NEW HORIZON
COLLEGE OF ENGINEERING

Department of Computer Science & Engineering (Data Science)

Academic Year 2024-25

5th and 6th Semester

Scheme & Syllabus

BATCH: 2022-26

CREDITS: 160

NEW HORIZON COLLEGE OF ENGINEERING

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
- Integrity
- Inclusiveness
- Innovation
- Professionalism
- Social Responsibility

PROGRAM OUTCOMES (POs)

PO1 Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex Computer Science and Data Science engineering problems.

PO2 Problem Analysis: Identify, formulate, review research literature and analyze complex Computer Science and Data Science engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

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

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, 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 modelling to complex Computer Science and Data Science engineering activities 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 Science and Data Science Engineering.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in Computer Science and Data Science engineering in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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

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

PO10 Communication: Communicate effectively on complex Computer Science and Data Science engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective report 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Apply Computer Science and Data Science principles, practices, and mechanisms to produce sustainable products and use knowledge in various domains to identify research gaps and hence provide solution to new ideas and innovations.
PSO2	Collaborate proficiently with experts from diverse fields and actively engage in continuous professional growth in the domain of computing.

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Computer Science and Engineering (Data Science)

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

V Semester													
S. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**Contact Hours**	**Marks**		
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	HSMS	22CDS51	Software Engineering and Project Management	DS	3	0	0	0	3	3	50	50	**100**
2	PCC	22CDS52	Design and Analysis of Algorithms	DS	3	0	0	0	3	3	50	50	**100**
3	PCCL	22CDL52	Design and Analysis of Algorithms Lab	DS	0	0	1	0	1	2	50	50	**100**
4	PCC	22CDS53	Fundamentals of Data Science	DS	3	0	0	0	3	3	50	50	**100**
5	PCCL	22CDL53	Fundamentals of Data Science Lab	DS	0	0	1	0	1	2	50	50	**100**
6	PEC	22CDS54X	Professional Elective Course-I	DS	3	0	0	0	3	3	50	50	**100**
7	AEC	22RMK55	Research Methodology and IPR	DS	1	1	0	0	2	3	50	50	**100**
8	AEC	22SDK56	Critical and Creative Thinking Skills	DS	0	0	1	0	1	2	50	--	**50**
9	UHV	22ESK57	Environmental Studies	Any Dept.	1	0	0	0	1	1	50	50	**100**
10	PROJ	22CDS58	Mini Project -II	DS	0	0	1	0	1	0	50	50	**100**
11	NCMC	22NSS50	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED50	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YOG50	Yoga	Yoga Teacher									
Total									**19**	**24**	**550**	**450**	**1000**

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

Professional Elective Course-I			
22CDS541	Data Engineering	22CDS544	Automata Theory and Computability
22CDS542	Principles of Cloud Computing	22CDS545	Advanced Java
22CDS543	Business Analytics		

22XXX51 (HSMS) - This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.
For IT allied Branches: Software Product Management
For Core Branches: Engineering Economics and Management / Industrial Management and Entrepreneurship

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

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

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

(iii) A group of 2 - 4 students if the Mini Project work is a multidisciplinary (Applicable to all Branches)

CIE procedure for Mini-project:

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

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

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

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

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

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

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Computer Science and Engineering (Data Science)

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

VI Semester													
S. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**Contact Hours**	**Marks**		
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	PCC	22CDS61	Artificial Intelligence & Machine Learning	DS	3	0	0	0	3	3	50	50	**100**
2	PCCL	22CDL61	Artificial Intelligence & Machine Learning Lab	DS	0	0	1	0	1	2	50	50	**100**
3	PCC	22CDS62	Computer Networks	DS	3	0	0	0	3	3	50	50	**100**
4	PCCL	22CDL62	Computer Networks Lab	DS	0	0	1	0	1	2	50	50	**100**
5	PCC	22CDS63	Essentials of Cyber Security	DS	2	1	0	0	3	4	50	50	**100**
6	PEC	22CDS64X	Professional Elective Course-II	DS	3	0	0	0	3	3	50	50	**100**
7	PROJ	22CDS65	Project Phase - I	DS	0	0	2	0	2	0	50	50	**100**
8	AEC	22SDK66	Problem Solving Skills	DS	0	0	1	0	1	2	50	--	**50**
9	AEC	22CDS67X	Ability Enhancement Course – V	DS	0	0	1	0	1	2	50	50	**50**
10	OEC	23NHOP6XX	Industrial Open Elective Course-I	Offering Dept.	3	0	0	0	3	3	50	50	**100**
11	NCMC	22NSS60	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED60	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YOG60	Yoga	Yoga Teacher									
Total									**21**	**26**	**550**	**450**	**1000**

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

Professional Elective Course-II			
22CDS641	Scalable Data Science	22CDS644	Advanced DBMS
22CDS642	Predictive Analytics	22CDS645	Software Testing and Automation
22CDS643	Optimization Techniques		

Ability Enhancement Course – V			
22CDS671	Fundamentals of Mobile Application Development	22CDS673	Applied Data Science with Julia
22CDS672	Scala Programming	22CDS674	Advanced Python Programming

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

Project Phase-I: Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

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

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

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

V Semester

SOFTWARE ENGINEERING AND PROJECT MANAGEMENT			
Course Code	**22CDS51**	**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:

22CDS51.1	Understand the Software Engineering basics and Software Process Models.
22CDS51.2	Identify the core Requirements and Design principles applicable in the Projects.
22CDS51.3	Demonstrate Coding and Testing principles applicable in the Projects.
22CDS51.4	Analyze the metrics in process and project domains, focusing on software measurement and software quality
22CDS51.5	Examine the risk management techniques to effectively address project risks.
22CDS51.6	Interpret project scheduling, tracking techniques and cost management practices.

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
22CDS51.1	1	1	1	-	-	-	-	2	-	-	-	2	2	2
22CDS51.2	1	1	1	-	-	-	-	-	-	-	-	2	2	2
22CDS51.3	2	2	2	-	-	-	-	2	-	-	-	2	2	2
22CDS51.4	2	2	2	-	-	-	-	2	-	2	-	2	2	2
22CDS51.5	-	-	-	-	-	-	-	2	-	2	-	2	2	2
22CDS51.6	2	2	2	-	-	-	-	-	-	2	-	2	2	2

MODULE-1	**Introduction**	**22CDS51.1**	**8 Hours**

Overview of Software Engineering, Definition and importance of software engineering, Historical perspective, Software engineering ethics, Software Development Life Cycle (SDLC), Phases of SDLC, Activities in each phase, Software Process Models, Waterfall model, Incremental model, Spiral model, V-Model, Agile Development, Principles of Agile, Scrum framework, Extreme Programming (XP).

Case Study	A small software development company specializing in mobile application development, Over the past year, faced challenges with project delays, scope creep, and customer satisfaction due to inefficient project management practices. The company is considering adopting a structured software process model to streamline their development processes and improve project outcomes. Recommend the most suitable software process model based on the company's current challenges and future growth prospects.
Text Book	Text Book 1: Chapter 1, 2, 3.1-3.3.

MODULE-2	**Requirements Engineering & Design**	**22CDS51.2**	**8 Hours**

Requirements Engineering Process, Elicitation techniques, Requirements analysis, Requirements validation, Functional and Non-functional Requirements, System Models, Context models, Behavioural models, Use Case Modeling., Architectural Design, Design Patterns, Introduction to design patterns, Creational, Structural, and Behavioural patterns.

Text Book	Text Book 2: Chapter 5.1-5.3,6.1-6.5

MODULE-3	**Software Implementation and Testing**	**22CDS51.3**	**8 Hours**

Software Coding - Programming principles and coding guidelines ,method of incrementally developing code , managing the evolving code Testing ,Unit testing and Code Inspection ,Testing concepts and testing process, Design of Test case and Test plan , Black-box testing , White box testing, test Case Design.

Case Study	Examine the matrix multiplication program to identify key functionalities, inputs, outputs, and expected behaviour.
Text Book	Text Book 1: Chapter 7,8

MODULE-4	**Project Management & Metrics**	**22CDS51.4**	**8 Hours**

Project Management Basics, the Management Spectrum, People, Process, Product, Project, Project Planning, and Work Breakdown Structure (WBS), Metrics in the Process and Project Domains, Software Measurement, Metrics for Software Quality, Integrating metrics with the software process.

Text Book	Text Book 2:24,24.1-24.5, 25.1-25.4

MODULE-5	Risk Management & Maintenance	22CDS51.5, 22CDS51.6	8 Hours

Risk Management, Risk identification, Risk analysis, Risk mitigation strategies, Communication Management, Stakeholder communication, Information distribution, Performance reporting.
Project Scheduling and Tracking, Gantt charts, Critical Path Method (CPM), PERT charts, Cost Management, Budgeting, Cost estimation techniques, Earned value management, Quality Management, Quality planning, Quality assurance, Quality control, Project Closure, Post-project evaluation.

Text Book	Text Book 2 – Chapter 27.1-27.5 ,28.1-28.4

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	5	7.5	-
L4	Analyze	5	7.5	-
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

TEXT BOOK(S):

1. Roger S Pressman and Bruce Maxim: Software Engineering–A Practitioner's Approach, Mc-GrawHill, 9th editions, 2020, ISBN: 9781260548006, 1260548007

2.Ian Somerville: Software Engineering, Pearson Education,Tenthedition,2017, ISBN:9789332582699, 9332582696

Reference Books:

1. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India, 2009, ISBN:9788126523115, 8126523115

2.Hans VanVliet: Software Engineering: Principles and Practices, Wiley India, 2018, ISBN: 8126527374, 978-8126527373

3. Richard Fairley: Software Engineering Concepts, McGraw-Hill, 2018, ISBN: 9780074631218, 978-0074631218

DESIGN AND ANALYSIS OF ALGORITHMS			
Course Code	**22CDS52**	**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:

22CDS52.1	Analyze the algorithmic efficiencies using asymptotic notations for various problems.
22CDS52.2	Demonstrate divide-and-conquer design strategies to evaluate an algorithm's effectiveness in devising a solution.
22CDS52.3	Analyze greedy and dynamic programming strategies for solving intricate problems.
22CDS52.4	Interpret the P, NP, and NP-complete complexity classes to scrutinize the constraints and boundaries of an algorithm's performance.
22CDS52.5	Apply backtracking and branch & bound methods for crafting solutions to real-time problems.
22CDS52.6	Apply appropriate algorithm design technique for a given problem.

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
22CDS52.1	3	3	-	-	-	-	-	-	-	-	-	1	3	3
22CDS52.2	3	3	3	3	-	-	-	-	-	-	-	1	3	3
22CDS52.3	3	3	3	3	-	-	-	-	-	-	-	1	3	3
22CDS52.4	3	3	3	3	-	-	-	-	-	-	-	1	3	3
22CDS52.5	3	3	3	3	-	-	-	-	-	-	-	1	3	3
22CDS52.6	3	3	-	-	-	-	-	-	-	-	-	1	3	3

MODULE-1	**ALGORITHM FUNDAMENTALS AND BRUTE FORCE TECHNIQUES**	**22CDS52.1**	**8 Hours**

Introduction: Fundamentals of Algorithms Problem Solving; Important Problem Types; Analysis Framework: Worst-Case, Best-Case, and Average-Case Efficiencies; Asymptotic notations and Basic efficiency classes: Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), Mathematical analysis for Recursive and Non recursive algorithms.
Brute Force Approach: Selection Sort and Bubble Sort; Sequential Search and Brute-Force String Matching

Self-study	Solve practice problems and exercises to reinforce concepts such as asymptotic notations and mathematical analysis of algorithms.
Text Book	Text Book 1: 1.1,1.2, 2.1 to 2.4 , Text Book 2: 1.3

MODULE-2	**ADVANCED SORTING AND SEARCHING TECHNIQUES**	**22CDS52.2**	**8 Hours**

Divide and Conquer: Merge sort, Quick sort, Binary Search
Decrease and Conquer: Insertion sort, Depth-First Search and Breadth-First Search**,** Topological Sorting
Transform and Conquer: Balanced Search Trees, Heaps and Heap Sort.

Case Study	Explore applications of depth-first search and breadth-first search in graph traversal algorithms, such as finding shortest paths or network analysis.
Text Book	Text Book 1: 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.3, 6.4

MODULE-3	**OPTIMIZATION TECHNIQUES**	**22CDS52.3**	**8 Hours**

Dynamic Programming: Warshall's and Floyd's Algorithms: Warshall's Algorithm, Floyd's Algorithm for the All-Pairs Shortest-Paths Problem, The Knapsack Problem and Memory Functions.
Greedy Approach: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm

Case Study	Explore applications of Prim's, Kruskal's, and Dijkstra's algorithms in network optimization, such as finding minimum spanning trees or shortest paths in transportation or communication networks.
Text Book	Text Book 1: 8.2, 8.4, 9.1, 9.2, 9.3

MODULE-4	**ALGORITHMIC COMPLEXITY AND NP PROBLEMS**	**22CDS52.4**	**8 Hours**

Limitations of Algorithm Power: Lower-Bound Arguments, Decision Trees: Decision Trees for Sorting Algorithms, Decision Trees for Searching a Sorted Array; *P, NP,* and NP-complete Problems: *P* and *NP* Problems, NP-Complete Problems.

Self-study	Study decision trees for sorting algorithms and searching a sorted array to gain insights into their efficiency and performance.
Text Book	Text Book 1: 11.1, 11.2, 11.3

MODULE-5	ADVANCED PROBLEM-SOLVING TECHNIQUES	22CDS52.5, 22CDS52.6	8 Hours

Coping with the Limitations of Algorithm Power: Backtracking: n-Queens Problem, Hamiltonian Circuit Problem, Subset-Sum Problem. Branch-and-Bound: Assignment Problem, Knapsack Problem, Traveling Salesman Problem.

Case Study	Investigate real-world examples of the subset-sum problem used in resource allocation tasks, such as budget planning or inventory management.
Text Book	Text Book 1: 12.1, 12.2

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	5	7.5	-
L4	Analyze	5	7.5	-
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Anany Levitin , "Introduction to the Design and Analysis of Algorithms,3rd Edition,Pearson, 2012, ISBN-13, 978-9332585485.
2. Thomas H Cormen, Charles E Leiserson, Ronald R Rivest & Clifford Stein, "Introduction to Algorithms", fourth edition, 2022, MIT Press, ISBN:9780262367509.

Reference Books:

1. Anuradha A. Puntambekar, "Analysis and Design of Algorithms", 2020, Technical Publications, ISBN: 9789333223867.
2. Design and Analysis of Algorithms, S. Sridhar, 2014, Oxford University Press, ISBN: 9780198093695.

Web links and Video Lectures (e-Resources):

- https://www.javatpoint.com/daa-rabin-karp-algorithm
- https://www.javatpoint.com/daa-knuth-morris-pratt-algorithm
- https://www.javatpoint.com/greedy-algorithms
- https://www.javatpoint.com/dynamic-programming
- https://www.javatpoint.com/backtracking-introduction

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

- Group implementation of merge sort, quick sort, and binary search.
- Solve decision tree problems for sorting and searching.

