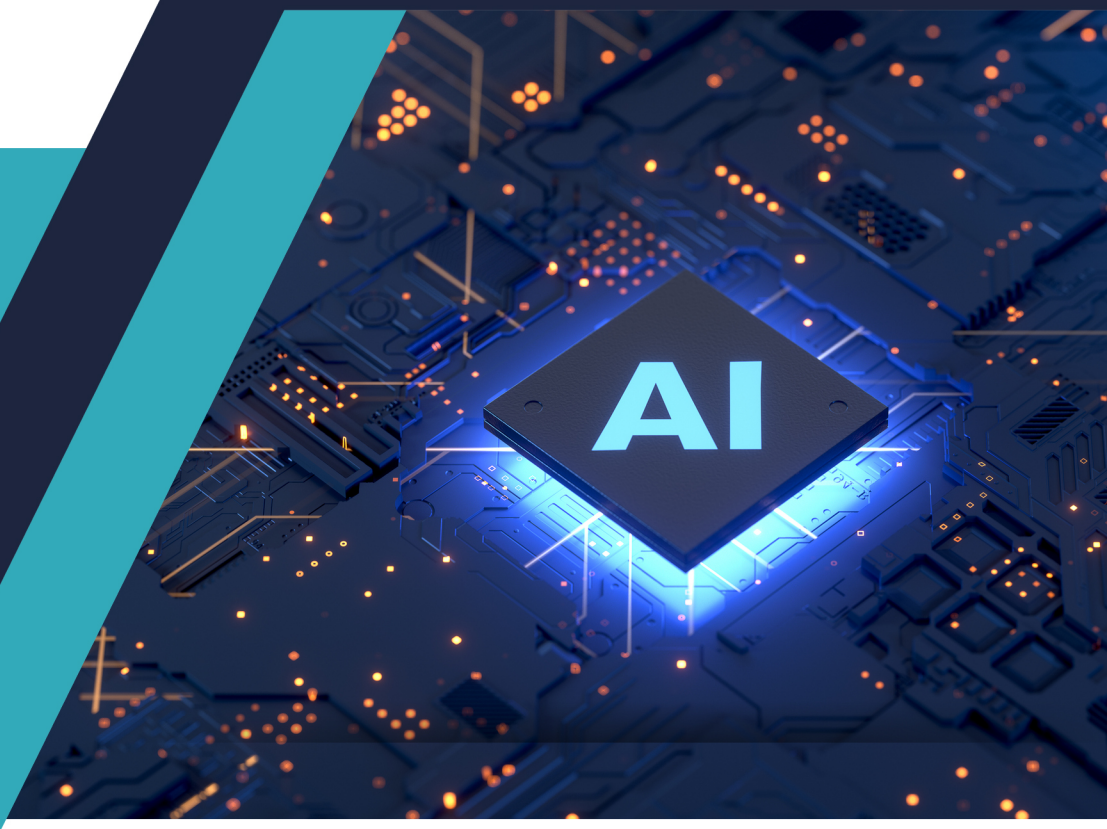
NEW HORIZON
COLLEGE OF ENGINEERING

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Academic Year 2024 - 2025



3rd and 4th Semesters Scheme & Syllabus

BATCH: 2023 - 2027
CREDITS: 160
[2022 Scheme]

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Academic Year
2024 - 2025

[2022 Scheme]

3rd and 4th Semesters
Scheme & Syllabus

BATCH: 2023 - 2027
CREDITS: 160

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
- Innovation
- Integrity
- Professionalism
- Inclusiveness
- 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 disseminate strong theoretical and practical exposure to meet the emerging trends in the industry.

To promote a freethinking environment with innovative research and teaching-learning pedagogy.

To develop value based socially responsible professionals with high degree of leadership skills will support for betterment of the society.

Program Educational Objectives (PEOs)

PEO1	Develop and excel in their chosen profession on technical front and progress towards advanced continuing education or Inter-disciplinary Research and Entrepreneurship
PEO2	Become a reputed innovative solution provider- to complex system problems or towards research or challenges relevant to Artificial Intelligence and Machine learning
PEO3	Progress as skilled team members achieving leadership qualities with trust and professional ethics, pro-active citizens for progress and overall welfare of the society

PEO to Mission Statement Mapping

Mission Statements	PEO1	PEO2	PEO3
To disseminate strong theoretical and practical exposure to meet the emerging trends in the industry.	3	3	2
To promote a freethinking environment with innovative researchand teaching-learning pedagogy.	2	3	2
To develop value based socially responsible professionals with high degree of leadership skills will support for betterment of the society.	2	3	3

Program Outcomes (POs) with Graduate Attributes

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems in Computer Engineering.

PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems in Computer Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.

PO3 **Design / Development of Solutions:** Design solutions for complex Engineering problems anddesign system components or processes of Computer Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.

PO4 **Conduct Investigations of Complex Problems:** Use research based knowledge and research methods including design of experiments in Computer Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities in Computer Engineering with an understanding of the limitations.

PO6 **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Computer Engineering.

PO7 **Environment and Sustainability:** Understand the impact of the professional Engineering solutions of Computer Engineering in societal and Environmental contexts, demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and normsof the Engineering practice.

PO9 **Individual and Team Work:** Function effectively as an individual, and as a member or leaderin diverse teams, and in multidisciplinary settings.

PO10 **Communication Skills:** Communicate effectively on complex Engineering activities with the Engineering community and with society, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clearinstructions.

PO11 **Project Management and Finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.

PO12 **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

A graduate of the Computer Engineering Program will demonstrate:

PSO1: Develop models in Data Science, Machine learning, Deep learning and Bigdata technologies, using acquired AI knowledge and modern tools.

PSO2: Formulate solutions for interdisciplinary problems through acquired programming knowledge in the respective domains complying with real-time constraints.

NEW HORIZON COLLEGE OF ENGINEERING

B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examinations for 2023-2027 BATCH (2022 Scheme)

III Semester

Sl. No.	Course and CourseCode		CourseTitle	BoS	Credit Distribution				Overall Credits	Contact Hours	Marks		
					L	T	P	S			CIE	SEE	Total
1	BSC	22MAC31	Mathematical Foundation for Computing Sciences	BS	2	1	0	0	3	4	50	50	**100**
2	PCC	22AIM32	Data Structures and Algorithms	AIML	3	0	0	0	3	3	50	50	**100**
3	PCCL	22AIL32	Data Structures and Algorithms Lab	AIML	0	0	1	0	1	2	50	50	**100**
4	PCC	22AIM33	Object Oriented Programming with Java	AIML	3	0	0	0	3	3	50	50	**100**
5	PCCL	22AIL33	Object Oriented Programming with Java Lab	AIML	0	0	1	0	1	2	50	50	**100**
6	PLC	22AIM34X	Programming Language Course	AIML	2	0	1	0	3	4	50	50	**100**
7	AEC	22AIM35X	Ability Enhancement Course –III	AIML	0	0	1	0	1	2	50	50	**100**
8	BSC	22BIK36	Bio Inspired Design and Innovation	Any Dept	3	0	0	0	3	3	50	50	**100**
9	UHV	22SCK37	Social Connect and Responsibility	AIML	0	0	1	0	1	2	50	--	**50**
10	NCMC	22NSS30	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED30	Physical Education (PE) (Sports andAthletics)	PE Director									
		22YOG30	Yoga	Yoga Teacher									
Total									**19**	**27**	**500**	**400**	**900**

11	NCMC	22DMAT31*	Basic Applied Mathematics-I	BS	0	0	0	0	0	2	50	--	50

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 LanguageCourse, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

22DMAT31***:** This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Programming Language Course (PLC)			
22AIM341	Linux Programming	22AIM344	Java Script Programming
22AIM342	Perl Programming	22AIM345	AI for Robotics
22AIM343	Programming for IoT		

Ability Enhancement Course–III (all are Laboratory Courses 0-0-1-0)			
22AIM351	Problem solving using Prolog	22AIM354	Exploratory Data Analysis
22AIM352	Python for Data Analytics	22AIM355	Julia for Numerical Analysis
22AIM353	Data Analysis using MSExcel		

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the coursesnamely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with theconcerned coordinator of the course during the first week of III semesters. Activities shall be carried out betweenIII semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIEscore is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and thesame shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not beconsidered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courseismandatoryfortheawardofdegree.

Credit Definition: 1-hour Lecture (L) per week=1Credit2-hours Tutorial(T) per week=1 Credit 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

Scheme of Teaching and Examinations for 2022-2026 BATCH (2022 Scheme)

IV Semester													
Sl. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**Contact Hrs**	**Marks**		
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	BSC/PCC	22MAC41	Discrete Mathematics and Graph Theory	BS	2	1	0	0	3	4	50	50	**100**
2	PCC	22AIM42	Database Management System	AIML	3	0	0	0	3	3	50	50	**100**
3	PCCL	22AIL42	Database Management System Lab	AIML	0	0	1	0	1	2	50	50	**100**
4	PCC	22AIM43	Design and Analysis of Algorithm	AIML	3	0	0	0	3	3	50	50	**100**
5	PCCL	22AIL43	Design and Analysis of Algorithm Lab	AIML	0	0	1	0	1	2	50	50	**100**
6	PCC	22AIM44	Data Science	AIML	3	0	0	0	3	3	50	50	**100**
7	PCCL	22AIL44	Data Science Lab	AIML	0	0	1	0	1	2	50	50	**100**
8	PLC	22AIM45X	Programming Language Course	AIML	2	0	1	0	3	4	50	50	**100**
9	AEC	22AIM46X	Ability Enhancement Course –IV	AIML	0	0	1	0	1	2	50	50	**100**
10	UHV	22UHK47	Universal Human Values and Life Skills	Any Dept	1	0	0	0	1	2	50	50	**100**
11	PROJ	22AIM48	Mini Project-I	AIML	0	0	1	0	1	0	50	50	**100**
12	NCMC	22NSS40	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED40	Physical Education (PE) (Sports and Athletics)	PE Director									
		22YOG40	Yoga	Yog Teacher									
Total									**21**	**29**	**600**	**550**	**1150**

13	NCMC	22DMAT41*	Basic Applied Mathematics-II	BS	0	0	0	0	0	2	50	--	50

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.

22DMAT41*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students

Programming Language Course (PLC)			
22AIM451	Ruby Programming	22AIM454	Advanced Python Programming
22AIM452	C #and.Net Framework	22AIM455	AI Powered Tools & Services
22AIM453	R Programming		
AbilityEnhancementCourse–IV (all are Laboratory Courses 0-0-1-0)			
22AIM461	Database Programming using Cassandra	22AIM464	Haskell programming
22AIM462	DataVisualization	22AIM465	Basics for Digital and Image Processing
22AIM463	Golang Programming		

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to studentsto 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 dominiprojectas

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

(ii) Agroup 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 isa multi disciplinary (Applicable to all Branches)

CIEprocedureforMini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concernedDepartment and two faculty members of the Department, one of them being the Guide. The CIE marks awarded forthe 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 thebatchesmates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participationof alltheguidesofthe project.

TheCIEmarksawardedfortheMini-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

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) withthe concerned coordinator of the course during the first week of III semesters. Activities shall be carried outbetween III semester to the VI semester (for 4 semesters). Successful completion of the registered course andrequisite 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,

CreditDefinition: 1-hour Lecture (L) per week=1Credit2-hours Tutorial(T) per week=1 Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hours 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

III SEMESTER

MATHEMATICAL FOUNDATION FOR COMPUTING SCIENCES			
Course Code	**22MAC31**	**CIE Marks**	**50**
L:T:P:S	**2:1:0:0**	**SEE Marks**	**50**
Hrs. / Week	**4**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22MAC31.1	Use appropriate numerical methods to solve algebraic equations and transcendental equations.
22MAC31.2	Solve initial value problems using appropriate numerical methods and also Evaluate definite integrals numerically.
22MAC31.3	Demonstrate the idea of Linear Dependence and Independence of sets in the vector space.
22MAC31.4	Gain ability to use probability distributions to analyze and solve real time problems
22MAC31.5	Justify the concept of sampling distribution to solve the engineering problems.
22MAC31.6	Use the large/small samples to analyse the data to make decision about the hypothesis.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22MAC31.1	3	3	-	-	-	-	-	-	-	-	-	-
22MAC31.2	3	3	-	-	-	-	-	-	-	-	-	-
22MAC31.3	3	3	-	-	-	-	-	-	-	-	-	-
22MAC31.4	3	3	-	-	-	-	-	-	-	-	-	-
22MAC31.5	3	3	-	-	-	-	-	-	-	-	-	-
22MAC31.6	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**NUMERICAL METHODS-1**	**22MAC31.1**	**8 Hours**
Numerical solution of algebraic and transcendental equations: Regula-falsi method and 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.			
Case Study	Case study on Numerical Analysis.		
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 METHODS-2**	**22MAC31.2**	**8 Hours**
Numerical solution of ordinary differential equations of first order and of first degree: Taylor's series metho 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 (witho proofs)-Problems.			
Applications	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**	**22MAC31.3**	**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**	**22MAC31.4**	**8 Hours**
Random variables (discrete and continuous), probability density functions, moment generating function. Discrete Probability distributions: Binomial and Poisson Distributions-Problems. Continuous Probability distribution: Normal Distributions-Problems. Concept of joint probability-Joint probability distribution, Discrete and Independent random variables. Expectation, Covariance, Correlation coefficient.			
Case Study	Case study on Distributions.		
Text Book	Text Book 1: 26.8, 26.9, 26.10, 26.11, 26.12, 26.14, 26.15, 26.16.		
MODULE-5	**SAMPLING THEORY**	**22MAC31.5, 22MAC31.6**	**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.	
Case Study	Case Studies on sampling theory and significant measures of scores.
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, 27.19.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s) (25)	Qualitative Assessment (s) (15)	MCQ's (10)
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	10	5	10
L4	Analyze	2.5	-	-
L5	Evaluate	2.5	-	-
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) 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/mIFwzg11uO4?si=Xd13dh0eNlmIswPS
3)https://youtu.be/74g5_3TC-tQ?si=yB2PHVGr4hxIlqPo
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-oriJZaC1kSzx
8)https://youtu.be/dOr0NKyD31Q?si=dMBU-BXGdGL6jIZy
9)https://youtu.be/BR1nN8DW2Vg?si=melzz97SqhK3wr--
10)https://youtu.be/ugd4k3dC_8Y?si=xF5U2gjIgP0woDQt
11)https://youtu.be/z0Ry_3_qhDw?si=6IG2a65BZgdbaKsn
12)https://youtu.be/36cAE1Ovpq4?si=jfR8gkFmMOCkWNZ_

13)https://youtu.be/vFz2FG65HBc?si=SCHi3Y1XuHWg-pPT
14)https://youtu.be/2Dsz1lZBJ3Y?si=8ATLUE-mkJSMewO3

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

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Algorithms/Flowcharts/Programming Codes
  - Organizing Group wise discussions on related topics
  - Seminars

DATA STRUCTURES AND ALGORITHMS			
Course Code	**22AIM32**	**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:

22AIM32.1	Understand the different types of data structures and their implementations
22AIM32.2	Apply the knowledge of data structures to solve the real time problems.
22AIM32.3	Analyze the application-based real-time solutions using Linear and Non-linear Data structure
22AIM32.4	Design programs for solving real-world problems using appropriate data structures.
22AIM32.5	Implement the searching and sorting methods to enhance solution efficiency.
22AIM32.6	Present a case study on a real-world scenario to demonstrate problem-solving using data structures.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM32.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM32.2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM32.3	-	3	-	-	-	-	-	-	-	-	-	3	3	3
22AIM32.4	-	-	3	3	-	-	-	-	-	-	-	3	2	3
22AIM32.5	-	3	3	3		-	-	-	-	-	-	-	3	-
22AIM32.6	-	-	3	-	2	-	-	-	-	-	-	3	3	3

MODULE-1	**LINEAR DATA STRUCTURES-I**	22AIM32.1, 22AIM32.2, 22AIM32.3	**8 Hours**

Data structures: Introduction to pointers, Linear and non-linear data structures, ADT concept. Stacks: Stack Operation, Stack Applications: Infix to postfix conversion, Infix to prefix conversion, evaluation of postfix expression, recursion. Queue: Definition, Queue Representation, Circular Queues, Priority Queues.

Text Book	Textbook 3: Chapter: 1, 2, 3, 7, 8 Textbook 4: Chapter: 2, 3, 4

MODULE-2	**LINEAR DATA STRUCTURES-II**	22AIM32.1, 22AIM32.2, 22AIM32.3	**8 Hours**

Linked representation, singly linked lists: insertion (beginning, specific position, end), deletion (beginning, specific position, end), search operations, concatenating using linked list, doubly linked lists: insertion (beginning, specific position, end), deletion operations ((beginning, specific position, end), circular linked lists, application of linked List.

Applications	Linked list representation of real-world queues -Music player.
Text Book	Textbook 3: Chapter: 6 Textbook 4: Chapter: 4

MODULE-3	**NON-LINEAR DATA STRUCTURES-I**	22AIM32.1, 22AIM32.3, 22AIM32.4	**8 Hours**

Binary SearchTrees: Basics, querying a Binary search tree, Insertion and Deletion, Heap-Heap Operation, B-Trees: Definition of B -trees, Basic operations on B-Trees: Deleting a key from a B-Tree. Splay Trees: Bottom-Up Splay Tree, Top-Down Splay Trees.

Text Book	Text book 3: Chapter: 9, 12, 13 Text book 4: Chapter: 5

MODULE-4	**NON-LINEAR DATA STRUCTURES-II**	22AIM32.3, 22AIM32.4, 22AIM32.5, 22AIM32.6	**8 Hours**

Elementary Graph Algorithms: Representations of Graphs, Breadth-First Search, Depth-First Search. Graph coloring problems, Single-Source Shortest Paths:The Bellman-Ford algorithm, Single-Source Shortest paths in Directed Acyclic Graphs, Dijkstra's Algorithm.

Case Study	Bi-Connected Graph
Text Book	Text Book 1: Chapter: 13

	Text Book 3: Chapter: 13 Text Book 4: Chapter: 7, 8		
MODULE-5	**SEARCHING, SORTING, AND HASHING TECHNIQUES**	22AIM32.2, 22AIM32.3, 22AIM32.5 22AIM32.6	**8 Hours**
Searching: Linear Search, Binary Search, Ternary Search. Sorting: Bubble Sort, Selection sort, Insertion sort, Shell sort, Radix sort, Heap sort, Topological sort. Hashing: Hash functions, separate chaining, open Addressing, Rehashing. Introduction to NP.			
Case Study	Different types of Hash Functions.		
Text Book	Textbook 1: Chapter: 7, 9, 18, 19 Text Book 2 : Chapter: 3, 4, 7 Text Book 3 : Chapter: 14, 15		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	**Remember**	5	-	**5**
L2	**Understand**	5	-	**5**
L3	**Apply**	10	5	
L4	**Analyze**	5	10	-
L5	**Evaluate**	-	-	-
L6	**Create**	-	-	-

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) S.Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 1st Edition,2014. ISBN: 978-0198093695
2) Anany Levitin "Design & Analysis of Algorithms" 2nd edition, Pearson Education. ISBN: 978-0321358288
3) Reema Thareja "Data Structures using C", Oxford University Press, 2nd Edition,2014. ISBN: 978-0198099307
4) Aaron M.Tenenbaum, Yedidyah Langsam, Moshe J.Augenstein, "Data Structures Using C", Pearson 3rd Editon, 2020. ISBN: 9780130369970

Reference Books:

1) Adam Drozdex, "Data Structures and Algorithms in C++", Cengage Learning, 4th Edition, 2013. ISBN: 9781285415017
2) T. H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall ofIndia, 3rd Edition, 2012. IBN: 9780262033848
3) Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education,3rd Edition, 2009. ISBN: 9780321441461

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/106/106106131/
- https://nptel.ac.in/courses/106/105/106105171/
- http://www.nptelvideos.com/lecture.php?id=5949
- https://www.youtube.com/watch?v=5Y8Lfsreeck&list=PL7DC83C6B3312DF1E

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

- Undo/ Redo Stacks in Excel.
- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)

  Organizing Group discussions on real-world problems

  Seminars

DATA STRUCTURES AND ALGORITHMS LAB			
Course Code	**22AIL32**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22AIL32.1	Implement linear and non-linear data structures using a link list.
22AIL32.2	Design the solutions for computing problems using data structures stacks, queues, trees, graphs, and heaps.
22AIL32.3	Develop a solution for real time problem using various searching and Hashing techniques.
22AIL32.4	Employ an appropriate data structure and algorithm to address a real-world problem, demonstrating effective problem-solving skills.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIL32.1	2	3	-	-	2	-	-	-	-	-	-	-	-	-
22AIL32.2		3	3	-	2	-	-	-	-	-	-	-	2	3
22AIL32.3	-	3	3	-	2	-	-	-	-	-	-	-	2	-
22AIL32.4	-	-	-	3	2	-	-	-	-	-	-	3	2	3

Exp. No. /Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Basic data structures concepts/ program	2	NA
	PART-A		
1	Write a program that performs infix-to-postfix conversions, allowing users to easily input and process expressions.	2	22AIL32.1 22AIL32.2 22AIL32.4
2	Write a program to implement the doubly linked list deletion at the end.	2	22AIL32.1 22AIL32.4
3	Develop a Program for the following operations on the Binary Search Tree (BST) of integers. (i). Create a BST of N Integers (ii). Traverse the BST in Inorder, Preorder and Postorder	2	22AIL32.1 22AIL32.2 22AIL32.4
4	Develop a program to create a Max heap using a given set of integers.	2	22AIL32.1 22AIL32.4
5	Implement a program for the Activity Selection Problem using an optimal selection strategy.	2	22AIL32.1 22AIL32.4
6	Implement a program using a circular queue to manage print job requests in a printer job scheduling system. The program should be able to add new print jobs to the circular queue, process and print them, and handle the circular queue's operations efficiently.	2	22AIL32.1 22AIL32.2 22AIL32.4
	PART-B		
7	Implement a program that employs a singly linked list to manage music playlists within a music management system. The program should enable users to insert new songs at specific positions in the playlist, remove songs if desired, and facilitate navigation through the playlist in the forward direction.	2	22AIL32.1 22AIL32.4
8	In a university, students need to plan their course schedules based on prerequisites. Develop a program using Topological Sort that helps students determine the correct order to take their	2	22AIL32.4

	courses, ensuring all prerequisite courses are completed before enrolling in advanced ones.		
9	Implement a program using BFS to manage a social network where each user is a node, and friendships between users are edges. Find the shortest connection path between any two users in the network.	2	22AIL32.3 22AIL32.4
10	Develop a program for a city's public transportation system that helps commuters find the shortest travel time from a single bus stop to all other bus stops using Bellman-Ford.	2	22AIL32.2 22AIL32.3 22AIL32.4
11	Implement a hash function for an efficient data retrieval of a library's book database, with a focus on reducing search time for books via unique identifiers.	2	22AIL32.3 22AIL32.4
12	Design a data compression program using Huffman coding to minimize the storage space required for the given text by encoding characters based on their frequency of occurrence.	2	22AIL32.3 22AIL32.4

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

1. https://ds2-iiith.vlabs.ac.in/exp/min-spanning-trees/index.html
2. https://ds1-iiith.vlabs.ac.in/exp/poly-arithmetic/index.html
3. https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html
4. https://ds2-iiith.vlabs.ac.in/exp/red-black-tree/index.html
5. https://ds1-iiith.vlabs.ac.in/exp/heap-sort/index.html

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:
Reference Books:

1. Lipschutz Seymour, "Data Structures Schaum's Outlines Series", Tata McGraw Hill, 3rd edition, 2014. ISBN: 9781259029967, 1259029964
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
3. http://www.coursera.org/specializations/data-structures-algorithms

OBJECT ORIENTED PROGRAMMING WITH JAVA			
Course Code	**22AIM33**	**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:

22AIM33.1	Understand the basic concepts of object-oriented programming.
22AIM33.2	Apply the static and non-static concepts, overloading, inheritance, package and interface concepts in Java programming to develop application programs.
22AIM33.3	Analyze the concept of Multithreading in concurrent programming
22AIM33.4	Examine the flow of a program through appropriate exception handling techniques
22AIM33.5	Evaluate the input and output operations and different kinds of file I/O.
22AIM33.6	Design code using general collections, list interface, set interface and queue interface for a given scenario

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM33.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM33.2	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22AIM33.3	-	3	-	-	-	-	-	-	-	-	-	-	3	2
22AIM33.4	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22AIM33.5	-	3		-	-	-	-	-	-	-	-	2	3	2
22AIM33.6	-	-	3	-	-	-	-	-	-	-	-	2	3	2

MODULE-1	**INTRODUCTION TO OOPs AND JAVA**	22AIM33.1	**8 Hours**

Basics of Object-oriented programming, Key principles: Encapsulation, Inheritance, Polymorphism, and Abstraction. Basics of java language, Data types, Operators, Control structures including selection, Looping, Java methods, Math class, Arrays in java. Classes and objects. Instance variables and methods, Access modifiers (public, private, protected), Constructors and methods.

