created. 3. In the main method, declare an array for five Book objects, instantiate each element by calling the Book constructor, and then print every book's details in a clear, well-formatted manner. Print the details of each Book object in a clear, well formatted manner.										2	24CSLK42.1	
2a.	A courier company must calculate the volume of shipping cartons that come in different shapes and require optional padding. Design and develop a Java class Box and a driver program that meet the following requirements: Constructor Overloading <ul style="list-style-type: none"> • Box() → creates a default carton of 1 cm × 1 cm × 1 cm. • Box(double side) → creates a cube-shaped carton whose three edges are all side cm. • Box(double length, double breadth, double height) → creates a rectangular carton with the given dimensions in centimetres. Method Overloading (all named volume) <ul style="list-style-type: none"> • double volume() → returns the carton's raw volume in cm³. • double volume(double scaleFactor) → returns the volume after being multiplied by scaleFactor (e.g., 1.05 for 5 % padding). • static double volume(double l, double b, double h) → static helper that calculates the volume of any block without creating a Box object. In a driver class (BoxDemo): <ul style="list-style-type: none"> • Construct one object with each constructor. • Display the dimensions of every box. • Demonstrate each overloaded volume method, clearly labelling the output. 										2	24CSLK42.1	

<p>3a.</p>	<p>Design and implement a Java program to demonstrate both multilevel inheritance and hierarchical inheritance.</p> <ol style="list-style-type: none"> 1. Create a Class Person <ul style="list-style-type: none"> ○ Attributes – String name, int age ○ Methods <ul style="list-style-type: none"> ▪ void inputDetails()– read name and age from the keyboard (use a Scanner object). ▪ void showDetails() – print name and age in a tidy format. 2. Class Employee (extends Person – first level of multilevel inheritance) <ul style="list-style-type: none"> ○ Additional Attribute – int empId ○ Methods <ul style="list-style-type: none"> ▪ double calculateAnnualSalary(double basicSalary)– return basicSalary * number of months in a year ▪ void showEmployeeInfo(double basicSalary) – display empId and the annual salary computed by calculateAnnualSalary. 3. Class Manager (extends Employee – second level of multilevel inheritance; first branch of hierarchical inheritance) <ul style="list-style-type: none"> ○ Additional Attribute – String department ○ Methods <ul style="list-style-type: none"> ▪ double totalCompensation(double basicSalary, double incentive)– return calculateAnnualSalary(basicSalary) + incentive. ▪ void showManagerInfo(double basicSalary, double incentive) – display department and the total compensation. 4. Class Clerk (extends Employee – second level of multilevel inheritance; second branch of hierarchical inheritance) <ul style="list-style-type: none"> ○ Additional Attribute – int typingSpeed (words per minute) ○ Methods <ul style="list-style-type: none"> ▪ int dailyWordCount(int hours)– return typingSpeed * 60 * hours. ▪ void showClerkInfo(int hours) – display typingSpeed and the daily word count for the given hours. <p>Driver Program (CompanyDemo)</p> <ol style="list-style-type: none"> 1. Create at least two Manager objects and two Clerk objects, gathering data from the user via the methods listed above or via constructors. 2. Store all objects in an array 3. For each object, call the class-specific methods (showDetails(), showEmployeeInfo(), showManagerInfo(), showClerkInfo(), etc.) to display the information produced by your calculations. 	<p>2</p>	<p>24CSLK42.1</p>
<p>4a.</p>	<p>Write a Java program that models different kinds of musical instruments and shows runtime (dynamic) polymorphism through method overriding.</p> <ol style="list-style-type: none"> 1. Base class <ul style="list-style-type: none"> ○ Create an abstract class Instrument containing a method void playNote(). 2. Subclasses (hierarchical inheritance) <ul style="list-style-type: none"> ○ Piano overrides playNote() to print "Piano: C-E-G chord". ○ Guitar overrides playNote() to print "Guitar: Strum on E minor". ○ Flute overrides playNote() to print "Flute: Sustained A note". 3. Driver code (OrchestraDemo) <ul style="list-style-type: none"> ○ Declare an Instrument[] array that holds one object of each subclass. ○ Iterate through the array and invoke playNote() on every element. ○ Show that the correct subclass version executes at runtime, proving dynamic dispatch. 	<p>2</p>	<p>24CSLK42.1</p>

5a.	<p>Design and implement a Java program to calculate the area and perimeter of the geometric shapes, Circle, Rectangle, and Right-Angled Triangle using an interface and an abstract class.</p> <ol style="list-style-type: none"> 1. Define an interface that declares methods for calculating area and perimeter. 2. Create an abstract class that implements the interface and contains a common attribute such as color. 3. Derive concrete classes for the shapes Circle, Rectangle, and Right-Angled Triangle, each implementing the logic to calculate area and perimeter. 4. In the main class, allow the user to input dimensions and color for each shape, store the objects in a collection, and display the area, perimeter, and color for each shape. <p>The program should demonstrate the use of abstraction, inheritance, and runtime polymorphism.</p>	2	24CSLK42.1
6a.	<p>Create a class in Java called "Calculator" which contains the following:</p> <ol style="list-style-type: none"> 1. A static method called powerInt(int num1,int num2) that accepts two integers and returns num1 to the power of num2 (num1 power num2). 2. A static method called powerInt(double num1,int num2) that accepts one double and one integer and returns num1 to the power of num2 (num1 power num2). 3. Call your method from another class without instantiating the class (i.e. call it like Calculator.powerInt(12,10) since your methods are defined to be static). <p>Hint: Use Math.pow(double,double) to calculate the power.</p>	2	24CSLK42.1
PART-B			
1b.	<p>Design and Develop a Java program to find the longest substring without repeating characters in a given String. Accept the String through Command Line argument.</p>	2	24CSLK42.2
2b.	<p>Design and develop a Java program that uses both StringBuffer manipulation and basic file input/output:</p> <ol style="list-style-type: none"> 1. Read an initial line of text from a file named input.txt. The file must contain the single line NEW HORIZON. 2. Load that line into a StringBuffer. 3. Append the text " COLLEGE", insert the phrase "ENGINEERING " immediately after the first space character, and finally delete the word "World" if it exists. 4. After each of these three operations, print the current buffer content along with its capacity both to the console and to a file named output.txt (append mode so every step is recorded). 	2	24CSLK42.2
3b.	<p>Design and develop a Java program that takes the names and marks of three subjects for two students from the user, calculates the average marks for each student, and handles Number Format Exception in case the user enters non-integer values for the marks. The program should display an appropriate error message and prompt the user to re-enter valid integer values.</p> <ul style="list-style-type: none"> • In the same Program write your own Exception classes to take care of Negative values and values out of range (i.e. other than in the range of 0-100) • Include finally to output the statement "Program terminated". 	2	24CSLK42.3
4b.	<p>Design and implement a Java program to solve the classic Producer-Consumer problem with a fixed-size shared buffer. Program must include Producer threads that add items and Consumer threads that remove items. Crucially, producers should wait if the buffer is full, and consumers should wait if it's empty, ensuring proper synchronization using synchronized, wait(), and notifyAll().</p>	2	24CSLK42.3
5b.	<p>Create a Student Attendance Management System using a HashMapCollection type. Perform the following operations: Add the key-value pair. Retrieve the value associated with a given key</p>	2	24CSLK42.4

	Check whether a particular key/value exist. replace a value associated with a given key in the HashMap		
6b.	Write a Java program that creates a new ArrayList<Integer> , adds several exam marks, and then performs the following operations: <ol style="list-style-type: none"> Add all elements of another List<Integer> to the original ArrayList. Copy the ArrayList to a plain int[] array. Reverse the contents of the ArrayList. Extract a sub-list (e.g., marks from index 2 to index 5). Sort the ArrayList in ascending order. Clone the ArrayList into another ArrayList<Integer>. 	2	24CSLK42.4

PART-C

Self-Study Component - Virtual Lab Content

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

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

CIE Assessment Pattern (50 Marks - Lab)

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

SEE Assessment Pattern (50 Marks - Lab)

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

Suggested Learning Resources:

Reference Books

- 1) Herbert Schildt & Danny Coward, Java: The Complete Reference, 13th Edition, McGraw Hill, 2024. ISBN 978-1265058432
- 2) J. Nino and F.A. Hosch, "An Introduction to programming and OO design using Java", John Wiley & sons, 2019 (Reprint).
- 3) Y. Daniel Liang, "Introduction to JAVA Programming", 10th Edition, Pearson Education.
- 4) R. A. Johnson, "Java Programming and Object-Oriented Application Development", Cengage Learning, 2017 (Reprint)

MACHINE LEARNING													
Course Code	24AIM43							CIE Marks	50				
L:T:P:S	3:0:0:0							SEE Marks	50				
Hrs / Week	4							Total Marks	100				
Credits	3							Exam Hours	3				
Course outcomes: At the end of the course, the student will be able to:													
24AIM43.1	Apply fundamental machine learning concepts to solve real-world problems.												
24AIM43.2	Analyze linear and polynomial regression models, employing error metrics to measure their performance and recognize issues of overfitting and underfitting												
24AIM43.3	Develop machine learning models using different algorithms to address their performance												
24AIM43.4	Evaluate the effectiveness of probabilistic classifiers such as Naive Bayes and Bayesian networks in different classification tasks.												
24AIM43.5	Interpret the results of unsupervised clustering algorithms and association rule mining techniques to derive significant patterns from diverse datasets.												
24AIM43.6	Investigate the latest breakthrough or developments in Machine Learning algorithms via seminar, learning and ongoing professional growth within the dynamic field of machine learning												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM43.1	3	-	-	-	-	-	-	-	-	-	-	2	-
24AIM43.2	-	3	-	-	-	-	-	-	-	-	-	3	-
24AIM43.3	-	-	3	-	-	-	-	-	-	-	-	3	-
24AIM43.4	-	-	-	3	-	-	-	-	-	-	-	3	-
24AIM43.5	-	-	3	-	-	-	-	-	-	-	-	3	-
24AIM43.6	-	-	-	-	-	2	-	2	2	-	3	2	-
-													
MODULE-1	INTRODUCTION TO MACHINE LEARNING							24AIM43.1	8 Hours				
Understanding Machine Learning: Definition, Types of Machine Learning- Mathematical Foundations: Linear Algebra and Analytical Geometry for machine learning, hypothesis space and Generalization, Bias-variance trade off.													
Text Book			Text Book 1: Ch 1,4										
MODULE-2	REGRESSION TECHNIQUES							24AIM43.1, 24AIM43.2	8 Hours				
Regression: Introduction to Regression- Linear Regression, Ranking and Ordinal Regression, Bayesian Linear Regression, Shrinkage methods, PAC (Probably Approximately Correct) learning in Regression, Sample complexity, VC(Vapnik-Chervonenkis) Dimensions.													
Classification: Logistic Regression, Fitting Logistic Regression models, Support Vector Machine (SVM).													
Text Book			Text Book 1: Ch 4										
MODULE-3	SUPERVISED LEARNING							24AIM43.2 24AIM43.3	8 Hours				
k-Nearest Neighbors (k-NN): Introduction to k-Nearest Neighbors Algorithm-Distance Metrics and Choosing 'k' - k-NN for Classification. Decision Trees- Introduction, Tree Construction Algorithms:ID3, CART, Splitting Criteria, Tree Pruning. Ensemble Learning: Random Forest, XGBoost.													
Text Book			Text book 1: Ch 8										
Case study			Predicting salaries with Decision Tree										
MODULE-4	PROBABILISTIC MODELS							24AIM43.3, 24AIM43.4	8 Hours				
Probabilistic Generative Model-Naive Bayes: -Bayes' Theorem and Conditional Probability-Maximum Likelihood-Gaussian, Multinomial, and Bernoulli Naive Bayes. Inference in Bayesian Belief Network, Markov Models.													
Text Book			Text Book 1: Ch 6										
MODULE-5	UNSUPERVISED LEARNING							24AIM43.5 24AIM43.6	8 Hours				
Introduction to unsupervised Algorithms- types of clustering algorithms- k-means clustering algorithms, adaptive hierarchical clustering, Gaussian mixture model. Introduction to Rule Based learning and Association rules- Apriori Algorithm, FP-Growth. Semi-supervised Learning, Multi-task learning, Introduction to Reinforcement Learning.													
Case Study			Using Super market dataset, analysis the frequent Item sets (Association Rules algorithms)										
Text Book			Text Book 1: Ch 6. Text Book 2: Ch 4,6										

CIE Assessment Pattern (50 Marks - Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	5	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	10
L2	Understand	10
L3	Apply	20
L4	Analyze	5
L5	Evaluate	5
L6	Create	--

Suggested Learning Resources:**Text Books:**

1. S.Vijayalakshmi, "Machine Learning", Oxford University Press, 2021.ISBN:978-9391050504.
2. Charu C. Aggarwal, "Data Mining", Springer, 2015. ISBN: 9783319141428, 3319141422

Reference Books:

1. Introduction to Machine Learning with Python: A Guide for Data Scientists" by Andreas C. Müller and Sarah Guido, 2016. ISBN: 9781449369903
2. Machine Learning for Engineers: Using Data to Solve Problems for Physical Systems by Ryan G. Mc Clarren , 2021, Springer Nature, ISBN: 978-3030703875
3. Tom Mitchell, "Machine Learning", McGraw Hill, 1997. ISBN 9780071154673, 0071154671 2.