DESIGN AND ANALYSIS OF ALGORITHMS LAB			
Course Code	**22CDL52**	**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:

22CDL52.1	Analyze sorting and searching algorithms with graph traversal.
22CDL52.2	Demonstrate graph algorithms Floyd Warshall's, Prim's, Kruskal's, and Dijkstra's algorithms for various graph-related problems
22CDL52.3	Implement combinatorial optimization problems for backtracking.
22CDL52.4	Apply dynamic programming by implementing solutions for the 0/1 Knapsack problem and the Traveling Salesman problem

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
22CDL52.1	3	3	3	3	3	-	-	-	-	-	-	2	3	3
22CDL52.2	3	3	3	3	3	-	-	-	-	-	-	2	3	3
22CDL52.3	3	3	3	3	3	-	-	-	-	-	-	2	3	3
22CDL52.4	3	3	3	3	3	-	-	-	-	-	-	2	3	3

Exp. No. / Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs		
	Implement and analyze sorting and sorting algorithms.	3	NA
	PART-A		
1	Given a list of integers perform the sorting of elements in ascending order using : • Selection Sort algorithm. • Bubble Sort algorithm. Compare the performance of both algorithms in terms of: • Number of comparisons made by each algorithm. • Number of swaps performed by each algorithm.	3	22CDL52.1
2	Given a list of integers representing shipment IDs integers perform the sorting of elements in ascending order using : • Merge Sort algorithm. • Analyze the performance of the algorithm in terms of the number of comparisons made and the time taken to sort the list.	3	22CDL52.1
3	Consider a record with tuple containing employee ID, name, and age, implement the Quick Sort algorithm to sort these records in ascending order based on the employee IDs.	3	22CDL52.1
4	Implement the following graph traversal techniques using decrease and conquer approach: a. Breadth First Search method. b. Depth First Search method.	3	22CDL52.1
5	Implement the floyd_warshall( ) function to compute the shortest paths between all pairs of vertices using the Floyd-Warshall algorithm, Analyze the time complexity of the implemented algorithm in relation to the number of vertices and edges.	3	22CDL52.2
6	Develop a function prim_mst(graph) that computes the Minimum Cost Spanning Tree using Prim's algorithm, Ensure the algorithm handles graph representations efficiently, such as adjacency lists or matrices.	3	22CDL52.2
	PART-B		
7	Implement and analyze Kruskal`s algorithm and find minimum cost spanning tree of a given connected undirected graph.	3	22CDL52.2

8	Implement and analyze Dijkstra's algorithm to find the shortest path from a given source.	3	22CDL52.2
9	Implement N-Queens problem using backtracking, Verify the correctness of the solution by comparing results with known solutions for different values of N.	3	22CDL52.3
10	Implement sum of subset problem using backtracking.	3	22CDL52.3
11	Implement 0/1 Knapsack problem.	3	22CDL52.4
12	Implement travelling salesman problem using dynamic programming.	3	22CDL52.4

PART-C

Beyond Syllabus Virtual Lab Content

- https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html
- https://ds2-iiith.vlabs.ac.in/exp/red-black-tree/index.html

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

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Second Edition, 2017, Pearson Education, ISBN: 978-9332585485.
2. Design and Analysis of Algorithms, S. Sridhar, 2014, Oxford University Press, ISBN: 9780198093695

FUNDAMENTALS OF DATA SCIENCE			
Course Code	**22CDS53**	**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:

22CDS53.1	Understand the probability, Statistics and Linear algebra concepts essential for data science.
22CDS53.2	Apply sampling and dimensionality reduction techniques to enhance data analysis and modeling
22CDS53.3	Analyze linear regression and multiple linear regression for model building and prediction.
22CDS53.4	Demonstrate Classification & Clustering algorithms with respect to theoretical foundations, practical applications across diverse datasets.
22CDS53.5	Evaluate the performance metrics associated with various models.
22CDS53.6	Understand the optimization techniques used to enhance computational efficiency in data-driven decision-making processes.

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
22CDS53.1	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS53.2	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS53.3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS53.4	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS53.5	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS53.6	3	3	3	3	-	-	-	-	-	-	-	2	3	3

MODULE-1	**FOUNDATIONS OF DATASCIENCE**	**22CDS53.1**	**8 Hours**

Introduction to data science, Data mining and Data Warehousing, Descriptive analytics, Probability Theory, Probability distribution, Confidence interval for population mean and proportion, Hypothesis Testing and the power of Hypothesis Testing.

Case Study	Analyzing Online Customer Reviews for an E-commerce Company.
Text Book	Text Book 1: 1.2,1.3, 1.5,5.1,6.1, Text Book 2: 1.1,1.2,1.3

MODULE-2	**DATA PREPROCESSING**	**22CDS53.2**	**8 Hours**

Types of Data, Sampling Theory, Sampling Techniques, Correlation, Feature Selection. Dimensionality Reduction Techniques: Projections, Eigen Value Decomposition, Principal Component Analysis (PCA).

Self-study	Experiment with Python libraries like scikit-learn and pandas that offer functionalities for data analysis and dimensionality reduction techniques.
Text Book	Text Book 1: 4.1,4.3,4.4,4.5,8.1,10.7, Text Book 2: 3.4,3.5

MODULE-3	**LINEAR REGRESSION**	**22CDS53.3 22CDS53.5**	**8 Hours**

Simple Linear Regression- Steps in building a regression model, Model diagnostics, Multiple Linear Regression Developing Multiple Linear Regression, Co linearity, Residual Analysis, Detecting Influencers.

Self-study	In a scenario where you are building a model to predict student loan repayment, what potential challenges might you encounter when collecting data and building the model
Text Book	Text Book 1: 9.1, 9.2, 9.7,9.8,9.9,9.10,10.1, Text Book 1:11.1,11.2,12.1, Text Book 2: 8.3.1,8.3.2

MODULE-4	**CLASSIFICATION**	**22CDS53.4 22CDS53.5**	**8 Hours**

Classification Algorithms: Logistic Regression, Regularization techniques, Naïve Bayes, K- Nearest Neighbor, Ensemble methods, Hyper parameter tuning, Decision Trees, Random Forest.

Text Book	Text Book 1: 14.1 to 14.6

MODULE-5	**CLUSTERING AND OPTIMIZATION**	**22CDS53.5, 22CDS53.6**	**8 Hours**

Clustering techniques- Hierarchical Clustering, Single – link, Complete linkage, and Clustering algorithms-K means, DB Scan, Jaccard Coefficient, Elbow technique. Optimization, Optimization techniques for Data Science.

Text Book	Text Book 1: 14.1 to 14.6

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	5	7.5	-
L4	Analyze	5	7.5	-
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. U Dinesh Kumar, "Business Analytics : The Science of Data Driven decision making", First Edition, Wiley Publishers, 2017, ISBN-13, 978-8126568772.
2. Jiawei Han , Micheline Kamber , Jian Pei Professor, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann Series,2011, ISBN-13, 978-9380931913.
3. Manaranjan Pradhan, U Dinesh Kumar, "Machine Learning using Python", First Edition, Wiley Publishers, 2019, ISBN-13, **978-8126579907.**
4. Gilbert Strang, "Introduction to Linear Algebra, Fifth Edition", Wellesley-Cambridge Press and SIAM, 2016, ISBN : 978-09802327-7-6.

Reference Books:

1. Bruce M King, Edward W Minium , "Statistical Reasoning in the Behavioral Sciences", 5th Edition, Wiley Publishers, 2018,ISBN-1119379733.
2. Douglas C. Montgomery, George C. Runger, "Applied Statistics and Probability for Engineers",6th Edition, Wiley Publishers, 2016, ISBN-13, **978-8126562947**
3. McKinney W. "Python for data analysis: Data wrangling with Pandas, NumPy, and IPython." O'Reilly Media, Inc., 2012, ISBN-13, **978-9352136414.**
4. EMC Education Services , "Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", John Wiley & Sons, Inc, ISBN:9781119183686.

Web links and Video Lectures (e-Resources):

- https://machinelearningmastery.com/
- https://towardsdatascience.com/data-science/home
- https://www.mastersindatascience.org/
- https://onlinecourses.nptel.ac.in/noc20_cs46/preview

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

- Demonstrate the need of statistics and probability for data science to students.
- Demonstration of jupyter notebook for hands-on experience with datasets.
- Construct flowcharts to represent the supervised and unsupervised learning techniques

- Contents related activities (Activity-based discussions)

➢ For active participation of students, instruct the students to understand real-world datasets and various optimization techniques.

➢ Organizing Group wise discussions on issues

➢ Seminars

FUNDAMENTALS OF DATA SCIENCE LAB			
Course Code	**22CDL53**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:

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

22CDL53.1	Understand basic operations of NumPy, Pandas, and Matplotlib.
22CDL53.2	Implement Regression models for the sample datasets.
22CDL53.3	Demonstrate Classification & Clustering algorithms with respect to theoretical foundations, practical applications across diverse datasets.
22CDL53.4	Evaluate the performance metrics associated with various 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
22CDL53.1	3	3	3	2	2	-	-	-	-	-	-	3	3	3
22CDL53.2	2	2	2	2	2	-	-	-	-	-	-	3	3	3
22CDL53.3	2	2	2	2	2	-	-	-	-	-	-	3	3	3
22CDL53.4	2	2	2	2	2	-	-	-	-	-	-	3	3	3

Exp. No. / Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs		
	• Mathematics- Probability, statistics and calculus • Object- oriented programming languages like java, C, Python • Structured Query Language (SQL) for database queries	3	NA
	PART-A		
1	Using NumPy library write a python program to demonstrate i.arange, linspace, logspace Function ii.Array indexing iii.Slicing Arrays iv.Joining Arrays v.Splitting and Searching Arrays	3	22CDL53.1
2	Using pandas in python demonstrate the following operations for the sample dataset given, 1)Indexing of Data frame 2)Grouping and aggregating 3)Adding and removing attributes 4)Joining data frames 5)Filtering the data 6) Handling missing values.	3	22CDL53.1
3	Write a Python Program to import any CSV file to Pandas Data Frame and perform the following: i. Visualize the first and last 10 records ii. Get the shape, index and column details iii. Select/Delete the records(rows)/columns based on conditions. iv. Perform ranking and sorting operations. v. Do required statistical operations on the given columns. vi.Find the count and uniqueness of the given categorical values. vii. Rename single/multiple columns.	3	22CDL53.1
4	Using pandas and Matplotlib demonstrate the following operations for the sample dataset given, i) Bar chart and Histogram ii) Comparing Distribution iii) Box plot and mention quartiles.	3	22CDL53.21

5	1. Develop a program to implement Simple Linear Regression model and evaluate the model by evaluate the performance by Mean Squared Error (MSE), Mean Absolute Error (MAE). 2. Develop a program to implement Multiple Linear Regression model and evaluate the model by verifying the performance by R-squared (Coefficient of Determination)	3	22CDL53.2
6	Develop a program to implement Logistic Regression and indicate the class label for the test dataset. (Computing coefficients (weights) using gradient descent).	3	22CDL53.2
	PART-B		
7	Develop a program to implement Naive Bayes classifier model and analyze the model using confusion matrix	3	22CDL53.3 22CDL53.4
8	Develop a function or class decision_tree(X_train, y_train) that implements a Decision Tree classifier. • Use the trained Decision Tree model to predict class labels for a test dataset (X_test). • Compute a confusion matrix to evaluate the model's performance.	3	22CDL53.3 22CDL53.4
9	Develop a program to implement Random Forest classifier model and analyze the model using Receiver Operating Characteristic (ROC) Curve and Area Under the Curve (AUC).	3	22CDL53.3 22CDL53.4
10	Develop a program to implement KNN classifier model and analyse the model using Classification Report.	3	22CDL53.3 22CDL53.4
11	Develop a program to implement K Means clustering model for the given value of K, where K is number of clusters.	3	22CDL53.3 22CDL53.4
12	Develop a program to implement Hierarchical clustering model for the given value of N, where N is number of clusters.	3	22CDL53.3 22CDL53.4

PART-C

Beyond Syllabus Virtual Lab Content

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

- https://cloudlabs.ai/virtual-labs
- https://www.iiitmk.ac.in/DAVirtalLab/

CIE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1. U Dinesh Kumar, "Business Analytics : The Science of Data Driven decision making", First Edition, Wiley Publishers, 2017, ISBN-13, **978-8126568772.**

2 N Jiawei Han, Micheline Kamber , Jian Pei Professor, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann Series,2011, ISBN-13, **978-9380931913.**

DATA ENGINEERING			
Course Code	**22CDS541**	**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:

22CDS541.1	Understand. core data engineering concepts and technologies in Data Engineering.
22CDS541.2	Demonstrate the data modeling techniques and database design principles to create optimized database schemas for various applications.
22CDS541.3	Apply ETL processes to ensure data integrity and quality in data warehousing environments.
22CDS541.4	Examine data workflows using modern orchestration tools, ensuring data integration and quality across sources.
22CDS541.5	Understand the data governance fundamentals stewardship, ownership, and adherence to regulatory compliance such as GDPR, CCPA.
22CDS541.6	Analyze the concepts of data security, focusing on encryption techniques, monitoring and ethical considerations in data management.

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
22CDS541.1	2	2	2	2	-	-	-	-	-	-	-	2	3	3
22CDS541.2	2	2	2	2	2	-	-	-	-	-	-	2	3	3
22CDS541.3	2	2	2	2	2	-	-	-	-	-	-	2	3	3
22CDS541.4	2	2	2	2	2	-	-	-	-	-	-	2	3	3
22CDS541.5	2	2	2	2	2	-	-	-	-	-	-	2	3	3
22CDS541.6	2	2	2	2	2	-	-	2	-	-	-	2	3	3

MODULE-1	**INTRODUCTION TO DATA ENGINEERING**	**22CDS541.1**	**8 Hours**

Overview of Data Engineering, Role of a Data Engineer, Data Engineering vs. Data Science, Data Lifecycle Management, Data Architecture and Infrastructure, Introduction to Big Data, Characteristics of Big Data, Tools and Technologies in Data Engineering.

Text Book	Text Book 1: Chapter 1
Self Study	Explore the latest trends and advancements shaping the field of data engineering, including technological innovations, industry practices, and evolving roles and responsibilities.

MODULE-2	**DATA MODELING AND DATABASE DESIGN**	**22CDS541.2**	**8 Hours**

Data Modeling Concepts, Dimensional Modeling, SQL and NoSQL Databases, Relational Database Management Systems (RDBMS), Document Stores, Key-Value Stores, Column-Family Stores, Graph Databases, Normalization and Denormalization, Indexing and Query Optimization.

Text Book	Text Book 2: Chapter 4,7
Case Study	Design a dimensional model for an online retail company aiming to optimize its business operations and customer experience. Discuss the normalization and demoralization strategies, indexing techniques, and database technology choices, considering scalability and performance requirements. Evaluate the potential use of graph databases for analyzing customer-product relationships.

MODULE-3	**DATA WAREHOUSING AND ETL PROCESSES**	**22CDS541.3**	**8 Hours**

Data Warehousing Concepts, OLAP vs. OLTP, Data Warehouse Architecture, ETL (Extract, Transform, Load) Processes, ETL Tools and Techniques, Data Cleansing and Transformation, Data Lakes.

Text Book	Text Book 3: Chapter 2,3

MODULE-4	**DATA INTEGRATION AND WORKFLOW MANAGEMENT**	**22CDS541.4**	**8 Hours**

Data Integration Techniques, APIs, Webhooks, Data Connectors, Workflow Orchestration, Apache Airflow, Luigi, Prefect, Data Quality Management, Data Profiling, Data Quality Dimension.

Text Book	Text Book 2: Chapter 11

MODULE-5	**DATA GOVERNANCE AND COMPLIANCE**	**22CDS541.5, 22CDS541.6**	**8 Hours**

Data Governance Fundamentals, principles of Data Governance, Data Stewardship and Ownership, Regulatory Compliance, GDPR, CCPA, and Other Data Privacy Regulations, Industry-specific Compliance Requirements (e.g., HIPAA for Healthcare), Data Security and Encryption, Encryption Techniques and Best Practices, Secure Data Transmission and Storage, Auditing and Monitoring, Ethical Considerations

Text Book	Text Book 3: Chapter 1

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Joe Reis , Matt Housley , Fundamentals of Data Engineering: Plan and Build Robust Data Systems (Grayscale Indian Edition) – 27 June 2022,ISBN-13, 978-9355421548.
2. Hector Garcia-Molina Jeffrey D. Ullman Jennifer Widom, DATABASE SYSTEMS ,The Complete Book Second Edition ,2019, ISBN-13, **978-0131873254.**
3. Mayank Malhotra, Ultimate Data Engineering with Databricks: Develop Scalable Data Pipelines Using Data Engineering's Core Tenets Such as Delta Tables, Ingestion, Transformation, Security, and Scalability – Import, 14 February 2024, ISBN-13, **978-8196994785.**

Reference Books:

1. Roberto Zagni, Data Engineering with dbt: A practical guide to building a cloud-based, pragmatic, and dependable data platform with SQL,Second Edition,2023, ISBN-13978-1803246284.

Web links and Video Lectures (e-Resources):

- https://www.datacamp.com/category/data-engineering
- https://www.udemy.com/topic/data-engineering/

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

➢ Contents related activities (Activity-based discussions)

➢ Organizing Group wise discussions on issues

PRINCIPLES OF CLOUD COMPUTING			
Course Code	**22CDS542**	**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:

22CDS542.1	Understand the foundational principles of cloud computing and centralized computing systems.
22CDS542.2	Demonstrate the Cloud infrastructure of Google Cloud ad Amazon Cloud.
22CDS542.3	Identify private and hybrid cloud for organizations to execute customized applications.
22CDS542.4	Analyze authentication, confidentiality, and privacy issues in Cloud computing environment.
22CDS542.5	Analyze the financial and technological implications for selecting cloud computing platforms
22CDS542.6	Categorize the security issues and emerging technologies of Cloud computing.

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
22CDS542.1	2	2	2	-	-	-	-	-	-	-	-	2	3	3
22CDS542.2	2	2	2	-	-	-	-	-	-	-	-	2	3	3
22CDS542.3	2	2	2	-	-	-	-	-	-	-	-	2	3	3
22CDS542.4	2	2	2	-	-	-	-	-	-	-	-	2	3	3
22CDS542.5	2	2	2	-	-	-	-	-	-	-	-	2	3	3
22CDS542.6	2	2	2	-	-	-	-	-	-	-	-	2	3	3

MODULE-1	**Introduction of Cloud Computing**	**22CDS542.1, 22CDS542.2**	**8 Hours**

Introduction and Fundamentals of Centralized and distributed Computing, Historical evolution of cloud computing, Introduction to Cloud Computing, Cloud Architecture, characteristics of cloud computing, Cloud issues and challenges, Overview of cloud computing concepts relevant to data science, Benefits of using cloud services for data science projects.

Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16

MODULE-2	Cloud Infrastructure and Service models	**22CDS542.1, 22CDS542.2**	**8 Hours**

Cloud Service models, Cloud Deployment Models, Data Pipelines in the Cloud, Cloud resources: Network and API - Virtual and Physical computational resources - Data-storage. Virtualization concepts - Types of Virtualizations- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs. Virtualization in Data Science Development Pipelines.

Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	Cloud Computing Tools and Services	**22CDS542.3, 22CDS542.4**	**8 Hours**

Cloud Storage Solutions, Cloud based data storage solutions, Data lakes and data warehouses in the cloud, Cloud providers, Networking in Cloud Computing, Serverless Computing, Cloud Development and Deployment, Cloud platform & Management: Computation, Storage - Case studies. Software as a Service (SaaS) - Web services - Web 2.0 - Web OS - Case studies – Anything as a service (XaaS).

Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10

MODULE-4	Cloud Applications and Programming	**22CDS542.3, 22CDS542.4**	**8 Hours**

Cloud Applications – Moving Applications to the Cloud – Microsoft Cloud Services – Google Cloud Applications – Amazon Cloud Services, Cloud Programming and Software Environments – Parallel and Distributed Programming paradigms – Programming on Amazon AWS and Microsoft Azure – Programming support of Google App Engine – Emerging Cloud software Environment, Cloud-based Data Processing Frameworks

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	Emerging Trends and Security in Cloud Computing	22CDS542.5, 22CDS542,6	8 Hours

Edge Computing, Edge Computing Platforms and Tools, Serverless Architectures and Functions, Security in Edge Computing, Hybrid and Multi-cloud Strategies - Cloud Access: authentication, authorization and accounting - Cloud Provenance and meta-data - Cloud Reliability and fault-tolerance - Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards, Compliance and Governance in Cloud-based Data Science.

Text Book	Text Book 2: 12.1 to 12.10

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012. ISBN-13, 978-0123858801.
2) A.Srinivasan and J.Suresh, "*Cloud Computing – A Practical Approach for Learning and Implementation*", Pearson India Publications 2014,ISBN-9788131776513

Reference Books:

1. Barrie Sosinsky, " Cloud Computing Bible" John Wiley & Sons, 2010, ISBN: 978-0-470-90356-8.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2009,ISBN-9780596802769.
3. Rajkumar Buyya, James Broberg, Andrzej, "*Cloud Computing: Principles and Paradigms*", Wiley India Publications 2011, ISBN-13- 978-8126541256.

Web links and Video Lectures (e-Resources):

- **WEB REFERENCES:**
- NPTEL & MOOC courses titled Cloud computing
  https://nptel.ac.in/courses/106105167/

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

- Cloud Service Provider Visit
- Industry Collaboration Projects, Hackathon, or Innovation Challenge
- Internships or Summer Programs
- Analyze case studies of successful cloud implementations in various industries.
- Video demonstration of latest trends in cloud computing
- 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

BUSINESS ANALYTICS			
Course Code	**22CDS543**	**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:

22CDS543.1	Understand fundamental business analytics concepts and techniques across various functions (marketing, finance, HR, operations)
22CDS543.2	Apply analytics methodology to prepare objectives, identify data requirements, collect and prepare data
22CDS543.3	Demonstrate proficiency in organizing and structuring data, including tabulation, ordering, and frequency distribution techniques
22CDS543.4	Understand basic time series techniques like decomposition and ARIMA models for effective analysis and forecasting.
22CDS543.5	Examine advanced time series models including STL, ARCH, and GARCH, gaining proficiency in diverse analytical approaches.
22CDS543.6	Apply advanced Excel functions and quantitative techniques in financial modeling for risk management, project finance, and ESG analysis, improving proficiency

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
22CDS543.1	2	2	2	2	-	-	-	-	-	2	-	2	3	3
22CDS543.2	2	2	2	2	2	-	-	-	-	-	-	2	3	3
22CDS543.3	2	2	2	2	2	-	-	-	-	-	-	2	3	3
22CDS543.4	2	2	2	2	2	-	-	-	-	-	-	2	3	3
22CDS543.5	2	2	2	2	2	-	-	-	-	-	-	2	3	3
22CDS543.6	2	2	2	2	2	-	-	-	-	2	-	2	3	3

MODULE-1	**INTRODUCTION TO BUSINESS ANALYTICS**	**22CDS543.1**	**8 Hours**

Concept of analytics, Types of Analytics, Application fields - Marketing Analytics, Finance Analytics, HR Analytics, Operation Analytics, organization and source of data, importance of data quality, dealing with missing or incomplete data, Role of Data Scientist in Business & Society

Text Book	Text Book 1: Chapter 1
Case Study	A global e-commerce company wants to optimize its marketing strategies to increase customer acquisition, improve customer retention, and enhance overall sales performance. They decide to leverage marketing analytics to gain actionable insights from their data. 1. Identify distinct customer segments based on behavior, demographics, and purchasing patterns. 2. Evaluate the effectiveness of marketing campaigns across different channels (e.g., email, social media, paid ads) and optimize allocation of marketing budget.

MODULE-2	**ANALYTICS METHODOLOGY**	**22CDS543.2**	**8 Hours**

Introduction to Analytics Methodology, preparing objectives & identifying data requirements, Data Collection, Understanding data, Data preparation – Data Cleansing, Normalization, Data preparation, Data Blending, Data Modelling, Evaluation & feedback

Text Book	Text Book 2: Chapter 2 ,2.1-2.6

MODULE-3	**EXPLORING DATA**	**22CDS543.3**	**8 Hours**

Storing and Structuring Data, Organization of Data, Tabulation, Ordering Data, Frequency Distribution, Grouped Frequency Distribution, Cumulative Frequency Distribution, Percentiles, Measures and evaluating variation in Data Values.

Text Book	Text Book 3: Chapter 3,3.1-3.12

MODULE-4	**TIME SERIES AND FORECASTING**	**22CDS543.4, 22CDS543.5**	**8 Hours**

Introduction to Time Series Analysis, Time Series Decomposition, Exponential Smoothing, Autoregressive Integrated Moving Average (ARIMA) Models, Seasonal Decomposition of Time Series (STL), Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized ARCH (GARCH) Models ,State Space Models

Text Book	Text Book 2: Chapter 7

MODULE-5	**FINANCIAL MODELLING**	**22CDS543.6**	**8 Hours**

Advanced Excel Functions for Financial Modeling, Project Finance Models, Financial Modeling using Python and R, Quantitative Financial Modeling, Financial Modeling for Risk Management, Environmental, Social, and Governance (ESG) Financial Modeling.

Text Book	Text Book 3: Chapter 9&10

Case Study	A multinational financial institution wants to enhance its risk management framework by developing advanced financial models to assess and mitigate various types of risks across its investment portfolio. The institution decides to leverage quantitative financial modeling techniques to improve decision-making and regulatory compliance. Gather historical financial data, market data, and economic indicators relevant to the institution's investment portfolio. Cleanse and preprocess data to ensure accuracy and consistency for modeling purposes.

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Foster Provost and Tom Fawcett, Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, O'Reilly Media, ISBN-13, **978-1449361327.**
2. Arun Sukumar,Lucian TIPI, Jayne Revill, Applied Business Analytics.1st Edition,2016, ISBN-9788740313635.

Reference Books:

1. Thomas H. Davenport and Jeanne G. Harris, Competing on Analytics: The New Science of Winning,2017, ISBN-13, 978-1422103326.

Web links and Video Lectures (e-Resources):

- https://www.udemy.com/courses/business/analytics-and-intelligence.
- https://www.coursera.org/specializations/business-analytics

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

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

AUTOMATA THEORY AND COMPUTABILITY			
Course Code	**22CDS544**	**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:

22CDS544.1	Demonstrate finite automata properties, Chomsky classification, and language-set relations.
22CDS544.2	Analyze regular sets and grammars using regular expressions, finite automata, and pumping lemma techniques.
22CDS544.3	Analyze context-free languages through derivation trees and resolving ambiguity in context-free grammars.
22CDS544.4	Understanding pushdown automata and their relationship with context-free languages, including parsing techniques.
22CDS544.5	Analyze Turing machine theory, linear bounded automata, and relationship with type 0 grammars.
22CDS544.6	Explore the analysis and construction of computable functions to understand their computational properties

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
22CDS544.1	3	3	-	-	-	-	-	-	-	-	-	1	3	3
22CDS544.2	3	3	3	3	-	-	-	-	-	-	-	1	3	3
22CDS544.3	3	3	3	3	-	-	-	-	-	-	-	1	3	3
22CDS544.4	3	3	3	3	-	-	-	-	-	-	-	1	3	3
22CDS544.5	3	3	3	3	-	-	-	-	-	-	-	1	3	3
22CDS544.6	3	3	-	-	-	-	-	-	-	-	-	1	3	3

MODULE-1	AUTOMATA AND FORMAL LANGUAGES	22CDS544.1	8 Hours

THEORY OF AUTOMATA: Definition, Description of a Finite Automaton; Transition Systems; Properties of Transition Functions; Acceptability of a String by a Finite Automaton; Nondeterministic Finite State Machines; The Equivalence of DFA and NDFA; Mealy and Moore Models; Minimization of Finite Automata.

FORMAL LANGUAGES: Definitions and Examples; Chomsky Classification of Languages; Languages and Their Relation; Recursive and Recursively Enumerable Sets; Operations on Languages; Languages and Automata.

Self-study:	Study academic papers or research articles on minimization techniques for finite automata.
Text Book	Textbook 1: 3.1 to 3.9, 4.1 to 4.6

MODULE-2	REGULAR SETS AND GRAMMARS	22CDS544.2	8 Hours

REGULAR SETS AND REGULAR GRAMMARS: Regular Expressions; Finite Automata and Regular Expressions: Transition System Containing A-moves, NDFAs with A-moves and Regular Expressions, Conversion of Nondeterministic Systems to Deterministic Systems, Algebraic Method Using Arden's Theorem, Construction of Finite Automata Equivalent to a Regular Expression, Equivalence of Two Finite Automata, Equivalence of Two Regular Expressions; Pumping Lemma for Regular Sets; Application of Pumping Lemma; Closure Properties of Regular Sets.

Case Study	Analyze the implementation of regular expression engines in programming languages or search engines to understand how they efficiently match patterns in text data.
Text Book	Textbook 1: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6

MODULE-3	CONTEXT-FREE LANGUAGES & PUSHDOWN AUTOMATA	22CDS544.3 22CDS544.4	8 Hours

CONTEXT·FREE LANGUAGES(CFL): CFL and Derivation Trees; Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars.

PUSHDOWN AUTOMATA(PDA): Basic Definitions, Acceptance by PDA, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata.

Case Study:	Explore applications of pushdown automata in syntax analysis stages of compilers and interpreters, where they are used to recognize and parse context-free grammars.
Text Book	Textbook 1: 6.1 to 6.4, 7.1 to 7.4

MODULE-4	TURING MACHINES & LINEAR BOUNDED AUTOMATA	22CDS544.5	8 Hours

TURING MACHINES AND LINEAR BOUNDED AUTOMATA: Turing Machine Model; Representation of Turing Machines; Language Acceptability by Turing Machines; Design of Turing Machines; Description of Turing Machines; Techniques for TM Construction; Variants of Turing Machines; The Model of Linear Bounded Automaton; Turing Machines and Type 0 Grammars; Linear Bounded Automata and Languages.

Self-study	Solve practice problems and exercises to reinforce concepts such as designing Turing machines and their relationship with type 0 grammars.
Text Book	Textbook 1: 9.1 to 9.10

MODULE-5	**COMPUTABILITY THEORY ESSENTIALS**	**22CDS544.6**	**8 Hours**

COMPUTABILITY: Introduction and Basic Concepts; Primitive Recursive Functions; Recursive Functions; Partial Recursive Functions and Turing Machines: Computability, A Turing Model for Computation, Turing-computable Functions, Construction of the Turing Machine that Can Compute the Zero Function Z, Construction of the Turing Machine for Computing the Successor Function, Construction of the Turing Machine for Computing the Projection U_i^m, Construction of the Turing Machine that Can Perform Composition, Recursion, Minimization.

Case Study	Investigate real-world examples of computable functions used in algorithmic decision-making or problem-solving tasks, and analyze their efficiency and limitations.
Text Book	Textbook 1: 11.1, 11.2, 11.3, 11.4

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. K L P Mishra, N Chandrasekaran , 3rd Edition, Theory of Computer Science, PhI, 2012, ISBN-13, 978-8120329683.

Reference Books:

1. Michael Sipser : Introduction to the Theory of Computation, 3rd edition, Cengage learning,2013, ISBN-13, **978-8131525296.**
1. Elaine Rich, Automata, Computability and Complexity, 1st Edition, Pearson Education,2012, ISBN-13, **978-8131788226**.
2. John C Martin, Introduction to Languages and The Theory of Computation, 3rd Edition, Tata McGraw –Hill Publishing Company Limited, 2013, ISBN-13, **978-0072322002.**

Web links and Video Lectures (e-Resources):

1. https://www.geeksforgeeks.org/theory-of-computation-automata-tutorials/
2. https://brilliant.org/courses/computer
3. https://www.youtube.com/playlist?list=PLEbnTDJUr_IcPtUXFy2b1sGRPsLFMghhS
4. https://www.youtube.com/playlist?list=PLF7D3B75EDA17FE4D

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

- **Grammar Construction Challenge:**
- Provide students with a set of language specifications or constraints.
- Challenge them to construct context-free grammars that generate the specified languages.
- Have students present their grammars to the class and discuss their design choices.
- **Turing Machine Simulation:**
- Use online Turing machine simulators or develop a simple Turing machine simulator.
- Assign students various language recognition tasks and ask them to implement Turing machines to recognize these languages.
- Students can test and debug their Turing machine implementations using the simulator.

ADVANCED JAVA			
Course Code	**22CDS545**	**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:

22CDS545.1	Analyze the event-based classes and interfaces for creating GUI applications in Java.
22CDS545.2	Demonstrate JDBC connectivity to access database through Java Programs
22CDS545.3	Apply servlet technologies to build server-side applications.
22CDS545.4	Develop JSP based server-side solutions.
22CDS545.5	Implement web-based software components and frame works to solve real world problems.
22CDS545.6	Interpret the importance of Spring frame works in enterprise software solutions.

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
22CDS545.1	2	2	3	3	2	-	-	-	1	1	-	2	3	3
22CDS545.2	2	2	3	3	2	-	-	-	1	1	-	2	3	3
22CDS545.3	2	2	3		2	-	-	-	1	1	-	2	3	3
22CDS545.4	2	2	3	3	2	-	-	-	1	1	-	2	3	3
22CDS545.5	2	2	3	3	2	-	-	-	1	1	-	2	3	3
22CDS545.6	2	2	3	3	2	-	-	-	1	1	-	2	3	3

MODULE-1	**INTRODUCTION TO EVENT HANDLING**	**22CDS545.1**	**8 Hours**

Event driven programming in Java, Event handling Process, Swing Controls and UI elements, The Delegation Event Model, Swing Event Classes, Event Sources, Event Listener, Adapter Classes.

Text Book	Text Book 1: Chapter 24
Self Study	Design a simple Swing application with a button and a text field. Clicking the button should update the text field content. Implement this functionality using event handling concepts.