Project	Develop a simple calculator application using basic operators and control flow.
Case Study	Design and build a "Student" class with attributes and methods
Text Book	Text Book1: 1, 3, 4, 5, 6

MODULE-2	**ABSTRACTION AND POLYMORPHISM**	22AIM33.1,22AIM33.2	**8 Hours**

Static Variables and Methods, Method Overloading, Polymorphic behavior, Dynamic binding, Casting objects, Instance of operator. **Strings –** string class, StringBuffer, StringBuilder, StringTokenizer, StringJoiner.**Packages** – Introduction, Subpackages, Built-in packages, User-defined packages, Static import.

Text Book	Text Book2: 5, 6, 7,

MODULE-3	**INHERITANCE AND EXCEPTION HANDLING**	22AIM33.2	**8 Hours**

Inheritance: Inheritance, and its types, Super and subclass, overriding. Abstract classes, Interface. **Exception Handling -** Try-catch blocks, Exception types, checked vs. unchecked exceptions, User defined custom exceptions, throw and throws, chained exceptions

Case Study	Design and implement exception handling for potential errors in a program.
Text Book	Text Book1: 8, 13

MODULE-4	**OBJECT CLASS & MULTITHREADING**	22AIM33.3, 22AIM33.4	**8 Hours**

Arrays – Array of Objects, Nested Classes, Object class
Multithreading – Basics, Thread creation mechanism, Lifecycle and States, Thread Priority, Thread synchronization, Interthread Communications. Files I/O - Reading and Writing Files, Buffered streams.

Case Study	Generic Programming: Generic Classes and methods
Text Book	Text Book1: 11, 12, 14

MODULE-5	**COLLECTION FRAMEWORK & APPLET**	22AIM33.5,22AIM33.6	**8 Hours**

Collection framework Overview, Collection Interfaces, List, Set, Queue. Collection Classes: ArrayList, Linkedlist. Life Cyle of Applet, window programming and Swing Component.

Case Study	Create a simple Applet program using event handling function.
Text Book	Text Book1: Ch 17,18

CIE Assessment Pattern (50 Marks – Theory)

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

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

SEE Assessment Pattern (50Marks– Theory)

RBTLevels		ExMarks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	

Suggested Learning Resources:

Text Books:

1) Object Oriented Programming with Java by M.T. Somashekara, D.S. Guru, 2017 ISBN: 9788120352872
2) Interactive Object-Oriented Programming with Java, Second Edition, Vaskaran Sarcar. ISBN: 9781484225431

Reference Books:

1) Rogers Cedenhead and Leura, Lemay SAMS teach yourself Java–2,3rdEdition by Pub.Pearson Education,2004. ISBN: 9780672323706, 0672323702
2) KenKousen, Modern Java Recipes, O'ReillyMedia, Inc.,2017. ISBN: 9781491973141

Weblinks and Video Lectures(e-Resources):

- https://onlinecourses.nptel.ac.in/noc24_cs105/
- https://youtu.be/HcpfiA2P8So?si=XA5B2DBO7TwEMCtS
- **https://youtu.be/6aOp14kDEmw?si=VobmR-tsZ056jpFp**

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

- Video demonstration of advanced java concepts and projects
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Simple java projects
  - Seminars/presentations

OBJECT ORIENTED PROGRAMMING WITH JAVA LAB			
Course Code	**22AIL33**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs/Week	**3**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22AIL33.1	Apply OOP concepts with Java constructors, inheritance, Interfaces, packages to solve the given problem.
22AIL33.2	Analyse the output of the program using thread concepts in Java.
22AIL33.3	Design an application program for manipulating strings, text documents, and exception handling.
22AIL33.4	Implement the java program using Collection Framework and File I/O.

MappingofCourseOutcomestoProgramOutcomesandProgramSpecificOutcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIL33.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIL33.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
22AIL33.3	-	-	3	-	2	-	-	-	-	-	-	-	3	3
22AIL33.4	-	3	-	-	2	-	-	-	-	-	-	-	3	3

Pgm.No.	List of Experiments/Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Basic understanding of computer programming	**2**	**NA**
	PART-A		
1	Create a Java class named Employee with the following attributes: 1. name (String), id (int), department (String), salary (double) 2. Use constructor to initialize the Employee object 3. Create two Employee objects using the constructor 4. Print the details of each employee object in a clear format	**2**	22AIL33.1
2	Write a Java program to check the strength of a password based on specific criteria using String class.	2	22AIL33.1
3	Create a Java program to model a hierarchy of vehicles using inheritance. Apply various access controls, method overriding.	2	22AIL33.3
4	Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number	2	22AIL33.1
5	Write a program to read a given File and multiply by 2 if it contains numerical value	2	22AIL33.1
6	Write a program to implement Singleton Pattern	2	22AIL33.1
	PART-B		
7	Write a Java program to create a simple banking system where a user can check balance, deposit money, and withdraw money using class, constructor, constructor overloading concepts.	**2**	22AIL33.1
8	Design a Java program to compute area and perimeter for different shapes using abstract classes and interfaces.		

9	Write a Java program to manage bank account transactions using exception handling.	2	22AIL33.1
10	**Task 1: Creating Shared Resources:** Define two shared resources (objects) that the threads will contend for. Let's call them Resource A and Resource B. **Task 2: Implementing Threads:** Create two threads (Thread A and Thread B). Each thread will try to acquire locks on both Resource A and Resource B. **Main Program:** Start both threads. Observe threads executions and write outputs.	2	22AIL33.2
11	1. Write a program to demonstrate ArrayListClass, Linked List Class. 2. Create a Java program to manage books and users in a library using different packages.	2	22AIL33.2
12	Wrtie a program to demonstrate eventhandling.	2	22AIL33.4

PART-C
Beyond Syllabus Virtual Lab Content

1. Overloading Concepts:https://java-iitd.vlabs.ac.in/exp/method-overloading/procedure.html
   https://java-iitd.vlabs.ac.in/exp/method-overloading/simulation.html.
2. OOPs Concepts: https://java-iitd.vlabs.ac.in/exp/encapsulation/simulation.html
3. Threads Concepts: https://java-iitd.vlabs.ac.in/exp/life-cycle-thread/simulation.html
4. Exception-Handling Concepts: https://java-iitd.vlabs.ac.in/exp/exceptions/simulation.html

CIE Assessment Pattern (50 Marks–Lab)

RBTLevels		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)

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

Suggested Learning Resources:
ReferenceBooks:

1) HerbertSchildt, Java™: The Complete Reference, McGraw-Hill, Tenth Edition,2018. ISBN: 9781259589348
2) CayS.Horstmann, CoreJava®SE9for the Impatient, Addison Wesley, Second Edition,2017. ISBN: 9780134694849

LINUX PROGRAMMING			
Course Code	**22AIM341**	**CIE Marks**	**50**
L:T:P:S	**2:0:1:0**	**SEEMarks**	**50**
Hrs/Week	**2+2**	**TotalMarks**	**100**
Credits	**03**	**ExamHours**	**03**

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

22AIM341.1	Understand the concept, feature, architecture and general-purpose commands of Linux OS
22AIM341.2	Demonstrate the various file and directory related commands.
22AIM341.3	Analyse various kinds of filter commands and regular expressions that can be used for quick retrieval of data from the file.
22AIM341.4	Apply the file commands to extract data from files.
22AIM341.5	Examine the process creation mechanism and kernel support for the process.
22AIM341.6	Develop shell scripts for given scenario.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM341.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM341.2	3	-		-	-	-	-	-	-	-	-	-	-	3
22AIM341.3		3		-	-	-	-	-	-	-	-	-	-	3
22AIM341.4	3	-	-	-	-	-	-	-	-	-	-	-	-	3
22AIM341.5	-	3	-			-	-	-	-	-	-	-	-	3
22AIM341.6		-	3	-	3	-	-	-	-	-	-	-	-	3

MODULE-1	LINUX OS AND GENERAL-PURPOSE UTILITIES COMMANDS	22AIM341.1	6 Hours

LINUX Operating System: Introduction, LINUX architecture, Features of LINUX operating system **General Purpose Utilities**: passwd, who, tty, lock, stty, script, clear and tput with options, uname with options, date with options, cal, calendar, bc, man, echo, script, passwd, historyandalias

LaboratoryComponent: 3 Hours

1. Execute the following commands with options(ifany)
   Date with all options, cal, calender, who, whoami, tty, stty, clear and tput
2. Execute the following commands with options (ifany) Man, echo, whatis,
   Unamewith alloptions
3. Execute the following commands, bc with scale factor, using bc convert from one base to another
   Base (eg. Binary to decimal, decimal to octal, decimal to hexa etc), password, history, alias and script

Self-study	Procedure to Install ubuntu on windows system
Text Book1	Text Book1:1.1,1.2,1.10,1.11,2,1to 2.15

MODULE-2	FILE SYSTEM AND FILE HANDLING COMMANDS	22AIM341.2,22AIM341.4	6 Hours

File System and Attributes: Introduction to LINUX filesystem, inode, FileTypes, FileAttributes, Application program Interface to Files, LINUX kernel support for files

File Handling Commands:ls, cat, cp, mv, rm, wc, od, printf, pwd, mkdir, rmdir, cd, file and directory permissions-chmod, file ownership-chown, chgrp, umask, tar, gzip, du, df, find, file modification and access times and touch command

Laboratory Component: 3 Hours

1. Execute ls command and display all the attribute of the file with all options, display the content of the file, copy and move the file from one place to another, remove the file

2. Execute the following directory related commands. (i)create the directory, change the directory, print the current directory, display the disk space usage, compress the contentof the file and archive the file Identify the commands used to change the permission of the user, group and others using symbolic octal, absolute formats, create the file using touch command, modify the access time and modification time, change the default permission of the fileor directory using umask			
Text Book	Text Book1:3.1 to 3.25,4.1 to 4.11 Text Book2:6.1 to 6.9		
MODULE-3	**SIMPLE FILTER AND REGULAR EXPRESSIONS**	22AIM341.3, 22AIM341.4	6 Hours
Simple filters and Regular Expressions: more, wc with options, od with options, pr, cmp, diff, comm, head, tail, cut, paste, sort, tr, uniq, nl, grep–searching for a pattern, grep options, regular expressions, egrep and fgrep			
LaboratoryComponent: 1. Create a student database of 10 records with five fields and use the following commands on the database to display the records accordingly (i) Head, tail, cut, paste, sort, uniq, tee, nl and tr with allpossible options 2. Create the student/employee database with 5 fields and apply the grep command with all options to display the pattern or records using regular expressions Create the 3 different sorted files with some duplicate records and apply cmp. Diff and comm commands to compare the file contents, count the words, characters and lines using wc command			3 Hours
Text Book1	TextBook1: 9.1, 9.13, 10.1 to 10.5		
MODULE-4	**PROCESS**	22AIM341.5	6 Hours
Process: Process, LINUX kernel support for processes, process attributes, process table, viewing processes – ps, system processes, starting new processes, waiting for a process, killing a process, zombie processes, orphan process, running jobs in background, nohup, job execution with low priority-nice, schedule execution of one or more command at specified time-at and batch, run jobs periodically-cron introduction to fork, vfork, exit, wait, waitpid, exec and sleep system calls			
LaboratoryComponent: 1. Display the user process and system processes and kill the process using process ids 2. Identify and use the command to execute the jobs in foreground and background at the same time Execute the following commands nice, nohup, at, batch and cron			3 Hours
Self-study	1.Usage of fork, vfork, wait and ait pid 2. Create zombie process		
Text Book	Text Book1:7.1 to7.13 Text Book2:8.1		
MODULE-5	**SHELL PROGRAMMING**	22AIM341.6	6 Hours
Shell Programming: Shellvariables, shellscripts, read, positional parameters, exitstatus, logical operators, exit, if conditional, test and [], case, expr, sleepand wait, while, until and for, base name			
LaboratoryComponent: 1. Write a shell script that takes pattern and file name as input from the user to search a string in the file 2. Write a shell script which will accept a filename, starting linenumber, ending line numbers from the user and displays those lines fromthe givenfile. 3. Write a shell script which displays a list of all the files in the current directory to which you have read, write and execute permissions 4. Write a shell script which gets executed the moment the user logs in. It should display the message, " Good Morning", "Good Afternoon","Good Evening", depending upon the time at which the user logs in.			3 Hours
Text Book1	Text Book1:13.1to 13.13		

CIE Assessment Pattern (50 Marks–Theory and Lab)

RBTLevels		Test(s) (25)	Assessment(s)* (5)	Lab (20)
L1	**Remember**	**5**	**-**	
L2	**Understand**	5	**5**	**5**
L3	**Apply**	5	**-**	**10**
L4	**Analyze**	5	-	5
L5	**Evaluate**	5	-	-
L6	**Create**	-	-	-

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

SEE Assessment Pattern (50Marks– Theory)

RBTLevels		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) Your UNIX/Linux The UltimateGuide Third Edition by sumitabha das Published byMcGraw-Hill, ISBN978-0-07-337620-2(alk. paper), ISBN-10: 0-07-337620-5 (alk. paper)
2) UNIX System Programming Using C++, Terrence Chan, Prentice-Hall of India Private Limited, ISBN 0-13-331562-2

ReferenceBooks:

1) UNIX–Concepts&Applications, SUMITABHA DAS, TATAMcGraw Hill Edition, Fourth edition,26th reprint 2015, McGraw Hill. ISBN: 9780070611085
2) Advanced Programming in the UNIX Environment, WRichard Stevens and Stephen A Rago, Addison Wesley Publications, Third Edition. ISBN: 9780321638007
3) UNIX and SHELL Programming, Richard F Gilberg and Behrouz A Forouzan,15th impression, 2015, Cengage Learning ISBN: 9780534951597.

Web links and Video Lectures(e-Resources):

- Linux Full Course In 5 Hours |Linux Tutorial For Beginners|Linux Training |Edureka-YouTube
- https://www.udemy.com/course/learn-linux-in-5-days/
- LinuxOperatingSystem -CrashCourseforBeginners-YouTube
- The Complete Linux Course: Beginner to Power User- YouTube
- https://nptel.ac.in/courses/117106113/

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

- Playing videos related to course content (Activity-based discussions)
- Team based learning
- Topics will be given to the student teams and each team should give demo or ppt presentation based on the activity

PERL PROGRAMMING			
Course Code	**22AIM342**	**CIE Marks**	**50**
L:T:P:S	**2:0:1:0**	**SEEMarks**	**50**
Hrs/Week	**2+2**	**TotalMarks**	**100**
Credits	**03**	**ExamHours**	**03**

Course out comes: At the end of the course, the student will be ableto:

22AIM342.1	Understand the basic concepts of perl programming.
22AIM342.2	Apply the Concept of Loops and control statements in Subroutine
22AIM342.3	Analyze the working of List and Debug Output.
22AIM342.4	Examine the operation of Sort and File I/O.
22AIM342.5	Design a class involving data members and methods for the given scenario.
22AIM342.6	Implement the Inheritence for real-word problems

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM342.1	**2**	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM342.2	**3**	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM342.3	3	**3**	-	-	-	-	-	-	-	-	-	-	3	3
22AIM342.4	3	3	-	-	2	-	-	-	-	-	-	2	3	3
22AIM342.5	3	3	**3**	-	**2**	-	-	-	-	-	-	2	3	3
22AIM342.6	3	3	**3**	-	**2**	-	-	-	-	-	-	2	3	3

MODULE-1	**Introduction to Perl: Basics**	22AIM342.1	6 Hours

Introduction-Single line comments-multi-line comments-variable: Scalars-Array References-Scalar References-Arrays-Type globs-type globrefs-file handles and constants-Sigils-Hash References-Hashes-
Operators-DataTypes

LaboratoryComponent: 3 Hours

1. Write a simple program to find circle circumstance using scalars variables.
2. Write a program for converts between numbers and string on the fly.
3. Write a program to print array of elements.
4. Write a program using Type globs and type glob.
5. Write a program using sigils.
6. Write a program using Hashes

Text Book	Text Book1:Ch1,2,3

MODULE-2	**Loops and control statements**	22AIM342.2	6 Hours

Conditionals–Loops-Subroutines: Creating sub-routines-Sub-routine arguments are passed by reference.

LaboratoryComponent: 3 Hours

1. Write a simple program using conditional statement to precedeor succeed the code to be executed.
2. Write a program to print sum of integers using for loop statement.
3. Write a program using do-until statements for check the number is prime or not.
4. Write a program for swap two numbers using subroutine.

Text Book	Text Book1:Ch7,8

MODULE-3	**List and Debug Output**	22AIM342.3	3 Hours

Debug Output: Dumping with style-Dumping data-structures-Data: show-Dumping arraylist-Lists-Array as list-Assigning a list to a hash-Lists can be passed into subroutines-Return list from subroutine-Hash as list-using array refto pass array to sub

LaboratoryComponent: *1.* Write a program to display the output in specified format using Data: Show method. *2.* Write a program to display arraylis tvalue using Dumper. *3.* Write a program to pass list to subroutine. Write a program to getlist elements from subroutine			3 Hours
Self-study/	Command line arguments		
Text Book	Text Book1; Ch 9,10		
MODULE-4	**Sort and FileI/O**	22AIM342.4	6 Hours
The Basic Lexical Sort-The SchwartzanTransform-CaseInsensitiveSort-NumericSort-Opening a file handle for reading-Reading from a file-Write to a file-Use auto die–Rewind a file handle-Reading and writing Gzip compressed files.			
LaboratoryComponent: *1.* Write a program to sort elements using Lexical sort. *2.* Write a program to write content into a file using a utidie function. *3.* Write a program to read and write from/to compressed file. Write a program using perltore wind a file handle method			3 Hours
Self-study/	System Programming.		
Text Book	Text Book1:Ch11 and12		
MODULE-5	**Object Oriented Perl**	22AIM342.5,22AIM342.6	6 Hours
Defining class edin modern perl-Creating Objects-Defining Classes-Inheritance and methods resolution-Class and Object methods.			
LaboratoryComponent: *1.* Create a class and object using perl *2.* Implement inheritance concept using perl *3.* Write a program for methods resolution using perl.			3 Hours
Self-study	Perl Symbol Table.		
Text Book	Text Book1:Ch16.		

CIE Assessment Pattern (50Marks–Theory and Lab)

RBTLevels		Test(s) 25 marks	Assessment(s)* (5 marks)	Lab (20 marks)
L1	**Remember**	**5**	**-**	
L2	**Understand**	5	**-**	**5**
L3	**Apply**	5	**5**	**10**
L4	**Analyze**	5	**-**	**5**
L5	**Evaluate**	5	**-**	
L6	**Create**	-	**-**	

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

SEE Assessment Pattern (50Marks– Theory)

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

Suggested Learning Resources:

TextBooks:

1) Perl Notes for Professionals from Stack Overflow Documentation-Online
2) Learning Perl: Making Easy Easy Things Easy and Hard Things Possible, 7th Edition by Randal Schwatz, Brain Foy, Tom Phoenix, O'REILLY,2016. ISBN: 9781491954270,

Web links and Video Lectures(e-Resources):

- https://digimat.in/nptel/courses/video/117106113/L20.html
- https://nptel.ac.in/courses/117106113

Activity-Based Learning (SuggestedActivitiesinClass)/Practical Based learning

- Video demonstration of latest version and updates related videos
- Contents related activities (Activity-baseddiscussions)
  - For active participation of students, instruct the students to prepare Handouts/Questions.
  - Organizing Groupwise discussions.
  - Seminars

PROGRAMMING FOR IOT			
CourseCode	**22AIM343**	**CIEMarks**	**50**
L:T:P:S	**2:0:1:0**	**SEE Marks**	**50**
Hrs/ Week	**2+2**	**TotalMarks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM343.1	Understand the concepts of IoT along with its applications.
22AIM343.2	Apply a prototype using Arduino Uno to interface with different devices.
22AIM343.3	Identify different types of sensors, actuators to interface using Arduino Uno
22AIM343.4	Analyze the different communication Protocols to interface Arduino Uno/Raspberrypi.
22AIM343.5	Develop a prototype involving Raspberry Pi to connect with various devices.
22AIM343.6	Design an IoT application to interact with Django.

Mapping o fCourse Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM343.1	2	-	-	-	-	-	-	-	-	-	-	-	2	2
22AIM343.2	3	-	-	-	2	-	-	-	-	-	-	-	2	3
22AIM343.3	3	3	-	-	2	-	-	-	-	-	-	-	2	3
22AIM343.4	3	3	-		2	-	-	-	-	-	-	-	2	3
22AIM343.5	3	3	3	3	3	-	-	-	-	-	-	-	2	3
22AIM343.6	3	3	3	3	3	-	-	-	-	-	-	-	2	3

MODULE-1	**INTRODUCTION TO IoT**	22AIM343.1	**6 Hours**

Microprocessor, Microcontroller, EmbeddedSystem, Definition of IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, IoT Enabling Technologies, IoT levels &Deployment Templates, IoT Applications.

LaboratoryComponent:(minimum3experiments/programs)	3 Hours
1) Install IDE of Arduino and write a program using Arduino IDE to blink LED. 2) Interface LED and buzzerwith Arduinotobuzz for a period of time. 3).Interface RGB LED with Aurdino to obtain different colours and brightness using PWM.	

TextBook	Text Book 1- Ch-2,3; Text Book 3- Ch- 1,2,3

MODULE-2	**IOT WITH ARDUINO**	22AIM343.2	6 Hours

Introduction to the Arduino, creating an Arduino programming Environment, Using the Arduino IDE, Creating an Arduino program, Using Libraries, Working with Digital Interfaces, Interfacing with Analog devices, Adding Interrupts, communicating with devices, using sensors, Working with Motors, Using an LCD.

LaboratoryComponent:	3 Hours
1) a) Control a servo motor using Arduino with an input given through a push button (e.g: When the pushbuttonis pressedthe servo motorhasto rotate by15 degrees). b) Rotate Stepper motor either clockwise or anticlockwise at 'n' number of steps using Arduino. 2) Write a program to read the data from the RFID tag and display the information on the display board using Arduino and control LED (e.g: if it is a valid card then the LED should be ON otherwise OFF). Control any two actuators connected to the Arduino using Bluetooth/Wifi	

Text Book	Text Book 2-Ch-1,2

MODULE-3	**IOT SENSORS AND ACTUATORS**	22AIM343.3, 22AIM343.4	6 Hours

Introduction, Sensor, Types of Sensors, Actuators, classification of Actuators.
Technologies used in IoT: Bluetooth, Bluetooth Low Energy (BLE), WiFi, LiFi, Cellular Networks, Z-Wave, X-10, Sigfox, ZigBee, LoRaWAN, 6LowPAN, 5-G, LPWAN, RFID and NFC, WSN, Communication Protocols: CoAP, MQTT, XMPP, DDS, AMQP, REST, HTTP.