Web links and Video Lectures (e-Resources):

- <https://towardsdatascience.com/the-fp-growth-algorithm-1ffa20e839b8>
- <https://www.analyticsvidhya.com/blog/2021/08/decision-tree-algorithm/>
- https://ocw.mit.edu/courses/15-097-prediction-machine-learning-and-statistics-spring2012/eb02afbd0a9c32637dd64cdb6b76c2f1_MIT15_097S12_lec01.pdf

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

- Group discussion on real-world problems.
- Seminars

MACHINE LEARNING LAB													
Course Code	24AIL43							CIE Marks	50				
L: T:P:S	0:0:1:0							SEE Marks	50				
Hrs. / Week	2							Total Marks	100				
Credits	1							Exam Hours	03				
Course outcomes: At the end of the course, the student will be able to:													
24AIL43.1	Apply statistical, regression, classification, clustering, and association algorithms to real-world dataset.												
24AIL43.2	Analyze the model performance using metrics such as confusion matrices, ROC curves, precision, recall, F1, AUC, MSE, R ² , and clustering validity indices, to interpret strengths and limitations of supervised and unsupervised learning approaches.												
24AIL43.3	Design supervised models and unsupervised models in Python using standard libraries, demonstrating understanding of underlying algorithms.												
24AIL43.4	Evaluate practical applications by critically assessing model outcomes, interpreting new-sample predictions, and recommending suitable techniques based on problem context.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIL43.1	3	-	-	-	2	-	-	-	-	-	-	2	-
24AIL43.2	-	3	-	-	3	-	-	-	-	-	-	3	-
24AIL43.3	-	-	3	-	3	-	-	-	-	-	-	3	-
24AIL43.4	-	-	-	3	3	-	-	-	-	-	3	3	-
Pgm. No.													
List of Experiments / Programs											Hours	COs	
Prerequisite Experiments / Programs / Demo													
	<ul style="list-style-type: none"> Basic Python program using libraries Read and write a CSV file using python 										2	NA	
PART-A													
1a	Develop a python program using Logistic Regression to perform binary classification and evaluate performances using Confusion matrix, ROC Curve Precision, Recall and F1 Score for any given dataset.										2	24AIL43.1 24AIL43.2 24AIL43.4	
2a	Develop models for Ridge regression and Lasso regression for the given dataset and evaluate its performance then compare above two methods.										2	24AIL43.1 24AIL43.2 24AIL43.4	
3a	Write a program to demonstrate SVM algorithm for the given dataset and evaluate its performance.										2	24AIL43.1 24AIL43.2 24AIL43.4	
4a	Write a program to demonstrate the working of the decision tree Based CART and ID3 algorithms. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new Sample.										2	24AIL43.1 24AIL43.3	
5a	Write a program to demonstrate the Random Forest and XGBoost algorithm for given data sets.										2	24AIL43.2 24AIL43.3 24AIL43.4	
6a	Write a program to implement K-means clustering algorithm and form clusters using the optimum value of k for given data set.										2	24AIL43.3 24AIL43.4	
PART-B													
1b	Develop a multiple regression model for the given data set and evaluate its performance										2	24AIL43.3 24AIL43.4	
2b	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem										2	24AIL43.2 24AIL43.3 24AIL43.4	

3b	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	2	24AIL43.1 24AIL43.3 24AIL43.4
4b	Write a program to classify data stored as a .CSV and a set of documents using the Naïve Bayes classifier. Calculate the accuracy, precision, and recall for the given data set.	2	24AIL43.1 24AIL43.2 24AIL43.4
5b	Apply k-means and DBSCAN Clustering algorithms to generate clusters for the given dataset and evaluate its performance and compare.	2	24AIL43.1 24AIL43.3 24AIL43.4
6b	Develop a python program for Apriori Algorithm for given dataset and evaluate its performances.	2	24AIL43.2 24AIL43.3 24AIL43.4

PART-C

Beyond Syllabus Virtual Lab Content

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

- <https://ai1-iiith.vlabs.ac.in/exp/construction-bayesian-network/>
- <https://vlab.spit.ac.in/ai/#/experiments/3>
- <https://vlab.spit.ac.in/ai/#/experiments/4>
- <https://vlab.spit.ac.in/ai/#/experiments/11>

CIE Assessment Pattern (50 Marks - Lab)

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

SEE Assessment Pattern (50 Marks - Lab)

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

Suggested Learning Resources:

Reference Books:

1. Tom Mitchell, "Machine Learning", McGraw Hill, 1997 ISBN: 9780071154673
2. E. Alpaydin, "Introduction to Machine Learning", MIT Press, 2020. ISBN: 9780262043793

DATABASE MANAGEMENT SYSTEMS													
Course Code	24CSK44							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:													
24CSK44.1	Describe DBMS architecture, components and database design.												
24CSK44.2	Implement database schema for an application using RDBMS concepts.												
24CSK44.3	Write SQL queries for tasks of various complexities.												
24CSK44.4	Design an application program that uses a database system as the backend and the internal working of a DBMS including indexing and Hashing.												
24CSK44.5	Understand the internal working of a DBMS including transaction processing, concurrency control and recovery mechanisms.												
24CSK44.6	Demonstrate modern database techniques including NoSQL systems for efficient data storage and retrieval.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24CSK44.1	3	3	3	2	-	-	-	-	-	-	1	2	2
24CSK44.2	3	3	3	2	-	-	-	-	-	-	1	2	2
24CSK44.3	3	3	3	2	-	-	-	-	-	-	1	2	2
24CSK44.4	3	3	3	2	-	-	-	-	-	-	1	2	2
24CSK44.5	3	3	3	2	-	-	-	-	-	-	1	2	2
24CSK44.6	3	3	3	2	-	-	-	-	-	-	1	2	2
MODULE-1 DATABASE FUNDAMENTALS AND DATABASE DESIGN 24CSK44.1, 24CSK44.2 8 Hours													
Database Concepts: Definitions, Characteristics, Advantages of DBMS, Three-schema architecture, Data Abstraction & Independence, DBMS Components: Database Designers, Administrators, Users.													
Entity-Relationship Model: Entity types, attributes, keys (super key, primary, candidate), Relationship types, structural constraints, weak entities, Reduction of ER schema to relational schema, Relational Model Concepts: Schema, Tuples, Domains, Keys, Integrity Constraints: Entity, Referential.													
Self-study	Explore different real-world databases (e.g., railway reservation systems, hospital management systems) and identify the advantages of DBMS over traditional file systems.												
Text Book	Text Book 1: 1.1,1.2, 1.3, 1.4, 1.6, 2.2, 2.4, 3.3, 3.4, 3.5, 5.1, 5.2												
MODULE-2 RELATIONAL DATABASES AND SQL 24CSK44.3 8 Hours													
Relational Algebra: Select, Project, Join, Union, Intersection, Difference, Rename, Division.													
SQL Basics: DDL: Create, Drop, Alter, Truncate; DML: Insert, Delete, Update; SQL Clauses: Where, Order By, Group By; Constraints: Not Null, Unique, Primary, Foreign Key; Aggregate functions: SUM, AVG, COUNT, MIN, MAX.													
Case Study	Consider three related tables representing entities and their associations. Design relational algebra queries to: Retrieve records that meet specific conditions. Identify records not associated with certain data (using difference). Write SQL statements to: Create tables and define their structures (DDL). Insert sample data (DML). Retrieve and summarize data using SELECT with various clauses (WHERE, GROUP BY, ORDER BY).												
Text Book	Text Book 1: 8.1, 8.2, 8.3, 6.1, 6.2, 6.3, 6.4												
MODULE-3 QUERY PROCESSING & INDEXING 24CSK44.4 8 Hours													
Advanced SQL: Union, Intersect and Except; Nested Queries; Correlated Queries; Joins; Introduction to Views; Triggers; Dynamic SQL, ODBC/JDBC.													
Indexing: Tree Structured Indexing: Indexed sequential access method, B+ Trees, Format of a node, Search, Insert, Delete, Duplicates, Hash based indexing: Static Hashing, Extendible Hashing, Linear Hashing													
Self-study	Explore different types of joins (inner, outer, left, right, natural) by creating simple tables and writing example queries to understand how results differ.												
Text Book	Text Book 2: 3.6, 5.3, 5.4, 5.6, 5.9, 5.10, 5.12, 9.1 - 9.7, 10.1 - 10.3												
MODULE-4 NORMAL FORMS & TRANSACTION PROCESSING 24CSK44.5 8 Hours													
Normalization: Functional Dependencies; Normal Forms: 1NF, 2NF, 3NF, BCNF;													
Transaction Management: ACID Properties; Schedules: Recoverability, Serializability; Concurrency Control: 2PL- Two-Phase Locking, Time-stamp based & Optimistic Concurrency; Database Recovery concepts.													

Case Study	Start with a large unnormalized relation containing redundant and repeating groups. Identify all functional dependencies. Normalize the relation step by step to achieve 3NF or BCNF, clearly explaining the design decisions.			
Text Book	Text Book 1: 20.1, 20.3, 20.4, 20.5, 21.1, 21.2, 21.4, 22.1,			
MODULE-5	NoSQL & MODERN DATABASE SYSTEMS	24CSK44.6	8 Hours	
<p>NoSQL: Introduction to NoSQL: Need, Features, ACID vs BASE, CAP Theorem; Types: Key-Value, Document, Column, Graph.</p> <p>Modern Database Systems: Cassandra DB: Architecture, Data Centers and Racks, Gossip Protocol, Snitches vs Nodes, Replication, Read/Write Operations, Caching, Compaction, Tombstones. Mongo DB: Overview.</p>				
Self-study	Compare different NoSQL database types: Key-Value, Document, Column, Graph, focusing on their data models and use cases.			
Text Book	Text Book 1: 24.1 - 24.6, Text Book 3: 6.1, 6.2, 6.3, 6.5, 6.7, 6.15,6.16, 6.17, 9.1, 9.2			
CIE Assessment Pattern (50 Marks - Theory)				
RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-
SEE Assessment Pattern (50 Marks - Theory)				
RBT Levels		Exam Marks Distribution (50)		
L1	Remember	10		
L2	Understand	10		
L3	Apply	10		
L4	Analyze	10		
L5	Evaluate	10		
L6	Create	-		
Suggested Learning Resources:				
Text Books:				
1. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems” , Pearson / Addison - Wesley, ISBN-0133970779 7th Edition 2021.				
2. Raghu Ramakrishnan, “Database Management Systems”, Third Edition, ISBN-0-07-246563-8 McGraw Hill, 2013.				
3. Jeff Carpenter, Eben Hewitt, Cassandra: The Definitive Guide”, O'Reilly Media, ISBN-10. 1491933666				
Reference Books:				
4. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Seventh Edition, ISBN-13: 978-9390727506, Tata McGraw Hill, 2020.				
5. Pramod J. Sadalage, Martin Fowler, “NoSQL Distilled”, Pearson Education, ISBN-13. 9780321826626.				
Web links and Video Lectures (e-Resources):				
<ul style="list-style-type: none"> • https://onlinecourses.nptel.ac.in/noc23_cs79/preview • https://www.youtube.com/watch?v=DRSog3SA4-Y&list=PLlwC9bZ0rmjSkm1VRJROX4vP2YMI4Ebh • https://www.youtube.com/watch?v=f1oV46r69YM 				
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning				
<ul style="list-style-type: none"> • Qualitative Assessment - Explore Live Database Application • Case Study- Designing a relational database for any given scenario 				