MODULE-2	**WORKING WITH JDBC**	**22CDS545.2**	**8 Hours**

Exploring web architecture models, Exploring the MVC architecture, Introducing JDBC, Exploring JDBC Drivers, Describing JDBC APIs, Exploring JDBC processes with java. sql package

Text Book	Text Book 2: Chapter 10

MODULE-3	**WORKING WITH SERVLETS**	**22CDS545.3**	**8 Hours**

Http protocol, Exploring the features of java servlets, Exploring the servlets API, Servlets life cycle, Working with the Http servlets request and Http servlets response interfaces, Exploring request delegation and request scope

Text Book	Text Book 2: Chapter 10

MODULE-4	**WORKING WITH JAVA SERVER PAGES**	**22CDS545.4**	**8 Hours**

Introducing JSP, Listing advantages of JSP over java servlets, Exploring the architecture of a JSP page, Describing the life cycle of a JSP page, Working with JSP basic tags and implicit objects, Working with the action tags in JSP Case Study/Application: Demonstrate the learnt concept of JSP and Servlets to develop a web registration module and integrate with Database using JDBC. A three tier based application needs to be developed and presented as case study

Text Book	Text Book 2: Chapter 11

MODULE-5	**INTRODUCTION TO SPRING FRAMEWORK**	**22CDS545.5, 22CDS545.6**	**8 Hours**

Introduction to Spring framework, Benefits , Spring Architecture, Components, Bean Life Cycle, XML Configuration on Spring, Spring Model View Controller (MVC)

Text Book	Text Book 3: Chapter 1

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	5	5
L2	Understand	5	5

L3	**Apply**	5	**5**
L4	**Analyze**	5	**10**
L5	**Evaluate**	5	
L6	**Create**	**-**	**-**

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. HerbertSchildt,"JAVAtheCompleteReference",11thEdition,TataMcGrawHill,2020(print).ISBN-13: 978-. 0072263855.
2. JimKeogh,"J2EE-TheComplete Reference",McGrawHill,2017, ISBN-13, **978-0070529120**
3. Rod Johnson, "Professional Java Development with the Spring Framework",Wrox ,July 2018(Re-print),ISBN-13, **978-0764543852.**

Reference Books:

1. Stephanie Bodoff et al, "The J2EE Tutorial", 3rd Edition, Pearson Education,2015(Reprint), ISBN-13:978-8176111652.
2. Uttam K Roy, "Advanced JAVA programming", Oxford University press, 2018 ISBN-13- **978-0199455508**

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_cs47/preview
- https://www.udemy.com/course/how-to-connect-java-jdbc-to-mysql/
- https://www.javatpoint.com/html-tutorial
- https://www.geeksforgeeks.org/life-cycle-of-a-servlet/?ref=ml_lbp
- https://www.youtube.com/results?search_query=java+jdbc+connection
- https://spring.io/projects/spring-framework

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

- ➢ Create Dynamic web projects by using JDBC drivers.
- ➢ Contents related activities (Activity-based discussions)
- ➢ Organizing Group wise discussions on issues
- ➢ Seminars

RESEARCH METHODOLOGY AND IPR			
Course Code	**22RMK55**	**CIE Marks**	**50**
L: T: P: S	**1:1:0:0**	**SEE Marks**	**50**
Hours / Week	**02**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

Course outcomes:

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

22RMK55.1	Define a research problem and to formulate research questions
22RMK55.2	Demonstrate the various processing techniques of research
22RMK55.3	Choose appropriate methods to formulate research objectives
22RMK55.4	Develop advanced critical thinking skills and enhance writing skills
22RMK55.5	Understand the statutory provisions of different forms of IPRs in simple forms
22RMK55.6	Identify the significance of practice and procedure of patents

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22RMK55.1	3	3	2	2	1	-	-	-	1	2	-	-
22RMK55.2	3	3	2	2	2	-	-	-	1	2	-	-
22RMK55.3	3	3	2	2	1	-	-	-	1	2	-	-
22RMK55.4	3	2	2	-	1	-	-	-	1	2	-	-
22RMK55.5	3	3	2	1	-	-	-	1	1	2	-	-
22RMK55.6	3	3	2	1	-	-	-	1	1	2	-	-

MODULE-1	**FORMULATION OF RESEARCH PROBLEM**	**22RMK55.1, 22RMK55.2**	**6 Hours**

Research– Meaning and Objectives – Criteria of Good Research–Problems Encountered by Researchers –Types of Research– Research Approaches-Research Process–Literature Review– Significance of Literature Review–Review of Selected Literature– Research Problem– Identification and Defining the Research Problem.

Text Book	Text Book 1: Ch. 1, 2

MODULE-2	**RESEARCH DESIGN PROCEDURES**	**22RMK55.2, 22RMK55.3**	**6 Hours**

Meaning of Research Design – Need for Research design – Features of a Good Design –Concepts Related to Research Design– Different Research Designs – Basic Principles of Experimental Designs.

Case Study	To find the solution for the given research problem using different types of research methods
Text Book	Text Book 1: Ch. 3

MODULE-3	**INTERPRETATION AND REPORT WRITING**	**22RMK55.4**	**6 Hours**

Meaning and Technique of Interpretation – Precautions in interpretation – Significance of Report Writing – Different Steps in Report Writing – Layout of a Research Report– Types of Report – Mechanics of Writing a Research Report –Conclusion-Referencing in Academic Writing –Bibliography.

Text Book	Text Book 2: Ch. 14

MODULE-4	**INTRODUCTION TO IPR**	**22RMK55.5**	**6 Hours**

Introduction and Significance of Intellectual Property Rights –Types of Intellectual Property Rights–Need for IPR –Rationale for Protection of IPR–IPR in India and Abroad–Forms of IPR – Royalty – Copyright – Trademark – Patents – Industrial Designs – Trade Secrets – Geographical Indications – Application of Different Forms of IPR– Future Aspects of IPR– Some Examples of IPR.

Text Book	Text Book 2: Ch. 1 and 2

MODULE-5	BASICS OF PATENTS	22RMK55.5, 22RMK55.6	6 Hours

Patents and its Basics – Patentable and Non-Patentable Inventions–Patent Application Process (National and International level) – Searching a Patent-Drafting and Filing a Patent –Types of Patent Applications–Patent Documents– Specification and Claims– Assignment, Licensing, Infringement–Different Layers of International Patent System–Some Examples of Patent – forms requirement for patent application with charges

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

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	5
L2	Understand	5	-	5
L3	Apply	5	7.5	-
L4	Analyze	5	7.5	-
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Kothari, C.R.,Research Methodology: Methods and Techniques, New Age International, 2018, ISBN-13: 978-8122436235
2) Ramakrishna Chintakunta, A Text book of Intellectual Property rights, Blue Hill Publication, ASIN: B09T6YDB5N, 2022

Reference Books:

1) Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K, An Introduction to Research Methodology, RBSA Publishers. 2015, ISBN-13:978-8176111652
2) Ranjith Kumar, Research methodology, Saga publications,4th edition, 2014, ISBN-13- 978-9351501336
3) Sinha, S.C. and Dhiman, A.K., Research Methodology, EssEss Publications. 2 volumes, 2012. ISBN : 81-7000-324-5, 81-7000-334-2
4) Asha Vijay Durafe, Dhanashree K. Toradmalle , Intellectual Property Rights, Dreamtech Press,2020, ISBN:9390395917

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=GSeeyJVD0JU
- https://www.youtube.com/watch?v=nv7MOoHMM2k
- https://www.youtube.com/watch?v=BGSgZ1J8-yQ

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

- Video Sessions
- Organizing Group Wise Discussions
- Seminars

CRITICAL AND CREATIVE THINKING SKILLS			
Course Code	**22SDK56**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**01**

Course outcomes:

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

22SDK56.1	Demonstrate proficiency in solving quantitative aptitude problems using fundamental concepts
22SDK56.2	Apply advanced quantitative techniques to address and solve complex real-world problems.
22SDK56.3	Develop and enhance logical reasoning skills essential for problem-solving in various competitive examinations.
22SDK56.4	Cultivate critical and creative thinking skills necessary for analytical reasoning and problem-solving.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22SDK56.1	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
22SDK56.2	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
22SDK56.3	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
22SDK56.4	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

MODULE-1	**CRITICAL THINKING THROUGH QUANTITATIVE ANALYSIS**	**22SDK56.1 22SDK56.2**	**6 Hours**

Number systems: LCM and HCF of numbers, Squaring and Cubing Techniques, Multiplication Tricks, Divisibility rules, Digit sum method, Speed Math, Simplifications, Approximations.

Percentages: Conversion of Fraction to Percentage Table, Percentage Change, Net percentage change/Effective percentage change, Successive Percentage, Concept of more/less percentage, Percentage of percentage, Product constancy, Increased/decreased by P%, Percentage Changes in Numerator and Denominator, Successive Percentage.

Averages: Basic concept, Consecutive Numbers, Non-Consecutive Numbers, Equation Concept, True/False concept, Including/Excluding concept, Replacement concept, Average Speed concept.

MODULE-2	**NUMERICAL TECHNIQUES FOR PROBLEM SOLVING**	**22SDK56.1 22SDK56.2**	**6 Hours**

Profit and Loss: Basic concept, Profit Percentage, Loss Percentage, Profit/Loss Percentage, Overall Profit/Loss, Dishonest shopkeeper, More/less loss concept.

Discounts: Successive discounts, Buy X and Get Y Free, Profit after allowing discount, True Discount, Difference between percentage profit and percentage discount.

Ratio and Proportion: Concept Explanation, Duplicate Ratio, Triplicate Ratio, Direct Proportion, Indirect Proportion, Double rule of three or compound proportion, Ratio in investment, Ratio in partnership, Ratio in averages, Ratio in profit and loss, Ratio in interest rates.

Time and Work: Unit work, Combined work, Individual efficiency, Group efficiencies, Time taken by an individual or a group, Work done by an individual or a group, Total work done, Chain Rule Concept, Pipes and Cisterns, 4 Rules of Pipes and Cistern.

MODULE-3	**ADVANCED QUANTITATIVE TECHNIQUES**	**22SDK56.1 22SDK56.2**	**6 HOURS**

Algebra: Simple Arithmetic Operations, Linear equation is one, Two and three variables, Methods of solving linear equations, Methods of solving quadratic equations, Surds and indices, Logarithms.

Series and Progressions: Arithmetic Sequences, Geometric Sequences, Harmonic Sequences, Fibonacci Numbers.

Geometry: Concepts of Angles, Different polygons like triangles, rectangle, square, right-angle triangle, Pythagorean Theorem, Perimeter and Area of Triangle, Rectangle, and circles.

Statistics: Mean, Median, Mode, Standard Deviation, Variance.

MODULE-4	ANALYTICAL REASONING AND CREATIVE PROBLEM SOLVING	22SDK56.3 22SDK56.4	6 Hours

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

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

Analogies: Alphabet Classification, Word Classification, Number Classification.

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

MODULE-5	PROBLEM SOLVING THROUGH LOGICAL ANALYSIS	22SDK56.3 22SDK56.4	6 Hours

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

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

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

CIE Assessment Pattern (50 Marks – Theory)

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

ENVIRONMENTAL STUDIES			
Course Code	**22ESK57**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**1**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:

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

22ESK57.1	Understand the concepts of Environment, ecosystem and biodiversity.
22ESK57.2	Explain the strategies for management of natural resources to achieve sustainability
22ESK57.3	Analyze the control measures of Environmental pollution and global Environmental issues.
22ESK57.4	Apply the knowledge of Environment Impact Assessment, Technology, Environmental acts and laws in protecting Environment and human health.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO100	PO11	PO12
22ESK57.1	-	-	-	-	-	3	3	-	-	-		-
22ESK57.2	-	-	-	-	-	3	3	-	-	-	-	3
22ESK57.3	-	-	-	-	-	3	3	3	-	3	-	3
22ESK57.4	-	-	-	-	1	3	3	3	-	3	-	3

MODULE 1	**INTRODUCTION TO ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**	**22ESK57.1**	**3hrs**
Environment: Definition, Components of Environment; Ecosystem: Types & Structure of Ecosystem, Energy flow in the ecosystem; Biodiversity: Types, Hot-spots, Threats and Conservation of biodiversity.			
Self-study / Case Study / Applications	Data Analysis on Environment, Ecosystem And Biodiversity		
Text Book	Text Book 1: Ch. 1 , 3 & 4		
MODULE 2	**NATURAL RESOURCES**	**22ESK57.2**	**3hrs**
Advanced Energy resources (Hydrogen, Solar, OTEC, Tidal and Wind), merits and demerits, Water resources – cloud seeding, Mineral resources, Forest resources. Strategies of management, concept of sustainability.			
Self-study / Case Study / Applications	Data Analysis on Natural Resources		
Text Book	Text Book 1: Ch. 2		
MODULE 3	**ENVIRONMENTAL POLLUTION**	**22ESK57.3**	**3hrs**
Definition, Causes, effects and control measures of Air Pollution, Water Pollution, soil Pollution and Noise pollution. Solid wastes and its management. Role of society, NGO and Govt. agencies in prevention of pollution			
Self-study / Case Study / Applications	Data Analysis on Environment pollution		
Text Book	Text Book 1: Ch. 5,6, Text Book 2: Ch. 5		
MODULE 4	**GLOBAL ENVIRONMENTAL ISSUES, ENVIRONMENT ACTS AND AMENDMENTS**	**22ESK57.3**	**3hrs**
Fluoride problem in drinking water, Acid Rain, Ozone layer depletion, Global warming and climate change. National forest policy, Environmental laws and acts. International agreements and protocols.			
Self-study / Case Study / Applications	Data Analysis on Global environmental issues		
Text Book	Text Book 1: Ch. 6, Text Book 2: Ch. 6		
MODULE 5	**HUMAN POPULATION AND ENVIRONMENT IMPACT ASSESSMENT**	**22ESK57.4**	**3hrs**
Population growth & explosion, Population pyramids. Negative impact of agriculture and urbanization, Role of Technology in protecting environment and human health. Environment Impact Assessment.			
Self-study / Case Study / Applications	Data Analysis on human population		

Text Book	Text Book 1: Ch. 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	10	7.5	5
L3	Apply	10	7.5	-
L4	Analyze		-	-
L5	Evaluate		-	-
L6	Create		-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Environmental studies by Benny Joseph, Tata McGraw Hill Education Private Limited, 2009, ISBN: 9870070648135.
2. "Environmental Studies: Basic Concepts" by Ahluwalia, V. K. The Energy and Resources Institute (TERI) Publication, 2nd edition, 2016. ISBN: 817993571X, 9788179935712.

Reference Books:

1. Handbook of Environmental Engineering by Rao Surampalli, Tian C. Zhang, Satinder Kaur Brar, Krishnamoorthy Hegde, Rama Pulicharla, Mausam Verma; McGraw Hill Professional, 2018. ISBN: 125986023X, 9781259860232
2. Environmental Science and Engineering by P. Venugopala, Prentice Hall of India Pvt. Ltd, New Delhi, 2012 Edition. ISBN: 978-81-203-2893-8.
3. Elements of Environmental Science and Engineering by P. Meenakshi, Prentice Hall of India Pvt. Ltd, 2005 Edition. ISBN: 8120327748, 9788120327740

Web links and Video Lectures (e-Resources):

- **https://archive.nptel.ac.in/courses/120/108/120108004/**
- **https://archive.nptel.ac.in/courses/103/107/103107215/**

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

- Visit to any company to study the initiative taken for environmental impact.
- Case study based learning on engineering approaches for pollution prevention.
- Video/ model / charts based learning
- Activities/awareness program for preventing environmental pollution

MINI PROJECT - II			
Course Code	**22CDS58**	**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:

22CDS58.1	Apply the knowledge of appropriate domains of the Solve real world problems
22CDS58.2	Design modules for solving the problems identified
22CDS58.3	Implement modules with a suitable software framework
22CDS58.4	Analyze real world problems through survey of existing 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
22CDS58.1	3	3	3	2	3	1	2	1	1	1	3	2	3	3
22CDS58.2	3	3	3	2	3	1	2	1	1	1	3	2	3	3
22CDS58.3	3	3	3	2	3	1	2	1	1	1	3	2	3	3
22CDS58.4	3	3	3	2	3	1	2	1	1	1	3	2	3	3

The student shall be capable of identifying a problem related to the field of Computer Science and carry out a mini project on the problem defined. Each student is expected to do the mini project individually. The work progress towards the project will be reviewed by a panel of experts during the course of the semester. At the completion of a project the student will submit a project report, which will be evaluated by duly appointed examiner(s).