Laboratory Component:	3 Hours
1) Interface analog/digital sensors with Arduino and analyse the corresponding readings. (Sensors like temperature, alcohol, humidity, pressure, gas, sound pollution, level, weight, flow, proximity, LDR, PIR, pulse, vibration, sound) 2) Demonstration of setup & working of RaspberryPi. (Students have to prepare the report for the same). Interface RGB LED with Raspberry Pi to obtain different colours and brightness using PWM.	

Text Book	Text Book 3-Ch -5,6		
MODULE-4	**IoT WITH RASPBERRY PI**	22AIM343.5	6 Hours

PHYSICAL DEVICES&END POINTS: RaspberryPi, About the Board, Linux on RaspberryPi, RaspberryPi Interfaces, Programming RaspberryPi with Python, Controlling LED with RaspberryPi, interfacing a LED and Switch with RaspberryPi, Interfacing a Light Sensor.

LaboratoryComponent:	3 Hours
1) a) Interface an ultrasonic sensor with Raspberry pi to print distance readings on the monitor when the sensor changes its position. b) Reading the data from an analog sensor with Raspberry using Arduino serial portorADCMCP3208 usingSPI. 2) Post/read the data to/from the cloud viaMQTT broker with a RaspberryPi. Send real-time sensor datato a smart phone using RaspberryPi on board Bluetooth	

Text Book	Text Book 1-Ch 4,5		
MODULE-5	**ASSOCIATED IOT TECHNOLOGIES**	22AIM343.6	6 Hours

Python Packages for IoT, WAMP-Auto BahnforIoT, Python Web Application Frame work–Django, Amazon Web Services for IoT, SkyNet IoT messaging platform.

LaboratoryComponent:	3 Hours
1) Interface Pi camera module using Raspberry Pi toper form operations of PiCamera-API or Open CV library. 2) Implement an intruder alert system that alerts through email Implement remote monitoring of smoke alarm systems using Raspberry Pi.	

Text Book	Text Book 1-Ch-3,4

CIE Assessment Pattern (50 Marks– Theory and Lab)

RBTLevels		Test(s) 25 marks	Assessment(s)* (5 marks)	Lab (20 marks)
L1	**Remember**	**5**	**-**	
L2	**Understand**	5	**-**	**5**
L3	**Apply**	5	**5**	**10**
L4	**Analyze**	5	**-**	**5**
L5	**Evaluate**	5	**-**	
L6	**Create**	-	**-**	

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

SEE Assessment Pattern(50Marks–Theory)

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

Suggested Learning Resources:

TextBooks:

1) VijayMadisetti and Arshdeep Bahga, Internet of Things (AHands-on-Approach), 1st Edition, VPT, 2016. ISBN: 978-8173719547
2) Richard Blum, Arduino Programming in 24 Hours, SamsTeach Yourself, Pearson Education, 2017. ISBN:

978-0672337123

3) Jain, Prof.Satish, Singh, Shashi, Internet of Things and itsApplications, 1st Edition, BPB, 2020. ISBN: 978-9389845761

ReferenceBooks:

1) Donald Norris, Internet of things_do-it-yourself projects with Arduino, RaspberryPi, and BeagleBoneBlack, 1st Edition, McGraw-Hill, 2015. ISBN: 9780071835206
2) Adeal Javed Lake Zurich, Illinois, Building Arduino Projects for the Internet: Experiments with Real-WorldApplications, 1st Edition, USA, A press, 2016.ISBN: 9781484219393.
3) Yashavant Kanetkar, Shrirang Korde, 21 IOT Experiments, 1st Edition, BPB Publications, 2018. ISBN: 9789387284814,
4) Dr. Rajesh Singh, Dr. Anita Gehlot, Dr. Lovi Raj Gupta, Navjot Rathour, Mahendra Swain, Bhupendra Singh, IoT based Projects Realization with RaspberryPi, Node MCU and Arduino, 1st Edition,BPB Publications, 2020. ISBN: 9789389328523, 9389328527

Web links and Video Lectures(e-Resources):

- https://www.arduino.cc/reference/en
- https://create.arduino.cc/projecthub
- https://maker.pro/raspberry-pi/tutorial
- https://projects.raspberrypi.org/en/projects
- https://www.digikey.com/en/maker/blogs/2019/how-to-use-mqtt-with-the-raspberry-pi

Activity-Based Learning (SuggestedActivitiesinClass)/Practical Based learning

- Contents related activities (Activity-baseddiscussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Groupwise discussions on issues
  - Seminars

JAVA SCRIPT PROGRAMMING			
Course Code	**22AIM344**	**CIE Marks**	**50**
L: T:P:S	**2:0:1:0**	**SEEMarks**	**50**
Hrs/Week	**2+2**	**TotalMarks**	**100**
Credits	**03**	**ExamHours**	**03**

Course out comes: At the end of the course, the student willbe ableto:

22AIM344.1	Understand the context and rationale for using HTML versus XHTML
22AIM344.2	Apply the concepts of HTML, XHTML to construct the web pages
22AIM344.3	Examine various attributes, values and types of CSS
22AIM344.4	Analyse event handling mechanisms of Java Script.
22AIM344.5	Evaluate the dynamic documents using Java Script.
22AIM344.6	Design a responsive, and visually appealing websites using advanced CSS techniques

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM344.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM344.2	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22AIM344.3	3	3	-	-	-	-	-	-		-	-		3	2
22AIM344.4	3	3	-	2	-	-	-	-	-	-	-	-	3	2
22AIM344.5	3	3	-	2	-	-	-	-	-	-	-	-	3	2
22AIM344.6	3	3	3	3	3	-	-	-	-	-	-	3	3	2

MODULE-1	**Introduction to HTML**	22AIM344.1	6 Hours

HTML and XHTML: Origins of HTML and XHTML, Basic syntax, Standard XHTML document structure, Basictext markup, Images, Hypertext Links, Lists, Tables. Forms, Syntactic differences between HTML and XHTML. CSS: Introduction, Levels of style sheets, Style specification formats, Selector forms,Property value forms, Font properties, List properties, Color, Alignment of text, Background images, tags.

LaboratoryComponent:(minimum3experiments/programs)	3 Hours
1.Design simple calculator using HTML and CSS 2.Design a registration form using Html and CSS. Include Image in the form. 3. Illustrate 3 levels of CSS style sheets.	

Text Book	Text Book2:Ch-2.1 to2.10,3.1 to 3.12

MODULE-2	**Introduction to Java Script:**	22AIM344.2	6 Hours

History of JavaScript, Js Introduction, Hello World Web Page, Buttons, Functions, Variables, Identifiers, Assignment Statements form Element, Controls, Text Control, accessing a Form's Control Values, reset and focus Methods, Event-Handler Attributes.

LaboratoryComponent:(minimum 3 experiments/programs)

1. Write a JavaScript Program to Print Hello World.
2. Write a javascript program to change html content dynamically
3. Write a JavaScript Program to Find the Factorial of a Number.
4. Write a JavaScript code that displays text "TEXT-GROWING" with increasing font size in the interval of 1000ms in RED COLOR, when the font size reaches 50pt it displays "TEXT-SHRINKING" in BLUE color. Then the font size decreases to 5pt.

Text Book	TextBook 1: Ch- 8.1 to 8.18

MODULE-3	**Java Script Essentials**	22AIM344.3	6 Hours

Window Object, alert and confirm Methods, prompt Method, Strings, Arithmetic operators, Math Object Method,Parsing Numbers, Constraint Validation for Form Controls.

LaboratoryComponent:	3 Hours
1) Write a POPUP Message Program Using Event. 2) Display Alert for Prompt Message Program. Check whether a string contains a substring	

Text Book	Text Book 1: Ch- 9.2 to 9.16

MODULE-4	**The Basics of Java Script**	22AIM344.4	6 Hours

Control statements, Object creation and Modification; Arrays; Array methods, Array sort, JS date formats. Functions; Errors, Element access in Java Script.

Laboratory Component:

1. Program to convert an array to string.
2. Program to illustrate JavaScript date objects.
3. Write a program to remove the last element from an array.

Text Book	Text Book 2: Ch-4.6 to 4.14		
MODULE-5	**Loops, Additional Controls, Manipulating CSS with JavaScript**	22AIM344.5,22AIM344.6	6 Hours

While Loop, External JavaScript Files, Radio Buttons, Checkboxes, Manipulating CSS with JavaScript, Text area Controls, Pull-Down Menus, List Boxes.

LaboratoryComponent: 3 Hours

1) Implement a web design that uses buttons and text area controls.
2) Creating a simple and easy dropdown list without using JavaScript code and CSS stylesheet.
   Javascript to display the square and cube of n numbers in a table.

Text Book	Text Book 1:Ch-10.2 to 10.16

CIE Assessment Pattern (50Marks– Theory and Lab)

RBTLevels		Test(s) (25) marks	Assessment(s) * (5) marks	Lab 20 marks
L1	**Remember**	5	**-**	
L2	**Understand**	5	**-**	**5**
L3	**Apply**	5	5	10
L4	**Analyze**	5	-	5
L5	**Evaluate**	5	-	
L6	**Create**	**-**	**-**	

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

SEE Assessment Pattern (50Marks–Theory)

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

TextBooks:

1) WEB PROGRAMMING with HTML5, CSS and JavaScript by JohnDean, Jones&Bartlett Learning, FirstEdition.2018. ISBN: 9781284091793, 1284091791
2) Robert W Sebesta, "Programming the World Wide Web",6th Edition, Pearson Education,2011 ISBN: 9780132130813, 0132130815.

ReferenceBooks:

1) M. Deitel, P.J.Deitel,A.B.Goldberg,"Internet & World Wide Web How to program" ,3rd Edition, Pearson Education/PHI, 2004. ISBN: 9788131762837.
2) Chris Bates,"Web Programming Building Internet Applications",3rd Edition, Wiley India,2006. ISBN: 9788126512904
3) XueBai et al,"The Web Warrior Guide to Web Programming",Thomson,2003. ISBN: 9780619064587
4) Sklar,"The Web Warrior Guide to Web Design Technologies",1st Edition, Cengage Learning India,2003. ISBN: 9780619064600

Weblinks and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=DR9dr6gxhDM2).
- HTMLand XHTML: https://www.youtube.com/watch?v=A1XlIDDXgwg
- CSS:https://www.youtube.com/watch?v=J35jug1uHzE
- Java Script and HTML Documents: https://www.youtube.com/watch?v=Gd0RBdFRvF0
- DynamicDocumentswithJavaScript:https://www.youtube.com/watch?v=HTFSIJALNKc

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

- Develop simple GUI interfaces for a computer program to interact with users
- Contents related activities (Activity-baseddiscussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Groupwise discussions on issues.
  - Seminars

AI for Robotics			
Course Code	**22AIM345**	**CIE Marks**	**50**
L:T:P:S	**2:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2+2**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM345.1	Understand the fundamental concepts, historical evolution of AI in Robotics, key AI algorithms and techniques used in robotic systems
22AIM345.2	Apply various sensor technologies, computer vision and image processing techniques, and sensor fusion methods for robust perception in robotic systems.
22AIM345.3	Evaluate path planning, motion control algorithms, navigation strategies and the ethical implications for robots operating.
22AIM345.4	Design a machine learning and reinforcement learning algorithms to enable learning, adaptation, and decision-making and human-robot interaction in robots.
22AIM345.5	Develop a system using Navigation methods
22AIM345.6	Implement the ethical implications of deploying AI-driven robots in society by considering issues related to privacy, safety, and societal impact.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM345.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22AIM345.2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
22AIM345.3	-	-	3	-	-	-	-	-	-	-	-	2	2	3
22AIM345.4	3	-		-	-	-	-	-	-	-	-	2	2	3
22AIM345.5	-	-	3	-	-	-	-	-	-	-	-	2	2	3
22AIM345.6	-	-	3	-	3	-	-	-	-	-	-	2		3

MODULE-1	**Foundations of AI in Robotics**	22AIM345.1	6 Hours

Introduction to AI and Robotics-History and Evolution of AI in Robotics-Basic Concepts of Robotics-AI Algorithms and Techniques for Robotics.

Laboratory Component: 3 Hours

1. Obstacle Avoidance with a Simple Robot.

Objective: Implement a basic obstacle avoidance algorithm using AI techniques.

Experiment: Use sensors (e.g., ultrasonic sensors) to detect obstacles and program a robot to navigate around them using a simple AI algorithm (e.g., basic path planning or reactive control).

Text Book	Text Book 2: ch:1-5

MODULE-2	**Perception and Sensing in Robotics**	22AIM345.2,22AIM345.3	6 Hours

Sensor Technologies and Integration-Computer Vision and Image Processing-Lidar and Radar Systems-Sensor Fusion Techniques-Object Detection and Recognition.

Laboratory Component: 3 Hours

1. Line Following Robot.

Objective: Develop a robot that can follow a line using AI algorithms.

Experiment: Use sensors (e.g., infrared sensors) to detect a line on the ground and program a robot to

follow the line using a control algorithm (e.g., PID control or finite state machine).

2. Object Recognition and Manipulation.

Objective: Implement AI algorithms for object recognition and manipulation by a robot.

Experiment: Use a camera or depth sensor to detect objects, implement a computer vision algorithm .			
Text Book	Textbook 1: ch:1-6		
MODULE-3	**Robot Learning and Adaptation**	22AIM345.4, 22AIM345.5	6 Hours
Machine Learning for Robotics-Reinforcement Learning in Robotics-Autonomous Learning and Adaptation-Imitation Learning and Behavior Cloning.			
Laboratory Component: 1. **Machine Learning for Robotics: Line Following Robot** a. **Objective:** Train a robot to follow a line using Machine Learning techniques. b. **Experiment:** Use a simulated or physical robot with line sensors. Collect data of the robot following a line under different conditions (e.g., varying line thickness, curves). Train a Machine Learning model (e.g., Neural Network or Support Vector Machine) to predict motor commands based on sensor inputs to follow the line. Test the trained model on new tracks to see how well it can follow the line. 2. **Reinforcement Learning in Robotics: Robot Arm Manipulation** a. **Objective:** Teach a robot arm to reach a target using Reinforcement Learning. **Experiment:** Use a robot arm (physical or simulated) with a camera and depth sensor. Define a reward function that rewards the robot for getting closer to the target. Implement a Reinforcement Learning algorithm (e.g., Q-Learning or Deep Q Networks) to learn the optimal actions (joint angles) to reach the target. Train the robot arm using this algorithm and observe its behavior as it learns to reach the target.			3 Hours
Self-study/Case Study/ Applications	Case Studies of Learning Robots		
Text Book	Textbook 2: ch:7,8		
MODULE-4	**Planning and Navigation**	22AIM345.5	6 Hours
Path Planning Algorithms-Motion Planning and Control-Simultaneous Localization and Mapping (SLAM)-Navigation in Dynamic Environments-Multi-Robot Coordination and Path Planning.			
Laboratory Component: **1. Path Planning Algorithms: Maze Solving Robot** **Objective:** Implement a robot that can navigate through a maze using Path Planning algorithms. **Experiment:** Use a simulated or physical robot with distance sensors. Create a maze with walls and open spaces. Implement a Path Planning algorithm (e.g., Breadth-First Search or A* algorithm) to find the shortest path from the start to the end of the maze. Program the robot to follow this path, avoiding obstacles using the sensor data. **2. Navigation in Dynamic Environments: Dynamic Obstacle Avoidance** **Objective:** Develop a robot that can navigate in an environment with moving obstacles. **Experiment:** Use a robot with sensors to detect both static and dynamic obstacles. Create a scenario where obstacles move randomly within the environment. Implement a navigation algorithm that can dynamically plan a path around these moving obstacles in real-time. Test the robot in this environment to see how well it can navigate while avoiding collisions with the moving obstacles.			3 Hours
Text Book	Textbook 1: Ch-11,12		
MODULE-5	**Human-Robot Interaction and Ethics**	22AIM345.6	6 Hours
Principles of Human-Robot Interaction--Designing User-Friendly Interfaces-Social Robotics and Interaction Models-Ethical Considerations in AI and Robotics-Future Trends and Challenges in AI for Robotics.			

Laboratory Component: **1. Principles of Human-Robot Interaction: Robot-Assisted Therapy** • **Task:** Design a robot-assisted therapy session for patients with limited mobility or social interaction. • **Description:** Develop a robot that can assist patients in performing physical or cognitive exercises. Design the interaction between the robot and the patient to be engaging, encouraging, and supportive. Implement sensors and algorithms that allow the robot to adapt its behavior based on the patient's responses and progress. **2. Ethical Considerations in AI and Robotics: Designing an Ethical Robot** • **Task:** Develop a set of ethical guidelines for a robot designed for home assistance. • **Description:** Consider ethical issues such as privacy, autonomy, and safety when designing the robot. Create guidelines that govern the robot's behavior in various situations, such as handling personal information, respecting user preferences, and ensuring the safety of both the user and others in the environment. Implement these guidelines into the robot's programming and behavior.	3 Hours
Text Book	**Textbook 1:ch 2,3,4**

CIE Assessment Pattern (50 Marks – Theory and Lab)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment	Lab
		25	05	20
L1	Remember		-	-
L2	Understand	5	-	-
L3	Apply	10	5	10
L4	Analyze	10	-	10
L5	Evaluate			-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. "Robotics: Modelling, Planning and Control" by Bruno Siciliano, 2009. ISBN: 9781846286414, 1846286417.
2. "Principles of Robot Motion: Theory, Algorithms, and Implementations" by Howie Choset, 2005. ISBN: 9780262033275, 0262033275

Reference Books:

1. "Human-Robot Interaction: A Survey" by Bilge Mutlu, 2007. ISBN: 9781601980922
2. "Robot Ethics: The Ethical and Social Implications of Robotics" by Patrick Lin ,2012. ISBN: 978-0262016667

Web links and Video Lectures (e-Resources):

- https://www.bing.com/videos/riverview/relatedvideo?q=Ai+for+robotics+video+link&mid=DEBFDAF89C4C784D2BCFDEBFDAF89C4C784D2BCF&FORM=VIRE

- https://www.bing.com/videos/riverview/relatedvideo?&q=motion+robotics+making+video&&mid=AF51911F7619496982E3AF51911F7619496982E3&&FORM=VRDGAR
- https://www.bing.com/videos/riverview/relatedvideo?&q=7.%09Path+Planning+Algorithms%3a+Maze+Solving+Robot+video&&mid=CB89ECB5BBDDFC875C63CB89ECB5BBDDFC875C63&&FORM

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

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

PROBLEM SOLVING USING PROLOG			
Course Code	**22AIM351**	**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:

22AIM351.1	Apply the basic concept of PROLOG programming language.
22AIM351.2	Design an expert system using recursion in PROLOG
22AIM351.3	Examine the use of appropriate operators for problem solving.
22AIM351.4	Develop an application program using the control structures to manipulate list data structure and File handling in PROLOG programming

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM351.1	3		-	-		-	-	-			-	-	3	3
22AIM351.2	3		-	-		-	-	-			-	-	3	3
22AIM351.3	3	3	-	-		-	-	-			-	-	3	3
22AIM351.4	3	3	3	2	3	-	-	-			-	-	3	3

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Basics of Expert system and C Programming	**2**	**NA**
	PART-A		
1	Develop a program to print "Hello world. Welcome to Prolog Programming" in two different line using PROLOG functional Programming concepts. **Note:** Discuss the Logic and functional programming conecpts.	**2**	22AIM351.1, 22AIM351.2, 22AIM351.3, 22AIM351.4
2	a. Create a sample knowledge base and execute queries for it. b. Write a program to illustrate Family Relations in Prolog. **Note:** Discuss the Knowledge base, Relations-Family Relations concepts	2	22AIM351.1, 22AIM351.2 22AIM351.3, 22AIM351.4
3	a. Write a program to demonstrate arithmetic operations in Prolog. b. Develop a program to demonstrate the comparison operators in Prolog. Note: Discuss Data Objects, Atoms and Anonymous Variables.	2	22AIM351.1, 22AIM351.2, 22AIM351.3, 22AIM351.4
4	Develop a program in Prolog for OR and AND logic. Note: Discuss about the properties of Conjunctions and disjunction properties.	2	22AIM351.1, 22AIM351.2, 22AIM351.3, 22AIM351.4
5	Write a program in Prolog to prints 1 to 25 prime numbers using loop concepts. Note: Discuss the syntax of looping and Decision-Making statements.	2	22AIM351.1, 22AIM351.2 22AIM351.3, 22AIM351.4
6	Write a program using if then else statement to find the greatest among three numbers.	**2**	22AIM351.1, 22AIM351.2 22AIM351.3, 22AIM351.4

Part B			
7	Write a program to create a list and perform length calculations, concatenation, deletion and append items in it using Prolog. Note: Discuss List manipulation Functions in Prolog.	2	22AIM351.1, 22AIM351.2, 22AIM351.3, 22AIM351.4
8	Write a program to implement write (), read () and tab () predicate in Prolog. Note: Discuss the concepts of File Handling and Predicate in Prolog.	**2**	22AIM351.1, 22AIM351.2, 22AIM351.3, 22AIM351.4
9	Develop a Prolog code that can read data from file and write data into it.	2	22AIM351.1, ,22AIM351.2 22AIM351.3, 22AIM351.4
10	Develop a program in Prolog to demonstrate Atoms using predicates. Note: Discuss about constructing Atoms.	2	22AIM351.1, 22AIM351.2, 22AIM351.3, 22AIM351.4
11	Write a program to create a file and read the data from console and write into file then perform append operation in same file using Prolog.	2	22AIM351.1, 22AIM351.2, 22AIM351.3, 22AIM351.4
12	Create a simple expert system application using Prolog programming.	**2**	22AIM351.1, 22AIM351.2, 22AIM351.3, 22AIM351.4

PART-C
Beyond Syllabus Content/ Virtual Lab

1. Programming Concepts: https://www.tutorialspoint.com/prolog/index.htm
2. Tutorial: https://www.javatpoint.com/prolog
3. Prolog in AI: https://www.youtube.com/playlist?list=PLWPirh4EWFpEYxjEJyDoqplBhJF91Mwkp

CIE Assessment Pattern (50 Marks–Lab)

RBTLevels		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) marks
L1	**Remember**	**-**
L2	**Understand**	**10**
L3	**Apply**	**10**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	**-**

ReferenceBooks:

1)Sterling, L. and Shapiro, E. (1994). The Art of Prolog. MIT Press (2nd edition). ISBN: 9780262193382

WeblinksandVideoLectures(e-Resources):

- https://www.tutorialspoint.com/prolog/index.htm

Activity-Based Learning /Practical Based Learning

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Groupwise discussions on issues
  - Seminars

PYTHON FOR DATA ANALYTICS			
Course Code	**22AIM352**	**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:

22AIM352.1	Demonstrate the necessary techniques and packages in Python for Data Analytics.
22AIM352.2	Apply the concepts of descriptive statistics for data preparation.
22AIM352.3	Examine appropriate methods for data wrangling and preprocessing.
22AIM352.4	Analyse the significance of heat map, correlation and data distribution in ML Models.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM352.1	**3**	--	-	-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM352.2	3		-	-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM352.3	3	3	**-**	-	3	-	-	-	**-**	**-**	-	-	3	3
22AIM352.4	**3**	**3**	3	-	3	-	-	-	**-**	**-**	-	-	3	3

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Basic Python concepts and Programs	**2**	**NA**
	PART-A		
1	a. Develop a python program to demonstrate data types and conversion from one data type to another. b. Write a python program to demonstrate list operations: a) Create b) append c) reverse d) indexing e) slicing. Note: Discuss the datatypes and list concepts.	**2**	22AIM352.1
2	Write a python program to demonstrate operations on dictionary: a) create b) append c) print key and values d) update **Note:** Discuss the Dictionary concepts and difference between list and dictionary.	2	22AIM352.1
3	a. Write a python program to create a NumPy array and perform array manipulation operations b. Write a python program for importing and exporting Data in Python Note: Discuss the NumPy Array and different data file formats.	2	22AIM352.1
4	a. Write a python program for creating data frames using pandas b. Write a python program to plot a graph using Matplotl ib. Note: Discuss the data frames in panda and Matplot library.	2	22AIM352.1
5	Write a python program to perform the following operations a) sum b) mean c) standard deviation	2	22AIM352.2
6	Write a program in Python to implement to identify and Handle Missing Values. Note: Discuss the Basic of data cleaning, Outlier Identification and Removal, How to Mark and Remove, Missing Data, Statistical Imputation.	2	22AIM352.2 22AIM352.3
	Part B		
7	Develop a python program to perform Data Normalization and Standardization for the given dataset. Note: Discuss about the data transforms and Rescale data standardize data, Normalize data.	**2**	22AIM352.2 22AIM352.4

8	Develop a python program to implement basic data pre - processing steps for the given dataset.	**2**	22AIM352.2 22AIM352.4
9	Write a python program to calculate Skewness and Kurtosis for the given data frame. Note: Discuss the Skewness and Kurtosis–Box Plots–Pivot Table – ANOVA, Hypothesis Testing.	**2**	22AIM352.3
10	Write a python program to demonstrate features selection using ANOVA Note: Discuss the Skewness and Kurtosis–Box Plots–Pivot Table – ANOVA, Hypothesis Testing.	2	22AIM352.3
11	Write a python program for Plot a Heat map to find the correlation for the given dataset. Note: Discuss about the Heat Map Correlation Statistics.	2	22AIM352.4
12	a. Develop a regression model for house price prediction dataset and evaluate its performance using Python. b. Develop a classification model for iris dataset using Python. c. Plot confusion matrix for any classification model using Python.	2	22AIM352.4

PART-C
Beyond Syllabus Content/ Virtual Lab

1.Python Programming: https://python-iitk.vlabs.ac.in/List%20of%20experiments.html
2. Data Analysis with Python: https://www.geeksforgeeks.org/data-analysis-with-python/
https://www.freecodecamp.org/learn/data-analysis-with-python/
3.Basics of Data Analystics: https://www.javatpoint.com/python-data-analytics

CIE Assessment Pattern (50 Marks–Lab)

RBTLevels		**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**	**-**

Reference Books:

1. Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter, 3rd edition, by Wes McKinney,2022,.ISBN: 978-9355421906.