DATABASE MANAGEMENT SYSTEMS LAB														
Course Code	24CSLK44								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:														
24CSLK44.1	Apply the concepts of DDL, DML, data constraints to various relations.													
24CSLK44.2	Analyze the concepts of joins to perform nested and correlated queries.													
24CSLK44.3	Evaluate user-defined View and Trigger to the database of any given scenario.													
24CSLK44.4	Examine NoSQL databases and execute CRUD (Create, Read, Update, and Delete) operations within the Cassandra database, MongoDB.													
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
24CSLK44.1	3	3	3	3	3	-	-	-	1	1	2	2	2	
24CSLK44.2	3	3	3	3	3	-	-	-	1	1	2	2	2	
24CSLK44.3	3	3	3	3	3	-	-	-	1	1	2	2	2	
24CSLK44.4	3	3	3	3	3	-	-	-	1	1	2	2	2	
Prerequisite Programs / Demo														
No.	List of Programs										Hours	COs		
	<ul style="list-style-type: none"> Demo on installation of SQL Demo on installation of NoSQL 										2	NA		
PART-A														
1a.	Demonstrate various DDL and DML commands to create, modify and manipulate data of a student database.										2	24CSLK44.1		
2a.	Apply various data constraints such as primary key, foreign key, unique, not null, check, and default constraints while creating tables in a company database.										2	24CSLK44.1		
3a.	Demonstrate the use of various SQL operators such as arithmetic, comparison, logical, and special operators on Hospital database.										2	24CSLK44.1		
4a.	Apply aggregate functions along with GROUP BY, HAVING, and ORDER BY clauses on the given relation of a Library Database: BOOK (Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS (Book_id, Author_Name) PUBLISHER (Id, Name, Address, Phone) BOOK_COPIES (Book_id, Programme_id, No-of_Copies) BOOK_LENDING (Book_id, Programme_id, Card_No, Date_Out, Due_Date) LIBRARY_PROGRAMME (Programme_id, Programme_Name, Address) 1. Insert at least 5 records for each table. Add appropriate database constraints 2. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each Program, etc. 3. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017. 4. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. 5. Create a view of all books and its number of copies that are currently available in the Library.										2	24CSLK44.2		
5a.	Analyze various types of joins (inner, outer, left, right, natural) on university database.										2	24CSLK44.2		
6a.	Demonstrate nested queries and correlated subqueries for Order Database: SALESMAN (Salesman_id, Name, City, Commission) CUSTOMER (Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS (Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id) 1. Insert at least 5 records for each table. Add appropriate database constraints 2. Count the customers with grades above Bangalore's average. 3. Find the name and numbers of all salesmen who had more than one customer. 4. List all salesmen and indicate those who have and don't have customers in their cities.										2	24CSLK44.2		

	5. Create a view that finds the salesman who has the customer with the highest order of a day. 6. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.		
PART-B			
1b.	Create/replace single table view and multiple tables view, update and drop views for the given relations ACTOR (Act_id, Act_Name, Act_Gender) DIRECTOR (Dir_id, Dir_Name, Dir_Phone) MOVIES (Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id) MOVIE_CAST (Act_id, Mov_id, Role) RATING (Mov_id, Rev_Stars)	2	24CSLK44.3
2b.	Create and drop Triggers for various events such as insert, update and delete transactions.	2	24CSLK44.3
3b.	Develop a Java program to connect to a database using JDBC/ODBC and perform basic CRUD operations.	2	24CSLK44.3
4b.	Design and implement the relations using Cassandra NoSQL DB.	2	24CSLK44.4
5b.	Demonstrate creating and dropping a database in MongoDB.	2	24CSLK44.4
6b.	Create the collection in MongoDB.	2	24CSLK44.4
PART-C Beyond Syllabus Virtual Lab Content (To be done during Lab but not to be included for CIE or SEE)			
<ol style="list-style-type: none"> Develop a conceptual schema for Library Information System [http://vlabs.iitkgp.ernet.in/se/4/case_study] Create and manipulate the database for Student Information System [http://vlabs.iitkgp.ernet.in/se/4/case_study] Identify the possible entity sets, their attributes, and relationships from the given problem statements for E-R Modeling [http://vlabs.iitkgp.ernet.in/se/4/exercise] 			
CIE Assessment Pattern (50 Marks - Lab)			
RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	5	5
L6	Create	-	-
SEE Assessment Pattern (50 Marks - Lab)			
RBT Levels		Exam Marks Distribution (50)	
L1	Remember	-	
L2	Understand	10	
L3	Apply	10	
L4	Analyze	20	
L5	Evaluate	10	
L6	Create	-	
Suggested Learning Resources:			
Reference Books:			
1) Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", 7th Edition, July 2021			
2) Jeff Carpenter, Eben Hewitt, "Cassandra: The Definitive Guide" Publisher: O'Reilly Media, 2nd edition 2019, ISBN-13: 978-1491933664.			

AI ETHICS FOR AIML ENGINEERS													
Course Code	24AIM451										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: comes: At the end of the course, the student will be able to:													
24AIM451.1	Understand the legal and ethical frame works governing artificial intelligence.												
24AIM451.2	Apply human rights-centered design, deliberation, and normative modes to mitigate ethics and address conflicts												
24AIM451.3	Examine the oral framework of justice in AI and accountability in computer systems.												
24AIM451.4	Evaluate the ethical implications of AI in health, public, legal fields.												
24AIM451.5	Develop the ethical considerations of AI and its impact on society.												
24AIM451.6	Collaborate with experts from various domains to build a cohesive ethical AI systems.												
Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM451.1	2	-	-	-	-	-	-	-	-	-	-	-	-
24AIM451.2	3	-	-	-	-	-	-	-	-	-	-	2	2
24AIM451.3	-	3	-	-	-	-	-	-	-	-	-	2	2
24AIM451.4	-	-	-	3	2	-	-	2	-	-	-	2	2
24AIM451.5	-	-	3	-	-	-	-	3	-	-	-	2	2
24AIM451.6	-	-	-	-	-	3	-	3	-	2	-	3	2
MODULE-1	INTRODUCTION							24AIM451.1			8Hours		
Introduction & Overview for Law and Regulation, Ethics of the Ethics of AI, Ethical Issues in Relationship with Artificial Entities.													
Text Book	Textbook 1: Ch 1												
MODULE-2	FRAMEWORK AND MODES							24AIM451.2			8Hours		
AI Governance by Human Rights- Centered Design, Deliberation and Oversight: End to Ethics Washing, The Incompatible Incentives of Private-Sector AI. Normative Modes: Codes and standards. The Role of Professional Norms in the Governance of Artificial Intelligence.													
Text Book	Textbook Book 1: 4-7												
MODULE-3	CONCEPTS AND ISSUES							24AIM451.3, 24AIM451.4			8Hours		
Moral Framework of Justice in AI: on the Limits, Failing and Ethics of Fairness, Accountability in Computer Systems- Responsibility and AI, The concept of Handoff as a Model for Ethical Analysis and Design.													
Text Book	Text book 1: 8 – 21												
MODULE-4	PERSPECTIVES AND APPROACHES							24AIM451.4			8Hours		
Perspective on Ethics of AI - Computer Science, Social Failure Modes in Technology and the Ethics of AI: An Engineering Perspective, Automating Origination: Perspectives from the Humanities, Perspectives on Ethics of AI: Philosophy													
Text Book	Text Book 1: Ch 22- 28												
MODULE-5	CASES AND APPLICATION							24AIM451.4, 24AIM451.5, 24AIM451.6			8Hours		
Ethics of AI in Transport - Ethics of AI in Biomedical Research, Patient Care and Public Health, Ethics of AI in Law: Basics Questions, Beyond Bias:” Ethical AI” in Criminal Law.													
Case Study	Solar Lighting Example												
Text Book	Text book 1: Ch 35-39.												

CIE Assessment Pattern (50 Marks - Theory)				
RBT Levels		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	-	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

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

SEE Assessment Pattern (50Marks -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. Markus D Dubber, Frank Pasquale, Sunit Das, "The Oxford Handbook of Ethics of AI", Oxford Press,2020. ISBN: 978-0-19-006739-7.

Reference Books:
 1. Melanie Mitchell, "Artificial Intelligence: A Guide for Thinking Humans", Farrar, Straus and Giroux,2019. ISBN:978-0374257835
 2. Patrick Lin, Keith Abney, and Ryan Jenkins, RobotEthics2.0: From Autonomous Cars to Artificial Intelligence", OUP USA,2017. ISBN:978-0190652951.

Weblinks and Video Lectures(e-Resources):

- <https://ocw.mit.edu/courses/res-ec-001-exploring-fairness-in-machine-learning-for-international-development-spring-2020/pages/module-one-introduction/>

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

- Group discussion on real-world problems.
- Seminars

COMPUTER NETWORKS													
Course Code	24AIM452					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:													
24AIM452.1	Understand the basic structure of an abstract layered Network protocol model for any Networking environment.												
24AIM452.2	Apply the functionality of OSI and TCP/IP reference models.												
24AIM452.3	Analyze network layer protocols.												
24AIM452.4	Evaluate Architecture for Application layer protocols.												
24AIM452.5	Design an appropriate protocol for the desired communication service.												
24AIM452.6	Implement a wide range of protocols for cryptography and firewalls.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM452.1	2	-	-	-	-	-	-	-	-	-	-	-	3
24AIM452.2	3		-	-	-	-	-	-	-	-	-	-	3
24AIM452.3	-	3	-	-	-	-	-	-	-	-	-	-	3
24AIM452.4	-	-	-	3	-	-	-	-	-	-	-	-	3
24AIM452.5	-	-	3	-		-	-	-	-	-	-	-	3
24AIM452.6	-	-	-	3	2	-	-	-	-	-	-	-	3
MODULE-1 INTRODUCTION													
24AIM452.1, 24AIM452.2	8 Hours												
OSI, TCP/IP and other networks models, Network Topologies, WAN, LAN, and MAN, Transmission media copper, twisted pair, wireless, Switching, Networking Devices.													
Text Book	Text Book 1: 2.2-2.4 Text Book 2: 1.4,1.5												
MODULE-2 DATA LINK LAYER													
24AIM452.1, 24AIM452.2	8 Hours												
Framing, Error detection and correction, Flow Control, Multiple Access Protocols – Data Link Layer Addressing, ARP, RARP, DHCP, Media Access Control Protocols, MAC addresses, Wireless LANS, High Level Data Link Control.													
Text Book	Text Book 1:3.10-3.16 Text Book 2: 3.1,3.2,4.1-4.6												
MODULE-3 NETWORK LAYER													
24AIM452.3	8 Hours												
Internet Protocol (IP), IPv4 and IPv6, Sub-netting, ICMP, Unicast Routing Protocols: Link State Routing, Distance Vector Routing, Hierarchical Routing, RIP, OSPF, BGP Multicast Routing.													
Text Book	Text Book 1:20.1-20.4, 21.2, 22.3,22.4												
MODULE-4 TRANSPORT LAYER													
24AIM452.2, 24AIM452.3, 24AIM452.4	8 Hours												
Transport Layer Services Connectionless Protocols: UDP, UDP segment, Reliable Data Transfer, Connection-Oriented Protocols: TCP Segment Structure, RTT estimation, Flow Control, Connection Management, Congestion Control, Integrated and Differentiated Services: Intserv– Diffserv.													
Self-Study	Session Layer Protocols: RPC, PPTP, SCP, SDP; Function and Design Issues												
Text Book	Text Book 1: 23,24: Text Book 2: 6.1-6.4												
MODULE-5 APPLICATION LAYER													
24AIM452.2, 24AIM452.3, 24AIM452.5, 24AIM452.6	8 Hours												
Principles of Network Applications, The Web and HTTP, FTP, Electronic Mail, SMTP, Mail Message Formats and MIME, DNS, Network Security: Principles of Cryptography, Firewalls, Attacks and Counter measures.													
Text Book	Text Book 1:25-29, Text Book 2: 7. 1-7.7												

CIE Assessment Pattern (50 Marks - Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
3	Apply	5	5	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	10
L2	Understand	10
L3	Apply	20
L4	Analyze	5
L5	Evaluate	5
L6	Create	--

Suggested Learning Resources:**Text Books:**

- 1) Behrouz A. Forouzan, "Data Communications and Networking", McGraw Hill, 2013, ISBN: 9780073376226.
- 2) Andrew S Tanenbaum, "Computer Networks", 4th Edition. Pearson, 2005, ISBN: 8177581651

Reference Books:

- 1) James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring The Internet", Pearson Education, Third edition, 2006. ISBN: 9780131365483
- 2) S. Keshav, "An Engineering Approach to Computer Networks", 2nd Edition, Pearson Education, 1997, ISBN: 9788131711453

Web links and Video Lectures (e-Resources):

- <https://www.cse.iitk.ac.in/users/dheeraj/cs425/>
- <https://www.geeksforgeeks.org/computer-networks/computer-network-tutorials/>
- <https://csc-knu.github.io/sys-prog/books/Andrew%20S.%20Tanenbaum%20-%20Computer%20Networks.pdf>