Scope of the Mini project areas, but are not limited to :

1) Data Structure driven applications
2) Web based Applications
3) Data Science Applications
4) Java Based Projects
5) IoT applications

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

SEE Assessment Pattern (50 Marks – Lab)

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

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:

22NSSX0.1	Understand the importance of his / her responsibilities towards society.
22NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSSX0.3	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.
22NSSX0.4	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
22NSSX0.1	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.4	-	-	-	-	-	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 forimplementation. **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). **11.** Govt. school Rejuvenation and helping them to achieve good infrastructure.	22NSS60.1, 22NSS60.2, 22NSS60.3, 22NSS60.4	30 HRS

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10

Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- 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 empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
6.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/	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	Evaluation as per the rubrics of scheme and syllabus by NSS officer

	vocational education.				authority		
7.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer	
8.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer	
9.	Spreading public awareness under rural outreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer	
10.	Organize National integration and social harmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer	

11.	Govt. school Rejuvenation andhelping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer	

PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)			
Course Code	**22PED30, 22PED40, 22PED50, 22PED60**	**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:

22PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
22PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
22PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PEDX0.4	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
22PEDX0.1	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.2	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.3	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.4	-	-	-	-	-	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. 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.	22PED40.3	20 HRS
	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	22PED50.1, 22PED50.2,	Total 30 Hrs/ Semester

	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.	22PED50.3, 22PED50.4	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. • 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.	22PED60.1, 22PED60.2, 22PED60.3, 22PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

	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		

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:

Reference Books:

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

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

22YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
22YOGX0.2	Become familiar with an authentic foundation of Yogic practices
22YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat Kriyas
22YOGX0.4	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
22YOGX0.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.4	-	-	-	-	-	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 and benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	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/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 4. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	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**

VI Semester

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING			
Course Code	**22CDS61**	**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:

22CDS61.1	Apply search techniques and concept learning for finding optimal solutions and inferring Boolean-Valued function
22CDS61.2	Analyze the heuristic algorithms and learning algorithms over a range of available options to obtain Better and Faster Decisions
22CDS61.3	Employ Decision tree learning and Bayesian Learning to make useful predictions
22CDS61.4	Derive the probabilistic framework using learning techniques to predict target variables
22CDS61.5	Compute new data points using memory-based learning
22CDS61.6	Examine the new query instance using instance-based learning

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
22CDS61.1	3	2	2	2	-	-	-	-	-	-	-	2	2	2
22CDS61.2	3	3	3	3	-	-	-	-	-	-	-	2	2	2
22CDS61.3	3	2	2	2	-	-	-	-	-	-	-	2	2	2
22CDS61.4	3	3	3	3	-	-	-	-	-	-	-	2	2	2
22CDS61.5	3	2	2	2	-	-	-	-	-	-	-	2	2	2
22CDS61.6	3	3	3	3	-	-	-	-	-	-	-	2	2	2

MODULE-1	**Introduction to AI**	**22CDS61.1 22CDS61.2**	**8 Hours**

What is artificial intelligence, Well-Posed Learning Problems, Designing a Learning System, Choosing the training experience, Choosing the target function, Choosing a representation for the target function, Choosing a function approximation algorithm, Perspectives and issues in Machine Learning, problem spaces and search, Heuristic search techniques

Applications	8 Puzzle problem
Text Book	Textbook 1: Chapter 1, 2 and 3

MODULE-2	**Concept Learning**	**22CDS61.1 22CDS61.2**	**8 Hours**

Knowledge representation issues, Predicate logic, Representation knowledge using rules. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm

Applications	• A candidate elimination approach to rule learning in version space
Text Book	Textbook 1: Chapter 4, 5 and 6 & Texbook2: Chapter 2 (2.1-2.5, 2.7)

MODULE-3	**Decision Tree Learning in Machine Learning**	**22CDS61.3 22CDS61.4**	**8 Hours**

Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems, ID3 algorithm. Artificial Neural Network: Introduction, NN representation, Appropriate problems,
Perceptrons, Back propagation algorithm.

Case Study	• Decision Tree Algorithm in Healthcare Applications
Text Book	Texbook2: Chapter 3 (3.1-3.4), Chapter 4 (4.1-4.5)

MODULE-4	**Bayesian Learning**	**22CDS61.3 22CDS61.4**	**8 Hours**

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting, MDL principle, Bates optimal classifier, Gibbs algorithm, Navie Bayes classifier, BBN, EM Algorithm

Applications	• Bayesian learning of network structures from interventional experimental data

Text Book	Texbook2: Chapter 6		
MODULE-5	**Instance- based Learning**	22CDS61.6	**8 Hours**
Instance-Base Learning: Introduction, k-Nearest Neighbour Learning, Locally weighted regression, Radial basis function, Case-Based reasoning. Reinforcement Learning: Introduction, The learning task, Q-Learning.			
Self-study / Case Study / Applications	• Personal Well-Being Analysis through the Integration of Instance-Based Learning with Interpretable AI Techniques		
Text Book	Text book 1: Chapter 8 (8.1-8.5), Chapter 13 (13.1 – 13.3)		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	7.5	5
L4	Analyze	5	7.5	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Textbooks:

1. Tom M Mitchell, "Machine Lerning",1st Edition, McGraw Hill Education, 2017, ISBN-13, **978-1259096952.**
2. Elaine Rich, Kevin K and S B Nair, "Artificial Intelligence", 3rd Edition, McGraw Hill Education, 2017, ISBN-13, **978-0070087705.**

Reference Books:

1. Saroj Kaushik, Artificial Intelligence, Cengage learning, ISBN-13, **978-813151099.**
2. Stuart Rusell, Peter Norving , Artificial Intelligence: A Modern Approach, Pearson Education 2nd Edition, ISBN-13, **978-8120323827.**
3. AurÈlienGÈron,"Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, Shroff/O'Reilly Media, 2017, ISBN-13, **978-9355421982.**
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics, ISBN-13, **978-0387848570.**

Web links and Video Lectures (e-Resources):

1. **https://nptel.ac.in/courses/106102220**
2. **https://www.kaggle.com/kanncaa1/machine-learning-tutorial-for-beginners**
3. **https://www.toptal.com/machine-learning/machine-learning-theory-an-introductory-primer**
4. **https://pythonprogramming.net/machine-learning-tutorial-python-introduction/**
5. **https://machinelearningmastery.com/start-here/**
6. **https://www.tutorialspoint.com/mahout/mahout_machine_learning.htm**

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

- Using Teachable Machine with Google
- NPTEL Videos

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB			
Course Code	**22CDL61**	**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:

22CDL61.1	Analyze search algorithms and learning algorithms for a training data set
22CDL61.2	Apply Heuristic search techniques and various learning techniques for efficient computing
22CDL61.3	Evaluate the various artificial intelligence and machine learning algorithms
22CDL61.4	Use machine learning models for solving classification and prediction 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
22CDL61.1	3	3	3	3	3	-	-	-	1	-	-	2	3	3
22CDL61.2	3	3	3	3	3	-	-	-	1	-	-	2	3	3
22CDL61.3	3	3	3	3	3	-	-	-	1	-	-	2	3	3
22CDL61.4	3	3	3	3	3	-	-	-	1	-	-	2	3	3

Exp. No. / Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs		
	• Introduction to Python programming • Use of numpy libraries • Use of pandas libraries • Use of visualization tool kit	3	NA
	PART-A		
1	Implement the A* Search algorithm for finding the shortest path in a weighted graph.	3	22CDL61 22CDL62
2	Implement AO* (AO-star) Search algorithm for finding the shortest path in a weighted graph.	3	22CDL61 22CDL62
3	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	3	22CDL61 22CDL62
4	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	3	22CDL61 22CDL62
5	Develop an Artificial Neural Network by implementing the backpropagation algorithm and test the same using appropriate data sets.	3	22CDL61 22CDL62
6	Write a program to implement the Naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	3	22CDL61 22CDL62
	PART-B		
7	Demonstrate the Bias-Variance Trade-off in a machine learning model, provide visualizations and insights.	3	22CDL63 22CDL64
8	Demonstrate Association Rule Mining using the FP-Growth Algorithm. Utilize a suitable dataset to identify frequent item sets and generate association rules.	3	22CDL63 22CDL64
9	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	3	22CDL63 22CDL64
10	Develop a Convolutional Neural Network (CNN) and test it using appropriate datasets. Implement key components such as convolutional layers, pooling layers, and fully connected layers. Evaluate the CNN's performance on tasks such as image classification	3	22CDL63 22CDL64
11	Implement Q learning algorithm.	3	22CDL63 22CDL64

12	Develop a simple Chabot using rule-based responses.	3	22CDL63 22CDL64

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

- **Parallel and distributed processing - I: Interactive activation and competition models (https://cse22-iiith.vlabs.ac.in/exp/parallel-distributed-processing-i/theory.html)**
- **Competitive learning neural networks for pattern clustering (https://cse22-iiith.vlabs.ac.in/exp/pattern-clustering/)**
- **Solution to travelling salesman problem using self organizing maps (https://cse22-iiith.vlabs.ac.in/exp/self-organizing-maps/)**

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:
Reference Books:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education, ISBN-13, **978-1259096952.**
2. Pattern Recognition and Machine Learning, Bishop, Christopher, Springer nature publications, ISBN-13, **978-1493938438.**
3. Hands-On Machine Learning with Scikit-Learn and TensorFlow, Concepts, Tools, and Techniques to Build Intelligent Systems, Aurélien Géron, O'Reilly Media, March 2017. ISBN-13, **978-9355421982.**

COMPUTER NETWORKS			
Course Code	**22CDS62**	**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:

22CDS62.1	Understand the concept of layering in networks
22CDS62.2	Predict the functions of protocols of each layer of TCP/IP protocol suite.
22CDS62.3	Illustrate the End-to-End flow of information
22CDS62.4	Analyze the functions of network layer and the various routing protocols
22CDS62.5	Examine the functions and protocols of the Transport layer
22CDS62.6	Implement network applications and end to end Data Communication

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
22CDS62.1	3	3	2	1	-	-	-	-	-	-	-	3	2	2
22CDS62.2	3	2	2	3	-	-	-	-	-	-	-	2	2	2
22CDS62.3	2	2	2	2	-	-	-	-	-	-	-	3	2	2
22CDS62.4	3	2	2	3	-	-	-	-	-	-	-	2	2	2
22CDS62.5	3	3	3	3	-	-	-	-	-	-	-	3	2	2
22CDS62.6	3	3	1	2	-	-	-	-	-	-	-	2	2	2

MODULE-1	**Introduction to Data Communication concepts**	**22CDS62.1**	**8 Hours**

Introduction to networks: Network hardware, Network software, Reference models, Physical layer connectivity (wired/wireless communication) with device standards. Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite –OSI Model – Introduction to Sockets - Application

Text Book	Textbook 1: Ch.1.2 to 1.4, Ch.2.2 to 2.3

MODULE-2	**Data Link layer**	**22CDS62.2**	**8 Hours**

The Data link layer: Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols. The medium access control sublayer: The channel allocation problem, Multiple access protocols.

Text Book	Textbook 1: Ch.3.1 to 3.4, Ch.4.1, 4.2

MODULE-3	**Network Layer**	**22CDS62.3**	**8 Hours**

The Network Layer: Network Layer Design Issues, Routing Algorithms, Flow and Congestion Control Algorithms, QoS.

Text Book	Textbook 1: Ch 6.1 to 6.4 and 6.5.1 to 6.5.7

MODULE-4	**Transportation Layer**	**22CDS62.4**	**8 Hours**

The Transport Layer: The Transport Service, Elements of transport protocols, Congestion control, The internet transport protocols.

Text Book	Text Book 1: 5.1,5.2,5.3,5.4,5.5,5.6, Text Book 2: 10.1, 10.3, 10.5, 10.7

MODULE-5	**Application Layer**	**22CDS62.5, 22CDS62.6**	**8 Hours**

Application Layer: Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service.

Text Book	Textbook 2: Ch 2.1 to 2.4

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	7.5	5
L4	Analyze	5	7.5	5
L5	Evaluate	5		-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Tanenbaum, Andrew S., et al. Computer Networks, Global Edition. United Kingdom, Pearson Education, 2021, ISBN-9781292374017.
2. Kurose, James F. Computer Networking: A Top-Down Approach Featuring the Internet, 3/e. India, Pearson Education, 2005, ISBN 0133594149

Reference Books:

1. Forouzan, Behrouz A. Data Communications and Networking: With TCP/IP Protocol Suite. United States, McGraw-Hill, 2021, ISBN-13, **978-1260597820.**
2. Peterson, Larry L. and Davie, Bruce S.. Computer Networks: A Systems Approach. Netherlands, Elsevier Science, 2011, ISBN-13: 978-0-12-370548-8

Web links and Video Lectures (e-Resources):

1. https://www.digimat.in/nptel/courses/video/106105183/L01.html
2. http://www.digimat.in/nptel/courses/video/106105081/L25.html

Activity-Based Learning (Suggested Activities in Class)

- Case Studies
  Simulation of Personal area network, Home area network, achieve QoS etc

Note: - Note: For the Simulation experiments modify the topology and parameters set for the experiment and take multiple rounds of reading and analyze the results available in log files and also plot graphs and reports using any open source software/python programming.

COMPUTER NETWORKS LAB			
Course Code	**22CDL62**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**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:

22CDL62.1	Apply the Linux commands to capture ping and protocols for network design
22CDL62.2	Analyze the network layers to data link layer
22CDL62.3	Implement socket programming for TCP/IP for file transferring
22CDL62.4	Examine the effectiveness of policies for various scenarios

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
22CDL62.1	3	3	2	1	1	-	-	-	-	-	-	3	2	2
22CDL62.2	3	2	2	3	1	-	-	-	-	-	-	2	2	2
22CDL62.3	2	2	2	2	2	-	-	-	-	-	-	3	2	2
22CDL62.4	3	2	2	3	2	-	-	-	-	-	-	2	2	2

Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs		
	• Basics of programing • HTTP programming	3	NA
	PART-A		
1	Examine the commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer.	3	22CDL62.1
2	Write a HTTP web client program to download a web page using TCP sockets.	3	22CDL62.1
3	Create a simple program to simulate basic Data Link Layer (DLL) functionalities such as framing, error detection, and flow control. The goal is to understand how data packets are prepared, transmitted, and verified at the DLL.	3	22CDL62.2
4	Develop a simple data link layer that performs the flow control using the sliding window protocol, and loss recovery using the Go-Back-N mechanism.	3	22CDL62.3
5	Implement the data link layer framing methods such as character, character stuffing and bit stuffing	3	22CDL62.2
6	Examine static routes and dynamic routing protocols (such as RIP, OSPF) on routers, and analyze their performance and behaviour in a simulated network environment.	3	22CDL62.2
	PART-B		
7	Design and implement network topologies (star, ring, mesh) using simulation tools.	3	22CDL62.2

8	Implement a specific application layer protocol (e.g., HTTP, FTP) using socket programming, simulate client-server communication, and analyze protocol messages exchanged between endpoints.	3	22CDL62.2
9	Evaluate the performance of TCP/IP in terms of reliability, throughput, and latency using network simulation tools, and compare its behaviour under various network conditions to understand its impact on application performance.	3	22CDL62.3
10	Implement TCP socket programming to enable file transfer between a client and server. Develop functionalities for file upload, download, and error handling, while analyzing the reliability and efficiency of TCP in file transfer scenarios.	3	22CDL62.3
11	Implement Quality of Service (QoS) policies on a network router to prioritize traffic based on specific criteria such as packet classification, traffic shaping, and bandwidth allocation.	3	22CDL62.4
12	Evaluate the effectiveness of QoS policies in ensuring optimal performance for different types of network traffic (e.g., VoIP, video streaming) under varying traffic loads and congestion scenarios.	3	22CDL62.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. http://vlabs.iitkgp.ac.in/ant/1/
2. http://vlabs.iitkgp.ernet.in/ant/2/

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

1. Forouzan, Behrouz A. Data Communications and Networking: With TCP/IP Protocol Suite. United States, McGraw-Hill, 2021, ISBN-13, **978-1260597820.**
2. Peterson, Larry L. and Davie, Bruce S.. Computer Networks: A Systems Approach. Netherlands, Elsevier Science, 2011, ISBN-13: 978-0-12-370548-8

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105183/
- https://www.youtube.com/watch?v=VwN91x5i25g
- https://www.nptelvideos.com/course.php?id=393

ESSENTIALS OF CYBER SECURITY			
Course Code	**22CDS63**	**CIE Marks**	**50**
L:T:P:S	**2:1:0:0**	**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:

22CDS63.1	Analyse the concept of cyber security, including its related issues and challenges
22CDS63.2	Identify the types of cybercrimes, delineate legal remedies, and outline reporting procedures
22CDS63.3	Analyze the interrelationship between privacy and security concerns in the realm of online social media, integrating this knowledge to evaluate and enhance reporting procedures
22CDS63.4	Evaluate the concepts of E-Commerce and digital payment modes within the context of cyber security, applying RBI guidelines to formulate strategies aimed at preventing payment frauds.
22CDS63.5	Restructure fundamental security principles pertaining to computers and mobile devices
22CDS63.6	Assess elementary tools and technologies for defending personal devices against cyber threats

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
22CDS63.1	3	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
22CDS63.2	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
22CDS63.3	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
22CDS63.4	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2**	**2**
22CDS63.5	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
22CDS63.6	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

MODULE-1	**Introduction to Cyber security**	**22CDS63.1**	**8 Hours**

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

Self-study / Case Study / Applications	1. Internet Society Statement regarding the Indian Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules 2021. 2. Organisations dealing with Cyber crime and Cyber security in India, Case studies. 1. Can you provide an overview of the key organizations in India dedicated to addressing cybercrime and cyber security issues? 2. Describe the roles and responsibilities of organizations like CERT-In (Indian Computer Emergency Response Team) in handling cyber incidents. 3. Could you provide a case study where a notable cybercrime incident was successfully resolved with the involvement of Indian cyber security organizations?
Text Book	Text Book1: Chapter-1

MODULE-2	**Cyber Crime and Cyber law**	**22CDS63.2**	**8 Hours**

Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India, Case studies.

Self-study / Case Study / Applications	1. Checklist for reporting cyber crime at Cyber crime Police Station. 2. Checklist for reporting cyber crime online. 3. Reporting phishing emails. 4. Demonstration of email phishing attack and preventive measures
Text Book	Text Book1: Chapter-2

MODULE-3	**Social Media Overview and Security**	**22CDS63.3**	**8 Hours**

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social

media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

Self-study / Case Study / Applications	1. Basic checklist, privacy and security settings for popular Social media platforms. 2. Reporting and redressal mechanism for violations and misuse of Social media platforms. 3. Best practices for the use of Social media, Case studies
Text Book	Text Book1: Chapter-9

MODULE-4	**E-Commerce and Digital Payments**	**22CDS63.4**	**8 Hours**

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, ECommerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures.