WeblinksandVideoLectures(e-Resources):

- https://realpython.com/python-for-data-analysis/
- https://www.freecodecamp.org/news/learn-data-analysis-with-python-course/

DATA ANALYSIS USING MS EXCEL			
Course Code	**22AIM353**	**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:

22AIM353.1	Distinguish the concept of Data Visualization using chart and Graphs.
22AIM353.2	Apply quantitative analysis method to analyze data in Excel.
22AIM353.3	Develop a solution to real time problem using inferential statistical methods
22AIM353.4	Classify different models using Excel simulation.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM353.1	**2**	-	-	-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM353.2	3	**-**	-	-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM353.3	3	3	**3**	--	-	-	-	-	**-**	**-**	-	-	3	3
22AIM353.4	**3**	**3**	3	3	3	-	-	-	**-**	**-**	-	-	3	3

Pgm	List of Experiments / Programs	Hrs	COs
	Prerequisite Experiments / Programs / Demo		
	N/A		**N/A**
	Part A		
1	The data below represent information on bank customers at 4 branch locations, their deposits at the branch, and the percent of the customers over 60 years of age at the branch. Create graphs that show: (1) line graph for the series No. Customers and $ Deposits for the various branches and (2) pie graphs for each quantitative series. Finally, consider how to create a graph that incorporates all the quantitative series (hint: bubble graph). Branch No. customers $ Deposits Percent of customers over 60 years of age A 1268 23,452,872 0.34 B 3421 123,876,985 0.57 C 1009 12,452,198 0.23 D 3187 97,923,652 0.41 8..	**2**	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
2	You read in a newspaper article that a Russian scientist has announced that he can predict the fall enrollment of students at Inner Mongolia University (IMU) by tracking last spring's wheat harvest in metric tons in Montana, USA. (a) What are the scientist's independent and dependent variables? (b) You are dean of students at IMU, so this announcement is of importance for your planning. But you are skeptical, so you call the scientist in Moscow to ask him about the accuracy of the model. What measures of fit or accuracy will you ask the scientist to provide?	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
3	What is a single annual payment for the PMT () function for the following data: 6.75% annual interest rate; 360 months term; and $100,000 principal?	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
4	Draw a Process Flow Map of your preparation to leave your home, dormitory, or apartment in the morning. Use a rectangle to represent process steps like, brush teeth, and diamonds to represent decisions, like wear warm weather clothes (?).	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
5	Create a diagram of a complex decision or process of your choice by using the structure of an influence diagram	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
6	Create a simple simulation that models the toss of a fair coin. Test the results (% Heads/% Tails) for sample sizes of 5, 10, 30, and 100. Hint-Use the RAND () function.	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
	Part B		
7	For a given data, create a chart using Pivot Table.	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4

8	Create a report with a custom column and interactive filter.	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
9	Two uncertain events are related. The first event occurs and effects the second. The first event has a 35% chance of an outcome we will call small, and 65% chance of a large outcome. If the first outcome is small then the second event will result in equal chances of 3, 4, 5, and 6, as outcomes; if the first event is large then the second event has equal chances of 11, 13, 14, and 15, as outcomes. Create a simulation that provides a risk profile of outcomes. The simulation should replicate the experiment a minimum of 300 times	**2**	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
10	Create a VLOOKUP that: (a) Allows a user to enter a percent (0–100%) and returns a categorical value based on the following data: 0–30% 31–63% 64–79% 80–92% 93–100% A B C D E (b) For the same data above, create a VLOOKUP that returns a categorical value for a randomly generated %. Hint-Use the RAND () function. (c) Expand the table so that the category A and B is defined as Good, C as OK, and D and E as Terrible. With this new, three row table, return the new outcomes (Good, etc.) for exercise (a) and (b) above	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
11	A coffee shop opens in a week and is considering a choice among several brands of coffee, Medalla de Plata and Startles, as their single offering. They hope their choice will promote visits to the shop. What are the treatments and what is the response variable.	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4
12	a. What does the Chi-square test of independence for categorical data attempt to suggest? b. Sampling errors can occur naturally, due to the uncertainty inherent in examining less than all constituents of a population—T or F?. c. sample mean is an estimation of a population mean—T or F?.	2	22AIM353.1 22AIM353.2 22AIM353.3 22AIM353.4

PART-C
Beyond Syllabus Content/ Virtual Lab

1. Basic Excel Formula: https://exceljet.net/formulas
2. Basic Execl formulas and functions: https://www.ablebits.com/office-addins-blog/basic-excel-formulas-functions/

CIE Assessment Pattern (50 Marks–Lab)

RBTLevels		Test(s) (20)	Weekly Assessment (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 Reources:

Reference Book:

1. Microsoft Excel Data Analysis and Business Modeling by Wayne Winston,2017. ISBN : 9781509304219

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=iG6lN9aBrcM
- https://www.youtube.com/watch?v=_XfWkCsvbEU
- https://onlinecourses.nptel.ac.in/noc21_ge21/

Activity-Based Learning /Practical Based learning

- For active participation of students, instruct the students to prepare Flowcharts and Handouts
- Organizing Group wise discussions on issues
- Seminars

EXPLORATORY DATA ANALYSIS			
Course Code	**22AIM354**	**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:

22AIM354.1	Demonstrate the techniques and packages in Python for Exploratory Analysis
22AIM354.2	Apply the concepts of descriptive statistics for data preparation.
22AIM354.3	Examine appropriate methods for data wrangling.
22AIM354.4	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	PO12	PSO1	PSO2
22AIM354.1	**3**			-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM354.2	3	**-**		-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM354.3	3	3	**3**	-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM354.4	**3**	**3**	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		
1	a. Write a simple program using NumPy. b. Write a data manipulation using Pandas Note: Discuss the NumPy and Pandas Libraries.	**2**	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
2	Write a program to visual sample data using Matplot lib. Note: Discuss about MatPlot library.	2	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
3	Draw a Bubble chart and Bar Chart for sample data using Python . Note: Discuss the charts available in Python for visualize the data.	2	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
4	Draw a Lollipop chart and Polor chart for sample data using python.	2	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
5	Create a python program to choose the best chart among others.	2	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
6	Develop a python program to load a CSV file and converting date.	2	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
	Part B		
7	Write a python program to removing NaN values. Note: Discuss the Removing NaN values.	**2**	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
8	Write a program for data refactoring and dropping columns using python.		22AIM354.1 22AIM354.2 22AIM354.3

			22AIM354.4
9	Write a python program for data refactoring and dropping columns using python. Note: Discuss the Applying descriptive statistics-Data refactoring - Dropping columns	2	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
10	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-reshaping and pivoting, data deduplication-Replacing values-handling missing data-outlier detection and filtering	2	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
11	Write a program to detect outlier and filtering.	2	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4
12	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	22AIM354.1 22AIM354.2 22AIM354.3 22AIM354.4

PART-C
Beyond Syllabus Content/ Virtual Lab

1. Steps in Exploatory 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:

TextBooks:

1. Hands-On Exploratory Data Analysis with Python, Suresh Kumar Mukhiya and Usman Ahmed, Packt Publishing, 2020. ISBN: 978-1789537253

Weblinks and Video Lectures(e-Resources):

- 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

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Handouts
  - Organizing Group wise discussions on use-cases.

JULIA FOR NUMERICAL ANALYSIS			
Course Code	**22AIM355**	**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:

22AIM355.1	Understand the fundamental of numerical methods to perform operation on numerical data.
22AIM355.2	Analyze the performance of numerical algorithms, evaluating the accuracy of numerical solutions, and making informed decisions based on data insights
22AIM355.3	Develop problem-solving skills by applying numerical methods to solve complex scientific mathematical problems, analyze numerical data, and interpret results.
22AIM355.4	Generate the precise result for complex real time scientific problem using Julia.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM355.1	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
22AIM355.2	**-**	**3**	**--**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
22AIM355.3	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
22AIM355.4	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

Exp.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Basic knowledge in Numerical Analysis and linear algebra conceps	2	NA
	PART-A		
1	Perform basic arithmetic operations (addition, subtraction, multiplication, division) on numerical values in Julia Note: Teach basics syntax and statements	2	22AIM355.1 22AIM355.2
2	Implement the bisection method in Julia to find the root of a given function within a specified interval.	2	22AIM355.1 22AIM355.2 22AIM355.3
3	Perform matrix multiplication of two matrices using Julia.	2	22AIM355.1 22AIM355.2 22AIM355.4
4	Implement Lagrange interpolation in Julia to approximate a function from given data points	2	22AIM355.1 22AIM355.2 22AIM355.3
5	Implement Gaussian elimination in Julia to solve a system of linear equations.	2	22AIM355.1 22AIM355.2 22AIM355.3
6	Use Julia to approximate the derivative of a function using numerical differentiation methods	2	22AIM355.1 22AIM355.2 22AIM355.4
	PART-B		
7	Use the trapezoidal rule in Julia to approximate the integral of a function	2	22AIM355.1 22AIM355.2 22AIM355.4
8	Implement Euler's method in Julia to solve a first-order ordinary differential equation (ODE).	2	22AIM355.1 22AIM355.2 22AIM355.3

9	Use the Newton-Raphson method in Julia to find the root of a nonlinear equation.	2	22AIM355.1 22AIM355.2 22AIM355.4
10	Implement the power method in Julia to find the dominant eigenvalue and eigenvector of a matrix.	2	22AIM355.1 22AIM355.2 22AIM355.3
11	Write a Julia program for high degree polynomial interpolation.	2	22AIM355.1 22AIM355.2
12	Write a Julia program for countdown timer concept.	2	22AIM355.1 22AIM355.2

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

1. **https://www.bing.com/videos/riverview/relatedvideo?q=julia+programming+video&mid=F2E185A4919F5F05AD7FF2E185A4919F5F05AD7F&FORM=VIRE**
2. Julia Documentation - The official Julia documentation provides comprehensive guides, tutorials, and examples for using Julia for numerical analysis. https://docs.julialang.org/en/v1/stdlib/LinearAlgebra/
3. Julia Discourse - The Julia Discourse forum is a great place to ask questions, share knowledge, and get help with using Julia for numerical analysis. https://discourse.julialang.org/
4. JuliaCon Videos - JuliaCon is the annual conference for Julia users, and the videos from past conferences often include talks and workshops on numerical analysis topics. https://juliacon.org/
5. MIT OpenCourseWare - MIT offers free online courses that cover numerical analysis topics. While not specific to Julia, these courses can provside valuable insights into numerical methods. https://ocw.mit.edu/index.htm

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	5	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	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:
Reference Books:

1) "Numerical Analysis Using Julia" by Huijun Hu, 2021,ISBN-13: 978-1138614188.
2) "Julia Programming for Operations Research: A Primer on Computing" by Changhyun Kwon and Jeffrey S. Saltzman,2016 ,ISBN-13: 978-1798205471.

BIO INSPIRED DESIGN AND INNOVATION			
Course Code	**22BIK36**	**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:

22BIK36.1	Understand the biomimetics principles in relation to the needs at that moment.
22BIK36.2	Evaluate the Bio-material properties for health care applications.
22BIK36.3	Investigate novel bioengineering initiatives by evaluating design and development principles.
22BIK36.4	Investigate creative biobased solutions for socially vital issues with critical thought.
22BIK36.5	Analyze the bio computing optimization through research and experiential learning.
22BIK36.6	Explain 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	PO12
22BIK36.1	3	3	3	3	2	-	-	-	1	1	-	2
22BIK36.2	3	3	3	3	2	-	-	-	1	1	-	2
22BIK36.3	3	3	3	3	2	-	-	-	1	1	-	2
22BIK36.4	3	3	3	3	2	-	-	-	1	1	-	2
22BIK36.5	3	3	3	3	2	-	-	-	1	1	-	2
22BIK36.6	3	3	3	3	2	-	-	-	1	1	-	2

MODULE-1	**BIO-INSPIRED DESIGN AND ENGINEERING**	**22BIK36.1**	**8 Hours**

Bio-Inspired Engineering and design, History, Evolution, Basics of Biomimetics and other Disciplines, Rawling's Classifications, 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**	**22BIK36.2**	**8 Hours**

Biomaterials, Design of Forms- (Hexagonal unit cells, Intrinsic disorder, anisotropy), Design of materials- (Hierarchy, fracture tough materials, structural colours, Actuating Materials, Bio-Compatible Materials). Bio-Mechanics, Applications of Biomaterials and Bio systems in Health care .

Self Study	Investigate Bio-Compatible alloys and polymers for human implants and health care applications.
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	**BIO SUSTAINABLE DEVELOPMENT**	**22BIK36.3, 22BIK36.4**	**8 Hours**

Innovations in Energy (Termite mound inspired shopping malls), Innovations in Resource-Air (purification, filtration), Dew water collection systems, water purification, desalination, Management of spaces, designs for megastructures.

Case Study	Explore the Bio inspired environmental constructions and development.
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10

MODULE-4	**BIO COMPUTING AND OPTIMISATION**	**22BIK36.5**	**8 Hours**

No Free Lunch Theorem, Bat Algorithm, Flower Pollination Algorithm, Genetic Algorithm- Crossover and Mutation Operations. Bio-Inspired Optimisation, Ant Colony Optimisation (ACO), Swam Intelligence- Particle Swam Optimisation (PSO).

Self Study	Scrutinize the Different types of Optimization techniques, genetic research.
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7

MODULE-5	**APPLICATIONS OF BIO-INSPIRED INNOVATIONS**	**22BIK36.6**	**8 Hours**

Bioinspired innovations in– Automotive, Automation, Materials and Manufacturing, Sensors, Controllers, Communications, Healthcare, Agriculture, food production, and Sports, Environment infrastructure. Carbon Neutral Solutions (Coral Reefs, Eco-cements), Carbon Free Solutions (Lotus leaf inspired paints), eco-restorations (Eco-friendly pesticide).

Application	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)	Qualitative Assessment (s) (15)	MCQ's (10)
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	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://www.youtube.com/watch?v=cwxXY9Qe8ss
- https://www.youtube.com/watch?v=V2GvQXvjhLA
- 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

- Presenting students with bio-inspired design challenges and asking them to come up with solutions.
- Create physical models or prototypes that mimic biological structures or functions.
- Organizing Group wise discussions on issues
- Seminars

SOCIAL CONNECT AND RESPONSIBILITY			
Course Code	**22SCK37**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**--**
Hrs / Week	**02**	**Total Marks**	**50**
Credits	**01**	**Exam Hours**	**02**

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

22SCK37.1	Communicate and connect to the surrounding
22SCK37.2	Understand the needs and problems of the community and involve them in problem –solving
22SCK37.3	Develop among themselves a sense of social & civic responsibility and utilize their knowledge in finding practical solutions to individual and community problems
22SCK37.4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22SCK37.1	-	-	-	-	-	3	2	-	2	3	-	1
22SCK372	-	-	-	-	-	3	2	-	2	3	-	1
22SCK37.3	-	-	-	-	-	3	2	-	2	3	-	1
22SCK37.4	-	-	-	-	-	3	2	-	2	3	-	1

MODULE-1	**PLANTATION AND ADOPTION OF A TREE**	**22SCK37.1, 22SCK37.2**	**3 Hours**

Plantation of a tree that will be adopted for three years by a group of B. Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.

MODULE-2	**HERITAGE WALK AND CRAFTS CORNER**	**22SCK37.2, 22SCK37.3**	**3 Hours**

Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms- Objectives, Visit, case study, report, outcomes.

MODULE-3	**ORGANIC FARMING AND WASTE MANAGEMENT**	**22SCK37.3, 22SCK37.4**	**3 Hours**

Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus – Objectives, Visit, case study, report, outcomes.

MODULE-4	**WATER CONSERVATION**	**22SCK37.3, 22SCK37.4**	**3 Hours**

Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

MODULE-5	**FOOD WALK**	**22SCK37.1, 22SCK37.4**	**3 Hours**

City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

CIE Assessment Pattern (50 Marks – Activity based) –

- **Each module is evaluated as given below and 100 marks in scaled down to 50 as final marks.**

CIE component for each module	Marks
Field Visit, Plan, Discussion	10
Commencement of activities and its progress	20
Case study-based Assessment Individual performance with report	20
Module wise study & its consolidation 5*5 = 25	25
Video based seminar for 10 minutes by each student at the end of semester with Report. Activities 1 to 5, 5*5 = 25	25
Total	**100**

- Implementation strategies of the project (NSS work).
- Individual student has to submit a final report which should be signed by NSS Officer, the HOD and Principal.
- Finally, the consolidated marks sheet and the reports should be available in the department.

Activity-Based Learning / Practical Based learning

- Platform to connect to others and share the stories with others:

- Jamming session
- Open mic
- Poetry

- Share the experience of Social Connect.
- Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

Pedagogy:

- The students will be divided into groups. Each group will be handled by faculty mentor.
- A total of 40 - 50 hrs engagement in the semester
- Faculty mentor will design the activities (particularly Jamming sessions, open mic and poetry)
- The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large.
- The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-longactivities conducted by faculty mentors.
- Students should present the progress of the activities as per the schedule in the prescribed practical session in the field.
- There should be positive progress in the vertical order for the benefit of society in general through activities.

Plan of Action:

- Each student should do activities according to the scheme and syllabus.
- At the end of semester student performance has to be evaluated by the faculty mentor for the assigned activity progress and its completion.
- At last consolidated report of all activities from 1st to 5th, compiled report should be submitted as per the instructions and scheme.
- Practice Session Description:
  - Lecture session in field to start activities
  - Students Presentation on Ideas
  - Commencement of activity and its progress
  - 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.

No	Topic	Group size	Location	Activity execution	Reporting	Evaluation of the Topic
1.	**Plantation and adoption of a tree**	May be individual or team (3-5)	Farmers land/ parks / 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
2.	**Heritage walk and crafts corner**	May be individual or team (3-5)	Temples / monumentalplaces / 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
3.	**Organic farming and waste managemen t**	May be individual or team (3-5)	Farmers land / parks /Villages visits / roadside/ communityarea /	Group selection / proper consultation / Continuous monitoring /	Report should be submitted by individual to the concerned evaluation	Evaluation as per the rubrics of scheme and syllabus

			College campus	Information board	authority	
4.	**Water conservation:** Conservation techniques	May be individual or team (3-5)	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
5.	**Food walk:** Practices in society	May be individual or team (3-5)	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

BASIC APPLIED MATHEMATICS-I			
Course Code	**22DMAT31**	**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:

22DMAT31.1	Know the principles of engineering mathematics through calculus
22DMAT31.2	Determine the power series expansion of a function
22DMAT31.3	Find the definite integrals with standard limits and also develop the ability to solve different types of differential equations
22DMAT31.4	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	PO12
22DMAT31.1	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT31.2	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT31.3	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT31.4	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**DIFFERENTIAL CALCULUS**	**22DMAT31.1 22DMAT31.2**	**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**	**22DMAT31.1**	**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**	**22DMAT31.3**	**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**	**22DMAT31.4**	**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**	**22DMAT31.4**	**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		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	10	5	10
L4	Analyze	2.5	-	-
L5	Evaluate	2.5	-	-

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=DWcAIiFnosT7zikY
7. https://youtu.be/N5YCGOyTSuU?si=Wsf75V5fkUpfVVxr
8. https://youtu.be/gd1FYn86P0c?si=7drzBEqVFSv6sQeZ
9. https://youtu.be/cSj82GG6MX4?si=4QN1DFXEqaJoUBn7
10. https://youtu.be/0c3yq9btr3A?si=jIoz8eu5TgV7mh8G
11. https://youtu.be/PhfbEr2btGQ?si=HVK1uk65oHph0t8G

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

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Algorithms/Flowcharts/Programming Codes
  - Organizing Group wise discussions on related topics
  - Seminars

NATIONAL SERVICE SCHEME (NSS)			
Course Code	**22NSS30**	**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:

22NSS30.1	Understand the importance of his / her responsibilities towards society.
22NSS30.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSS30.3	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.
22NSS30.4	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	PO12
22NSS30.1	-	-	-	-	-	3	3	-	2	-	-	1
22NSS30.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSS30.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSS30.4	-	-	-	-	-	3	3	-	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 22NSS30	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.	22NSS30.1, 22NSS30.2, 22NSS30.3, 22NSS30.4	30 HRS
4TH 22NSS40	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.	22NSS40.1, 22NSS40.2, 22NSS40.3, 22NSS40.4	30 HRS
5TH 22NSS50	7. Developing Sustainable Water management system for rural areas and implementationapproaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 9. Spreading public awareness under rural outreach programs. (minimum 5 programs).	22NSS50.1, 22NSS50.2, 22NSS50.3, 22NSS50.4	30 HRS
6TH 22NSS60	10. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs).	22NSS60.1,	30 HRS

	11. Govt. school Rejuvenation and helping them to achieve good infrastructure.	22NSS60.2, 22NSS60.3, 22NSS60.4	

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and principal.
- At last report should be evaluated by the NSS officer of the institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

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

Pedagogy:

- In every semester from 3rd semester to 6th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

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

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerme ntgroups/ Consulting NGOs & Govt Teams / College campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
6.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
7.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

9.	Spreading public awareness under rural outreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per 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/prop er consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
11.	Govt. school Rejuvenation andhelping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/prop er 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 (PE) (SPORTS AND ATHLETICS)			
Course Code	**22PED30**	**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:

22PED30.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
22PED30.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
22PED30.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PED30.4	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
22PED30.1	-	-	-	-	-	2	-	3	3	-	-	2
22PED30.2	-	-	-	-	-	2	-	3	3	-	-	2
22PED30.3	-	-	-	-	-	2	-	3	3	-	-	2
22PED30.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 22PED30	**Module 1: Orientation** A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.	22PED30.1, 22PED30.2	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	22PED30.2, 22PED30.3	15 HRS
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.	22PED30.3, 22PED30.4	10 HRS
4TH 22PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	22PED40.1, 22PED40.2	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.	22PED40.3	20 HRS