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

- Demonstration of various networking devices.
- Flipped classroom methodology Video demonstration of latest trends.
- Organizing Group wise discussions on Network issues
- Seminars

COMPUTER ARCHITECTURE													
Course Code	24AIM453							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:													
24AIM453.1	Apply the fundamental concepts and components involved in computer architecture.												
24AIM453.2	Design hardware structures such as fast adders, multipliers, and dividers.												
24AIM453.3	Analyze various number systems and their corresponding operations as implemented within computer architectures												
24AIM453.4	Develop innovative methods or foundational principles to enhance the efficiency of computer architecture operations.												
24AIM453.5	Evaluate the high-performance computing.												
24AIM453.6	Engage in lifelong learning to effectively integrate emerging technologies into professional practice, whether working individually or as part of a team, within the computing field												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM453.1	3	-		-	-	-	-	-	-	-	-	3	-
24AIM453.2		-	3	-	-	-	-	-	-	-	-	2	3
24AIM453.3	-	3		-	-	-	-	-	-	-	-	2	3
24AIM453.4	-	-	3	-	-	-	-	-	-	-	-	2	3
24AIM453.5	-	-	-	3	2	-	-	-	-	-	-	3	3
24AIM453.6	-	-	-	-	2	3	-	-	2	-	3	3	3
MODULE-1 INTRODUCTION													
											24AIM453.1	8 Hours	
Basic Structure of Computers Instruction Set Architecture: Functional Units, Basic Operational Concepts, Number Representation and Arithmetic Operations, Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Introduction to Assembly Language Basic Input/Output: Accessing I/O Devices, Interrupts, Bus Structure.													
Text Book			Text Book 2: 1.1,1.2,1.3										
MODULE-2 MEMORY SYSTEM													
											24AIM453.1, 24AIM453.2, 24AIM453.3	8 Hours	
Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations. Arithmetic Numbers, Arithmetic Operations, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed Operand Multiplication.													
Text Book			Text Book 1: 3.1,3.2,3.3,3.4										
MODULE-3 BASIC PROCESSING UNIT													
											24AIM453.4	8 Hours	
Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Hardwired Control. Parallel Processing and Performance: Hardware Multithreading, Vector Processing, Shared memory Multiprocessors, Cache Coherence.													
Text Book			Textbook 1: 4.1-4.10										
MODULE-4 PARALLELISM													
											24AIM453.4, 24AIM453.5	8 Hours	
Instruction Level Parallelism, Basic Compiler Techniques for Exposing ILP, Dynamic Scheduling, Thread Level Parallelism, Performance Metrics for Shared-Memory Multicore Systems, Cache Coherence Protocols, Synchronization, Memory Consistency, Data Level Parallelism.													
Text Book			Text Book 1: 6.1-9										
MODULE-5 EMERGING PROCESSING UNITS													
											24AIM453.5, 24AIM453.6	8 Hours	
GPU -Architecture and Applications, GPU Acceleration for Parallel Processing, GPU Applications in Graphics, Deep Learning, and HPC, Tensor Processing Units (TPUs) and Edge AI Processors- TPU Architecture, TPU Applications in Deep Learning (TensorFlow & ML Workloads), Energy Efficiency and Optimization Techniques													

Case Study	The team is evaluating how to optimize the device's computer architecture to meet the following constraints: Low power consumption and High-speed image processing			
Text Book	Text Book 1:C1-C11			
CIE Assessment Pattern (50 Marks - Theory)				
RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	5	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	10		
L2	Understand	10		
L3	Apply	20		
L4	Analyze	5		
L5	Evaluate	5		
L6	Create	--		
Suggested Learning Resources:				
Text Books:				
1) David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by, Elsevier,2022. ISBN: 978-0-12-383872-8				
2) Carl Hamacher, "Computer Organization and Embedded Systems", 6th Edition, McGraw Hill Higher Education,2023. ISBN: 978-9355323729.				
Reference Books:				
1) William Stallings, "Computer Organization and Architecture: Designing for Performance", 11th Edition, Pearson, 2023. ISBN: 9789356061590.				
Web links and Video Lectures (e-Resources):				
<ul style="list-style-type: none"> • https://onlinecourses.nptel.ac.in/noc21_cs61/preview • https://www.geeksforgeeks.org/computer-organization-architecture/computer-organization-and-architecture-tutorials/ • http://www.cs.iit.edu/~virgil/cs470/Book/ 				
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning				
<ul style="list-style-type: none"> • Group Discussion • Flipped Class • Seminar 				

INTRODUCTION TO EMBEDDED SYSTEMS													
Course Code	24AIM454						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:													
24AIM454.1	Understand the Basics of Embedded system												
24AIM454.2	Apply the system design method to address the real-world challenges.												
24AIM454.3	Analyze the key operational procedures and guiding design principles involved in creating a system.												
24AIM454.4	Design ARM-based systems												
24AIM454.5	Evaluate the performance of ARM controller using various instruction set.												
24AIM454.6	Develop innovative ARM controller-based systems for practical challenges, including those in IoT, through self-directed learning and the adoption of cutting-edge technologies												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM454.1	2	-	-	-	-	-	-	-	-	-	-	-	-
24AIM454.2	3		-	-	-	-	-	-	-	-	-	3	-
24AIM454.3	-	3	-	-	-	-	-	-	-	-	-	3	-
24AIM454.4	-	-	3	-	-	-	-	-	-	-	-	3	-
24AIM454.5	-	-	-	3	-	-	-	-	-	-	-	3	-
24AIM454.6	-	-	3		2	2	-	-	3	-	3	3	-
MODULE-1 INTRODUCTION TO EMBEDDED SYSTEM 24AIM454.1, 24AIM454.2 8 Hours													
Introduction to Embedded System, Embedded systems Vs General computing systems, History of Embedded Systems, Classification of Embedded systems, Major Application Areas of Embedded Systems. Purpose of Embedded Systems, The Typical Embedded System, Microprocessor Vs Microcontroller, Differences between RISC and CISC, Harvard V/s Von Neumann Processor/Controller Architecture, Big-endian V/s Little-endian processors, Memory (ROM and RAM types), Sensors & Actuators.													
Text Book	Text Book 1: Chapter-1, Chapter-2												
MODULE-2 EMBEDDED SYSTEM DESIGN 24AIM454.1, 24AIM454.2 8 Hours													
Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling, Embedded firmware design and development.													
Text Book	Text Book 1: Chapter-3, Chapter-4 (4.1, 4.2.1 and 4.2.2 only), Chapter-7 (Sections 7.1, 7.2 only), Chapter-9 (Sections 9.1, 9.2, 9.3.1, 9.3.2 only)												
MODULE-3 RTOS AND IDE FOR EMBEDDED SYSTEM DESIGN 24AIM454.3 8 Hours													
Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock. How to choose an RTOS, Integration and testing of Embedded hardware and firmware.													
Text Book	Text Book 1: Ch-10 (Sections 10.1, 10.2, 10.3, 10.5.2, 10.7, 10.8.1.1, 10.8.1.2 only), Ch-12, Ch-13 (a block diagram before 13.1, only).												
MODULE-4 ARM EMBEDDED SYSTEMS 24AIM454.2, 24AIM454.3, 24AIM454.4 8 Hours													
Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. ARM Processor Fundamentals, ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions.													
Self Study	ARM architecture overview (Cortex-M0/M3/M4/M7, A, R series)												
Text Book	Text Book 2: Chapter 1, 2												

MODULE-5	INTRODUCTION TO THE ARM INSTRUCTION SET	24AIM454.3, 24AIM454.4, 24AIM454.5, 24AIM454.6	8 Hours	
Introduction to the ARM Instruction set: Introduction, Data processing instructions, Load – Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution.				
Case Study	Smart Home Automation Using ARM Cortex-M, IoT Weather Monitoring Station			
Text Book	Text Book 2: Chapter-3			
CIE Assessment Pattern (50 Marks – Theory)				
RBT Levels		Test(s)25	AT1(15)	AT2(10)
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	5	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	10		
L2	Understand	10		
L3	Apply	20		
L4	Analyze	5		
L5	Evaluate	5		
L6	Create	--		
Suggested Learning Resources:				
Text Books:				
1 Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education,2017. ISBN: 978-9339219680				
2 Andrew N Sloss, Dominic System and Chris Wright, “ARM System Developers Guide”, Elsevier, Morgan Kaufman publisher, 2008. ISBN: 978-1558608740				
Reference Books:				
1. Raj Kamal, “Embedded Systems: Architecture and Programming”, Tata McGraw Hill, 2008. ISBN: 978-0070667648				
Web links and Video Lectures (e-Resources):				
<ul style="list-style-type: none"> • https://archive.nptel.ac.in/courses/106/105/106105193/ • https://developer.arm.com/documentation/dui0068/b/ARM-Instruction-Reference • https://www.udemy.com/course/introduction-to-arm-cortex-m3-and-m4-processors/ • www.Nuvoton.com/websites on Advanced ARM Cortex Processors • https://alison.com/tag/embedded-systems 				
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning				
<ul style="list-style-type: none"> • Group Discussion • Flipped Class • Seminar 				

FUNDAMENTALS OF SENSOR TECHNOLOGY													
Course Code	24AIM455							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:													
24AIM455.1	Understand the basic concepts, classification, and working principles of sensors and explain their key performance characteristics.												
24AIM455.2	Apply signal conditioning, data acquisition systems, and sensor interfacing techniques to prepare and collect accurate data.												
24AIM455.3	Analyze the performance of different sensors for various applications.												
24AIM455.4	Evaluate the characteristics of embedded sensor platforms and the methods used in fabricating MEMS and nanoscale sensors.												
24AIM455.5	Develop real-time solutions for practical problems by integrating sensor technology												
24AIM455.6	Create effective smart sensor systems to meet specific requirements in areas including robotics, healthcare, and environmental monitoring, leveraging acquired knowledge and skills												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM455.1	2	-	-	-	-	-	-	-	-	-		2	-
24AIM455.2	3	-	-	-	-	-	-	-	-	-	2	3	2
24AIM455.3	-	3	-		-	-	-	-	-	-	2	3	2
24AIM455.4	-	-	-	3	3	-	2	-	-	-	2	3	2
24AIM455.5	-	-	3	-	2	-	-	-	-	-	2	3	2
24AIM455.6	-	-	3	-	2	2	-	--	2	-	3	3	2
MODULE-1 INTRODUCTION TO SENSORS													
MODULE-1	INTRODUCTION TO SENSORS							24AIM455.1			8 Hours		
Introduction to sensors: Basic concepts, Classification of Sensors, and working principles. characteristics: Sensitivity, Resolution, Accuracy, Precision, Linearity, Hysteresis. Measurement systems: Functional elements, Transducers and Sensors													
Case Study		Sensors used in autonomous vehicles.											
Text Book		Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16											
MODULE-2 SIGNAL CONDITIONING AND DATA ACQUISITION													
MODULE-2	SIGNAL CONDITIONING AND DATA ACQUISITION							24AIM455.2 24AIM455.4			8 Hours		
Signal conditioning circuits: Amplifiers, filters, and analog-to digital conversion, Noise reduction and signal amplification techniques. Calibration and linearization of sensor outputs. Data acquisition systems and their components. Interfacing sensors with microcontrollers and processors.													
Self-study		Self-study on Sensor interfacing with Arduino											
Text Book		Text Book 1: 2.2, 2.3, 2.4 to 2.15											
MODULE-3 MISCELLANEOUS SENSORS													
MODULE-3	MISCELLANEOUS SENSORS							24AIM455.3 24AIM455.4			8 Hours		
Principle of operation: Moisture sensor, humidity sensors, gas sensors, Direction sensor, Ultrasound sensor. Photo sensors: Photovoltaic cell, Photo resistor, Phototransistor. Tactile sensors: Construction and operation, types.													
Case Study		Breath analyzer using temperature sensor.											
Text Book		Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10											
MODULE-4 SENSOR TECHNOLOGIES													
MODULE-4	SENSOR TECHNOLOGIES							24AIM455.4			8 Hours		
Sensor hardware: sensing elements, signal conditioning, ADC, power, communication interfaces. Sensor software: firmware, drivers, calibration, data processing, edge/cloud integration. Sensor platforms: Arduino, Raspberry Pi, Beagle Bone, ESP32. Definition and classification of MEMS and nanoscale sensors. Structure and working principles of MEMS-based sensors. MEMS fabrication techniques: Sputtering, Chemical vapor deposition, Electroplating. Microtechnology in MEMS Fabrication.													