Self-study / Case Study / Applications	1. Configuring security settings in Mobile Wallets and UPIs. Checklist for secure net banking. 2. RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act,2007
Text Book	Text Book1:Chapter-7

MODULE-5	**Digital Devices Security, Tools and Technologies for Cyber Security**	**22CDS63.5 22CDS63.6**	**8 Hours**

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security.

Self-study / Case Study / Applications	1 Setting, configuring and managing three password policy in the computer (BIOS, 2 Administrator and Standard User). 3 Setting and configuring two factor authentications in the Mobile phone.
Text Book	Text Book1: Chapter-8

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**	**5**	**7.5**	-
L4	**Analyze**	**5**	**7.5**	-
L5	**Evaluate**	**5**	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011), ISBN-13, 978-8126521791.
2. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition 2010, ISBN-13 978-8172730888.

3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson , 13th November, 2001), ISBN-13, **978-1516821020**

Reference Books:

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011), ISBN-13, **978-8126521791**
2. Michael E. Whitman, Herbert J. Mattord, (2018). Principles of Information Security, 6th edition, Cengage Learning, N. Delhi, ISBN-13, **978-1337102063**
3. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd , ISBN-13, **978-0470502495.**

Web links and Video Lectures (e-Resources):

- **https://www.youtube.com/watch?v=lpa8uy4DyMo**
- **https://onlinecourses.nptel.ac.in/noc23_cs127/preview**
- **https://www.coursera.org/professional-certificates/google-cybersecurity?**

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

- Capture the flag challenges
- Threat hunting exercises
- Secure Coding Challenges

SCALABLE DATA SCIENCE			
Course Code	**22CDS641**	**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:

22CDS641.1	Demonstrate the core concepts in data science such as probability, linear algebra, and optimization.
22CDS641.2	Apply basic principles of hash functions and sketches to approximate data operations effectively.
22CDS641.3	Illustrate approximate near neighbors search techniques, including extensions and randomized numerical linear algebra methods, to efficiently process large datasets
22CDS641.4	Demonstrate the ability to implement map-reduce programming examples, such as page rank, k-means, and matrix multiplication, to analyze and process big data efficiently.
22CDS641.5	Evaluate the Hadoop ecosystem and related paradigms, including Map-reduce, Scala, and Spark, to design and optimize computational solutions for large-scale data processing tasks.
22CDS641.6	Implement basic functional programming concepts in parallel data processing tasks.

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
22CDS641.1	2	2	2	2	-	-	-	-	-	-	-	2	2	2
22CDS641.2	2	2	2	2	-	-	-	-	-	-	-	2	2	2
22CDS641.3	2	2	2	2	-	-	-	-	-	-	-	2	2	2
22CDS641.4	2	2	2	2	-	-	-	-	-	-	-	2	2	2
22CDS641.5	2	2	2	2	-	-	-	-	-	-	-	2	2	2
22CDS641.6	2	2	2	2	-	-	-	-	-	-	-	2	2	2

MODULE-1	**INTRODUCTION**	**22CD641.1**	**8 Hours**
Introduction, Probability: Concentration inequalities, Linear algebra: PCA, SVD, Optimization: Basics, Convex, GD, Machine Learning: Supervised, generalization, feature learning, clustering.			
Text Book	Text Book 1: Chapter 1		
Self Study	Provide an example of how concentration inequalities can be applied in analyzing algorithms or data.		
MODULE-2	**MEMORY-EFFICIENT DATA STRUCTURES**	**22CDS641.2**	**8 Hours**
Hash functions, universal / perfect hash families, Bloom filters, Sketches for distinct count. Count Sketch, Count-Min Sketch , Approximate near neighbors search: Introduction, kd-trees, LSH families, MinHash for Jaccard, SimHash for L2			
Text Book	Text Book 2: Chapter 2 ,2.1-2.6		
Self Study	Prepare a report on the way hash functions and sketching techniques contribute to efficient data processing and storage in computer science.		
MODULE-3	**APPROXIMATE NEAR NEIGHBORS SEARCH**	**22CDS641.3**	**8 Hours**
Extensions e.g. multi-probe, b-bit hashing, Data dependent variants Randomized Numerical Linear Algebra Random projection, Randomized Numerical Linear Algebra CUR Decomposition, Sparse RP, Subspace RP, Kitchen Sink			
Text Book	Text Book 3: Chapter 3,3.1-3.12		
MODULE-4	**MAP-REDUCE AND RELATED PARADIGMS**	**22CDS641.4, 22CDS641.5**	**8 Hours**
Map-reduce and related paradigms Map reduce - Programming examples - (page rank, k-means, and matrix multiplication) Big data: computation goes to data, Hadoop ecosystem, Map-reduce and related paradigms, Scala, Spark.			
Text Book	Text Book 2: Chapter 7		
MODULE-5	**INTRODUCTION TO PARALLEL DATA PROCESSING**	**22CDS641.6**	**8 Hours**
Parallel data processing strategies, Programming language options, Functional programming basics, Resilient Distributed Dataset and Data Frames on ApacheSparkSQL.			
Text Book	Text Book 3: Chapter 9&10		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	5	5

L2	**Understand**	**5**	**5**
L3	**Apply**	**5**	5
L4	**Analyze**	**5**	10
L5	**Evaluate**	**5**	**-**
L6	**Create**	**-**	**-**

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. J. Leskovec, A. Rajaraman and JD Ullman. Mining of Massive Datasets. Cambridge University Press, 2nd Ed.2014, ISBN-13, **978-1316638491.**
2. Woodruff, David P. ""Sketching as a tool for numerical linear algebra."" Foundations and Trends® in Theoretical Computer Science 10.1–2 (2014): 1-157., ISBN-13- **978-1680830040.**
3. Muthukrishnan, S. (2005). Data streams: Algorithms and applications. Foundations and Trends® in Theoretical Computer Science, 1(2), 117-236, ISBN-13, **978-1933019147.**

Reference Books:

1. Essential PySpark for Scalable Data Analytics Paperback – Import, 29 October 2021, ISBN-13, **978-180056887.**
2. Mahoney, Michael W. ""Randomized algorithms for matrices and data."" Foundations and Trends® in Machine Learning 3.2 (2011): 123-224, 978-1-60198-506-4

Web links and Video Lectures (e-Resources):

- https://www.classcentral.com/course/swayam-scalable-data-science-14279.
- https://www.ibm.com/training/badge/fundamentals-of-scalable-data-science

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

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

PREDICTIVE ANALYTICS			
Course Code	**22CDS642**	**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:

22CDS642.1	Understand predictive modeling techniques like supervised, unsupervised learning, decision trees, and neural networks.
22CDS642.2	Interpret data preparation, including cleaning, handling missing values, and creating features.
22CDS642.3	Apply PCA and clustering algorithms for dimensionality reduction and pattern recognition.
22CDS642.4	Implement and assess predictive models, focusing on key metrics and interpretation.
22CDS642.5	Evaluate predictive models using percent correct classification and rank-ordered methods.
22CDS642.6	Analyse the challenges in predictive analytics, including data understanding and integrating BI and data mining.

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
22CDS642.1	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS642.2	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS642.3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS642.4	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS642.5	3	3	3	3	-	-	-	-	-	-	-	2	3	3
22CDS642.6	3	3	3	3	-	-	-	-	-	-	-	2	3	3

MODULE-1	**Overview of Predictive Analytics**	**22CDS642.1**	**8 Hours**

Predictive Analytics: Supervised vs. Unsupervised Learning, Parametric vs. Non-Parametric Models; Business Intelligence, Predictive Analytics vs. Business Intelligence, Predictive Analytics vs. Statistics; Predictive Analytics vs. Data Mining; Challenges in Using Predictive Analytics, Data Understanding

Self-study	Study key differences and applications of supervised vs. unsupervised learning, parametric vs. non-parametric models
Text Book	Text Book 1: Ch1, Ch3

MODULE-2	**Data Preparation**	**22CDS642.2**	**8 Hours**

Data Preparation: Variable Cleaning, Incorrect Values, Consistency in Data Formats, Outliers, Multidimensional Outliers, Missing Values, Fixing Missing Data; Feature Creation: Simple Variable Transformations, Fixing Skew, Binning Continuous Variables, Numeric Variable Scaling, Nominal Variable Transformation, Ordinal Variable Transformations, Date and Time Variable Features, ZIP Code Features, Multidimensional Features, Sampling.

Case Study	Detecting and managing outliers in sensor data collected from a network of environmental monitoring devices, ensuring data integrity and reliability for accurate analysis
Text Book	Text Book 1: Ch4

MODULE-3	**Descriptive Modeling**	**22CDS642.3, 22CDS642.4**	**8 Hours**

Descriptive Modeling; Data Preparation Issues with Descriptive Modeling; Applying PCA to New Data, PCA for Data Interpretation, Additional Considerations before Using PCA, The Effect of Variable Magnitude on PCA Models; Selecting the Number of Clusters, The Kohonen SOM Algorithm, Visualizing Kohonen Maps, Similarities with K-Means.

Case Study	Apply Principal Component Analysis (PCA) to financial data for dimensionality reduction and understand market trends.
Text Book	Text Book 1: Ch6

MODULE-4	**Predictive Modeling**	**22CDS642.5**	**8 Hours**

Predictive Modeling; The Decision Tree Landscape, Building Decision Trees, Decision Tree Splitting Metrics, Decision Tree Knobs and Options, Reweighting Records: Priors, Reweighting Records: Misclassification Costs; Interpreting Logistic Regression Models; Neural Networks: Building Blocks-The Neuron, Neural Network Training, The Flexibility of Neural Networks, Neural Network Settings, Neural Network Pruning, Interpreting Neural Networks, Neural Network Decision Boundaries.

Self-study / Case Study / Applications	Case Study: Apply decision trees for customer segmentation in retail and logistic regression for predicting customer churn in telecommunications,		
Text Book	Text Book 1: Ch8		
MODULE-5	**Assessing Predictive Models**	**22CDS642.6**	**8 Hours**
Assessing Predictive Models: Batch Approach to Model Assessment, Percent Correct Classification, Rank-Ordered Approach to Model Assessment; Assessing Regression Models; Model Ensembles: Motivation for Ensembles, Bagging, Boosting, Improvements to Bagging and Boosting.			
Case Study	Apply k-NN for movie recommendations and evaluate model performance in practical applications.		
Text Book	Text Book 1: Ch9, Ch10		

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Dean Abbott "Applied Predictive Analytics, Principles and Techniques for the Professional Data Analyst", Wiley, ISBN: 978-1-118-72796-6, 2014.

Reference Books:

1. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett (2020). ISBN-13 **978-1449361327.**
2. "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die" by Eric Siegel (2020), ISBN-13, **978-1119145677.**
3. "Advanced Analytics with Spark: Patterns for Learning from Data at Scale" by Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills (2019), ISBN-13, **978-1491912768.**

Web links and Video Lectures (e-Resources):

3. **https://www.coursera.org/learn/predictive-analytics**
4. **https:// www.youtube.com/watch?v=PaFPbb66DxQ**
5. **https://www.udemy.com/course/data-science-analytics-ai-for-business-the-real-world**
6. **https://onlinecourses.swayam2.ac.in/imb24_mg71/preview**

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

- Use k-means clustering on a dataset and visualize the clusters, then compare with Kohonen SOM.
- Implement PCA on a dataset to reduce dimensionality and visualize the principal components.
- Implement a decision tree classifier on a dataset, adjusting various parameters and observing the effects.
- Implement k-NN and Naïve Bayes classifiers on a dataset and evaluate their performance.

OPTIMIZATION TECHNIQUES FOR COMPUTING SCIENCES			
Course Code	**22CDS643**	**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:

22CDS643.1	Understand different types of optimization techniques in engineering problems
22CDS643.2	Analyze linear programming methods and classical optimization techniques
22CDS643.3	Apply unconstrained optimization techniques in single variable problems
22CDS643.4	Analyze nonlinear programming model to solve constrained optimization techniques
22CDS643.5	Implement Modern methods of optimization to solve decision problems
22CDS643.6	Develop various applications using tools to solve different optimization 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**
22CDS643.1	3	3	3	2	-	-	-	-	-	-	-	2	3	3
22CDS643.2	3	3	3	2	-	-	-	-	-	-	-	2	3	3
22CDS643.3	3	3	3	2	-	-	-	-	-	-	-	2	3	3
22CDS643.4	3	3	3	2	-	-	-	-	-	-	-	2	3	3
22CDS643.5	3	3	3	2	-	-	-	-	-	-	-	2	3	3
22CDS643.6	3	3	3	2	-	-	-	-	-	-	-	2	3	3

MODULE-1	Introduction to Optimization	22CDS643.1	8 Hours

Engineering application of optimization, Statement of an optimization problem, Optimal Problem formulation, Classification of optimization problem, Optimization techniques, Solution of optimization problems using MATLAB, Optimum design concepts, Definition of global and local optima – Optimality criteria.

Text Book	Text Book 1: Chapter 1.1 to 1.7

MODULE-2	Classical Optimization Techniques and Linear programming methods	22CDS643.2	8 Hours

Introduction, Single variable optimization, Multi variable optimization with no constraints, Multi variable optimization with Equality constraints, Multi variable optimization with inequality constraints, Convex programming problem. Linear programming: Review of Linear programming methods for optimum design, Duality in linear programming, Decomposition principle, Post optimality analysis, Application of LPP models in design and manufacturing.

Text Book	Text Book 1: Chapter 2.1 to 2.6, 4.1 to 4.6

MODULE-3	Algorithm for Unconstrained Optimization	22CDS643.3	8 Hours

Classification of unconstrained minimization methods, Rate of convergence, Random Jumping method, Random Walk method, Random Walk method with direction exploitation, Grid search method, Univariate search methods, Gradient of a function, Cauchy's steepest descent method, Newton's method, Conjugate gradient method, Marquardt method, Quasi -Newton method, Davidon - Fletcher-Powell method

Text Book	Text Book 1: Chapter 6.1 to 6.4, 6.8 to 6.14		
MODULE-4	Algorithm for Constrained Optimization	22CDS643.4	8 Hours

Optimization algorithms for solving constrained optimization problems, Characteristics of a constrained problem, Random search method, Complex method, Sequential linear programming, Basic approach for feasible directions, Zoutendijk's method of feasible directions, Rosen's gradient projection method, Generalized reduced gradient method, Sequential quadratic programming.

Text Book	Text Book 1: Chapter 7.1 to 7.10		
MODULE-5	Modern methods of Optimization	22CDS643.5 22CDS643.6	**8 Hours**

Introduction, Genetic Algorithms, Genetic operators, Simulated Annealing, Ant colony optimization, Ant search behavior, Path retracing, Neural-Network based Optimization, Fuzzy optimization techniques, Fuzzy set theory, Computational procedure, Use of MATLAB to solve optimization problems.

Case study	A case study on the application of a genetic algorithm for optimization
Text Book	Text Book 1: Chapter 13.1 to 13.7

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1 . Singiresu S. Rao, 'Engineering Optimization, Theory and Practice' New Age International Publishers, 4th Edition,2012, ISBN-13, **978-8122427233.**

Reference Books:

1. 1. Deb K., 'Optimization for Engineering Design Algorithms and Examples', PHI 2000, ISBN-13, **978-8120346789.**

2. Arora J., 'Introduction to Optimization Design' – Elsevier Academic Press, New Delhi ,2004, ISBN: 9780128008065.

3. Saravanan R., 'Manufacturing Optimization through Intelligent Techniques', Taylor & Francis (CRC Press), 2006, ISBN 9781138106093.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=WYyWIpa5QPQ
- https://www.youtube.com/watch?v=d7_4uOQXDFs
- https://en.wikipedia.org › wiki › Constrained_optimization
- https://en.wikipedia.org › wiki › Genetic_algorithm
- https://www.researchgate.net › figure › Fuzzy-optimization

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

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

ADVANCED DBMS			
Course Code	**22CDS644**	**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:

22CDS644.1	Understand the fundamentals of Storage and Indexing, including Disks and Files.
22CDS644.2	Apply Tree-Structured indexing principles for various operations.
22CDS644.3	Examine and Implement Hash-Based Indexing in various scenario.
22CDS644.4	Analyze queries using external sorting algorithms.
22CDS644.5	Evaluate queries involving relational operators.
22CDS644.6	Examine the stages of physical database design and optimization.

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
22CDS644.1	3	3	3	-	-	-	-	-	-	-	-	1	2	3
22CDS644.2	3	3	3	-	-	-	-	-	-	-	-	1	2	3
22CDS644.3	3	3	3	-	-	-	-	-	-	-	-	1	2	3
22CDS644.4	3	3	3	2	-	-	-	-	-	-	-	1	2	3
22CDS644.5	3	3	3	2	-	-	-	-	-	-	-	1	2	3
22CDS644.6	3	3	3	2	-	-	-	-	-	-	-	1	2	3

MODULE-1	DIGITAL DATA STORAGE AND MANAGEMENT	22CDS644.1,	8 Hours

Storage and Indexing: File organizations and indexing; Index data structures; Comparison of file organizations; Indexes and performance tuning.