	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.		
	Module 3: Role of Organization and administration	22PED40.4	5 HRS
5TH 22PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 1. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** A. Fundamental Skills 1. Catching, Throwing and Ball control, 2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 3. Dribbling: High and low. 4. Attack and counter attack, simple counter attack, counter attack from two wings and center. 5. Blocking, Goal Keeping and Defensive skills. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of officials **Ball badminton:** A. Fundamental Skills 1. Basic Knowledge: Various parts of the Racket and Grip. 2. Service: Short service, Long service, Long-high service. 3. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	22PED50.1, 22PED50.2, 22PED50.3, 22PED50.4	Total 30 Hrs/ Semester 2 Hrs/week
6TH 22PED60	**Athletics**: 1. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations)use of Starting Block.	22PED60.1, 22PED60.2, 22PED60.3,	Total 30 Hrs/ Semester 2 Hrs/week

	• Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Football OR Hockey** **Football:** A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. 2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 4. Heading: In standing, running and jumping condition. 5. Throw-in: Standing throw-in and Running throw-in. 6. Feinting: With the lower limb and upper part of the body. 7. Tackling: Simple Tackling, Slide Tackling. 8. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting. 9. Game practice with application of Rules and Regulations. A. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing 4. Penalty stroke practice. 5. Penalty corner practice. 6. Tackling: Simple Tackling, Slide Tackling. 7. Goal Keeping, Ball clearance- kicking, and deflecting. 8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials	22PED60.4	

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	25

in competitions/ practical on specific tasks assigned to the students	
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	**22YOG30**	**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:

22YOG30.1	Understanding the origin, history, aim and objectives of Yoga
22YOG30.2	Become familiar with an authentic foundation of Yogic practices
22YOG30.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
22YOG30.4	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	PO12
22YOG30.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOG30.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOG30.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOG30.4	-	-	-	-	-	3	-	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 22YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	22YOG30.1, 22YOG30.2, 22YOG30.3, 22YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 22YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	22YOG40.1, 22YOG40.2, 22YOG40.3, 22YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 22YOG50	**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	22YOG50.1, 22YOG50.2, 22YOG50.3, 22YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 22YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3round **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 pos 4. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	22YOG60.1, 22YOG60.2, 22YOG60.3, 22YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

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)

Web links and Video Lectures (e-Resources):

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

SEMESTER IV

DISCRETE MATHEMATICS AND GRAPH THEORY			
Course Code	**22MAC41**	**CIE Marks**	**50**
L: T:P:S	**2:1:0:0**	**SEE Marks**	**50**
Hrs. / Week	**4**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22MAC41.1	Explain the counting techniques and combinatorics by using the context of discrete probability.
22MAC41.2	Illustrate the principle of Inclusion and Exclusion
22MAC41.3	Apply Pigeon hole principle to solve real life problems.
22MAC41.4	Solve the engineering problems involving relations and functions.
22MAC41.5	Analyze the computer science problems by using graph theory techniques.
22MAC41.6	Justify the arguments with propositional and predicate logic and from truth tables.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22MAC41.1	3	3	-	-	-	-	-	-	-	-	-	-
22MAC41.2	3	3	-	-	-	-	-	-	-	-	-	-
22MAC41.3	3	3	-	-	-	-	-	-	-	-	-	-
22MAC41.4	3	3	-	-	-	-	-	-	-	-	-	-
22MAC41.5	3	3	-	-	-	-	-	-	-	-	-	-
22MAC41.6	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**MATHEMATICAL LOGIC**	22MAC41.1	**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.			
Case Study	Case studies on roles of logic in specification of computation.		
Text Book	Text Book 1: 2.1, 2.2, 2.3.		
MODULE-2	**PRINCIPLES OF COUNTING**	22MAC41.2	**8 Hours**
Catalan Numbers, Ramsey Numbers, Stirling Numbers and Bell Numbers, The principle of Inclusion and Exclusio Generalizations of the principle, Derangements, Rook-Polynomials, Arrangements with Forbidden Positions.			
Text Book	Text Book 1: 1.5, 8.1, 8.2, 8.3, 8.4, 8.5.		
MODULE-3	**RELATIONS AND FUNCTIONS**	22MAC41.3	**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.			
Text Book	Text Book 1: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 7.4.		
MODULE-4	**GRAPH THEORY**	22MAC41.4	**8 Hours**
Graphs-Definitions and examples, Sub graphs, Walks, Paths, Circuits, Connectedness, Components, graph isomorphism, Euler graphs, Hamiltonian paths and cycles.			
Case Study	Case studies on Network Analysis.		
Text Book	Text Book 1: 11.1, 11.2, 11.3, 11.5. Text Book 2: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9.		
MODULE-5	**TREES, CONNECTIVITY AND PLANARITY**	22MAC41.5 22MAC41.6	**8 Hours**
Trees, Properties of trees, Rooted and binary trees. Spanning trees, cut sets, Properties of cut set, all cut sets, Fundamental circuits Network flows: Kruskal's algorithm, Planar graphs, Dual of planar graphs, Different representation of a planar graph.			
Case Study	Case studies on Social Network Analysis.		
Text Book	Text Book 1: 11.4, 12.1, 12.2, 12.3, 13.2, Text Book 2: 3.1, 3.5, 3.7, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 5.2, 5.6, 5.7.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	**15**	**10**
L1	**Remember**	5	5	-
L2	**Understand**	5	5	-
L3	**Apply**	10	5	10
L4	**Analyze**	2.5	-	-
L5	**Evaluate**	2.5	-	-
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) 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=ALqpJIlzrAafEVDq

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

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Algorithms/Flowcharts/Programming Codes
  - Organizing Group wise discussions on related topics
  - Seminars

DATA BASE MANAGEMENT SYSTEM

Course Code	**22AIM42**	**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 ableto:

22AIM42.1	Understand the concepts of Data Base Management Systems
22AIM42.2	Design ER Diagram for the various real-world data base.
22AIM42.3	Analyze the principles of DDL (Data Definition Language), DML (Data Manipulation Language), DCL (Data Control Language), and TCL (Transaction Control Language) for the provided scenario.
22AIM42.4	Examine the notion of functional dependencies and employ normalization techniques to enhance the precision and structure of databases
22AIM42.5	Investigate the functionalities of joins, views, triggers, and assertions across different database systems.
22AIM42.6	Characterise different high-level databases and the selection of the right database.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM42.1	2	-	-	-	-	-	-	-	-	-	-	-	3	2
22AIM42.2	3	3	2	-	-	-	-	-	-	-	-	-	3	2
22AIM42.3	2	2	-	-	-	-	-	-	-	-	-	-	3	2
22AIM42.4	3	3	3	-	3	-	-	-	-	-	-	3	3	2
22AIM42.5	2	2	2	2	3	-	-	-	-	-	-	3	3	2
22AIM42.6	3	3	3	3	3	-	-	-	-	-	-	3	3	2

MODULE-1	**INTRODUCTION TO DATABASES**	22AIM42.1, 22AIM42.2	**8 Hours**

Definition of database, DBMS; Characteristics of Database approach; Advantages of using DBMS approach; when not to use a DBMS Database Concept and Architecture: Datamodels, schemas and instances; Data Abstraction; Three-schema architecture and data independence; Components of a DBMS- Database Designer- Database Administrator- Database Users. Introduction to Entity-Relationship Model: Entity Types, Attributes and Keys; Relationship types, Roles and Structural Constraints; Weak Entity Types; ER Diagrams, Naming Conventions and Design Issues; Reduction of an E-R schemato relational Tables

Case Study	Construct an E-R diagram for hospital management database and company database.
Text Book	Text Book 1 : Chapter 1,2, Textbook 2: 3.3-3.7

MODULE-2	**LOGICAL DESIGN AND RELATIONAL MODEL**	22AIM42.1, 22AIM42.3	**8 Hours**

Domains, Attributes, Tuples, and Relations; Relational Model Constraints; Relational Database Schemas; SQL1: Overview of SQL language; SQL Data Definition and Data Types; Schema change statements in SQL; Enforcing basic constraints in SQL; Basic structure of SQL queries Joins; Logical connectives-AND, OR and NOT; Addition basic operations; Setoperations; Aggregate function

Case Study	Develop a database for the hospital to maintain the records of various departments, rooms, and doctors in the hospital. It also maintains records of the regular patients, patients admitted in the hospital, the check up of patients done by the doctors, the patients that have been operated, and patients discharged from the hospital.
Text Book	Text Book1: 3.1-3.9,4.1-4.5

MODULE-3	**ADVANCED SQL**	22AIM42.1, 22AIM42.5	**8 Hours**

Introduction to Nested Queries; Correlated Nested Queries; Introduction to Views: creation, implementation, update of views; Introduction to Assertion and Trigger

Case Study/Application	Develop a relational database is to be designed for a medium sized Company dealing with industrial applications of computers. Each employee works in some department. An employee may possess a number of skills, every manager (including the MD) is an employee. A department may participate in none/one/many projects. At least one department participates in a project. An employee may be engaged in none/one/many projects, Project teams consist

	of at least one member.		
Text Book	Text Book 1: Ch-4.2,5.3,5.4		
MODULE-4	**DATABASE DESIGN AND INDEX STRUCTURES**	22AIM42.4,22AIM42.5	**8 Hours**
Indexes on Sequential Files: dense, sparse index; multi-level indexing; Hash Based Indexing: Static Hashing and dynamic hashing. Database Refinement: Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normalization on Relational Data Base:1NF, 2NF, 3NF, BCNF; Transaction Management: The ACID Properties.			
Text Book	Text Book 2: Ch 15.1-15.7 ,18.1-18.5		
MODULE-5	**INTRODUCTION TO HIGH_LEVEL DATABASES**	22AIM42.6	**8 Hours**
What is NOSQL, Need of NOSQL, Features OF NO SQL, CAP Theorem, ACID v/s BASE, Advantages&Disadvantages ofNO SQL, Types of NOSQL: Key-Value database- Document-based database- Column-baseddatabase-Graphbased database? **Introduction to Cassandra:** Architecture, Gossip protocol, Snitches, Virtual Nodes, write consistency level and write process, read consistency level and read data operation, indexing, Tombstones			
Case Study	MongoDB, DynamoDB		
Text Book	Text Book 3:Ch 1.1,1.2, 2.1-2.4,8.1,8.2,9.1,9.2,10.1,10.2 Textbook 4: Ch 1,2		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s) (25)	**Qualitative Assessment (s) (15)**	**MCQ's (10)**
L1	**Remember**	5	**-**	**5**
L2	**Understand**	5	**-**	**5**
L3	**Apply**	10	5	
L4	**Analyze**	5	10	-
L5	**Evaluate**	-	-	**-**
L6	**Create**	**-**	**-**	**-**

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

SEE Assessment Pattern (50Marks– Theory)

RBTLevels		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. Abraham Silberschatz, Henry F. Korth , S. Sudarshan," Database System Concepts", 6th Edition, McGraw Hill,2011. ISBN: 978-0073523323
2. Ramez Elmasri and Shamkant B. Navathe: Fundamentals of Database Systems, 6th Edition, Pearson, 2016. ISBN: 978-0136086208
3. "NOSQL distilled" by Pramod sadalalge, Pearson Education, November 2014. ISBN: 978-0321826626.
4. "Mastering Apache Cassandra", Second edition, Nishant Neeraj, Packt publishing, 2015. ISBN:9781784392611

Reference Books:

1. Johannes Gehrke, Raghu Ramakrishnan, Database Management Systems 3rd Edition, McGraw Hill Education,2014. ISBN: 9780072465631

Weblinks and Video Lectures(e-Resources):

- https://youtube.com/playlist?list=PLyqSpQzTE6M-xymXgqewlzcC3U4cdRoSu&si=LJektfE889sBkPxi
- https://youtu.be/5TU7zH0Z8ps?si=QR6Yy6SQVqfWm74U
- https://youtu.be/o-PAdq64rk8?si=qaIId3P755O7HLvG
- https://youtu.be/lyTPtoBfs9I?si=bPuQnOGDlOM6JTZJ

- https://youtu.be/aUPVpIYiLCc?si=dSdsnx9cWUkdEHKM
- https://youtu.be/s1xc1HVsRk0?si=tckBELRr00zjJhWL

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

- Video demonstration of latest trends in Database Technology
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues

DATABASE MANAGEMENT SYSTEM LAB			
Course Code	**22AIL42**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs/Week	**2**	**TotalMarks**	**100**
Credits	**01**	**ExamHours**	**03**

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

22AIL42.1	Apply data base management techniques to solve the real-world problem
22AIL42.2	Design a data base for the given problem
22AIL42.3	Analyse the database for the given scenario.
22AIL42.4	Conduct experiments as individual/team by using My SQL/Oracle and prepare a report based on output /results.

Mapping of Course Outcomes to Program Outcomes an dProgram Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIL42.1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22AIL42.2	3	3	3	-	-	-	-	-	-	-	-	-	3	2
22AIL42.3	3	3	3	-	-	-	-	-	-	-	-	-	3	2
22AIL42.4	3	3	3	3	3	-	-	-	2	2	-	-	3	2

Exp. No.	ListofExperiments/Programs	Hours	COs
	Pre-requisite Experiments/ Programs/ Demo		
	DrawE-Rdiagram and convert entities and relationships to relation table for a given scenario. Two assignments shall be carriedout i.e. consider two different scenarios (eg. bank, college)	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
	PART-A		
1	Write relational algebra queries: Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With andWith outConstraints), Inserting/Updating/Deleting tables records in a Table, Saving (Commit) and Undoing (rollback)	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
2	Write relational algebra queries: Altering a Table, Dropping/Truncating/RenamingTables, Backingup/RestoringaDatabase.	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
3	Consider the following database for student enrolment for course: STUDENT (snum: integer, sname: string, major: string, level: string, age: integer) CLASS (name: string, meetsat: time, room: string, fid: integer) ENROLLED (snum: integer cname: string) FACULTY (fid: integer, fname: string, deptid: integer) The meaningof these relations is straightforward; for example, Enrolled has onerecord per student-class pair such that the student is enrolled in theclass. Level is a two-character code with 4 different values (example: Junior: JRetc) Write the following queries in SQL. No duplicates should be printed in any of the answers i. Find the names of all Juniors(level=JR) who are enrolled in a class taught by Prof. ABC ii. Find the names of all classes that either meet in room R128 or have five or more Students enrolled. iii. Find the names of all students who are enrolled in two classes that meet at the same time. iv. Find the names of faculty members who teach in every room in which some class is taught. Find the names of faculty members for whom the combined enrolment of the courses that they teach is less than five.	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4

4	Consider the following database that keeps track of airline fligh tinformation: FLIGHTS (flno: integer, from: string, to: string, distance: integer, departs: time, arrives: time, price: integer) AIRCRAFT (aid: integer, aname: string, cruising range: integer) CERTIFIED (eid: integer, aid: integer) EMPLOYEE (eid: integer, ename: string, salary: integer) Note that the Employees relation describes pilots and other kinds ofemployees as well; Every pilot is certified for some aircraft, and onlypilotsare certified tofly. Write each of the followingqueries inSQL. i. Find the names of aircraft such that all pilots certified to operatethem have salariesmore than Rs.80,000. ii. For each pilot who is certified for more than three aircrafts, find the eid and the maximum cruising range of the aircraft for which she or he is certified. iii. Find the names of pilots whose salary is less than the price of thecheapestroutefromBengaluru to Frankfurt. iv. For all aircraft with cruising range over 1000 Kms, find the nameof the aircraft and the average salary of all pilots certified for thisaircraft. Find the names of pilots certified for some Boeing aircraft.	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
5	Consider the following relations for an Order Processing database application in a company. CUSTOMER (CUST #: int, cname: String, city: String) ORDER (order #: int, odate: date, cust #: int, ord-Amt: int) ITEM (item#:int, unit-price: int) ORDER-ITEM (order #: int, item #: int, qty: int) WAREHOUSE (warehouse#:int, city: String) SHIPMENT (order#:int, warehouse #: int,ship-date:date) i. Create the above tables by properly specifying the primary keys and the foreign keysand the foreignkeys. Enterat least five tuples for each relation. iii. Producea listing: CUSTNAME, #of orders, AVG_ORDER_AMT, where the middle column is the total numbers of orders by the customer and the last column is the average order amount for that customer. iv. List the order # for orders that were shipped from all warehouses that the company has in a specific city. v. Demonstrate how you delete item# 10 from the ITEM table and make that field null in the ORDER_ITEM table.	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
	The following tables are maintained by abook dealer: AUTHOR (author_id: int, name: string, city: string, country:string)		
6	PUBLISHER (publisher_id:int, name: string, city: string, country: string) CATALOG (book_id:int, title: string, author_id:int, publisher_id:int, category_id:int, year:int, price:int) CATEGORY (category_id:int, description: string) ORDER-DETAILS (order_no:int, book_id:int, quantity:int) i. Create the above tables by properly specifying the primary keys and the foreign keys. ii. Enter at least five tuples for each relation. iii. Give the details of the authors who have 2 or more books in the catalog and the price of the books is greater than the average price of the booksin the catalogand the year of publication is after 2000. iv. Find the author of the book which has maximum sales. Demonstrate how you increase the price of books published by a specific publisher by10%.	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
	PART-B		

7	Consider the following database of student enrollment in courses and books adopted for each course. STUDENT (regno:String,name:String,major:String,bdate:date) COURSE(course #:int, cname:String,dept:String), ENROLL (regno: String, course #: int, sem: int, marks: int) BOOK_ADOPTION (course #: int, sem: int, book-ISBN: int), TEXT(book-ISBN:int, book-title:String, publisher:String,author:String) i. Create the above tables by properly specifying the primary keys and the foreign keys. Enterat least five tuples for each relation. ii. Demonstrate how you add a new textbook to the database and make this book be adopted by some department. iii. Produce a list of textbooks (include Course #, Book-ISBN, Book-title) in the alphabetical order for courses offered by the 'AIML'department that use more than two books. iv. List any department that has all its adopted books published by a specific publisher.	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
8	Consider the schema for Movie Database: 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) Write SQL queries to i. List the titles of all movies directed by 'Hitchcock'. ii. Find the movie names where one or more actors acted in two or more movies. iii. List all actors who acted in a movie before 2000 and in a movie after 2015 (use JOIN operation). iv. Find the title of movies and number of stars for each movie that has at least one rating and find the highest number of stars that movie received. Sort the result by movie title. v. Update rating of all movies directed by'Steven Spielberg' to 5	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
9	Queries using aggregate functions (COUNT,AVG,MIN,MAX,SUM),Group by,Orderby. Employee(E_id, E_name, Age, Salary) 1. Create Employee table containing all Records E_id, E_name, Age, Salary. 2. Count number of employee names from employee table 3. Find the Maximum age from employee table. 4. Find the Minimum age from employee table. 5. Find salaries of employee in Ascending Order. 6. Find grouped salaries of employees	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
10	Create a table and perform the search operation on table using indexing and non-indexing techniques	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
11	Design and develop MongoDB queries to implement the CRUD operations	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
12	Implement aggregation and indexing using MongoDB	2	22AIL42.1 22AIL42.2 22AIL42.3 22AIL42.4
	PART-C (Beyond Syllabus Virtual Lab Content)		
	DDL Concepts:**https://vsit.edu.in/vlab/DBMS/Views_Simulator.html** E-R Modeling: **http://vlabs.iitkgp.ernet.in/se/4/theory/** **http://vlabs.iitkgp.ernet.in/se/4/exercise/**		

CIE Assessment Pattern (50 Marks–Lab)

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

L5	**Evaluate**	-	-
L6	**Create**	-	

SEE Assessment Pattern (50 Marks–Lab)

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

Suggested Learning Resources:

ReferenceBooks:

1. Ramez Elmasri and Shamkant B.Navathe: Fundamentals of DatabaseSystems,7thEdition, Pearson,2016. ISBN: 978-0133970777

2. Abraham Silberschatz, Henry F.Korth, S.Sudarshan, "Database System Concepts", 6th Edition, McGrawHill, 2011. ISBN: 9781260084504

DESIGN AND ANALYSIS OF ALGORITHMS			
Course Code	**22AIM43**	**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:

22AIM43.1	Design algorithmic method to solve simple to complex problems using various approaches
22AIM43.2	Employ both brute force and divide-and-conquer design strategies to evaluate an algorithm's effectiveness in devising a solution
22AIM43.3	Identify from a variety of design techniques to address searching and sorting challenges
22AIM43.4	Analyze both greedy and dynamic programming strategies for solving intricate problems
22AIM43.5	Apply back-tracking and branch&bound technique to assess an algorithm and formulate solution
22AIM43.6	Examine the NP, and NP-complete complexity classes to scrutinize the constraints and boundaries of an algorithm's performance

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM43.1	-	-	3	-	-	-	-	-	-	-	-	-	3	3
22AIM43.2	-	-	3	3	2	-	-	-	-	-	-	-	3	3
22AIM43.3	3	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM43.4	3	3	-	-	-	-	-	-	-	-	-	-	3	3
22AIM43.5	3	-	-	-		-	-	-	-	-	-	-	3	3
22AIM43.6	-	3	-			-	-	-	-	-	-	-	3	3

MODULE-1	**INTRODUCTION**	22AIM43.1	**8 Hours**

Introduction to Algorithms, Role of algorithms in computing, Time and Space Complexity of Algorithms, Asymptotic notations, worst-case, Average-case and Best-case analysis, Analysis Framework- Empirical analysis- Mathematical analysis for Recursive and Non-recursive algorithms.

Case Study	Illustrate real-world applications of algorithms and growth functions.
Text Book	Text Book 1:1.1,1.2,1.3

MODULE-2	**DIVIDE AND CONQUER**	22AIM43.2	**8 Hours**

Divide and Conquer Methodology: Binary search, Merge sort, Quick sort, Finding the maximum and minimum, Strassen's matrix, advantages and disadvantages of divide and conquer.

Case Study	Compare and contrast the time complexity and suitability of the bubble sort, merge sort, and quicksort algorithms. Provide scenarios where one might be preferred over the others.
Text Book	Text Book 1: 2.1,2.2

MODULE-3	**GREEDY METHOD AND DYNAMIC PROGRAMMING**	22AIM43.3	**8 Hours**

Greeedy method: Introduction, Job scheduling problem, Minimum Spanning tree algorithms – Kruskals & Prims. Optimal Tree Problem: Huffman Trees. **DYNAMIC PROGRAMMING:** Introduction, Knapsack problems, Travelling Salesman problem. Transitive closure - Warshall's and Floyds algorithm.

Case Study	shortest path algorithms in GPS navigation.
Text Book	Text Book 1: 9.1,9.2,9.3,9.4

MODULE-4	**DECREASE & CONQUER, TRANSFORM & CONQUER**	22AIM43.4	**8 Hours**

Decrease &conquer: Introduction – Decrease by constant, decrease by constant factor-Fake Coin Problem-Russian Peasant Multiplication, variable size decrease.
Transform & conquer:Introduction, Balanced Search trees – AVL trees & 2-3 trees, Red Black Trees

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

MODULE-5	BACKTRACKING, BRANCH AND BOUND	22AIM43.5,22AIM43.6	8 Hours

Backtracking: Introduction, N Queens problem, subset sum problem, **Branch and Bound:** Introduction, Travelling Salesman problem, Knapsack problem, Assignment problem, NP-Hard and NP-Complete problems: Basic concepts, non- deterministic algorithms.

Text Book	Text Book 1: 12.1,12.2,12.3

CIE Assessment Pattern (50 Marks – Theory)

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

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Anany Levitin, "Introduction to the Design &Analysis of Algorithms",3rd Edition,PEARSON Education, 2012. ISBN: 978-9332585485

ReferenceBook:

1.Thomas H Cormen, Charles E Leiserson, Ronald R Rivest & Clifford Stein, "Introduction to Algorithms", 3rd Edition,Eastern Economy Edition, 2009. ISBN: 9780262033848,

Web links and Video Lectures (e-Resources):

1. https://youtu.be/gY0MwGLq9W8
2. https://onlinecourses.nptel.ac.in/noc19_cs47/preview

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

- Assign coding challenges or mini-projects that require students to apply programming concepts to real coding problems.
- Creating simple apps, design, and problem-solving skills.