Case Study	Smart Air Monitoring System using MEMS Sensors and Arduino			
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7			
MODULE-5	APPLICATIONS, CHALLENGES, AND FUTURE TRENDS	24AIM455.5	8 Hours	
Applications in robotics, automotive systems, healthcare, and agriculture. Environmental monitoring and smart cities. Ethical considerations and challenges in smart sensor Implementation. Emerging trends: AI and machine learning in sensor systems. Case studies on innovative smart sensor solutions				
Case Study	Identify current challenges in deployment or scalability, and finally propose future trends or innovative ideas to overcome those challenges.			
Text Book	Text Book 2: 12.1 to 12.10			
CIE Assessment Pattern (50 Marks - Theory)				
RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	-	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-
SEE Assessment Pattern (50 Marks - Theory)				
RBT Levels		Exam Marks Distribution (50)		
L1	Remember	10		
L2	Understand	10		
L3	Apply	10		
L4	Analyze	10		
L5	Evaluate	10		
L6	Create	--		
Suggested Learning Resources:				
Text Books:				
1) Jacob Fraden ,“Handbook of Modern Sensors: Physics, Designs, and Applications”, PHI Publication, 2016, ISBN: 978-1-4419-6465-6.				
2) S. Nihtianov, A. Luque, "Smart Sensors and MEMS", Woodhead Publishing,2018. ISBN:9780081020560				
Reference Books:				
1) D. Patranabis, "Sensors and Transducers", PHI Learning, 2003. ISBN: 9788120311560.				
2) Clarence W.de Silva,“ Sensors and Actuators: Control systems Instrumentation” , CRC Press, 2013. ISBN: 978-1-4200-4483-6.				
Web links and Video Lectures (e-Resources):				
<ul style="list-style-type: none"> • IIoT Fundamentals: Smart Sensors & Actuators in Automation, • https://www.realpars.com/courses/iotsensors-actuators?utm • Introduction to Sensors, https://online.stanford.edu/courses/me220-introduction-sensors?utm • Concept of Smart Sensors and Their Important Features. • https://www.youtube.com/watch?v=aUe1251TxS8&utm 				
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning				
<ul style="list-style-type: none"> • Classify 10 real-world sensors into mechanical, thermal, optical, etc., and justify their classification. • Observe and measure characteristics like sensitivity and hysteresis using a temperature or strain sensor • Construct a simple obstacle detection system using an ultrasonic sensor. • Interface an IMU (accelerometer + gyroscope) with Arduino or Raspberry Pi and visualize data. 				

EXPLORATORY DATA ANALYSIS													
Course Code	24AIM461							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:													
24AIM461.1	Demonstrate the techniques and packages in Python for Exploratory Analysis												
24AIM461.2	Apply the concepts of descriptive statistics for data preparation.												
24AIM461.3	Examine appropriate methods for data wrangling												
24AIM461.4	Analyse the significance of correlation and data distribution.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM461.1	3	-	-	-	-	-	-	-	-	-	-	3	3
24AIM461.2	3	-	-	-	-	-	-	-	-	-	-	3	3
24AIM461.3	-	3	-	-	-	-	-	-	-	-	3	3	3
24AIM461.4	-	3	-	-	-	-	-	-	-	-	-	3	3
Pgm. No.	List of Experiments / Programs										Hours	COs	
Prerequisite Experiments / Programs / Demo													
	Introduction to Descriptive Statistics and Python packages										2	NA	
PART-A													
1a	a. Write a simple NumPy program for statistical measures (mean, median, std). b. Load a dataset using Pandas and display shape, data types, and basic statistics using .info() and describe(). Note: Discuss the NumPy and Pandas Libraries.										2	24AIM461.1	
2a	Write a program to visualize sample data using Matplot lib (line, scatter, pie). Note: Discuss about MatPlot library.										2	24AIM461.1 24AIM461.2	
3a	Draw a Bubble chart and Bar Chart for sample data using Python . Note: Discuss the charts available in Python for visualize the data.										2	24AIM461.1 24AIM461.2	
4a	Draw a Lollipop chart and Polor chart for sample data using python.										2	24AIM461.1 24AIM461.2	
5a	Create a python program to choose the best chart among others.										2	24AIM461.1 24AIM461.2	
6a	Develop a python program to load a CSV file and converting date.										2	24AIM461.1 24AIM461.2	
PART-B													
1b	Write a python program to removing NaN values. Note: Discuss the Removing NaN values.										2	24AIM461.1 24AIM461.3 24AIM461.4	
2b	Load the video game sales dataset and understand the various columns. Identify trends if they exist in the data using bivariate graphs										2	24AIM461.1 24AIM461.3 24AIM461.4	
3b	Write a python program for data refactoring and dropping columns using python. Note: Discuss the Applying descriptive statistics-Data refactoring - Dropping columns										2	24AIM461.1 24AIM461.4	
4b	a. Write a program to merge the data-frames using python. b. Write a program to perform data deduplication and replacing values using python. Note: Discuss the data frames-merging on index-resaping and pivoting, data deduplication-Replacing values-handling missing data-outlier detection and filtering										2	24AIM461.1 24AIM461.4	
5b	Write a program to detect outlier and filtering.										2	24AIM461.1 24AIM461.2 24AIM461.4	

6b	a. Write a program to calculating percentiles using Kurtosis. b. Write a program to visualizing quartiles using python. c. Write a program to group datasets using group by () functions. Note: Discuss the distribution techniques.	2	24AIM461.1 24AIM461.4
PART-C			
Beyond Syllabus Virtual Lab Content			
(To be done during Lab but not to be included for CIE or SEE)			
1. Steps in Exploratory Data Analysis: https://www.analyticsvidhya.com/blog/2022/07/step-by-step-exploratory-data-analysis-eda-using-python/			
2. Data Analytics with Python: https://digimat.in/nptel/courses/video/106107220/L01.html			
CIE Assessment Pattern (50 Marks - Lab)			
RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	-	5
L6	Create	-	-
SEE Assessment Pattern (50 Marks - Lab)			
RBT Levels		Exam Marks Distribution (50)	
L1	Remember	-	
L2	Understand	10	
L3	Apply	10	
L4	Analyze	20	
L5	Evaluate	10	
L6	Create		
Suggested Learning Resources:			
Reference Books:			
1. Suresh Kumar Mukhiya and Usman Ahmed "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020. ISBN: 978-1789537253			
Weblinks and Video Lectures(e-Resources):			
<ul style="list-style-type: none"> • https://www.geeksforgeeks.org/exploratory-data-analysis-in-python/ • https://www.digitalocean.com/community/tutorials/exploratory-data-analysis-python • https://www.analyticsvidhya.com/blog/2022/02/exploratory-data-analysis-in-python/ 			
Activity-Based Learning /Practical Based learning			
<ul style="list-style-type: none"> • Seminar • Project Presentation 			

CLOUD SERVICE MANAGEMENT													
Course Code	24AIM462					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:													
24AIM462.1	Explore the AWS management console and configure secure access using IAM users, groups, roles, and MFA												
24AIM462.2	Launch and manage Amazon EC2 instances through the AWS Console and CLI with appropriate networking and storage settings												
24AIM462.3	Configure Elastic Block Store and S3 for object storage operations, and perform static hosting												
24AIM462.4	Deploy serverless applications using AWS Lambda and monitor AWS services using Amazon CloudWatch												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM462.1	3	-	-	-	-	-	-	-	-	-	-	3	3
24AIM462.2	3	-	-	-	-	-	-	-	-	-	-	3	3
24AIM462.3	-	-	3	-	-	-	-	-	-	-	-	3	3
24AIM462.4	-	-	3	-	-	-	-	-	-	-	3	3	3
Prerequisite Experiments / Programs / Demo													
Pgm. No.	List of Experiments / Programs										Hours	COs	
	Basics of Cloud Computing and Unix commands										2	NA	
PART-A													
1a	Create an IAM user, group, and role. Attach permission policies and enable MFA. Explore access control from the AWS Management Console.										2	24AIM462.1	
2a	a. Launch a Linux EC2 instance using AWS Console and connect using SSH. b. Launch a Linux EC2 instance using AWS CLI and verify connection.										2	24AIM462.1 24AIM462.2	
3a	Launch a Windows EC2 instance and connect using RDP. Explore basic app installation on the Windows instance.										2	24AIM462.1 24AIM462.2	
4a	Create and attach an EBS volume to a Linux EC2 instance. Format, mount, and verify the volume persistence.										2	24AIM462.1 24AIM462.3	
5a	a. Create an S3 bucket using AWS Console and upload/download files. b. Perform the same operations using AWS CLI.										2	24AIM462.1 24AIM462.3	
6a	Write a script to back up a file from an EC2 instance to S3 bucket and automate it using cron jobs.										2	24AIM462.1 24AIM462.2 24AIM462.3	
PART-B													
1b	Create a basic AWS Lambda function in Python or Node.js. Invoke the function with test events and explore the output.										2	24AIM462.4	
2b	Build a REST API using API Gateway connected to a Lambda function. Test it using Postman.										2	24AIM462.4	
3b	Monitor an EC2 instance using Amazon CloudWatch. Create alarms for CPU usage and configure email alerts via SNS.										2	24AIM462.4	
4b	Enable logs for EC2 and set up metric filters and composite alarms in CloudWatch. Create a CloudWatch Dashboard for monitoring.										2	24AIM462.4	
5b	Monitor Lambda and API Gateway metrics using CloudWatch. Visualize function invocations and errors in dashboard.										2	24AIM462.4	
6b	Deploy a static website on an EC2 instance using Free Tier services. Include all necessary configuration steps such as installing web server, copying files, modifying inbound rules, and testing accessibility.										2	24AIM462.1 24AIM462.2 24AIM462.3 24AIM462.4	

PART-C			
Beyond Syllabus Virtual Lab Content			
(To be done during Lab but not to be included for CIE or SEE)			
<ul style="list-style-type: none"> https://aws.amazon.com/console/ 			
CIE Assessment Pattern (50 Marks - Lab)			
RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	-	5
L6	Create	-	
SEE Assessment Pattern (50 Marks - Lab)			
RBT Levels		Exam Marks Distribution (50)	
L1	Remember	-	
L2	Understand	10	
L3	Apply	10	
L4	Analyze	20	
L5	Evaluate	10	
L6	Create	-	
Suggested Learning Resources:			
Reference Books:			
1) Mark Wilkins, "Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud", Pearson, 2019. ISBN: 9789389552959			
Web links and Video Lectures (e-Resources):			
<ul style="list-style-type: none"> https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/amazon-web-services-aws/?v=c86ee0d9d7ed https://www.coursera.org/specializations/aws-fundamentals 			
Activity-Based Learning/Practical Based learning			
<ul style="list-style-type: none"> Organizing Group wise discussions on issues Project Presentation 			

DIGITAL ELECTRONICS USING HDL													
Course Code	24AIM463					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:													
24AIM463.1	Understand basic logic gates and combinational circuit design.												
24AIM463.2	Apply design rules to write Verilog code for the applications												
24AIM463.3	Develop Sequential logic circuits.												
24AIM463.4	Design and simulate combinational logic using HDL												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM463.1	2	-	-	-	-	-	-	-	-	-	-	2	2
24AIM463.2	3	-	-	-	-	-	-	-	-	-	-	2	2
24AIM463.3	-	-	3	-	3	-	-	-	-	-	-	2	2
24AIM463.4	-	-	3	-	3	-	-	-	-	-	-	2	2
Pgm. No.													
List of Experiments													
Hours													
COs													
Prerequisite Experiments													
	<ul style="list-style-type: none"> • Knowledge of Basic Electronics Components • Familiar with Basic electronic circuit connections • Basic knowledge of using a computer 											NA	
PART-A													
1a	Logic Gates using Verilog: To implement basic logic gates (AND, OR, NOT, NAND, NOR, EXOR) in Verilog. (To understand how fundamental Boolean operations (AND, OR, NOT) form the basis of all digital logic circuits.)											2	24AIM463.1 24AIM463.2
2a	Adder and Subtractor: To design a 3-bit binary adder & subtractor using HDL. (To understand binary arithmetic works and how multiple-bit numbers can be added using logic gates. Adders are foundational for ALUs, digital counters, and various computing elements.)											2	24AIM463.1 24AIM463.2
3a	4-bit Comparator: To design a 4-bit comparator using HDL (To learn how binary numbers can be compared using digital logic. This knowledge is necessary for decision-making circuits, such as ALUs, digital sorters, and processors that evaluate conditions)											2	24AIM463.1 24AIM463.2
4a	Converter: Write an HDL program for a 4-bit Binary to Gray converter											2	24AIM463.1 24AIM463.2
5a	MUX/DEMUX: To design and simulate a 4:1 MUX and a 1:4 DEMUX using HDL (To understand the role of a multiplexer in selecting one of many input signals based on control lines. MUXes & DEMUXes are key components in routing data within digital systems and optimizing logic implementation.)											2	24AIM463.1 24AIM463.2
6a	Encoder/Decoder: To design and simulate an Encoder/Decoder using HDL											2	24AIM463.1 24AIM463.2
PART-B													
1b	Flip-Flop: To develop the HDL code for the following flip flops: T, D, S K, J K (To study memory elements that store binary data. Understanding flip-flops											2	24AIM463.3 24AIM463.4

	helps in designing registers, pipelines, and state machines that require synchronization with a clock signal.)		
2b	Register: To develop the HDL code for the Registers SISO, SIPO, PISO, PIP0.	2	24AIM463.3 24AIM463.4
3b	Synchronous 4-bit Counter: To design a 4-bit synchronous up counter. (To understand how counters operate with a common clock signal. Synchronous counters are essential in time-based applications like clocks, digital timers, and frequency dividers.)	2	24AIM463.3 24AIM463.4
4b	Asynchronous 4-bit Counter: To design a ripple counter using HDL. (To analyze the ripple effect of flip-flops clocked at different times. The concept of propagation delay and the importance of synchronization in digital systems.)	2	24AIM463.3 24AIM463.4
5b	Design 4-bit Binary and BCD counters (Synchronous reset and Asynchronous reset, and “any sequence” counters).	2	24AIM463.3 24AIM463.4
6b	Write an HDL code to display messages on the given seven-segment display. (To study how binary values are decoded into human-readable decimal digits using combinational logic. This is useful for displaying numerical output in embedded systems, counters, and digital displays.)	2	24AIM463.3 24AIM463.4