Disks and Files: Memory hierarchy; RAID, Disk space management; Buffer manager; Files of records; Page formats and Record formats.

Self-study:	Explore different file organizations such as sequential, indexed sequential, and hashed files. Compare their advantages and disadvantages in terms of storage efficiency and access speed.
Text Book	Text Book 1: 8.2 to 8.5, 9.1 to 9.7.

MODULE-2	EXPLORING INDEXING: TREES TO HASHING	22CDS644.2, 22CDS644.3	8 Hours

Tree Structured Indexing: Indexed sequential access method; B+ trees, Search, Insert, Delete, Duplicates, B+ trees in practice.

Hash-Based Indexing: Static hashing; Extendible hashing, Linear hashing, comparisons of Extendible and Linear hashing.

Case Study:	Investigate real-world challenges faced by database administrators when implementing and maintaining B+ trees, such as rebalancing and optimizing tree structure.
Text Book	Text Book 1 : 10.2 to 10.8,11.1 to 11.4

MODULE-3	ENHANCING DATABASES: OPERATORS TO PLANNING	22CDS644.4	8 Hours

Query Evaluation: The system catalog; Introduction to operator evaluation; Algorithms for relational operation Introduction to query optimization; Alternative plans: A motivating example; Typical optimizer; **External Sorting:** DBMS sort data; A simple two-way merge sort; External merge sort.

Case Study:	Explore how the system catalog is utilized by the DBMS to enforce data integrity constraints, such as primary keys, foreign keys, and unique constraints, in a large-scale database system.
Text Book	Text Book 1: 12.1 to 12.6, 13.1,13.2,13.3

MODULE-4	PHYSICAL DATABASE DESIGN AND CRASH RECOVERY	22CDS644.5	8 Hours

Introduction to Physical Database Design: Database Workloads, Physical Design and Tuning Decisions, Need for Database Tuning; Guidelines for Index Selection, Clustering and Indexing , Co-clustering Two Relations, Indexes on Multiple-Attribute Search Keys, Indexes that Enable Index-Only Plans. Introduction to ARIES; Recovering from a System Crash; Media Recovery.

Self-study:	Explore different types of selection conditions used in SQL queries, including simple comparisons, logical operators, and pattern matching with wildcard characters.
Text Book	Text Book 1: 16.1 - 16.6, 20.1 - 20.3

MODULE-5	OPTIMIZING INDEXING AND DATABASE PERFORMANCE	22CDS644.6	8 Hours

Physical Database Design and Tuning: Introduction; Guidelines for index selection; examples; Clustering and indexing; Indexes that enable index-only plans; Tools to assist in index selection; Overview of database tuning; Choices in tuning the conceptual schema; Choices in tuning queries and views; Impact of concurrency.

Case Study	Explore how clustering and indexing techniques are applied in a healthcare information system to improve the efficiency of querying patient records and medical data.
Text Book	Text Book 2 : 20.1 to 20.10

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2003, ISBN-13, **978-0072465631.**
2. Elmasri and Navathe: Fundamentals of Database Systems, 5thEdition, Pearson Education, 2007,paper back-2018, ASIN : B076K8CM55

Reference Books:

1. Connolly and Begg: Database Systems, 4th Edition, Pearson Education, 2002, ISBN 0 321 21025 5

Web links and Video Lectures (e-Resources):

1. https://www.coursera.org/learn/database-clients
2. https://www.udemy.com/courses/search/?src=ukw&q=advanced+databases
3. https://www.amigoscode.com/courses/advanced-databases

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

- **Query Optimization Challenge:** Optimize SQL queries considering indexing strategies.
- **NoSQL Database Exploration:** Have students explore NoSQL databases like MongoDB or Cassandra.

SOFTWARE TESTING & AUTOMATION			
Course Code	**22CDS645**	**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:

22CDS645.1	Understand the fundamental concepts in software testing.
22CDS645.2	Analyze the importance of Structural and Regression testing.
22CDS645.3	Examine the various types of Non Functional Testing and related software metrics.
22CDS645.4	Interpret the Defect Management Process.
22CDS645.5	Analyze the Test Automation process and related tools.
22CDS645.6	Apply the testing tools related to web automation and mobile automation.

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
22CDS645.1	-	-	-	-	-	1	-	3	3	2	2	3	2	3
22CDS645.2	-	-	-	-	-	-	-	-	-	-	-	-	2	3
22CDS645.3	3	3	3	3	-	1	-	-	-	-	-	3	2	3
22CDS645.4	-	-	-	-	-	1	-	3	3	2	2	3	2	3
22CDS645.5	3	3	3	3	2	1	-	-	-	2	-	-	2	3
22CDS645.6	3	3	3	3	2	-	-	-	-	-	2	3	2	3

MODULE-1	**FUNDAMENTALS**	**22CD645.1**	**8 Hours**

Software Verification and Validation- Verification and Validation Techniques, V-Model of Testing , Software Testing ,Purpose of Testing - Taxonomy of Bugs, Defect And Failure Analysis, Types of Testing, Techniques , Black Box ,White Box – Gray Box Testing Test Adequacy and Coverage. Functional Testing Functional testing, Boundary Value Testing, Equivalence class testing, Decision table based testing , Evaluation of the testing ,Assessed exercise: Specify and design test cases.

Text Book	Text Book 2: Chapter 8,9
Self Study	Specify and design test cases for a simple software application. Consider boundary values, equivalence classes, and decision tables in your test case design.

MODULE-2	**STRUCTURAL TESTING**	**22CDS645.2**	**8 Hours**

Path testing - Data and Control Flow Testing – Graph Based Testing - Evaluation of the testing and summary Regression Testing: Need for Regression, Testing–Impact Analysis – Regression Test Selection Techniques – Code and Model Based Techniques – Test Case Optimization Techniques.

Text Book	Text Book 2: Chapter 8,8.1.-8.3,8.4,9.1-9..8
Self Study	Provide examples of situations where path testing is particularly useful compared to other testing methods.

MODULE-3	**NONFUNCTIONAL TESTING**	**22CDS645.3, 22CDS645.4**	**8 Hours**

GUI Testing – Domain Based Testing – Performance Testing – Stress Testing – Load Testing – Acceptance Testing – Alpha, Beta, Gamma Testing – Software Acceptance Plan. Metrics: Importance of Metrics in Testing - Effectiveness of Testing – Defect Density – Defect Leakage Ratio – Residual Defect Density – Test Team Efficiency – Test Case Efficiency–Various Test Reports.

Text Book	Text Book 1: Chapter 15,15.1-15.13, Text Book 2: 14.9

MODULE-4	**AUTOMATION TESTING**	**22CDS645.5**	**8 Hours**

Automation testing: Basics, Significance, Components, Process of Test Automation, Strategies, Automated tests, Examples of test automation, Test Automation maintenance, Automation test frameworks-types, tools.

Text Book	Text Book 1: Chapter 13,13.1-13.11

MODULE-5	**WEB & MOBILE AUTOMATION**	**22CDS645.6**	**8 Hours**

Selenium Automation Framework, Selenium IDE, Selenium Web Driver, Data driven, Keyword driven, Hybrid. Selenium basics, waits, Web Component concept, Junit4 basics, Selenium in Java, Page Object Concept, Data transfer Object Concept. Database Testing using Selenium, Cross Browser Testing. Mobile Automation: Mobile application framework, APPIUM basics.

Text Book	Text Book 3: Chapter 2,3
Case Study	Write and test a program to provide total number of objects present on a google web page using selenium.

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	5	5
L4	Analyze	5	10
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. M G Limaye, "Software Testing – Principles, Techniques and Tools", Tata McGraw Hill,2009, ISBN: 9780070139909.
2. Paul C. Jorgensen, Software Testing Fourth Edition, CRC Press,2013, ISBN-13,**978-1466560680.**
3. Selenium with Java – A Beginner's Guide: Web Browser Automation for Testing using Selenium with Java Paperback – 14 February 2022, ISBN-13 ,**978-9391392680.**
4. Boris Beizer, "Software Testing Techniques", 2nd Edition, Dream tech press,2003, ISBN-13,**978-1850328803**

Reference Books:

1. Edward Kit, "Software Testing in the Real World - Improving the Process", Pearson Education, 2004, ISBN: 978-1-4666-8662-5.
2. William E. Perry, "Effective methods for software testing", 2ndEdition, John Wiley, 2000, ISBN-13: 978-0471354185.

Web links and Video Lectures (e-Resources):

- Automation Testing Tutorial", https://artoftesting.com/automation-testing
- Tools QA, Selenium Tutorial, https://www.toolsqa.com/selenium-tutorial/
- "Appium Tutorials", https://appium.io/tutorial.html

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

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

PROJECT PHASE-1			
Course Code	**22CDS65**	**CIE Marks**	**50**
L:T:P:S	**0:0:3:0**	**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:

22CDS65.1	Identify an issue and derive problem related to society, environment, economics, energy and technology
22CDS65.2	Formulate and Analyze the problem and determine the scope of the solution chosen
22CDS65.3	Determine, dissect, and estimate the parameters, required in the solution and Evaluate the solution by considering the standard data / Objective function and by using appropriate performance metrics.
22CDS65.4	Compile the report and take part in present / publishing the finding in a reputed conference / publications

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
22CDS65.1	3	2	-	3	2	2	3	3	3	3	2	3	3	3
22CDS65.2	3	3	2	3	3	3	3	3	3	3	3	3	3	3
22CDS65.3	3	2	3	3	3	3	3	3	3	3	3	3	3	3
22CDS65.4	1	2	3	3	1	2	1	3	3	3	2	3	3	3

Project: Carried out at the Institution or at an Industry.

Project work shall preferably be batch wise, the strength of each batch shall have minimum of two and maximum of four students,For Project Phase –I and Project Phase –II, the CIE shall be 50 and 100 respectively.

Project activities to be communicated to the guide on regular basis.

The CIE marks of Phase-1 shall be based on the evaluation based on the reviews by a committee consisting of the Head of the concerned Department and the panel members of the Department, one of whom shall be the project guide.

Minimum requirement of CIE marks for Project work shall be 50% of the maximum marks.

Students failing to secure a minimum of 50% of the CIE marks in Project work shall not be eligible for the Project examination conducted by the University and they shall be considered as failed in that/those Course/s. However, they can appear for University examinations conducted in other Courses of the same semester and backlog Courses if any. Students after satisfying the prescribed minimum CIE marks in the Course/s when offered during subsequent semester shall appear for SEE.

Improvement of CIE marks shall not be allowed in Project where the student has already secured the minimum required marks

For a pass in a Project/Viva-voce examination, a student shall secure a minimum of 40% of the maximum marks prescribed for the University Examination.

CIE - Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests (50 Marks)
Remember	-
Understand	05
Apply	15
Analyze	10
Evaluate	-
Create	20

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests (50 Marks)
Remember	-
Understand	-
Apply	20
Analyze	-
Evaluate	-
Create	30

PROBLEM SOLVING SKILLS

Course Code	**22SDK66**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**3**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**1**

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

22SDK66.1	Infer the complex problems using the concepts of data structures and C programming
22SDK66.2	Apply object-oriented programming concepts in C++and Java to solve real time problem statements.
22SDK66.3	Solve real-world problem using python and C#
22SDK66.4	Develop the skills of handling data base queries and procedures

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SDK66.1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.4	3	3	3	2	2	-	-	-	-	-	-	2	2	2

MODULE-1	PROBLEM SOLVING ON DATA STRUCTURES AND C	22SDK66.I	6 Hours

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

MODULE-2	PROBLEM SOLVING ON OBJECT ORIENTED PROGRAMMING USING CPP	22SDK66.2	6 Hours

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

MODULE-3	PROBLEM SOLVING ON JAVA AND XML	22SDK66.2	6 Hours

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

MODULE-4	PROBLEM SOLVING USING C # AND PYTHON	22SDK66.3	6 Hours

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

MODULE-5	SCENARIO BASED PROBLEMS ON DBMS	22SDK66.4	6 Hours

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

CIE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Reference Books:

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

Web links and Video Lectures (e-Resources):

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

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

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

MOBILE APPLICATION DEVELOPMENT			
Course Code	**22CDS671**	**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:

22CDS671.1	Develop single screen mobile applications by setting up Android development environment
22CDS671.2	Use Intents & Services concepts in developing mobile applications.
22CDS671.3	Implement mobile applications using files.
22CDS671.4	Demonstrate methods of storing and retrieving data using 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
22CDS671.1	3	3	3	3	3	-	-	-	-	-	-	2	3	3
22CDS671.2	3	3	3	3	3	-	-	-	-	-	-	2	3	3
22CDS671.3	3	3	3	3	3	-	-	-	-	-	-	2	3	3
22CDS671.4	3	3	3	3	3	-	-	-	-	-	-	2	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs		
	• Basics of Programming		NA
	PART-A		
1	Develop an Android application using Button, TextView and EditText for designing a Calculator having basic functionality like Addition, Subtraction, Multiplication and Division.	2	22CDS661.1
2	Develop an Android application that displays information about a small business. Your design must include: Business name Photo of business Contact information and Description of Business	2	22CDS661.1
3	Develop an Android application to design a Visiting card. The visiting card should have a company logo at the top right corner. The company name should be displayed in capital letters, aligned to the center. Information like Name of the employee, Designation, Phone number, Address, Email, and the Website address is to be displayed.	2	22CDS661.1
4	Develop an Android application The Easy Unit Converter using Radio Buttons	2	22CDS661.1
5	Develop an Android application Currency Converter using Spinners	2	22CDS661.1
6	Develop an Android application using Explicit intent to display the login page. On giving the wrong credentials it should display the toast message and if credentials are correct it should display Welcome and the username	2	22CDS661.1
	PART-B		
7	Develop an Android application using Implicit intent to display the Gallery and Call buttons. On clicking these buttons, it should goto the respective pages	2	22CDS661.2
8	Develop an Android application Tourist spot with three activities : Welcome page, Display attractions of tourist spot and Webpage of the tourist spot	2	22CDS661.2

9	Develop an Android application to play music in background	2	22CDS661.2
10	Develop an Android application Hospital Database App using Android. The app should store Hospital ID, Hospital name and location of hospital in a file	2	22CDS661.3
11	Develop an Android application The Expense Manager using Android. The application should store all the expenses in a file	2	22CDS661.3
12	Develop an Android application Student Database App using Android. The app should store USN, Student name and Semester of student in SQLite database	2	22CDS661.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1) Develop an Android application Health Monitoring App using Android. The app should store Name, Age, blood pressure, blood group and glucose level of patient in SQLite database
2) Develop an Android application to display Map of your college locality
3) Develop an Android application to alert SMS to one given phone number

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Text Books:

1) Reto Meier; Professional Android 4 Application Development; Wiley India Pvt.ltd; 1st Edition; 2012; ISBN-13: 9788126525898.

2) Phillips, Stewart, Hardy and Marsicano; Android Programming, 2nd edition - Big Nerd Ranch Guide;2015; ISBN-13 978-0134171494.

Reference Books:

1) Mark Murphy; Beginning Android 3; Apress Springer India Pvt Ltd. ;1st Edition; 2011;ISBN-13: 978- 1- 4302-3297-1

2) Eric Hellman; Android Programming – Pushing the limits by Hellman; Wiley; 2013; ISBN 13: 978- 1118717370

3) www.developer.android

SCALA PROGRAMMING			
Course Code	**22CDS672**	**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:

22CDS662.1	Demonstrate the basic syntax, data types, conditional statements and Arrays
22CDS662.2	Implement primary operations such as filtering, grouping, aggregation, and joining to extract meaningful insights from data.
22CDS662.3	Apply Libraries to visualize and interpret data distributions, trends, and patterns.
22CDS662.4	Implement Machine learning algorithms such as Linear Regression and Clustering using Spark MLlib.