DESIGN AND ANALYSIS OF ALGORITHM LAB			
Course Code	**22AIL43**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEEMarks**	**50**
Hrs/Week	**2**	**TotalMarks**	**100**
Credits	**01**	**ExamHours**	**03**

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

22AIL43.1	Utilize optimized algorithms to address a range of problems effectively.
22AIL43.2	Examine the workings of sorting problems through the application of various algorithmic methods
22AIL43.3	Apply Greedy design technique to address complex problems
22AIL43.4	Apply different algorithmic design techniques to solve graph traversal, combinatorial problems, queens and sum of subset problems.

MappingofCourseOutcomestoProgramOutcomesandProgramSpecificOutcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIL43.1	-	3	-	-	-	-	-	-	-	-	-	3	3	2
22AIL43.2	-	3	-	-	-	-	-	-	-	-	-	3	3	2
22AIL43.3	3	-	-	-	-	-	-	-	-	-	-	3	3	2
22AIL43.4	3	-	-	-	-	-	-	-	-	-	-	3	3	2

Pgm.No.	List of Experiments/Programs	Hours	COs
	Prerequisite Experiments/Programs/ Demo		
	• **Basics of Datastructures.** • **C/Python Programming basics.**	2	NA
	Part A		
1	Write a program to find GCD of two numbers by using i) Euclidean Algorithm ii) Differential Algorithm a. Consecutive Integer Algorithm	2	22AIL43.1
2	Write a program to implement stringmatching using i) Brute Force Approach ii) Robin-Karp Algorithm	2	22AIL43.1
3	Write a program to sort a given set of n integer elements using merge sort and compute its time complexity. Run the program for varied values of n and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be fetched by user or can be generated using the random number generator.	2	22AIL43.1 22AIL43.2
4	Write a program to sort a given set of n integer elements using quick sort and compute its time complexity. Run the program for varied values of n and record the time taken to sort. Demonstrate how the brute force method works along with its time complexity analysis, worst case and best case.	2	22AIL43.2 22AIL43.3
5	Write a program to find minimum cost spanning tree of a given connected undirected graph using Prim's algorithm.	2	22AIL43.2 22AIL43.3
6	Write a program to find minimum cost spanning tree of a given connected undirected graph using Kruskal's algorithm.	2	22AIL43.2 22AIL43.3
	Part B		

7	Write a program to determine the most valuable items to carry in a knapsack with a limited weight capacity. Chooses the maximum number of non-overlapping activities from a set of activities using knapsack Greedy method.	2	22AIL43.2 22AIL43.3
8	Write a program to find the shortest path between two vertices in a graph, detecting negative cycles in a graph, and computing the transitive closure of a graph using Flyods algorithm.	2	22AIL43.2 22AIL43.3
9	Write a program to determine travel routes, distribution of resources, and evacuation planning for graph and find the time complexity using Warshall's Algorithm.	2	22AIL43.2 22AIL43.3
10	Write a program to sort a Directed Acyclic Graph (DAG) is a linear ordering of vertices such that for every directed edge u v, vertex u comes before v in the ordering using Topological Sorting	2	22AIL43.2 22AIL43.3
11	Design and implement in Java/Python to find a subset of a given set S = {Sl, S2,.....,Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S ={1,2, 5, 6, 8} and d= 9, there are two solutions {1,2,6}and {1,8}. Display a suitable message,if the given problem instance doesn't have a solution.	2	22AIL43.3 22AIL43.4
12	Write a program to solve the following puzzle using N Queen Problem: The sum of i and j is constant and unique for each right diagonal, where i is the row of elements and j is the column of elements. The difference between i and j is constant and unique for each left diagonal, where i and j are row and column of element respectively.	2	22AIL43.3 22AIL43.4

PART-C

Beyond SyllabusVirtualLab Content

Data structures Concepts: https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html

Sorting and Trees Concepts: https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html

https://cse01-iiith.vlabs.ac.in/List%20of%20experiments.html

CIEAssessmentPattern(50Marks–Lab)

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

SEEAssessmentPattern(50Marks–Lab)

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

Suggested Learning Resources:

ReferenceBooks:

1.Thomas H Cormen, Charles E Leiserson, Ronald R Rivest & Clifford Stein, "Introduction to Algorithms" , 3rd Edition, EasternEconomyEdition,2009. ISBN: 9780262033848,

DATA SCIENCE			
Course Code	**22AIM44**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEEMarks**	**50**
Hrs/Week	**3**	**TotalMarks**	**100**
Credits	**03**	**ExamHours**	**03**

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

22AIM44.1	Explore predictive modeling techniques with necessary python packages
22AIM44.2	Apply descriptive statistics concepts for data preparation
22AIM44.3	Develop and examine appropriate methods for data wrangling
22AIM44.4	Analyze efficient solution for the given data sources.
22AIM44.5	Examine the data transformation and dimension reduction techniques on the data source.
22AIM44.6	Design different types of conversion techniques for the Machine Learning model

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM44.1	3	-	-	-		-	-	-	-	-	-	3	3	3
21AIM44.2	3	-	-	-		-	-	-	-	-	-	3	3	3
21AIM44.3	-	-	3		3	-	-	-	-	-	-	3	3	3
21AIM44.4	-	3	-			-	-	-			-	3	3	3
21AIM44.5	-	3	-	-	-	-	-	-	-	-	-	3	3	3
21AIM44.6	-	-	3	-	2	-	-	-	-	-	-	3	3	3

MODULE-1	**BASIC CONCEPTS AND PYTHON PACKAGES**	22AIM44.1	**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.

Textbook	Textbook1: Chapter:1,2,3, 4

MODULE-2	**DESCRIPTIVE STATISTICS AND DATA PREPARATION**	22AIM44.1, 22AIM44.2, 22AIM44.4	**8 Hours**

Descriptive Statistics: Reasons to study Statistics, Sampling, Data Analysis Process, Mean, Median, StandardDeviation, Skewness, Kurtosis, Graphical Representation-Box Plots, Pivot Table, Heat Map Correlation, Statistics–ANOVA. **DataPreparation:** Need for Data Pre-processing, DataTransforms, and Rescale Data Standardize Data, Normalize Data, Binarize Data, Univariate and Bivariate Data, Recursive Feature Elimination, Principal Component Analysis.

Textbook	Textbook 2: Chapter:1, 2,4, 5, 8, 10,11, 12,13,14,15

MODULE-3	**DATA CLEANING AND FEATURE SELECTION**	22AIM44.3, 22AIM44.4	**8 Hours**

Data Cleaning: Basic data cleaning, Outlier Identification and Removal, how to Mark and Remove 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.

Textbook	Text Book1 : Chapter:5, 6,7, 8,9, 10,11, 12,13, 14,15, 16.

MODULE-4	**DATA TRANSFORM AND DIMENSIONALITY REDUCTION**	22AIM44.4, 22AIM42.5	**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

Textbook	Text Book1: Chapter:17,18, 19,20,21,23,27, 28,29, 30.		
MODULE-5	**OTHER TRANSFORMS**	22AIM44.5, 22AIM44.6	**8 Hours**

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

Case Study	Big Mart Sales Prediction ML Project –Learn about Unsupervised Machine Learning Algorithms, Health care (Pfizer), Boston House Pricing PredictionProject
Textbook	Textbook 1: Chapter:22,24,25, 26,

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**		
		Test (s)	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	5	**-**	**5**
L2	**Understand**	5	**-**	**5**
L3	**Apply**	10	5	
L4	**Analyze**	5	10	-
L5	**Evaluate**	-	-	**-**
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**	**20**
L4	**Analyze**	**10**
L5	**Evaluate**	**--**
L6	**Create**	**--**

Text Books:

1) Jason Brownlee, "Data Preparation for Machine Learning" 2020.
2) RoxyPeck, Chris Olsen and Jay Devore, "Introduction to Statistics & Data Analysis "3rd Edition Thomson Higher Education,2015. ISBN: 1305445961, 9781305445963

ReferenceBooks:

1) Andrew Park ,"DataScience For Beginners",2021. ISBN: 9781914167997
2) Nitish Vig, "Statistics101" by David Borman,2018.
3) Norman Matloff, "Probability and Statistics for Data Science",CRC Press,2019. ISBN: 9780429687112

Weblinks and Video Lectures(e-Resources):

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

DATA SCIENCE LAB			
CourseCode	**22AIL44**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEEMarks**	**50**
Hrs/Week	**2**	**TotalMarks**	**100**
Credits	**01**	**ExamHours**	**03**

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

22AIL44.1	Apply Data Science techniques to solve the problem
22AIL44.2	Derive the solution for real time problem using reading and writing the different real time dataset.
22AIL44.3	Develop visualizations, finding correlation, covariance, applying regression model.
22AIL44.4	Formulate and apply Classification and Clustering techniques.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	P SO1	PSO2
22AIL44.1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22AIL44.2	3	3	3	-	-	-	-	-	-	-	-	-	3	2
22AIL44.3	3	3	3	-	3	-	-	-	-	-	-	3	3	2
22AIL44.4	3	3	3	3	3	-	-	-	-	-	-	3	3	2

Ex. No		Hours	COs
	Prerequisite Experiments/Programs/ Demo		
	Recall the following python Libraries commandsfordata science. a. Numpy b. Pandas c. Matplot d. Scipy	**2**	NA
	Part A		
1.	Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location. a. Reading Excel data sheet using Python Pandas. b. Reading XML dataset using Python Pandas. c. Reading JSON data using Python Pandas Create three datasets in different formats: employees.xlsx (Excel), departments.xml (XML), and salaries.json (JSON). Perform the following tasks: a. Read all three datasets into Pandas DataFrames. b. Merge these datasets based on a common column (e.g.,employee_id). c. Save the merged DataFrame to a new CSV file in a specified disk location. .	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4
2.	Design a Python program to perform exploratory data analysis tasks on a sample dataset. Select an appropriate data set for your experiment and draw the following graphs. a. Find the data distributions using box and scatter plot. b. Find the outliers using plot. c. Plot the histogram, bar chart and pie chart on sample data. d. Plot the HeatMap	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4
3.	Implement K-fold cross validation techniques. Perform a cross-validation experiment on for a given set of training data examples stored in a .CSV file using 10 folds	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4

4	Perform the following methods in order to remove outliers a. Standard Deviation Method b. Interquartile Range Method c. Automatic outlier Detection Create a statistics_metrics.csv dataset with columns quarter, revenue, expenses and profit, and perform the following tasks: a. Identify and remove outliers using both the Standard Deviation method and the Interquartile Range (IQR) method. b. Compare the datasets before and after outlier removal using box plots and scatter plots.	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4
5	Implement the program to avoid Data leakage with Naïve Data preparation. Select an appropriate data set for your experiment and validate the results	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4
6	Apply the following on for a given set of training data examples stored in a .CSV file Find the correlation matrix. a. Plot the correlation plot on dataset and visualize giving an overviewof relationships among data. b. Interpret the correlation matrix and identify any strong correlations between features and housing prices. c. Perform ANOVA to compare the means of the numerical features across different neighborhoods or zones in Boston	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4
	Part B		
7.	Implement the following for a given set of training data examples stored in a .CSV file a. Load data set b. Convert into Dataframe c. Apply Scaler method d. Fit the Scaler Data into PCA e. Plot the visualization diagram for PCA Evaluate the Dimensionality Reduction: a. Compare the performance of a machine learning algorithm (e.g., logistic regression or k-nearest neighbors) on the original dataset versus the reduced-dimensional dataset using cross-validation or another suitable evaluation metric.	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4
8	For a given set of training data examples stored in a .CSV file a. Statistical Imputation b. KNN Imputation a. Iterative Imputation	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4
9	Implement the following Encoding methods for a given set of training data: a. Ordinal Encoding b. One Hot Encoding c. Dummy Variable Encoding	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4
10	Implement the following Transform methods on a numerical dataset: Uniform Discretization Transform	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4
11	Implement the following Transform methods on a numerical dataset: K-Means Discretization Transform	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4

12	Write a program to implement Binary classification, Multi-classification and regression for given dataset.	**2**	22AIL44.1 22AIL44.2 22AIL44.3 22AIL44.4

PART-C

Beyond Syllabus/ Virtual Lab Content

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)

RBTLevels		**Test (20 marks)**	**Weekly Assessments (30marks)**
L1	**Remember**	-	-
L2	**Understand**	**5**	**5**
L3	**Apply**	**5**	**10**
L4	**Analyze**	**10**	**10**
L5	**Evaluate**	**-**	**5**
L6	**Create**	**-**	**--**

SEEAssessmentPattern (50Marks–Lab)

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

Suggested Learning Resources:

Textbooks:

1)Yanchang Zhao,"R and DataMining:Examples and CaseStudies",Elsevier,1stEdition,2012, ISBN: 9780123972712

Reference Books:

1) Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition, Morgan Kaufmann Publishers,2016. ISBN: 9780123814807

RUBY PROGRAMMING			
Course Code	**22AIM451**	**CIE Marks**	**50**
L:T:P:S	**2:0:1:0**	**SEEMarks**	**50**
Hrs/Week	**2+2**	**TotalMarks**	**100**
Credits	**3**	**ExamHours**	**03**

Course outcomes: At the end of the course, the student willbeableto:

22AIM451.1	Understand the syntax, control structures and looping functions.
22AIM451.2	Apply the concept of object-oriented programming concepts on Ruby
22AIM451.3	Illustrate the MVC architecture of Ruby on Rails.
22AIM451.4	Analyze the coding standards and derive the test cases.
22AIM451.5	Develop application using meta-programming concepts.
22AIM451.6	Integrate Ruby with other programming languages to foster a cross-platform development.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM451.1	2	-	-	-	-	-	-	-	-	-	-	-	3	-
22AIM451.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
22AIM451.3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
22AIM451.4	3	3	-	-	--	-	-	-	-	-	-	-	3	-
22AIM451.5	3	3	3	-	-	-	-	-	-	-	-	-	3	-
22AIM451.6	3	3	3	3	-	-	-	-	-	-	-	-	3	-

MODULE-1	**INTRODUCTION**	22AIM451.1	6 Hours

Installation and Setup, Ruby Syntax, Variables, Data Types, and Operators, Control Structures and Loops, Functions and Methods.

Laboratory Component: 3 Hours

1. **Variables and Arithmetic**: Learn variable assignment and basic math operations.
2. **Data Types**: Explore integers, floats, strings, and booleans.
3. **User Interaction**: Accept user input and display it.
4. **Control Flow**: Master conditionals and loops for decision-making.
5. **Data Structures**: Work with arrays and strings.
6. **Functions (Methods)**: Define, call, and return values from functions.

Program Examples: Develop practical programs like a calculator and word game

Text Book	Text Book1:3,4, 5,6

MODULE-2	**OBJECT-ORIENTED PROGRAMMING**	22AIM451.2	6 Hours

Classes and Objects, Inheritance and Polymorphism, Encapsulation and Abstraction, Modules and Mixins.

Laboratory Component: 3 Hours

1. Write a program using Classes and Objects in Ruby.
2. Write a program for inheritance using Ruby.

Implement OOP concept on Net Banking system

Text Book	Text Book1:7,8 Text Book2:4

MODULE-3	**WEB DEVELOPMENT WITH RUBY ON RAILS**	22AIM451.3	6 Hours

Overview of Ruby on Rails, Setting and Configuration for Rails Application, MVC Architecture, Database Integration using Active Record, Views and TemplatesusingERB

Laboratory Component: 3 Hours

1. To create online stores with decent and sophisticated browsing and purchasing options.
2. To create efficient stock marketing platforms.
3. To create Social Networking sites.

Text Book	Text Book2:1,2

MODULE-4	**CODING STANDARDS AND TESTING**	22AIM451.4	6 Hours

Coding Style and Standards, Documentation using RDoc and YARD, Version Control using Git.TestingFrameworks -RSpec, Writing and Running Tests for Ruby Code, Code Debugging-Pry.

Laboratory Component: 1. Using Functional testing on Health care data. 2. Write a program for an Online survey process for healthcare dataTest. 3. Write a program in Ruby programming using coding standard and style.		3 Hours
Text Book	Text Book: 2	
MODULE-5	**ADVANCED RUBY** 22AIM451.5	6 Hours
eta-programming, Concurrency using threads and fibers, Performance Optimization, Integrating Ruby with Other Languages, Working withAPIs, Data Processing and Analysis using Ruby		
Laboratory Component: 1. Visualize the data using Ruby, 2. Develop a program for Data Science concepts in Ruby 3. Develop a program for Performance optimization using Ruby.		3 Hours
Text Book	Text Book: 2	

CIE Assessment Pattern (50Marks– Theory and Lab)

RBTLevels		Test(s) (25)	Assessment * (5)	Lab 20 marks
L1	**Remember**	5	**-**	
L2	**Understand**	5	**-**	
L3	**Apply**	5	5	10
L4	**Analyze**	5	-	10
L5	**Evaluate**	5	-	
L6	**Create**	**-**	**-**	

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

SEE Assessment Pattern (50Marks– Theory)

RBTLevels		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) David Flanagan and Yukihiro Matsumoto, "The Ruby Programming Language, Publisher:O'Reilly,1st edition 2008, ISBN-10:0-596-51617-7, ISBN-13:978-0-596-51617-8

2) Michael Hartl, "The Ruby on Rails Tutorial-LearnWebDevelopmentwithRails(Addison-wesley Professional Ruby)",4th edition2016,ISBN-100134598628**,** ISBN-13978-0134598628

ReferenceBooks:

1) David Thomas, Andrew Hunt, "Programming Ruby", Publisher: Addison-Wesley, 2001, ISBN:9780201710892, 0201710897

2) Jay McGavren, "Head First Ruby: A Brain-FriendlyGuide 1st Edition", Publisher:O'Reilly Media, 2015. ISBN-109781449372651, ISBN-13978-1449372651

3) DavidA.Black," The Well-GroundedRubyist", Manning Publications,2014, ISBN-109781617291692, 13978-1617291692,

Web links and Video Lectures(e-Resources):

- https://onlinecourses.swayam2.ac.in/aic20_sp37/preview
- https://www.aspiresys.com/casestudies/Case%20Study%20-%20Ruby%20on%20Rails.pdf
- https://www.toptal.com/ruby/ruby-metaprogramming-cooler-than-it-sounds
- https://www.rubyguides.com/ruby-tutorial/object-oriented-programming/
- https://semaphoreci.com/community/tutorials/getting-started-with-rspec

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

- Video demonstration of latest trends in Programming
- Contents related activities (Activity-baseddiscussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Groupwise discussions on issues
  - Seminars

C# AND .NET FRAMEWORK			
Course Code	**22AIM452**	**CIE Marks**	**50**
L:T:P:S	**2:0:1:0**	**SEEMarks**	**50**
Hrs/Week	**2+2**	**TotalMarks**	**100**
Credits	**03**	**ExamHours**	**03**

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

22AIM452.1	Demonstrate a comprehensive understanding of various data structures and Data Manipulation in C#
22AIM452.2	Apply delegates and events for .NET framework.
22AIM452.3	Analyze software architecture in web services.
22AIM452.4	Implement advanced file handling techniques, ensuring competency in file and data management within .NET applications
22AIM452.5	Proficiency in design, develop, and deploy web applications using .NET
22AIM452.6	Develop server-side applications and web services.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM452.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM452.2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM452.3	3	3	-	-	-	-	-	-	-	-	-	-	3	3
22AIM452.4	3	3	3	-	-	-	-	-	-	-	-	-	3	3
22AIM452.5	3	3	-	-	2	-	-	-	-	-	-	-	3	3
22AIM452.6	3	3	-	-	2	-	-	-	-	-	-	-	3	3

MODULE-1	**.NET frame work overview**	22AIM452.1	6 Hours

.NET frame work architecture. Introduction to C# language: Primitive datatypes–Enumerations–Expressions–Statements–Control structures (if, for,while,do.While,for each).Object-oriented concepts in .NET– Common type system.

Text Book	TextBook2 : unit1,2,3,4,5

Laboratory Component: 3 Hours

1. Write a program demonstrates the use of primitive data types, expressions, and control structures.
2. Write a program to illustrate object-oriented concepts in C#.
3. Write a program to demonstrate file I/O operations, expressions, , as well as the use of exceptions for error handling

MODULE-2	**Collection Classes and Strings**	22AIM452.2	6 Hours

Arrays and collections- Dictionaries-Hash Set and Sorted Set-Queues-Linked Lists.–Working with strings–The String and CharTypes-Literal Strings and Chars-Formatting Data for Output- Standard Numeric Format
Strings-Custom Numeric Format Strings-Dates and Times-Converting Strings to Other Types

TextBook	Text Book1: Ch- 9,10

Laboratory Component: 3 Hours

1. Create a program that demonstrates the use of a dictionary to store and retrieve key-value pairs
2. Develop a program that takes user input as a sentence and performs various string operations, such as counting the number of words, reversing the sentence, or converting it to title case.
3. Write a program that allows users to perform date and time calculations, such as finding the difference between two dates, adding or subtracting days, and displaying the current date and time in different formats

MODULE-3	**XML and Networking**	22AIM452.2, 22AIM452.3, 22AIM452.4	6 Hours

Working with XML Creating XML Documents- XML Elements-XML Attributes-Searching for a Single Node-Search Axes- Where Clauses- XMLSerialization–Networking-Web Application with Client-Side Code- .NET Client and.NETServer-.NET Client and External Party Web Service-External Client and .NET Web Service-WCF- Creating a WCF Project-Hosting a WCF Service

Text Book	TextBook 2: Ch-12,13

Laboratory Component: 1. Create a program that generates an XML document containing information about books, including titles, authors, and publication years. Save this XML data to a file 2. Write a program to parse and display specific book details from the XML file. 3. Develop a program that consumes a public web service, such as a weather forecast service or a currency conversion service.			3 Hours
MODULE-4	**Files and Streams**	22AIM452.2,22AIM452.3,22AIM452.4	6 Hours
Files and Streams -Inspecting Directories and Files-Examining Directories -Manipulating File Paths -Pathand the Current Working Directory -Examining File Information-Creating Temporary Files -Deleting Filesand directory -Writing Text Files-Finding and Modifying Permissions-Reading Files into Memory-MovingAroundina Stream -Writing Datawith Streams-Reading, Writing, and Locking Files			
Text Book	Text Book 2: Ch-11		
Laboratory Component: 1. Write a progam to retrieve data from the web service and display it in a user-friendly format. 2. Creating a program to create a file ,modifying permissions. 3. Write a program to identify the path in Dot Net .			3 Hours
MODULE-5	**Windows Forms**	22AIM452.4,22AIM452.5, 22AIM452.6	6 Hours
Creating a Web Application-Data Binding -Windows forms – ASP.NET and Web applications -Code-Behind Files-Adding Controls-Server Controls-Data Binding-Examining the Code-Adding Controls and Events			
Text Book	Text Book 2: Ch-21,22		
Laboratory Component: 1. Design a web form with server controls, employ data binding to display dynamic content using ASP.Net. 2. Write a code-behind logic to handle user interactions and events using ASP.Net. 3. Design a graphical user interface, implement data binding for data manipulation			3 Hours

CIE Assessment Pattern (50Marks– Theory and Lab)

RBT Levels		Test(s) (25)	Assessment(s) (5 marks)	Lab (20)marks
L1	**Remember**	5	**-**	
L2	**Understand**	5	**-**	
L3	**Apply**	5	5	10
L4	**Analyze**	5	-	10
L5	**Evaluate**	5	-	
L6	**Create**	**-**	**-**	
*Assessments are to be selected from the assessment list attached to **Appendix A.**				

SEE Assessment Pattern (50Marks– Theory)