PART-C

Beyond Syllabus Virtual Lab Content

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

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

CIE Assessment Pattern (50 Marks - Lab)

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

SEE Assessment Pattern (50 Marks - Lab)

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

Suggested Learning Resources:

Reference Books:

1. Nazeih M. Botros, “HDL Programming (VHDL and Verilog)”, John-Wiley India Pvt. Ltd, 2015. ISBN: 978-93-5014-407-7.
2. Charles H. Roth Jr., Lizy Kurian John, Byeong Kil Lee, Digital System design Using Verilog”, CL Engineering, 2015. ISBN: 978-1285051079.

Activity-Based Learning/Practical Based learning

- Organizing Group wise discussions.
- Project Presentation

TYPESCRIPT PROGRAMMING													
Course Code	24AIM464					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:													
24AIM464.1	Analyze the functions and polymorphism features of TypeScript programming												
24AIM464.2	Develop applications using Inheritance and Interfaces												
24AIM464.3	Create applications using advanced types												
24AIM464.4	Build robust TypeScript applications that leverage asynchronous programming across both frontend and backend frameworks.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM464.1	-	3	-	-	-	-	-	-	-	-	3	3	2
24AIM464.2	3	-	3	-	3	-	-	-	-	-	3	2	3
24AIM464.3	-	-	3	-	3	-	-	-	-	-	3	2	3
24AIM464.4	-	-	-	3	3	2	-	-	-	-	3	2	3
Pgm. No. List of Experiments / Programs Hours COs													
Prerequisite Experiments / Programs / Demo													
	The compiler, The type system, Typescript versus JavaScript, Code Editor Setup, About Types										2	NA	
PART-A													
1a	a. Write a TypeScript program to read the data b. Write a TypeScript program to demonstrate functions										2	24AIM464.1	
2a	a. Write a TypeScript program to demonstrate polymorphism b. Demonstrate the usage of optional parameters, default parameters, rest parameters, generator functions, iterators, generic type inference, and generic type aliases in TypeScript statements										2	24AIM464.2	
3a	Write a TypeScript program to demonstrate Inheritance										2	24AIM464.2	
4a	Write a TypeScript program to demonstrate Interfaces										2	24AIM464.2	
5a	Develop a program to demonstrate the use of classes, inheritance, the super keyword, and using this as a return type.										2	24AIM464.3	
6a	Demonstrates the Factory Pattern, which is a common design pattern used to create objects										2	24AIM464.2, 24AIM464.3	
PART-B													
1b	Write a TypeScript program to demonstrate advanced types										2	24AIM464.3	
2b	Write a TypeScript program to demonstrate exception handling										2	24AIM464.3	
3b	Write a TypeScript program that declares an array containing both numbers and strings. Use type assertions to extract number, string and Boolean values from the array.										2	24AIM464.3	
4b	Write a TypeScript class that defines a base class Car with properties like make, model, and year, along with a start () method that prints a starting message. Now create a class called Engine with the properties horsepower and fuel-Type. Modify the Car class to include an instance of the Engine class as a property. Implement a method print-Car-Details () in the Car class that prints both car and engine details.										2	24AIM646.2, 24AIM464.3	
5b	Write a TypeScript program to demonstrate Asynchronous Programming										2	24AIM464.4	
6b	Write a TypeScript program to demonstrate concurrency and parallelism										2	24AIM464.4	

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

- <https://github.com/topics/virtual-laboratory>
- <https://www.typescriptlang.org/docs/handbook/typescript-from-scratch.html>

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. Adam Freeman, "Essential TypeScript 4 from Beginner to Pro", Apress, 2nd edition, 2021. ISBN: 978-1484270103

PROBLEM SOLVING USING SCALA													
Course Code	24AIM465					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:													
24AIM465.1	Design data models using Scala's sealed traits and case classes to create algebraic data types												
24AIM465.2	Apply structural recursion and pattern matching to navigate and modify data.												
24AIM465.3	Develop programs that effectively utilize Scala's built-in data structures												
24AIM465.4	Master object-oriented programming techniques and implement file I/O operations effectively in Scala												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24AIM465.1	-	-	3	-	2	-	-	-	-	-	3	3	2
24AIM465.2	3	-	-	-	-	-	-	-	-	-	3	2	3
24AIM465.3	-	-	3	-	2	-	-	-	-	-	3	2	3
24AIM465.4	-	-	3	-	3	2	-	-	-	-	3	1	3
Pgm. No.													
	List of Experiments / Programs										Hours	COs	
Prerequisite Experiments / Programs / Demo													
	<ul style="list-style-type: none"> Write a program to print "Hello, Scala!" Declare and initialize variables with different types (Int, Double, String, Boolean). Use basic control structures: if-else, while loops, for loops. 										2	NA	
PART-A													
1a	a. Write a Scala program to compute the sum of the two given integer values. If the two values are the same, then return triples their sum. b. Write a Scala program to check two given integers, and return true if one of them is 22 or if their sum is 32.										2	24AIM465.1	
2a	a. Write a Scala program to remove the character in a given position of a given string. The given position will be in the range 0...string length -1 inclusive. b. Write a Scala program to create a new string taking the first 5 characters of a given string and return the string with the 5 characters added at both the front and back.										2	24AIM465.1	
3a	a. Write a Scala program to print the multiplication table of a given number using a for loop. b. Write a Scala program to find the largest element in an array using pattern matching										2	24AIM465.1	
4a	a. Write a Scala function to calculate the product of digits in a given number. b. Write a Scala function to check if a given number is a perfect square										2	24AIM465.1	
5a	a. Write a Scala program that creates a subclass Student that extends the Person class. Add a property called grade and implement methods to get and set it. b. Write a Scala program that creates a class Triangle with properties side1, side2, and side3. Implement a method is Equilateral to check if the triangle is equilateral.										2	24AIM465.4	
6a	a. Write a Scala program that creates an enum class Color with values for different colors. Use the enum class to represent an object's color. b. Write a Scala program that creates a class ContactInfo with properties name, email, and address. Create a class Customer that includes a ContactInfo object.										2	24AIM465.4	
PART-B													
1b	a. Write a Scala program to create a set and find the difference and intersection between two sets. b. Write a Scala program to create a set and find the second largest element in the set.										2	24AIM465.3	

2b	a. Write a Scala program to create a list in different ways. Note: Use Lisp style, Java style, Range list, Uniform list, Tabulate list b. Write a Scala program to flatten a given List of Lists, nested list structure.	2	24AIM465.3
3b	a. Write a Scala program to add each element n times to a given list of integers. b. Write a Scala program to split a given list into two lists.	2	24AIM465.3
4b	a. Write a Scala program to swap the elements of a tuple Further print no swapping required if elements are same. b. Write a Scala program to find non-unique elements in a tuple	2	24AIM465.3
5b	a. Write a recursive Scala function to calculate the factorial of a number. b. Implement a tail-recursive function to compute the greatest common divisor (GCD) of two integers.	2	24AIM465.2
6b	a. Write a Scala program to read a text file and count the number of lines, words, and characters. b. Write a Scala program to write a list of names to a file, one per line.	2	24AIM465.4

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

- <https://docs.scala-lang.org/tutorials/scala-for-java-programmers.html>
- <https://www.javatpoint.com/scala-tutorial>
- <https://www.coursera.org/learn/scala-functional-programming>

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:**

- Paul Chiusano, Rúnar Bjarnason, "Functional Programming in Scala" Manning Publications, 2014. ISBN: 978-9351197638
- Martin Odersky, Lex Spoon, Bill Venner, and Frank Sommers, "Programming in Scala", Artima Inc, 2021. ISBN: 978-0997148008

Weblinks and Video Lectures(e-Resources):

- <https://docs.scala-lang.org/tutorials/>
- <https://www.hackerrank.com/domains/tutorials/10-days-of-scala>

Activity-Based Learning/Practical Based learning

- Organizing Group wise discussions.
- Project Presentation

UNIVERSAL HUMAN VALUES AND LIFE SKILLS													
Course Code	24UHK47							CIE Marks	50				
L:T:P:S	1:0:0:0							SEE Marks	50				
Hrs / Week	2							Total Marks	100				
Credits	01							Exam Hours	02				
Course outcomes: At the end of the course, the student will be able to:													
24UHK47.1	Understand the concept and significance of life skills and universal human values.												
24UHK47.2	Develop Self-awareness and Self-management skills to promote personal growth.												
24UHK47.3	Apply Critical and Creative thinking and ethical decision-making skills in various contexts.												
24UHK47.4	Promote teamwork and collaboration while respecting diversity and inclusivity.												
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24UHK47.1	-	-	-	-	-	3	1	2	-	2	2	-	2
24UHK47.2	-	-	-	-	-	1	2	3	1	2	3	-	2
24UHK47.3	-	-	-	-	-	3	1	2	1	3	2	-	2
24UHK47.4	-	-	-	-	-	2	2	3	2	2	1	-	2
MODULE-1	Self-Awareness and Self-Management							24UHK47.1, 24UHK47.2			3 Hours		
Emotional Intelligence, Techniques of self-awareness: SWOT and JOHARI WINDOWS, Stress management and coming out of comfort zone, managing failure, Time Management to recalibrate priorities. Self-Exploration as a process of Value Education, the basic human Aspirations: Prosperity and Happiness, understanding infatuation.													
Self-study / Role play	Understand qualities of Role Models, explore self and do SWOT analysis for growth; participate in role play and presentations to come out of comfort zone												
MODULE-2	Towards Yourself							24UHK47.1, 24UHK47.3			3 Hours		
Exploring opportunities, understanding expectations and self for right fitment in profession, Goal Setting - Personal and Professional, aligning Personal and Professional goals for greater achievement, Mind-Maps as a tool for Goal Setting													
Self-study / Mind Maps	Understand industry expectations to set professional goals; realizing connection between personal and professional goals for peaceful living												
MODULE-3	Leading self to lead others							24UHK47.3, 24UHK47.4			3 Hours		
Quality analysis of leader and self-evaluation, Critical thinking, Creative thinking and Ethical decision making, Critical thinking and Creative thinking for contribution to technical world, Six thinking hats, Exploring ethical decision-making frameworks and principles.													
Case study	Case studies for Critical thinking and activities for Creative thinking												
MODULE-4	Ownership towards Family and Society							24UHK47.2, 24UHK47.3 24UHK47.4			3 Hours		
Responsibility, Diversity and Inclusivity: Understanding personal and social responsibility; Appreciating diversity and managing inclusivity, promoting teamwork and collaboration while respecting differences.													
Self-study / Interview with corporate people	Working on Task bar; team building activities; Interviewing Corporate experts to understand expectations												
MODULE-5	Towards Nature and Industry							24UHK47.3, 24UHK47.4			3 Hours		
Personal code of conduct for harmony between self and nature, resisting external pressures, negotiation and conflict resolution, assertiveness and empathy, change management													
Role play	Role play to understand contributions to nature and industry.												