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
22CDS662.1	1	1	1	1	-	-	-	-	-	-	-	2	2	2
22CDS662.2	2	2	2	2	2	-	-	-	-	-	-	2	2	2
22CDS662.3	2	2	2	2	2	-		-	-	-	-	2	2	2
22CDS662.4	2	2	2	2	2	-		-	-	-	-	2	2	2

Pgm. No.	List of Programs	Hours	COs
	Prerequisite Demo		
	• Programming knowledge (C/C++/JAVA/PYTHON)	2	NA
	PART-A		
1	Write a Scala program to declare variables of different data types (integer, double, string, boolean) and print their values.	2	22CDS662.1
2	Write a Scala program that checks if a given number is positive, negative, or zero, and prints an appropriate message.	2	22CDS662.1
3	Write a Scala program to create an array and a list of integers, then print all elements in both collections.	2	22CDS662.1
4	Write a Scala program that defines two functions, one to add two integers and another to multiply two integers. Use these functions to print the sum and product of two given numbers.	2	**22CDS662**.2
5	Write a Scala program to load a CSV file containing retail sales data into a DataFrame using Apache Spark. Perform the following operations: • Show the first 10 rows of the DataFrame. • Filter the records where sales are greater than $1000. • Group the data by the 'Category' column and calculate the total sales for each category.	2	**22CDS662**.2

	• Join this DataFrame with another DataFrame containing product details on a common column and display the result.		
6	Write a Scala program to visualize data using Breeze and Vegas libraries. Perform the following tasks: o Create a list of integers representing some data points. o Plot a histogram of these data points using Breeze. o Use Vegas to create a bar plot showing the distribution of these data points.	2	**22CDS662**.3
	PART-B		
7	Write a Scala program to calculate descriptive statistics for a dataset containing temperature readings , Visualize using appropriate libraries. Your program should: • Compute the mean, median, variance, and standard deviation of the temperature readings. • Print out the computed values.	2	**22CDS662**.3
8	Write a Scala program to train a linear regression model using Spark MLlib to predict house prices based on various features (e.g., size, location). Your program should: o Load the dataset from a file. o Split the data into training and test sets. o Train a linear regression model on the training data. o Evaluate the model on the test data and print out the coefficients and intercept of the model.	2	**22CDS662**.4
9	Write a Scala program to perform K-Means clustering on a dataset of customer attributes using Spark MLlib. Your program should: • Load the dataset from a file. • Train a K-Means model with a specified number of clusters. • Print out the coordinates of the cluster centers. • Assign each data point to a cluster and display the results.	2	**22CDS662**.4
10	Write a Scala program to classify movie reviews as positive or negative using Spark MLlib. Your program should: o Load a dataset of movie reviews and their corresponding labels. o Tokenize the text data and transform it into feature vectors. o Train a logistic regression model on the training data. o Evaluate the model and display the prediction results.	2	**22CDS662**.4
11.	Write a Scala program to perform time series forecasting on stock price data using the Prophet library. Your program should: • Load and prepare the stock price data. • Fit a Prophet model to the data. • Make future predictions for the next 12 months. • Print out the forecasted stock prices.	2	**22CDS662**.4
12	Write a Scala program to clean a dataset of customer information using Apache Spark. Your program should:	2	**22CDS662**.4

	• Load the dataset from a file. • Handle missing values by filling them with specified default values. • Filter out records with outlier values in the 'age' column. • Perform a transformation to create a new column 'income_scaled' where the income is divided by 1000. • Display the cleaned and transformed DataFrame.		

PART-C

Beyond Syllabus Virtual Lab Content

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

1. https://www.scala-exercises.org/

1. Demonstrate Functional Programming with Monads.

2. Demonstrate Actor Model with Akka.

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Text Books:

1. Martin Odersky, Lex Spoon, Bill Venners, "Programming in Scala", 3rd Edition Paperback – 31 May 2016, ISBN-13,**978-0981531687.**
2. Sandy Ryza, Uri Laserson, Sean Owen, and Josh Wills," Advanced Analytics with Spark: Patterns for Learning from Data at Scale", O'Reilly Media, 2nd Edition (July 2017), ISBN: 9781491972908.

Reference Books:

1. Pascal Bugnion,"Scala for Data Science", Packt Publishing, 1st Edition (October 2016), ISBN-13 :**9781785281372**

APPLIED DATA SCIENCE WITH JULIA			
Course Code	**22CDS673**	**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:

22CDS663.1	Apply Julia constructs to solve complex problems in linear algebra
22CDS663.2	Analyze the Data Science concepts using statistical packages
22CDS663.3	Evaluate various techniques for Data science operations
22CDS663.4	Solve the queries using graphs and visualizations

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
22CDS663.1	3	3	3	3	3	-	-	-	-	-	-	2	3	3
22CDS663.2	3	3	3	3	3	-	-	-	-	-	-	2	3	3
22CDS663.3	3	3	3	3	3	-	-	-	-	-	-	2	3	3
22CDS663.4	3	3	3	3	3	-	-	-	-	-	-	2	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs		
	• Basic programs on python • Basics of visualization	2	NA
	PART-A		
1	Demonstrate Matrices and Linear Algebra in Julia with a program that performs the following tasks with a 3x3 matrix AAA: • Compute and print the transpose of AAA. • Calculate and display the determinant of AAA.	2	22CDS663.1 22CDS663.2
2	Write a Julia program that generates 100 random numbers from a standard normal distribution. Perform the following statistical operations: • Calculate the mean and standard deviation of the generated data. • Perform a one-sample t-test to test if the mean of the data is significantly different from 0 (null hypothesis).	2	22CDS663.1 22CDS663.2
3	Demonstrate feature reduction using Principal Component Analysis (PCA). Generate a sample dataset with 100 observations and 3 features. Perform PCA to reduce the features to 2 principal components and display the transformed dataset.	2	22CDS663.1 22CDS663.2
4	Write a Julia program that performs K-means clustering on a randomly generated dataset with 100 observations and 2 features. Use K=3K = 3K=3 clusters and display the following results: Assignments of each data point to a cluster. Centroids of each cluster.	2	22CDS663.1 22CDS663.2
5	Write a Julia program that demonstrates classification using a machine learning model. Use the famous Iris dataset (available in RDatasets) and perform the following tasks:	2	22CDS663.1 22CDS663.2

	Load the Iris dataset and select the features (sepal length, sepal width, petal length, petal width) and target variable (species). • Split the dataset into training (70%) and testing (30%) sets. • Train a Random Forest classifier on the training data. • Predict the classes for the testing data and display the predicted classes.		
6	Write a Julia program to illustrate Classification operations.	2	22CDS663.1 22CDS663.2
	PART-B		
7	Write a Julia program that demonstrates linear regression operations using the following steps: • Generate sample data with independent variable XXX and dependent variable yyy. • Fit a linear regression model to predict yyy based on XXX. • Print the coefficients of the regression model and the R^2 score. • Predict values for new data points and calculate the mean squared error (MSE).	2	22CDS663.3 22CDS663.4
8	Write a Julia program that utilizes the Plots package with a GR backend to plot various types of graphs, including: • Line plot • Scatter plot • Histogram • Box plot • Bar plot	2	22CDS663.3 22CDS663.4
9	Write a Julia program that performs numerical optimization for portfolio investment using the following steps: • Define the objective function to maximize portfolio return or minimize risk (e.g., using Sharpe ratio or variance). • Set constraints on portfolio weights (e.g., sum of weights equals 1). • Implement a numerical optimization algorithm (e.g., gradient descent, Newton's method) to find optimal portfolio weights. • Display the optimized portfolio weights and expected return/risk metrics.	2	22CDS663.3 22CDS663.4
10	Write a Julia program that implements a neural network for classifying the MNIST dataset: • Load the MNIST dataset (available in Flux or other packages). • Preprocess the data (normalize, reshape). • Build a neural network model (e.g., feedforward neural network, convolutional neural network) using Flux.jl. • Train the model on the training data and evaluate its performance on the test data. • Print the classification accuracy and visualize some predictions.	2	22CDS663.3 22CDS663.4
11	Write a Julia program that demonstrates interfacing with Python, R, and C:	2	22CDS663.3 22CDS663.4

	• Call a Python function/module (e.g., using PyCall.jl) that performs a specific task (e.g., data preprocessing, machine learning). • Invoke an R function (e.g., using RCall.jl) to perform statistical analysis (e.g., hypothesis testing, regression).		
12	Write a Julia program that utilizes the Plots package with a GR backend to create advanced visualizations, such as: • 3D plots (e.g., surface plot, scatter plot with 3D points). • Interactive plots (e.g., using plotlyjs backend). • Customizing plot aesthetics (e.g., color schemes, markers).	2	22CDS663.3 22CDS663.4

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

- https://julia.mit.edu/
- https://juliahub.com/

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:
Reference Books:

1. https://juliaacademy.com/p/julia-for-data-science
2. https://github.com/pszufe/MIT_18.S097_Introduction-to-Julia-for-Data-Science.
3. McNicholas, Paul D., Tait, Peter. Data Science with Julia. United Kingdom: CRC Press, 2019, ISBN-13,**978-1138499997..**
4. Voulgaris, Zacharias. Julia for Data Science. United States: Technics Publications, 2016, ISBN-13

978-1634621304

ADVANCED PYTHON PROGRAMMING			
Course Code	**22CDS674**	**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:

22CDS664.1	Apply advanced python language constructs to use data structures and OOPS concepts
22CDS664.2	Analyze the language constructs for graphical opeartions
22CDS664.3	Evaluate various techniques for interconnection to network and databases
22CDS664.4	Solve the queries using advanced packages for python computing

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
22CDS664.1	3	3	3	3	3	-	-	-	1	1	-	2	3	3
22CDS664.2	3	3	3	3	3	-	-	-	1	1	-	2	3	3
22CDS664.3	3	3	3	3	3	-	-	-	1	1	-	2	3	3
22CDS664.4	3	3	3	3	3	-	-	-	1	1	-	2	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite Demo		
	• Basic programs on python • Basics of visualization	2	NA
	PART-A		
1	Write a Python program that performs the following tasks: • Manipulate a string to reverse its characters and count the occurrence of a specific substring. • Create a list of integers and perform sorting and slicing operations. • Define a tuple of mixed data types and unpack its elements into variables. • Implement a set to remove duplicates from a list of integers and perform set operations (union, intersection). • Use a dictionary to store student grades and calculate the average grade.	2	22CDS664.1 22CDS664.2
2	Write a Python program that demonstrates the following: • Use control flow statements (if-else, loops) to iterate through a list and perform conditional operations. • Implement list comprehensions to generate a list of squared numbers from 1 to 10. • Define a basic function to calculate factorial and use recursion. • Create a lambda function to compute the square of a number.	2	22CDS664.1 22CDS664.2
3	Write a Python program that performs file handling and exceptions handling: • Read data from a text file, count the number of lines, and print each line. • Write data to a new text file and handle exceptions for file opening and writing operations.	2	22CDS664.1 22CDS664.2

	• Use try-except blocks to handle specific exceptions (e.g., FileNotFoundError, IOError). • Implement file operations (open, read, write, close) using context managers (with statement).		
4	Write a Python program that demonstrates OOP concepts: • Define a class representing a Car with attributes (make, model, year) and methods (accelerate, brake). • Create instances of the Car class and invoke its methods to simulate driving actions. • Implement inheritance by creating a subclass (ElectricCar) that inherits from the Car class and has additional methods (charge_battery). • Use encapsulation to restrict access to certain attributes and methods of the Car class.	2	22CDS664.1 22CDS664.2
5	Python Turtle Graphics – Drawing Shapes, Filling shapes	2	22CDS664.1 22CDS664.2
6	Games programing using Pygame	2	22CDS664.1 22CDS664.2
PART-B			
7	Network programming – Client Server Application	2	22CDS664.3 22CDS664.4
8	Web Services in Python using webframeworks	2	22CDS664.3 22CDS664.4
9	Working with Relational Database	2	22CDS664.3 22CDS664.4
10	Web Development with Flask	2	22CDS664.3 22CDS664.4
11	Threading in python	2	22CDS664.3 22CDS664.4
12	Concurrent image processing	2	22CDS664.3 22CDS664.4

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

- https://python-iitk.vlabs.ac.in/
- https://codingjr.online/home/virtual_labs

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1. Hunt, John. Advanced Guide to Python 3 Programming. Germany: Springer International Publishing, 2023, ISSN 2197-1781.
2. Lanaro, Gabriele., Nguyen, Quan., Kasampalis, Sakis. Advanced Python Programming: Build High Performance, Concurrent, and Multi-threaded Apps with Python Using Proven Design Patterns. India: Packt Publishing, 2019, ISBN-13**978-1838551216**
3. Nguyen, Quan. Advanced Python Programming: Accelerate Your Python Programs Using Proven Techniques and Design Patterns. Germany: Packt Publishing, ISBN-13,**978-1801814010**

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:

22NSSX0.1	Understand the importance of his / her responsibilities towards society.
22NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSSX0.3	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.
22NSSX0.4	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
22NSSX0.1	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.4	-	-	-	-	-	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 HRS
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 HRS
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 HRS
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 HRS

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10

Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- 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, 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 byindividual 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/Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual 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 byindividual 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 byindividual 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/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual 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/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual 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/pro per consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and 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 byindividual 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/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
11.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual 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, 22PED50, 22PED60**	**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:

22PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
22PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
22PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PEDX0.4	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
22PEDX0.1	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.2	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.3	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.4	-	-	-	-	-	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. 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.	22PED40.3	20 HRS
	Module 3: Role of Organization and administration	22PED40.4	5 HRS
5TH	**Fitness Components:** Meaning and Importance, Fit India Movement,	22PED50.1,	Total 30 Hrs/

22PED50	Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 4. Track -Sprints: • 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. 5. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 6. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** B. Fundamental Skills 7. Catching, Throwing and Ball control, 8. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 9. Dribbling: High and low. 10. Attack and counter attack, simple counter attack, counter attack from two wings and center. 11. Blocking, Goal Keeping and Defensive skills. 12. Game practice with application of Rules and Regulations. C. Rules and their interpretations and duties of officials **Ball badminton:** B. Fundamental Skills 5. Basic Knowledge: Various parts of the Racket and Grip. 6. Service: Short service, Long service, Long-high service. 7. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	22PED50.2, 22PED50.3, 22PED50.4	Semester 2 Hrs/week
6TH 22PED60	**Athletics**: 4. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations)use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 5. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 6. 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. 10. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 11. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 12. Heading: In standing, running and jumping condition.	22PED60.1, 22PED60.2, 22PED60.3, 22PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

	13. Throw-in: Standing throw-in and Running throw-in. 14. Feinting: With the lower limb and upper part of the body. 15. Tackling: Simple Tackling, Slide Tackling. 16. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting. 17. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing 9. Penalty stroke practice. 10. Penalty corner practice. 11. Tackling: Simple Tackling, Slide Tackling. 12. Goal Keeping, Ball clearance- kicking, and deflecting. 13. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials		

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**	**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:

22YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
22YOGX0.2	Become familiar with an authentic foundation of Yogic practices
22YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat Kriyas
22YOGX0.4	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
22YOGX0.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.4	-	-	-	-	-	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, importance and benefits of Suryanamaskar. 4. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 5. Sitting: Padmasana, Vajrasana, Sukhasana 6. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 7. Prone line: Bhujangasana, Shalabhasana 8. 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**: 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, 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**: 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/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 5. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 6. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 7. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 8. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	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**

APPENDIX A

List of Assessment Patterns

SLNO	Assessments
1	Continuous Internal Evaluation
2	Assignments
3	Online/Offline Quizzes
4	Mini Projects/ Projects
5	Group Discussions
6	Case studies
7	Practical Activities/Problem Solving Exercises
8	Practical Orientation on design thinking, Creative & Innovation
9	Participatory & Industry-Integrated Activities
10	Class Presentations

APPENDIX B

Outcome Based Education

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

There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

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

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

Mapping of Outcomes

APPENDIX C

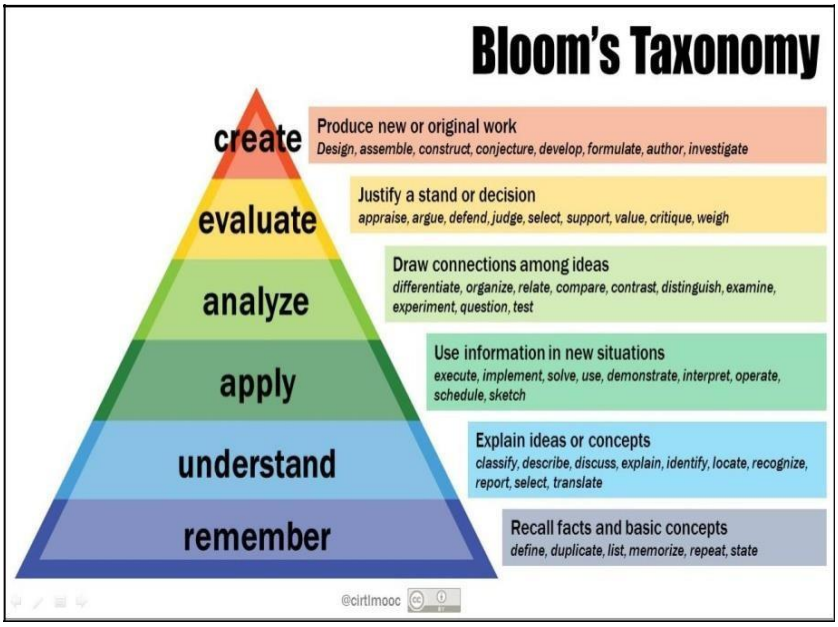
The Graduate Attributes of NBA

Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
Problem analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
Conduct investigations of complex problems	The problems that cannot be solved by straight forward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.
Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
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.
Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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.
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 of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



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