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

uggested Learning Resources:

Text Books:

1. Art Gittleman "Computing with C# and the .NET Framework", Jones and Bartlett Learning, 2nd Edition,2012, ISBN: 9781449615505, 1449615503
2. Programming C#: Building. NET Applications with C#, By Jesse Liberty, O' Reilly,2009. ISBN: 978-0596006990

ReferenceBooks:

1.Roger Villela Pro .NET Frame work with the Base Class Library Apress, First Edition, 2019. ISBN: 9781484241912

Weblinks andVideo Lectures(e-Resources):

1. www.nlp.stanford.edu/IR-book/html/htmledition/irbook.html
2. www.text-analytics101.rxnlp.com/2014/11/what-are-n-grams.html
3. www.nptel.ac.in/courses/106105084/
4. www.nitttrchd.ac.in/sitenew1/nctel/ppt/CS0.ppt
5. www.pragimtech.com/c-sharp-video-tutorials.aspx

Activity-Based Learning (SuggestedActivitiesinClass)/PracticalBasedlearning

- Contents related activities (Activity-baseddiscussions)
  - For active participation of students, instruct the students to prepare web-based projects
  - Organizing Group wise discussions on issues
  - Seminars

R PROGRAMMING			
Course Code	**22AIM453**	**CIE Marks**	**50**
L:T:P:S	**2:0:1:0**	**SEEMarks**	**50**
Hrs/Week	**2+2**	**TotalMarks**	**100**
Credits	**03**	**ExamHours**	**03**

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

22AIM453.1	Understand the types, classes and functions of R Programming.
22AIM453.2	Apply the knwolege of R Data Structures for real world example.
22AIM453.3	Develop programming logic using R–Packages
22AIM453.4	Analyze the Data manipulation in R programming.
22AIM453.5	Illustrate the basics of Data Preparation with real world examples.
22AIM453.6	Design Visualization using R tools for given data set.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM453.1	2	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM453.2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
22AIM453.3	3	3	3	-	3	-	-	-	-	-	-	-	3	3
22AIM453.4	3	3	-	-	-	-	-	-	-	-	-	-	3	3
22AIM453.5	3	3	-	3	3	-	-	-	-	-	-	-	3	3
22AIM453.6	3	3	-	3	3	-	-	-	-	-	-	-	3	3

MODULE-1	**FUNDAMENTALS OF RPROGRAMMING**	22AIM453.1	6 Hours

Installation of R & R Studio, Features of R, Variables in R, Constants in R, Operators in R, Datatypes and RObjects, Accepting Inputfrom keyboard, ImportantBuilt-infunctions

LaboratoryComponent:	3 Hours
1. Download and install R-Programming environment and install basic packages using install. Packages, command in R. 2. Learn all thebasics of R-Programming (Data types, Variables, Operators) etc. 3.Write a programtofindlistof even numbersfrom1ton usingR-Loops	

Self-study / Case Study /Applications	Data Frames in R
Text Book	Text Book1

MODULE-2	**UNDERSTANDING R DATASTRUCTURE**	22AIM453.2	6 Hours

Variables in R, Scalars, Vectors, Matrices, List, Data frames, Usingc, Cbind, Rbind, attach and detach functions in RFactors

Laboratory Component:(minimum3experiments/programs)	3 Hours
1. Implement different String Manipulation functions in R. 2. Implement different data structures in R (Vectors, Lists, Data Frames). 3.Implementation of matrix, array and factorsand perform in R	

Self-study / Case Study /Applications	R-Packages
Text Book	Text Book1

MODULE-3	**IMPORTING DATA**	22AIM453.3	6 Hours

Reading Tabular Data files, Reading CSV files, Importing data from excel, Importing data from SAS, Accessing database, Savingin Rdata, Loading R dataobjects, Writing to files

LaboratoryComponent:	3 Hours
1. Write a program to read a csv file and analyze the data in the file in R. 2.Implementation and use of data frames in R 3.Create a dataset and do statistical analysis on the data using R.	

Self-study / Case Study /Applications	R-Factors
Text Book	Text Book1

MODULE-4	MANIPULATING DATA	22AIM453.4	6 Hours
Selectingrows/observations, selecting columns/fields, merging data, Relabelling the column names, Converting variable types, Data sorting, Data aggregation			
LaboratoryComponent: 1. Create Sample (Dummy) Data in Rand perform data manipulation with R 2. Study and implementation of various control structures in R 3. Data Manipulation with dplyr package			3 Hours
Self-study / Case Study /Applications	DPLYRPackage		
Text Book	Text Book2		
MODULE-5	**R DATA VIZUALIZATION**	22AIM453.5	6 Hours
R Functions, Data Visualization, Boxplot, Histogram, Pare to charts, Piegraph, Linechart, Scatter plot, Developing graphs, Simulating a Linear Model			
LaboratoryComponent: 1. Create pie chart and bar chart using R. 2. Use R Graphics to visualize results of various statistical operations on data. 3. Study and implementation of Data Visualization with gg plot2			3 Hours
Self-study/Case Study /Applications	R-Graphics		
Text Book	Text Book2		

CIE Assessment Pattern (50Marks– Theory and Lab)

RBTLevels		Test(s) (25)	Assessment(s) * (5)	Lab 20 marks
L1	**Remember**	5	**-**	
L2	**Understand**	5	**-**	
L3	**Apply**	5	5	10
L4	**Analyze**	5	-	10
L5	**Evaluate**	5	-	
L6	**Create**	**-**	**-**	

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

SEE Assessment Pattern (50 Marks– Theory)

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

Suggested Learning Resources:

TextBooks:

1) S Norman Matloff, The Art of R Programming, UCDavis, 2009. ISBN: 978-1593273842
2) R Programming for Data Science, Roger DPeng, Lean Publication, 2016. ISBN: 978-1365056826

ReferenceBooks:

1)R for Data Science: Import, Tidy, Transform, Visualize, and Model Data by Hadley Wickham, O'RELLY,2017. ISBN: 9781492097402

WeblinksandVideoLectures(e-Resources):

- http://cran.r-project.org(linkisexternal)
- https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf(OnlineResources)
- https://onlinecourses.nptel.ac.in/noc19_ma33/preview
  https://www.youtube.com/watch?v=N-DQ8iDlH_U&list=PLJ5C_6qdAvBFfF7qtFi8Pv_RK8x55jsUQ

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

- Contents related activities (Activity-baseddiscussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Groupwise discussions on issues
  - Seminars

ADVANCED PYTHON PROGRAMMING			
Course Code	**22AIM454**	**CIE Marks**	**50**
L:T:P:S	**2:0:1:0**	**SEEMarks**	**50**
Hrs/Week	**2+2**	**TotalMarks**	**100**
Credits	**03**	**ExamHours**	**03**

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

22AIM454.1	Understand OOP concepts in Python including Inheritance and Polymorphism.
22AIM454.2	Apply the knowlogedge on files and perform operations on it using Python.
22AIM454.3	Develop regular expression and concept of threads for developing efficient program.
22AIM454.4	Analyze exception handling in Python applications for error handling.
22AIM454.5	Implement the objected Oriented Concepts to solve given problem
22AIM454.6	Design databases, designing GUI in Python and implement Networking in Python

MappingofCourseOutcomestoProgramOutcomesandProgramSpecificOutcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM454.1	2	-	-	-	-	-	-	-	-	-	-	-	3	2
22AIM454.2	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22AIM454.3	3	3	3	-	-	-	-	-	-	-	-	-	3	2
22AIM454.4	3	3	-	-	-	-	-	-	-	-	-	-	3	2
22AIM454.5	3	3	3	-	-	-	-	-	-	-	-	-	3	2
22AIM454.6	3	3	3	3	3	-	-	-	-	-	-	-	3	2

MODULE-1	**Working with files, Regular Expressions**	22AIM454.1	6 Hours

Working with files: Files, opening and closing a file, working with text files containing strings, knowing whether a file exists or not, working with binary files, the "with" statement, the seek() and tell() methods, random accessing of binary files, zipping and unzipping files, working with directories, running other programs from python program.

Regular expressions: What is a regular expression?, sequence characters in regular expressions, quantifiers in regular expressions, special characters in regular expressions, using regular expression on files, retrieving information from an html file.

LaboratoryComponent:	3 Hours
1. Write a Python program to implement various file operations. 2. Write a Python program to demonstrate use of regular expression for suitable Application. 3.Write a program to retrieve the information from an html file.	

Self-study / Case Study	Use Python's built-in open() function to read and write to text files. Implement context managers (with statements) to ensure proper file handling and automatic resource cleanup.
Text Book	Text Book1:8

Module 2	**Threads and Data**	22AIM454.2	6 Hours

Threads in python: Difference between process and thread, types of threads, benefits of threads, creating threads, single tasking and multitasking, thread synchronization, deadlock in threads, daemon threads.

Date and time in python: Date and time now, combining date and time, formatting dates and times, finding duration nusing "timedelta", comparing two dates, sorting dates, stopping execution temporarily, knowing the time taken by aprogram, calendar module.

LaboratoryComponent:	3 Hours
1. Write a Program to demonstrate concept of threading and multitasking in Python. 2. Write a Python Program to create application which uses date and time. 3. Write a program to stopping execution temporarily using python.	

Text Book	Text Book3:10

MODULE-3	**Exceptions and Database in python**	22AIM454.3 22AIM454.4	6 hours
Database in python: Using SQL with python, retrieving rows from a table, inserting rows into a table, deleting rows from a table, updating rows in a table, creating database tables through python, Exception handling in databases. **Exceptions in python:** Errors in a python program, compile&run-time errors, logical error, exceptions-exception handling, types of exceptions, the except block, the assert statement, user-defined exceptions, logging the exceptions			
Laboratory Component: 1. Write a Python Program to work with databases in Python to perform operations such as Connecting to database 2.Creating and dropping tables Inserting and updating into tables. 3. Write a Python Program to demonstrate differentty pes of exception handing.			3 Hours
Text Book	Text Book1:15		
MODULE-4	**Networking:** Protocols, server-client architecture, tcp/ip and udp communication Graphical user interface: Creating a GUI in python, Widget classes, Working with Fonts and Colors, working with Frames, Layout manager, Event handling **OOPs in python:** Features of Object-Oriented Programming system(oops) – classes and objects, encapsulation, abstraction inheritance, polymorphism, constructors and destructors.	22AIM454.4 22AIM454.6	6 Hours
LaboratoryComponent: 1. Write a GUI Program in Python to design application that demonstrates Different fonts and colors different Layout Managers and Event Handling 2. Write a Python program to create server-client and exchange basic information. 3.Write a python program for constructors and desstructors concepts			3 Hours
CaseStudy	Handle socket-related exceptions and errors effectively to prevent crashes and improve the application's robustness.		
Text Book	TextBook1:13 Textbook3:13		
MODULE-5	**Object Oriented Concepts in Python**	22AIM454.5	6 Hours
Classes and objects: Creating a class, the self-variable, types of variables, namespaces, types of methods, instance methods, class methods, static methods, passing members of one class to another class, inner classes **Inheritance and polymorphism:** Inheritance in python, types of inheritance- single inheritance, multilevelinheritance, hierarchical inheritance, multiple inheritance, constructors in inheritance, overriding super classconstructors and methods, the super () method, method resolution order (mro), polymorphism, duck typing, operator overloading, method overloading, method overriding, Abstract classes and interfaces: Abstractclass, Abstract method, Interfaces in python, abstract classes vs. Interfaces			
LaboratoryComponent: 1. Writea program to Python program to implement concepts of OOP such as a. Types of Methods b. Inheritance c. Polymorphism 2. Writea program to Python program to implement concepts of OOP such as a. Abstract methods and classes b. Interfaces 3. Write a program for inner class using Python.			3 Hours

CaseStudy	Design the system using OOP principles to create modular, maintainable, and extensiblecode. Create classes for data collection, strategy implementation, risk management, trade execution, and portfolio management.
Text Book	Text Book1:13

CIE Assessment Pattern (50Marks– Theory and Lab)

RBTLevels		Test(s) (25)	Assessment (s) * (5)	Lab 20 marks
L1	**Remember**	5	**-**	
L2	**Understand**	5	**-**	
L3	**Apply**	5	5	10
L4	**Analyze**	5	-	10
L5	**Evaluate**	-	-	
L6	**Create**	**-**	**-**	

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

SEE Assessment Pattern (50Marks– Theory)

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

Suggested Learning Resources:

Textbooks:

1. PaulGries, Jennifer Campbell, Jason Montojo, Practical Programming: An Introduction to Computer Science Using Python3, Pragmatic Bookshelf, 3rdEdition, 2018. ISBN: 978-1680502688.
2. Programming through Python, M.T Savaliya, R. K.Maurya, G M Magar, Revised Edition, Sybgen Learning India, 2020. ISBN: 978-8194736998.
3. Python: The Complete Reference, Martin C. Brown, McGrawHill, 2018. ISBN: 978-9387572942.

AdditionalReferences:

1. Advanced Python Programming, Dr. Gabriele Lanaro, QuanNguyen, SakisKasampalis, PacktPublishing,2019. ISBN: 9781838553692,
2. Programming in Python3, Mark Summerfield, Pearson Education,2ndEd,2018. ISBN: 9780321680563
3. Beginning Python: From Novice to Professional, Magnus LieHetland, Apress,2017. ISBN: 9781484200285

Weblinks and Video Lectures(e-Resources):

1. https://www.w3schools.com/python/pandas/default.asp
2. https://matplotlib.org/stable/gallery/index.html
3. https://seaborn.pydata.org/examples/index.html
4. https://docs.scipy.org/doc/scipy/reference/linalg.html#module-scipy.linalg
5. https://scikit-learn.org/stable/auto_examples/index.html
6. https://www.tutorialspoint.com/scipy/scipy_integrate.htm\

Activity-Based Learning /PracticalBasedlearning

- Contents related activities (Activity-based discussions)
  - Organizing Group wise discussions on issues
  - Seminars

AI POWERED TOOLS AND SERVICES			
Course Code	**22AIM455**	**CIE Marks**	**50**
L:T:P:S	**2:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2+2**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM455.1	Understand the Google AI Platform, including its features, capabilities, and benefits for machine learning projects.
22AIM455.2	Learn to prepare effectively, preprocess, upload, and manage datasets on Google AI Platform, ensuring data quality and suitability for machine learning models.
22AIM455.3	Develop optimized machine learning models on Google AI Platform
22AIM455.4	Deploy trained models on Google AI Platform for inference
22AIM455.5	Evaluate the Log, troubleshoot models, performance and resource usage of Google AI
22AIM455.6	Implement ML algorithm for real world problem using AI tools.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM455.1	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**--**	**-**	**-**
22AIM455.2	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
22AIM455.3	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
22AIM455.4	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
22AIM455.5	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
22AIM455.6	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

MODULE-1	**Introduction to Google AI Platform**	22AIM455.1	6 Hours
Overview of Google AI Platform-Features and capabilities of Google AI Platform-Benefits of using Google AI Platform for machine learning projects.			
Laboratory Component: Setting up a Google AI Platform account and accessing key features			3 Hours
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16		
MODULE-2	**Data Preparation and Management**	22AIM455.2	6 Hours
Preparing data for machine learning models-Uploading and managing datasets on Google AI Platform-Data preprocessing techniques supported by Google AI Platform.			
Laboratory Component: Preprocessing and uploading a dataset for a machine learning project			3 Hours
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15		
MODULE-3	**Model Development and Training**	22AIM455.2 22AIM455.3	6 Hours
Building and training machine learning models on Google AI Platform-Choosing the right model architecture and hyperparameters-Monitoring and optimizing model training performance.			
Laboratory Component: Developing and training a machine learning model using Google AI Platform			3 Hours
Text Book	Text Book 1: 3.1, 3.3, 3.5, 3.7, 3.10		
MODULE-4	**Model Deployment and Scaling**	22AIM455.4	6 hours
Deploying trained models on Google AI Platform for inference-Scaling models to handle large-scale inference requests-versioning and managing deployed models.			
Laboratory Component: 1. Deploying a trained model and testing its performance.			3 Hours
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7.		
MODULE-5	**Monitoring, Logging, and Troubleshooting**	22AIM455.5, 22AIM455.6	6 Hours

Monitoring model performance and resource usage-Logging and analyzing model predictions and errors-Troubleshooting common issues in model deployment and inference.

Laboratory Component: Monitoring a deployed model, analyzing logs, and troubleshooting issues	3 Hours

Text Book	Text Book 1: 12.1 to 12.10

CIE Assessment Pattern (50 Marks – Theory and Lab)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment	Lab
		25	05	20
L1	Remember		-	5
L2	Understand	5	-	5
L3	Apply	10	5	5
L4	Analyze	10	-	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" Machine Learning with Google Cloud Platform: Implementing and Deploying Machine Learning Models on Google Cloud Platform", Valliappa Lakshmanan, Jordan Tigani, Publisher: O'Reilly Media, 2022. ISBN-13: 978-1492075526.

Web links and Video Lectures (e-Resources):

- Google AI Platform Documentation: https://cloud.google.com/ai-platform
- Google Cloud Platform Tutorials: https://cloud.google.com/docs/tutorials
- Google Cloud Platform Blog: https://cloud.google.com/blog
- TensorFlow Hub: https://tfhub.dev/
- Google Cloud Platform YouTube Channel: https://www.youtube.com/user/googlecloudplatform

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

- Video demonstration of latest trends in AI Tools
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare reports.
  - Organizing Group wise discussions on issues
  - Seminars

DATABASE PROGRAMMING USING CASSANDRA			
Course Code	**22AIM461**	**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:

22AIM461.1	Illustrate the concepts of Cassandra.
22AIM461.2	Apply the basics of CQL for retrieval and management of data.
22AIM461.3	Develop programs using CQL shell
22AIM461.4	Analyze practical knowledge in CQL functions and triggers, materialized views.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM461.1	3		-	-		-	-	-			-	-	3	3
22AIM461.2	3		-	-		-	-	-			-	-	3	3
22AIM461.3	3	3		-		-	-	-			-	-	3	3
22AIM461.4	3	3	3	3	3	-	-	-			-	-	3	3

Pgm. No.	**List of Experiments / Programs**	**Hours**	**COs**
	Prerequisite Experiments/Programs/ Demo		
	Basics of Data base Conecpts and SQL Basics	2	**NA**
	PART-A		
1	Demonstrate the Cassandra Installations and service configuration.	2	22AIM461.1
2	Demonstrate the CQL Shell commands: help, capture, consistency and copy with sample data base. Note: Discuss the about the shell, DDC and DMC.	2	22AIM461.1 22AIM461.3
3	Write a CQL shell script to demonstrate the following commands: 1.expand 2.show 3. Source 4. Describe 5. Exit.	2	22AIM461.1 22AIM461.3
4	Write a CQL query using select, where and order by clauses using a sample data base. Note: Discuss the CQL Clauses.	2	22AIM461.2 22AIM461.3
5	Write a CQL query to demonstrate the Cassandra keyspace and Table index concepts: Create key space, alter keyspace and Drop Key space, Truncate Table. Note: Discuss the Keyspace, Table index in canssandra.	2	22AIM461.1 22AIM461.2
6	Write a CQL query using set collection and List collection methods to display the data. Note: Discuss the Collection framework in canssandra.	2	22AIM461.1 22AIM461.2
	PART B		
7	Write a CQL query using Map operation to store and retrieve data from data base. Note: Discuss the Map collection framework.	2	22AIM461.1 22AIM461.2 22AIM461.4
8	Demonstrate the scalar function and aggregate function using CQL query. Note: Discuss the CQL functions.	2	22AIM461.1 22AIM461.2 22AIM461.4
9	Demonstrate CQL Triggers concepts: a. Create the trigger b. drop the trigger Note: Discuss the importance of Triggers.	2	22AIM461.1 22AIM461.2 22AIM461.4
10	Write to demonstrate the materialized views using CQL: a. Create materialized view b. Alter materialized view c. Drop materialized view Note: Discuss the materialized views in canssandra.	2	22AIM461.1 22AIM461.2 22AIM461.4
11	Develop a small data base for real time data and manipulate data using basic DDL commands.	2	22AIM461.1 22AIM461.2 22AIM461.3 22AIM461.4

12	Develop a user define function for upadate and modify the database using CQL commands	2	22AIM461.1 22AIM461.2 22AIM461.3 22AIM461.4

PART-C

Beyond Syllabus/ VirtualLab Content

CQL Commands: https://docs.datastax.com/en/dse/6.7/cql/cql/cql_using/cqlSyntax.html

Triggers and Functions: https://cassandra.apache.org/doc/stable/cassandra/cql/triggers.html

https://polandll.github.io/site/Cassandra/3.11/cassandra/cql/triggers.html

Advanced Topics: https://courses.cs.tau.ac.il/0368-3276/bigdata2022/slides/bigdata-08-02-cassandra-advanced.pdf

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. Mastering Apache Cassandra, Second edition-Nishant Neeraj-Packt Publishing,2015. ISBN: 9781784396251

Weblinks and Video Lectures (e-Resources):

- https://youtu.be/J-cSy5MeMOA
- https://youtu.be/iDhIjrJ7hG0
- https://youtu.be/_UGxEMdPYVI

Activity-Based Learning /Practical Based learning

- Video demonstration of Cassandra Installation.
- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to prepare Handouts
- Organizing Group wise discussions on use-cases.

DATA VISUALIZATION			
Course Code	**22AIM462**	**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:

22AIM462.1	Understand basic concepts and terminology of the Power BI service.
22AIM462.2	Apply the concept of data importing, charts and data cleaning.
22AIM462.3	Analyze the concept of View and export data from dashboards and reports.
22AIM462.4	Design the relationship between dash boards 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	PO12	PSO1	PSO2
22AIM462.1	**2**			-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM462.2	3			-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM462.3	3	3	**3**	3	3	-	-	-	**-**	**-**	-	-	3	3
22AIM462.4	**3**	**3**	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		
1	Visualize different groups of data using bar chart. Note: Discuss the different types of data and choosing appropriate chart type.	**2**	22AIM462.1 22AIM462.2
2	Visualize many different items and the composition of each item? (Stacked Bar) Note: Discuss the Design principles for effective visualizations	2	22AIM462.1 22AIM462.2
3	Import external data files of formats like excel, CSV into Power BI **Note::** Discuss the Importing different data sources in Power BI	2	22AIM462.1 22AIM462.2
4	Handle data errors and missing values on the imported data **Note:** Discuss the Dealing with errors and inconsistent data	2	22AIM462.2 22AIM462.3
5	Create interactive report with filters **Note:** Discuss the inking visualizations through interactions	2	22AIM462.2 22AIM462.3
6	Create a dashboard report for the given dataset **Note:** Discuss the arranging visuals in dashboards	2	22AIM462.3 22AIM462.4
	PART-B		
7	Create a new column or metrics and display in the report **Note:** Discuss the Basic DAX functions and formulas	**2**	22AIM462.3 22AIM462.4
8	Create a report with parameters which accepts user input **Note:** Discuss the parameterizing reports for dynamics analysis	2	22AIM462.3 22AIM462.4
9	Demonstrate conditional colour formatting in the report **Note:** Discuss the Visual formatting	2	22AIM462.3 22AIM462.4
10	Demonstrate the heat map report **Note:** Discuss the Heat maps	2	22AIM462.3 22AIM462.4
11	Demonstrate the drillthrough report	2	22AIM462.4
12	Creative effective report for the given dataset using Visualization methods.	2	22AIM462.4

PART-C

Beyond Syllabus/ VirtualLab Content

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/

CIE Assessment Pattern (50 Marks–Lab)

RBTLevels		Test(s) 20 marks	Weekly Assessments (30) marks
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)Introducing Microsoft PowerBI, Alberto Ferrariand Marco Russo, Microsoft Press, 2016. ISBN: 9781509302758.