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	5	-
L5	Evaluate	-	5	-
L6	Create	-	-	-

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

Suggested Learning Resources:

REFERENCE BOOKS:

1. The 7 Habits of Highly Effective People, Stephen R Covey, Neha publishers.
2. Seven Habits of Highly Effective Teens, Convey Sean, New York, Fireside Publishers, 1998.
3. Emotional Intelligence, Daniel Coleman, Bantam Book, 2006.
4. How to win friends and influence people, Dale Carnegie.
5. BHAGAVADGITA for college students, Sandeepa Guntreddy.

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

- Conduct interviews with HR personnel of corporates to understand expectations in terms of Soft Skills and Values
- Participate in role plays and presentations to come out of comfort zone
- Talk to industry people to understand opportunities available
- Make a short movie to display creativity
- Use Mind maps to plan successful completion of semester
- Actively participate in Group Discussions and JAM sessions

MINI PROJECT													
Course Code	24AIM48					CIE Marks	50						
L:T:P:S	0:0:1:0					SEE Marks	50						
Hrs /Week	2					Total Marks	100						
Credits	03					Exam Hours	03						
Course outcomes: At the end of the course, the student will be able to:													
24AIM48.1	Understand the technological needs and/or societal needs and sustainability of the environment												
24AIM48.2	Apply practical knowledge and latest tools usage along with project development.												
24AIM48.3	Analyze the outcome of the project. Design application using Data Science concepts/ techniques												
24AIM48.4	Design application using Data Science concepts/ techniques												
24AIM48.5	Implement the project and provide solutions within the context of the Legal framework, addressing social concerns and upholding ethical issues												
24AIM48.6	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
24AIM48.1	2	-	-	-	-	1	1	1	-	-	3	3	2
24AIM48.2	3	-	-	-	3	-	-	-	-	-	-	-	-
24AIM48.3	3	3	-	-	3	-	-	-	-	-	-	-	-
24AIM48.4	3	3	3	-	-	-	-	-	-	-	3	3	2
24AIM48.5	3	3	3	3	3	2	2	2	2		3	3	2
24AIM48.6	3	3	3	3	3	1	1	1	2	2	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-Theory)													
RBT Levels		Review (50 marks)											
L1	Remember	-											
L2	Understand	10											
L3	Apply	15											
L4	Analyze	15											
L5	Evaluate	10											
L6	Create	-											
SEE Assessment Pattern (50Marks -Theory)													
RBT Levels		Exam Marks Distribution (50)											
L1	Remember	-											
L2	Understand	10											
L3	Apply	15											
L4	Analyze	15											
L5	Evaluate	10											
L6	Create	-											

BASIC APPLIED MATHEMATICS-II											
Course Code	24DMAT41						CIE Marks			50	
L:T:P:S	0:0:0:0						SEE Marks			--	
Hrs. / Week	2						Total Marks			50	
Credits	00						Exam Hours			--	
Course outcomes: At the end of the course, the student will be able to:											
24DMAT41.1	Gain knowledge of basic operations of vectors										
24DMAT41.2	Use curl and divergence of a vector function in three dimensions										
24DMAT41.3	Develop the ability to solve higher order Linear differential equations										
24DMAT41.4	Know the basic concepts of Laplace transform to solve the Periodic functions and also solve initial and boundary value problems using Laplace transform method.										
Mapping of Course Outcomes to Program Outcomes:											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24DMAT41.1	3	3	-	-	-	-	-	-	-	-	-
24DMAT41.2	3	3	-	-	-	-	-	-	-	-	-
24DMAT41.3	3	3	-	-	-	-	-	-	-	-	-
24DMAT41.4	3	3	-	-	-	-	-	-	-	-	-
MODULE-1	VECTORS							24DMAT31.1	8 Hours		
Definition of scalar and vector, Vector addition, Subtraction and Multiplication-Dot product, Cross product, Scalar triple product. Orthogonal, Co-planar and Angle between vectors-Problems.											
Text Book	Text Book 1: 3.1, 3.5, 3.6, 3.9, Text Book 2: 7.1, 9.2, 9.3, 9.4.										
MODULE-2	VECTOR DIFFERENTIATION							24DMAT31.2	8 Hours		
Vector differential operator-Gradient of a scalar function, Divergence of a vector function, Curl of vector function Problems. Solenoidal and irrotational vector fields-Problems.											
Text Book	Text Book 1: 8.5, 8.6, 8.7, Text Book 2: 9.7, 9.8, 9.9.										
MODULE-3	LINEAR DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS							24DMAT31.3	8 Hours		
Solution of initial and boundary value problems, Inverse differential operator techniques for the functions- e^{ax} , $\sin(ax + b)$ and $\cos(ax + b)$.											
Text Book	Text Book 1: 13.3, 13.4, 13.5, 13.6,										
MODULE-4	LAPLACE TRANSFORM							24DMAT31.4	8 Hours		
Definition and Laplace transforms of elementary functions-Problems. Properties of Laplace transforms (Shifting property-without proof), Periodic functions (without proof)-problems.											
Text Book	Text Book 1: 21.3, 21.4, 21.5, Text Book 2: 6.1.										
MODULE-5	INVERSE LAPLACE TRANSFORM							24DMAT31.4	8 Hours		
Inverse Laplace Transform by partial fractions-Problems. Solution of linear differential equations using Laplace Transforms-Problems.											
Text Book	Text Book 1: 21.12, 21.15, Text Book 2: 6.4.										
CIE Assessment Pattern (50 X 2=100 Marks - Theory)											
RBT Levels		Marks Distribution									
		Theory - Tests	AAT1	AAT2							
		25	15	10							
L1	Remember	5	-	-							
L2	Understand	5	-	-							
L3	Apply	5	5	5							
L4	Analyze	5	5	5							
L5	Evaluate	5	5	-							
L6	Create	-	-	-							

<p>Suggested Learning Resources:</p> <p>Text Books:</p> <ol style="list-style-type: none"> 1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491. 2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232. <p>Reference Books:</p> <ol style="list-style-type: none"> 1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236. 2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190. 3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831. 4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.
<p>Web links and Video Lectures (e-Resources):</p> <ol style="list-style-type: none"> 1) https://youtu.be/SaNDPSk1UVM?si=FRxMnRi1btCUIscK 2) https://youtu.be/HxrLu-qRJKc?si=pKc9XOCllBx-H4Wp 3) https://youtu.be/ma1QmE1SH3I?si=Hoo3_cjiIds203os 4) https://youtu.be/TKBXey91Gc4?si=JjZfQvJxdxN8I6YQ 5) https://youtu.be/1THkFmuIPXM?si=pc9VvmZ-9cQe_Wr_ 6) https://youtu.be/m7jH0jfRf2I?si=OOEWttfQhieJ9wih 7) https://youtu.be/qFnoRfZknBY?si=BeMrhMF3LML4hBGa 8) https://youtu.be/n9XP6pljtw8?si=3gU-XKgt5JIze9LE
<p>Activity-Based Learning (Suggested Activities in Class)/Practical Based Learning:</p> <ul style="list-style-type: none"> • Contents related activities (Activity-based discussions) <ul style="list-style-type: none"> ➤ Problem solving Approach ➤ Organizing Group wise discussions on related topics ➤ Seminars

NATIONAL SERVICE SCHEME											
Course Code	24NSS40					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:											
24NSS40.1	Understand the importance of his / her responsibilities towards society.										
24NSS40.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.										
24NSS40.3	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.										
24NSS40.4	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
24NSS40.1	-	-	-	-	-	3	3	2	-	-	1
24NSS40.2	-	-	-	-	-	3	3	2	-	-	1
24NSS40.3	-	-	-	-	-	3	3	2	-	-	1
24NSS40.4	-	-	-	-	-	3	3	2	-	-	1
Semester/ Course Code	CONTENT								COs	HOURS	
3RD 24NSS30	12. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 13. Waste management–Public, Private and Govt organization, 5R's. 14. 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 HRS	
4TH 24NSS40	15. Water conservation techniques – Role of different stakeholders– Implementation. 16. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 17. 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 HRS	
5TH 24NSS50	18. Developing Sustainable Water management system for rural areas and implementation approaches. 19. 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 development programs etc. 20. Spreading public awareness under rural outreach programs. (minimum 5 programs).								24NSS50.1, 24NSS50.2, 24NSS50.3, 24NSS50.4	30 HRS	
6TH 24NSS60	21. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 22. Govt. school Rejuvenation and helping them to achieve good infrastructure.								24NSS60.1, 24NSS60.2, 24NSS60.3, 24NSS60.4	30 HRS	
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	

<ul style="list-style-type: none"> • 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. 																					
<p>Suggested Learning Resources:</p> <p>Reference Books:</p> <ol style="list-style-type: none"> 13. NSS Course Manual, Published by NSS Cell, VTU Belagavi. 14. Government of Karnataka, NSS cell, activities reports and its manual. 15. Government of India, NSS cell, Activities reports and its manual. 																					
<p>Pre-requisites to take this Course:</p> <ol style="list-style-type: none"> 4. Students should have a service-oriented mindset and social concern. 5. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works. 6. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time. 																					
<p>Pedagogy:</p> <ul style="list-style-type: none"> • 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. <p>Plan of Action:</p> <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> ○ 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. 																					
<table border="1"> <thead> <tr> <th>Sl No</th> <th>Topic</th> <th>Groupsize</th> <th>Location</th> <th>Activity execution</th> <th>Reporting</th> <th>Evaluation of the Topic</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.</td> <td>May be individual or team</td> <td>Farmers land/Villages/ roadside / Community area / College campus</td> <td>Site selection /proper consultation/ Continuous monitoring/ Information board</td> <td>Report should be submitted by individual to the concerned evaluation authority</td> <td>Evaluation as per the rubrics of scheme and syllabus by NSS officer</td> </tr> <tr> <td>2.</td> <td>Waste management- Public, Private and Govt organization, 5 R's.</td> <td>May be individual or team</td> <td>Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/</td> <td>Site selection /proper consultation/ Continuous monitoring/ Information board</td> <td>Report should be submitted by individual to the concerned evaluation authority</td> <td>Evaluation as per the rubrics of scheme and syllabus by NSS officer</td> </tr> </tbody> </table>	Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic	1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer	2.	Waste management- Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/	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
Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic															
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer															
2.	Waste management- Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/	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															

			campus			
3.	Setting of the information imparting club for women leading to contribution in social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/ proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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. (minimum 5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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 and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS											
Course Code	24PED40						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:											
24PED40.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness										
24PED40.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle										
24PED40.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.										
24PED40.4	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
24PED40.1	-	-	-	-	-	2	-	3	3	-	-
24PED40.2	-	-	-	-	-	2	-	3	3	-	-
24PED40.3	-	-	-	-	-	2	-	3	3	-	-
24PED40.4	-	-	-	-	-	2	-	3	3	-	-
Semester	CONTENT									COs	HOURS
3RD 24PED30	Module 1: Orientation F. Lifestyle, G. Fitness H. Food & Nutrition I. Health & Wellness J. Pre-Fitness test.									24PED30.1, 24PED30.2	5 HRS
	Module 2: General Fitness & Components of Fitness G. Warming up (Free Hand exercises) H. Strength – Push-up / Pull-ups I. Speed – 30 Mtr Dash J. Agility – Shuttle Run K. Flexibility – Sit and Reach L. Cardiovascular Endurance – Harvard step Test									24PED30.2, 24PED30.3	15 HRS
	Module 3: Recreational Activities E. Postural deformities. F. Stress management. G. Aerobics. H. Traditional Games.									24PED30.3, 24PED30.4	10 HRS
4TH 24PED40	Module 1: Ethics and Moral Values C. Ethics in Sports D. Moral Values in Sports and Games									24PED40.1, 24PED40.2	5 HRS
	Module 2: Specific Games (Anyone to be selected by the student) G. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. H. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw. I. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. J. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up. K. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash. L. Athletics (Track / Field Events) – Any event as per availability of Ground.									24PED40.3	20 HRS
	Module 3: Role of Organization and administration									24PED40.4	5 HRS
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: 4. Track -Sprints:									24PED50.1, 24PED50.2, 24PED50.3, 24PED50.4	Total 30 Hrs/ Semester