Weblinks 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

GOLANG PROGRAMMING			
Course Code	**22AIM463**	**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:

22AIM463.1	Understand the basic Go language syntax and features.
22AIM463.2	Apply the concept of Go programming to solve real world problem.
22AIM463.3	Analyze the concept of arrays and pointer sin Go programming.
22AIM463.4	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	PO12	PSO1	PSO2
22AIM463.1	**3**	-	-	-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM463.2	3	**-**		-	-	-	-	-	**-**	**-**	-	-	3	3
22AIM463.3	3	3	**3**	3	-	-	-	-	**-**	**-**	-		3	3
22AIM463.4	**3**	**3**	3	-	-	-	-	-	**-**	**-**	-		3	3

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments/Programs/ Demo		
	C Program/C++ Program/Java Programming Concepts	**2**	**NA**
	PART-A		
1	Write a GoLang program to find LCM and GCD of three numbers and demonstrate the basic standard arithmetic operations. .	**2**	22AIM463.1 22AIM463.2 22AIM463.3 22AIM463.4
2	a. Write a Golang program to print Floyd's Triangle. b. Write a Golang program to swap two numbers without using third variable.	2	22AIM463.1 22AIM463.2 22AIM463.3 22AIM463.4
3	Write a Golang program to generate Fibonacci sequence up to a given number.	2	22AIM463.1 22AIM463.2 22AIM463.3 22AIM463.4
4	Write a Golang program to check whether given numbers is palindrome or not. Note: Discuss the loop and decision-making statements syntax and working methods.	2	22AIM463.1 22AIM463.2 22AIM463.3 22AIM463.4
5	a. Write a Golang program to print Pyramid of numbers. b. Write a program to sum of natural numbers.	2	22AIM463.1 22AIM463.2 22AIM463.3 22AIM463.4
6	Write a program to demonstrate the string manipulation using functions; a. creation of string b. Find string length c. concatenation of strings. Note: Discuss the functions and string.	2	22AIM463.1 22AIM463.2 22AIM463.3 22AIM463.4
	PART B		
7	Write a Golang program to illustrate comparison of two arrays.	**2**	22AIM463.1 22AIM463.2 22AIM463.3 22AIM463.4
8	Demonstrate the Working of Pointers in Golang	2	22AIM463.1 22AIM463.2 22AIM463.3 22AIM463.4
9	write a Golang program to show how to declare and define the structure.	2	22AIM463.1 22AIM463.2

	Note: Discuss the pointer in Golang.		22AIM463.3 22AIM463.4
10	write a Golang program to demonstrate the Structure as Functions Arguments.	2	22AIM363.1 22AIM363.2 22AIM363.3 22AIM363.4
11	write a Golang program to show how to access the fields of structure.	2	22AIM363.1 22AIM363.2 22AIM363.3 22AIM363.4
12	Write a Golang program using Pointers to Structures.	2	22AIM363.1 22AIM363.2 22AIM363.3 22AIM363.4

PART-C

Beyond Syllabus/ Virtual Lab Content

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. Hector Guerrero, "Excel Data Analysis Modeling and Simulation", Second Edition, Springer Nature Switzerland AG ,2019, ISBN: 9783030012809

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=iG6lN9aBrcM
- https://www.youtube.com/watch?v=_XfWkCsvbEU
- https://onlinecourses.nptel.ac.in/noc21_ge21/

Activity-Based Learning /Practical Based learning

- For active participation of students, instruct the students to prepare Flowcharts and Handouts
- Organizing Group wise discussions on issues
- Presentation

HASKELL PROGRAMMING			
Course Code	**22AIM464**	**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:

22AIM464.1	Understand the basic concepts of functional programming
22AIM464.2	Examine the operation of lists, higher order-lists and functions
22AIM464.3	Apply polymorphism and higher order functions
22AIM464.4	Analyse the different types of data structures like array and exception handling errors.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM464.1	**3**			-	-	-	-	-	**-**	**-**	-	-	3	-
22AIM464.2	3	**-**		-	-	-	-	-	**-**	**-**	-	-	3	-
22AIM464.3	3	3	**3**	-	-	-	-	-	**-**	**-**	-	-	3	-
22AIM464.4	**3**	**3**	3	-	-	-	-	-	**-**	**-**	-	-	3	-

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments/Programs/ Demo		
	Basic C Programming Concepts	**2**	**NA**
1	Write a Haskell program to demonstrate Currying and Region concepts. Note: Discuss the principles of Functional Programming.	**2**	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
2	Write a Haskell program to evaluate a expressions.	2	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
3	Write a program in Haskell to implement list function. Write a program in Haskell to demonstrate Recursive function. Note: Discuss the List and Recursive functions.	2	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
4	Write a program in Haskell to implement Tuples.	2	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
5	Demonstrate the polymorphism and higher-order functions using Haskell programming. Note: Discuss the concepts of Polymorphism and High-order functions.	2	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
6	Write a program in Haskell to implement Map and filter concepts.	2	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
	PART-B		
7	Write a program using infinite list in Haskell.	**2**	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
8	Write a Haskell Program to read and write the data into file. Note: Discuss the files, Input and output then streams.	2	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
9	Write a Program in Haskell using Zippers.	2	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
10	Write a Haskell program for Balanced binary search tree.		22AIM464.1

	.	2	22AIM464.2 22AIM464.3 22AIM464.4
11	Create a small application to implement monads and zippers	2	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4
12	Discuss th Zipper and Exceptions.	2	22AIM464.1 22AIM464.2 22AIM464.3 22AIM464.4

PART-C

Beyond Syllabus/ Virtual Lab Content

Zipper: https://wiki.haskell.org/Zipper
Monads: https://wiki.haskell.org/All_About_Monads
Tutoirals: https://learnyouahaskell.github.io/

CIE Assessment Pattern (50 Marks–Lab)

RBTLevels		Test(s) (20)	Weekly Assessment (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:

Text Books:

1. Graham Hutton, Programming in Haskell (2nd edition), Cambridge University Press, 2016. ISBN: 9781316626221

Reference Books:

1) Richard Bird, Thinking Functionally with Haskell, Cambridge University Press,2014. ISBN : 9781107087200
2) Bryan O'Sullivan, Don Stewart, and John Goerzen, Real World Haskell, O'Reilly Media,2008. ISBN: 9780596554309
3) Miran Lipovača, Learn You a Haskell for Great Good! A Beginner's Guide, No Starch Press,2011. ISBN: 9781593272838.

Weblinks and Video Lectures(e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_cs79/preview
- https://www.haskell.org/get-started/
- https://homepages.dcc.ufmg.br/~camarao/fp/haskell.pdf
- https://www.cmi.ac.in/~madhavan/papers/pdf/haskell.pdf

Activity-Based Learning /Practical Based learning

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues.

BASICS FOR DIGITAL AND IMAGE PROCESSING			
Course Code	**22AIM465**	**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:

22AIM465.1	Understand basic the basic concepts of Digital Signals and Image Processing System.
22AIM465.2	Apply the different techniques of Image Processing to solve the problem.
22AIM465.3	Analyze the Image Properties and signals with different DIP/Image Functions.
22AIM465.4	Develop a new algorithm in Signal and Image Processing Applications.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22AIM465.1	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
22AIM465.2	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
22AIM465.3	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
22AIM465.4	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments/Programs/ Demo		
	Basic C Programming Concepts	**2**	**NA**
1	Reading an image and display the gray scale, colour and B/W image using MATLAB/Python. Note: Discuss about the steps of Image Processing and its models.	**2**	22AIM465.1
2	Reading and RGB Image and extract the colour components using MATLAB/Python. Note: Discuss the Quantization, pixel Relationship.	2	22AIM465.1 22AIM465.2
3	Develop a program using MATLAB/Python for enhance the Brightness and Contrast of an image.	2	22AIM465.1 22AIM465.2
4	Develop a MATLAB/Python program for image smoothing and sharpening using different mask.	2	22AIM465.1 22AIM465.2
5	Develop a MATLAB/Python program for Image noising using different noise distribution.	2	22AIM465.1 22AIM465.2
6	Write a program using MATLAB/Python for De-noising the image using Arithmetic mean and median filter.	2	22AIM465.1 22AIM465.2
	PART-B		
7	Implement order statistics filter to De-nosing the image.	**2**	22AIM465.1 22AIM465.2
8	Write a MATLAB/Python program to generate signal.	2	22AIM465.3 22AIM465.4
9	Write a Program in MATLAB/Python for analysis the properties of the Z Transforms.	2	22AIM465.3 22AIM465.4
10	Write a program in MATLAB/Python for analysis of LTI system. .	2	22AIM465.3 22AIM465.4
11	Write a program in MATLAB/Python for DFT.	2	22AIM465.3 22AIM465.4

12	Write a program in MATLAB/Python for FFT and DIT.	**2**	22AIM465.3 22AIM465.4

PART-C

Beyond Syllabus/ Virtual Lab Content

https://cse19-iiith.vlabs.ac.in/List%20of%20experiments.html
https://cse19-iiith.vlabs.ac.in/exp/affinetransformation/simulation.html
https://cse19-iiith.vlabs.ac.in/exp/image-histogram/
https://www.tutorialspoint.com/dip/image_processing_introduction.htm
(Image Processing Concepts)

CIE Assessment Pattern (50 Marks–Lab)

RBTLevels		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 Book:

1.Gonzalez, Rafael C., and Richard E. Woods, "Digital Image Processing" 2nd Edition, Pearson Education, 2002.ISBN: 9788131726952

Weblinks and Video Lectures(e-Resources):

- http://nptelvideos.com/course.php?id=541
- https://www.youtube.com/watch?v=xUCsfKA8bi0
- https://in.mathworks.com/videos/image-processing-made-easy-81718.html

Activity-Based Learning /Practical Based learning

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

UNIVERSAL HUMAN VALUES AND LIFE SKILLS			
Course Code	**22UHK47**	**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:

22UHK47.1	Understand the concept and significance of life skills and universal human values.
22UHK47.2	Develop Self-awareness and Self-management skills to promote personal growth.
22UHK47.3	Apply Critical and Creative thinking and ethical decision-making skills in various contexts.
22UHK47.4	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	PO12
22UHK47.1	-	-	-	-	-	3	1	3	-	2	-	2
22UHK47.2	-	-	-	-	-	1	2	1	-	2	-	2
22UHK47.3	-	-	-	-	-	3	1	3	1	2	-	2
22UHK47.4	-	-	-	-	-	2	2	1	3	3	-	3

MODULE-1	**Self-Awareness and Self-Management**	**22UHK47.1 22UHK47.2**	**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**	**22UHK47.1 22UHK47.3**	**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**	**22UHK47.3 22UHK47.4**	**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**	**22UHK47.2 22UHK47.3 22UHK47.4**	**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	Working on Task bar; team building activities; Interviewing Corporate experts to understand expectations

with corporate people			
MODULE-5	**Towards Nature and Industry**	**22UHK47.3 22UHK47.4**	**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)	Alternative Assessment (s)
		25	25
L1	**Remember**	**-**	**-**
L2	**Understand**	**7**	**6**
L3	**Apply**	**8**	7
L4	**Analyze**	**10**	7
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 -I			
Course Code	**22AIM48**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs /Week	**-**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22AIM48.1	Understand the technological needs and/or societal needs and sustainability of the environment
22AIM48.2	Apply practical knowledge and latest tools usage along with project development.
22AIM48.3	Analyze the outcome of the project. Design application using Data Science concepts/ techniques
22AIM48.4	Design application using Data Science concepts/ techniques
22AIM48.5	Implement the project and provide solutions within the context of the Legel framework, addressing social concerns and upholding ethical issues
22AIM48.6	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	PO12	PSO1	PSO2
22AIM48.1	2	-	-	-	-	1	1	1	-	-	-	3	3	2
22AIM48.2	3	-	-	-	3	-	-	-	-	-	-	-	-	-
22AIM48.3	3	3	-	-	3	-	-	-	-	-	-	-	-	-
22AIM48.4	3	3	3	-	-	-	-	-	-	-	-	3	3	2
22AIM48.5	3	3	3	3	3	2	2	2	2		-	3	3	2
22AIM48.6	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 ofexperts 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 appointedexaminer(s).

CIE Assessment Pattern (50 Marks–Theory)

RBTLevels		Review (50 marks)
L1	**Remember**	**-**
L2	**Understand**	10
L3	**Apply**	15
L4	**Analyze**	15
L5	**Evaluate**	10
L6	**Create**	-

SEEAssessment Pattern(50Marks –Theory)

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

NATIONAL SERVICE SCHEME (NSS)			
Course code	**22NSS30, 22NSS40, 22NSS50, 22NSS60**	**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:

22NSS40.1	Understand the importance of his / her responsibilities towards society.
22NSS40.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSS40.3	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.
22NSS40.4	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	PO12
22NSS40.1	-	-	-	-	-	3	-	-	2	-	-	1
22NSS40.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSS40.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSS40.4	-	-	-	-	-	3	3	-	2	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3RD 22NSS30	**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.	22NSS30.1 22NSS30.2 22NSS30.3 22NSS30.4	30
4TH 22NSS40	**15.** Water conservation techniques – Role of different stakeholders–Implementation. **16.** Preparing an actionable business proposal for enhancing the village income and approach forimplementation. **17.** Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	22NSS40.1 22NSS40.2 22NSS40.3 22NSS40.4	30
5TH 22NSS50	**18.** Developing Sustainable Water management system for rural areas and implementationapproaches. **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 developmentprograms etc. **20.** Spreading public awareness under rural outreach programs. (minimum 5 programs).	22NSS50.1 22NSS50.2 22NSS50.3 22NSS50.4	30
6TH 22NSS60	**21.** Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). **22.** Govt. school Rejuvenation and helping them to achieve good infrastructure.	22NSS60.1 22NSS60.2 22NSS60.3 22NSS60.4	30

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation – 1: Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and principal.
- At last report should be evaluated by the NSSofficer 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:

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.

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, IndianAgriculture (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 Govtorganization, 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 contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/pro per 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/pro per 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 toachieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Governmen t Schemes officers	School selection/prop er 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 SustainableWater 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/prop erconsultation/ 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	May be individual or team	Villages/ City Areas /Grama panchayat/	Group selection/pro per	Report should be submitted by	Evaluation as per the rubrics of scheme and

	Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.		public associations/ Government Schemes officers/ campus	consultation/ Continuous monitoring / Information board	individual to the concerned evaluation authority	syllabus by NSS officer
9.	Spreading public awareness under ruraloutreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per 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 socialharmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/prop er 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/prop er 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 (PE) (SPORTS AND ATHLETICS)			
Course Code	**22PED30, 22PED40**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 2= 100**
Credits	**00**	**Exam Hours**	**02**

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

22PED40.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
22PED40.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
22PED40.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PED40.4	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
22PED40.1	-	-	-	-	-	2	-	3	3	-	-	2
22PED40.2	-	-	-	-	-	2	-	3	3	-	-	2
22PED40.3	-	-	-	-	-	2	-	3	3	-	-	2
22PED40.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 22PED30	**Module 1: Orientation** F. Lifestyle, G. Fitness H. Food & Nutrition I. Health & Wellness J. Pre-Fitness test.	22PED30.1, 22PED30.2	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	22PED30.2, 22PED30.3	15 HRS
	Module 3: Recreational Activities E. Postural deformities. F. Stress management. G. Aerobics. H. Traditional Games.	22PED30.3, 22PED30.4	10 HRS
4TH 22PED40	**Module 1: Ethics and Moral Values** C. Ethics in Sports D. Moral Values in Sports and Games	22PED40.1, 22PED40.2	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.	22PED40.3	20 HRS

	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.		
	Module 3: Role of Organization and administration	22PED40.4	5 HRS

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:

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

YOGA			
Course Code	**22YOG30, 22YOG40, 22YOG50, 22YOG60**	**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:

22YOG40.1	Use Yogasana practices in an effective manner
22YOG40.2	Become familiar with an authentic foundation of Yogic practices
22YOG40.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat Kriyas
22YOG40.4	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	PO12
22YOG40.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOG40.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOG40.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOG40.4	-	-	-	-	-	3	-	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 22YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 3. Suryanamaskar prayer and its meaning, Need, importa benefits of Suryanamaskar. 4. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 5. Sitting: Padmasana, Vajrasana, Sukhasana 6. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasa 7. Prone line: Bhujangasana, Shalabhasana 8. Supineline: Utthitadvipadasana, Ardhahalasana, Halas	22YOG30.1, 22YOG30.2, 22YOG30.3, 22YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 22YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rou **Different types of Asanas**: 5. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 6. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 7. Prone line: Dhanurasana 8. Supine line: Karna Peedasana, Sarvangasana, Chakraa **Patanjali's Ashtanga Yoga**: Asana, Pranayama	22YOG40.1, 22YOG40.2, 22YOG40.3, 22YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

	Pranayama: Chandra Bhedana, Nadishodhana, Surya Bhed		
5TH 22YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rou **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	22YOG50.1, 22YOG50.2, 22YOG50.3, 22YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 22YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3ro **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 Kapalabhat	22YOG60.1, 22YOG60.2, 22YOG60.3, 22YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

16. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
17. Tiwari, O P: Asana Why and How
18. Ajitkumar: Yoga Pravesha (Kannada)
19. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
20. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
21. Nagendra H R: The art and science of Pranayama
22. Tiruka: Shatkriyegalu (Kannada)
23. Iyengar B K S: Yoga Pradipika (Kannada)
24. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

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

BASIC APPLIED MATHEMATICS-II
(Common to all Branches)

Course Code	**22DMAT41**	**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:

22DMAT41.1	Gain knowledge of basic operations of vectors
22DMAT41.2	Use curl and divergence of a vector function in three dimensions
22DMAT41.3	Develop the ability to solve higher order Linear differential equations
22DMAT41.4	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	PO12
22DMAT41.1	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT41.2	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT41.3	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT41.4	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**VECTORS**	22DMAT41.1	**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**	22DMAT41.2	**8 Hours**
Vector differential operator-Gradient of a scalar function, Divergence of a vector function, Curl of a 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**	22DMAT41.3	**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**	22DMAT41.4	**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**	22DMAT41.4	**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		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	10	5	10
L4	Analyze	2.5	-	-
L5	Evaluate	2.5	-	-
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/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

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

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Algorithms/Flowcharts/Programming Codes
  - Organizing Group wise discussions on related topics
  - Seminars

APPENDIX A

	List of Assessment Pattern		
SNO	Tasks	Bloomscategory/Level	Remarks
1	Assignments	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
2	GroupDiscussions	Apply-L3, Analyse-L4	Group
3	CaseStudies/CaseLets	Apply-L3, Analyse-L4, Evaluate-L5	Individual/ Group
4	Practical Orientation on Designthinking	Analyse-L4, Create-L6	Creativity&Innovation
5	Participatory & Industry-IntegratedLearning	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
6	Practicalactivities/Problemsolvingexercises	Apply-L3, Analyse-L4, Evaluate-L5	Individual/ Group
7	ClassPresentations	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
8	Analysis of Industry/ Technical /BusinessReports	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
9	Reports on IndustrialVisit	Understand-L2, Apply-L3, Analyse-L4	Individual/ Group
10	Industrial/Social/RuralProjects	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	
	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-oridnator.		
	3.Students either submitthe report for Task or not, as determined by th ecourse coordinator.		
	4. Need to get final approval from the HoD/BOS Chairman once finalising the mark allocations for Tasks and Assessment types.		

APPENDIX B

Outcome Based Education

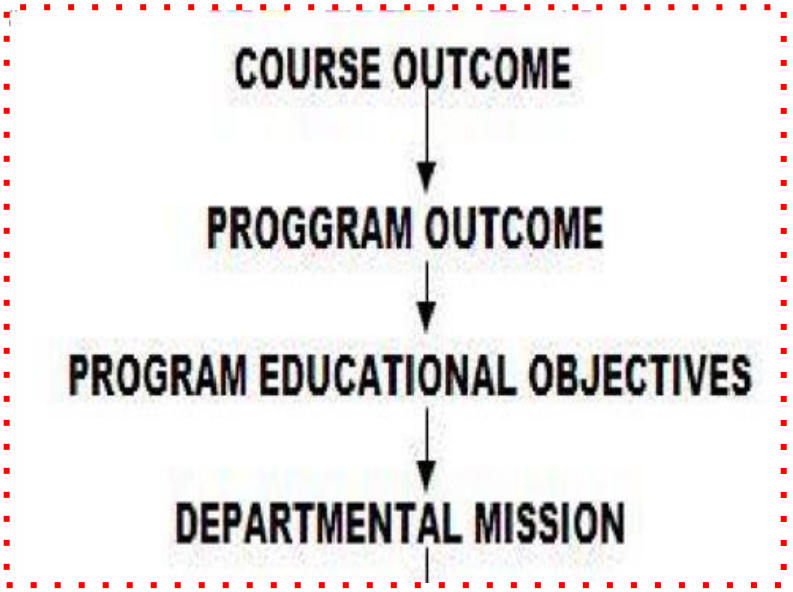
Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no specified style of teaching or assessmentin OBE; instead, classes, opportunities,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

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

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

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

Mapping of Outcome:



APPENDIX C

The Graduate Attributes of NBA

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems in Computer Engineering.

PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems in Computer Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.

PO3 **Design / Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes of Computer Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.

PO4 **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments in Computer Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, andmodern Engineering and IT tools including prediction and modeling to complexEngineering activities in Computer Engineering with an understanding of the limitations.

PO6 **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Computer Engineering.

PO7 **Environment and Sustainability:** Understand the impact of the professional Engineering solutions of Computer Engineering in societal and Environmental contexts, demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the Engineering practice.

PO9 **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication Skills:** Communicate effectively on complex Engineering activities with the Engineering community and with society, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

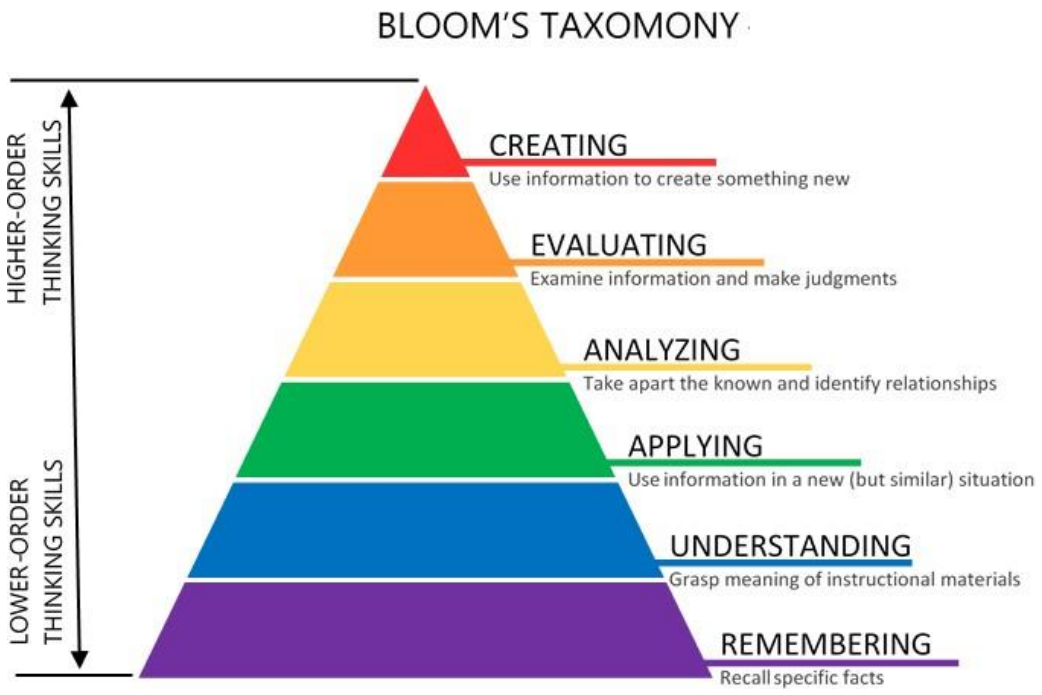
PO11 **Project Management and Finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.

PO12 **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX D

BLOOM'S TAXONOMY

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



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