	<ul style="list-style-type: none"> • 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. <p>5. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick) and Landing</p> <p>6. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique)</p> <p style="text-align: center;">Handball OR Ball Badminton</p> <p>Handball:</p> <p>B. Fundamental Skills</p> <p>7. Catching, Throwing and Ball control,</p> <p>8. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot.</p> <p>9. Dribbling: High and low.</p> <p>10. Attack and counter attack, simple counter attack, counter attack from two wings and center.</p> <p>11. Blocking, Goal Keeping and Defensive skills.</p> <p>12. Game practice with application of Rules and Regulations.</p> <p>C. Rules and their interpretations and duties of officials</p> <p>Ball badminton:</p> <p>B. Fundamental Skills</p> <p>5. Basic Knowledge: Various parts of the Racket and Grip.</p> <p>6. Service: Short service, long service, Long-high service.</p> <p>7. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash.</p> <p>8. Game practice with application of Rules and Regulations.</p> <p>B. Rules and their interpretation and duties of officials.</p>		2 Hrs/we ek
<p style="text-align: center;">6TH 24PED60</p>	<p>Athletics:</p> <p>4. Track -110 Mtrs and 400Mtrs:</p> <ul style="list-style-type: none"> • 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. <p>5. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing.</p> <p>6. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).</p> <p style="text-align: center;">Football OR Hockey</p> <p>Football:</p> <p>A. Fundamental Skills</p> <p>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.</p> <p>10. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot.</p> <p>11. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot.</p> <p>12. Heading: In standing, running and jumping condition.</p> <p>13. Throw-in: Standing throw-in and Running throw-in.</p> <p>14. Feinting: With the lower limb and upper part of the body.</p> <p>15. Tackling: Simple Tackling, Slide Tackling.</p> <p>16. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting.</p> <p>17. Game practice with application of Rules and Regulations.</p>	<p>24PED60.1, 24PED60.2, 24PED60.3, 24PED60.4</p>	Total 30 Hrs/ Semest er 2 Hrs/we ek

	B. 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 9. Penalty stroke practice. 10. Penalty corner practice. 11. Tackling: Simple Tackling, Slide Tackling. 12. Goal Keeping, Ball clearance- kicking, and deflecting. 13. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials		
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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	24YOG40					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:											
24YOG40.1	Understanding the origin, history, aim and objectives of Yoga										
24YOG40.2	Become familiar with an authentic foundation of Yogic practices										
24YOG40.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat										
24YOG40.4	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
24YOG40.1	-	-	-	-	-	3	-	-	-	-	1
24YOG40.2	-	-	-	-	-	3	-	-	-	-	1
24YOG40.3	-	-	-	-	-	3	-	-	-	-	1
24YOG40.4	-	-	-	-	-	3	-	-	-	-	1
Semester / Course Code	CONTENT								COs	HOURS	
3rd 24YOG30	<p>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</p> <p>Brief introduction of yogic practices for common man: Yogic practices for common man to promote positive health</p> <p>Rules and regulations: Rules to be followed during yogic practices by practitioner</p> <p>Misconceptions of yoga: Yoga its misconceptions, Difference between yogic and non-yogic practices.</p> <p>Suryanamaskara:</p> <ol style="list-style-type: none"> Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar. Suryanamaskar 12 count, 2 rounds <p>Different types of Asanas:</p> <ol style="list-style-type: none"> Sitting: Padmasana, Vajrasana, Sukhasana Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana Prone line: Bhujangasana, Shalabhasana Supine line: Utthitadvipadasana, Ardhalasana, Halasana 								24YOG30.1, 24YOG30.2, 24YOG30.3, 24YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week	
4TH 24YOG40	<p>Suryanamaskara: Suryanamaskar 12 count, 4 rounds</p> <p>Brief introduction and importance of:</p> <p>Kapalabhati: Revision of Kapalabhati -40 strokes/min 3 rounds</p> <p>Different types of Asanas:</p> <ol style="list-style-type: none"> Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana Prone line: Dhanurasana Supine line: Karna Peedasana, Sarvangasana, Chakraasana <p>Patanjali's Ashtanga Yoga: Asana, Pranayama</p> <p>Pranayama: Chandra Bhedana, Nadishodhana, Surya Bhedana</p>								24YOG40.1, 24YOG40.2, 24YOG40.3, 24YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week	

<p>5TH 24YOG50</p>	<p>Kapalabhati: Revision of Kapalabhati - 60strokes/min3rounds Brief introduction and importance of: Different types of Asanas: 5. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 6. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 7. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 8. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvangasana Patanjali's Ashtanga Yoga: Pratyahara, Dharana Pranayama: Ujjayi, Sheetali, Sheektari</p>	<p>24YOG50.1, 24YOG50.2, 24YOG50.3, 24YOG50.4</p>	<p>Total 32 Hrs/ Semester 2 Hrs/week</p>								
<p>6TH 24YOG60</p>	<p>Kapalabhati: Revision of Kapalabhati – 80 strokes/min3rounds Brief introduction and importance of: Different types of Asanas: 5. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 6. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 7. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 8. Balancing: Sheershasana Patanjali's AshtangaYoga: Dhyana (Meditation), Samadhi Pranayama: Bhastrika, Bhramari, Ujjai Shat Kriyas: Jalaneti and sutraneti, Sheetkarma Kapalabhati</p>	<p>24YOG60.1, 24YOG60.2, 24YOG60.3, 24YOG60.4</p>	<p>Total 32 Hrs/ Semester 2 Hrs/week</p>								
<p>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)</p> <table border="1" data-bbox="464 1055 1166 1205"> <thead> <tr> <th>CIE</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>Avg of Test 1 and Test 2</td> <td>25</td> </tr> <tr> <td>Demonstration of Yogasana</td> <td>25</td> </tr> <tr> <td>Total</td> <td>50</td> </tr> </tbody> </table>				CIE	Marks	Avg of Test 1 and Test 2	25	Demonstration of Yogasana	25	Total	50
CIE	Marks										
Avg of Test 1 and Test 2	25										
Demonstration of Yogasana	25										
Total	50										
<p>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)</p>											
<p>Web links and Video Lectures (e-Resources):</p> <ul style="list-style-type: none"> • https://youtu.be/KB-TYlgd1wE • https://youtu.be/aa-TG0Wg1Ls 											

APPENDIX A

List of Assessment Pattern			
SNO	Tasks	Blooms category /Level	Remarks
1	Assignments	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
2	Group Discussions	Apply-L3, Analyse-L4	Group
3	Case Studies/Case Lets	Apply-L3, Analyse-L4, Evaluate-L5	Individual/ Group
4	Practical Orientation on Design thinking	Analyse-L4, Create-L6	Creativity & Innovation
5	Participatory & Industry- Integrated Learning	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
6	Practical activities/Problem solving exercises	Apply-L3, Analyse-L4, Evaluate-L5	Individual/ Group
7	Class Presentations	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
8	Analysis of Industry/ Technical /Business Reports	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
9	Reports on Industrial Visit	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
10	Industrial/Social/Rural Projects	Analyse-L4, Create-L6	Individual/ Group
11	Participation in external seminars/workshops	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
12	Any other academic activity	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
13	Online/ Offline Quizzes	Understand-L2, Apply-L3	Individual
	Note:		
	1.The choice or selection of appropriate Tasks for each Assessment Type by the course coordinator		
	2.Assign/fix the marks for each Assessment Type by course Co-Ordinator.		
	3.Students either submit the report for Task or not, as determined by the course coordinator.		
	4. Need to get final approval from the HOD/BOS Chairman once finalizing the mark allocations for Tasks and Assessment types.		

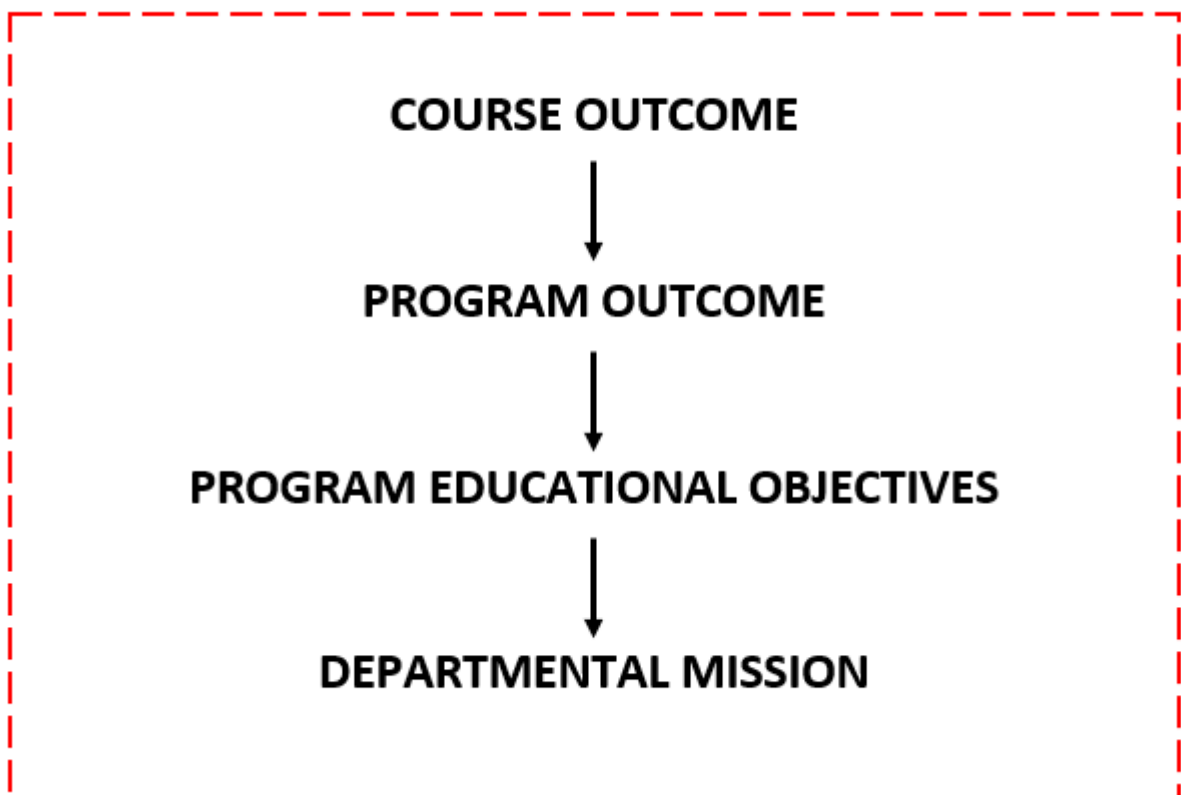
APPENDIX B**Outcome Based Education**

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

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

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

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

Mapping of Outcome:

APPENDIX C

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.

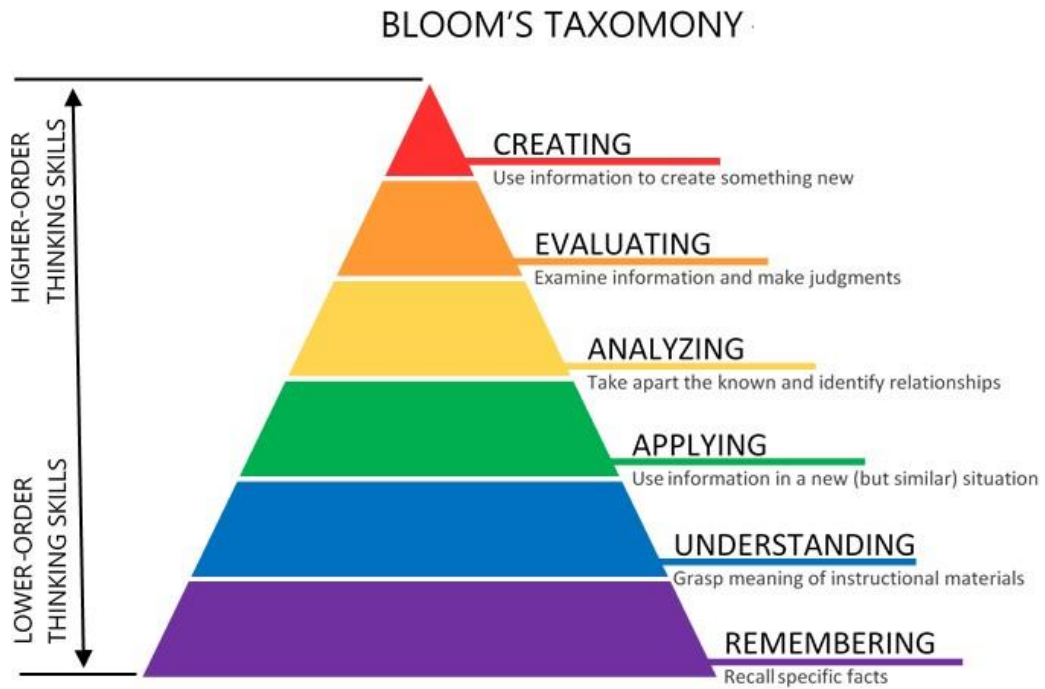
PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for

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 D

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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