



B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

Autonomous Institute, Affiliated to VTU

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)



BMS COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

BACHELOR OF ENGINEERING

**DEPARTMENT
OF
COMPUTER SCIENCE AND ENGINEERING
(DATA SCIENCE)**

SCHEME & SYLLABUS

**III - VI SEMESTERS
(Academic Year: 2024-25)**



B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

Autonomous Institute, Affiliated to VTU

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

INSTITUTE VISION

Promoting Prosperity of mankind by augmenting Human Resource Capital through Quality Technical Education & Training.

INSTITUTE MISSION

Accomplish Excellence in the field of Technical Education through Education, Research and Service needs of society.

DEPARTMENT VISION

To be recognized as Centre for Quality Education in Computer Science and Engineering with emphasis on Data Science

DEPARTMENT MISSION

- Enable quality Computer Science education through continually evolving curriculum and pedagogical techniques.
- Conduct research collaboratively with established research labs and industries contributing to the futuristic field of Data Science.
- Nurture ethical and skilled professionals by promoting multi-disciplinary thinking in solving problems of the data-driven world.



PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Excel in professional career as a Data Science Professional thereby contributing to the public/private sector or as an entrepreneur.

PEO2: Graduates to pursue higher education and research to upgrade themselves to serve the global market.

PEO3: Contribute to humankind by solving societal problems and exhibiting professionalism, team work & ethics.

PROGRAMME OUTCOMES (POs)

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

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

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

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

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities 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.



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PO7: 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.

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 in diverse teams, and in multidisciplinary settings.

PO10: 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.

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.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Apply computing theory, algorithms, mathematical and statistical models, optimization principles using programming languages and tools to effectively formulate and solve data analysis problems.

PSO2: Apply principles of databases and organize big data sets to derive meaningful insights and make informed decisions for business processes.

PSO3: Exhibit expertise in teamwork, professional ethics, communication, and documentation skills during the development of software products, while adhering to established software engineering methodologies.



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Scheme of Instructions

Semester – III

(With effect from the Academic Year 2023-24)

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
BS-1	23MA3BSSDM	Statistics and Discrete Mathematics	2	1	0	3	50	50	100
ES-1	23DC3ESCOA	Computer Organization & Architecture	3	0	0	3	50	50	100
PC-1	23DC3PCDSC	Data Structures	3	0	1	4	50	50	100
PC-2	23DC3PCDBM	Database Management Systems	3	0	1	4	50	50	100
PC-3	23DS3PCOOJ	Object Oriented Programming with Java	3	0	1	4	50	50	100
PC-4	23DS3PCFDS	Foundations of Data Science	3	0	0	3	50	50	100
AE-1	23DS3AEFWD	Full Stack Web Development	0	0	1	1	50	50	100
NCMC		NSS	Non-credit mandatory Course						
		YOGA							
		PHYSICAL EDUCATION							
TOTAL			17	1	4	22	350	350	700

Note: BS: Basic Science Course, ES: Engineering Science Course, PC: Professional Core Course, AE: Ability Enhancement Course, NCMC: Non-credit mandatory course



Scheme of Instructions
Semester – IV
(With effect from the Academic Year 2023-24)

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
BS-2	23MA4BSLAO	Linear Algebra and Optimization	2	1	0	3	50	50	100
ES-2	23DC4ESTOC	Theory of Computation	3	0	0	3	50	50	100
PC-5	23DC4PCOPS	Operating Systems	3	0	0	3	50	50	100
PC-6	23DS4PCCON	Computer Networks	3	0	0	3	50	50	100
PC-7	23DS4PCMLG	Machine Learning	3	0	1	4	50	50	100
PC-8	23DC4PCDAA	Design and Analysis of Algorithms	3	0	1	4	50	50	100
AE-2	23DS4AEDVZ	Data Visualization using Tools	0	0	1	1	50	50	100
UHV	23MA4AEUHV	Universal Human Values	0	1	0	1	50	50	100
NCMC		NSS	Non-credit mandatory Course						
		YOGA							
		PHYSICAL EDUCATION							
TOTAL			17	2	3	22	400	400	800



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Scheme of Instructions

Semester – V

(With effect from the Academic Year 2024-25)

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
PC-9	23DS5PCTSA	Time Series Analysis	2	1	0	3	50	50	100
PC-10	23DS5PCBDA	Big Data Analytics	3	0	1	4	50	50	100
PC-11	23DS5PCDLG	Deep Learning	4	0	1	5	50	50	100
PC-12	23DS5PCPWR	Programming with R	0	0	1	1	50	50	100
AE-3	23DC5AERMI	Research Methodologies & IPR	3	0	0	3	50	50	100
PE-1	23DS5PESWT	Software Testing	3	0	0	3	50	50	100
	23DS5PEIOT	Internet of Things	3	0	0	3	50	50	100
	23DS5PECNS	Cryptography & Network Security	3	0	0	3	50	50	100
	23DS5PERAI	Responsible AI	3	0	0	3	50	50	100
PW-1	23DS5PWMAD	Mini Project – Mobile Application Development	0	0	2	2	50	50	100
HS-1	23DC5HSEVS	Environmental Studies	1	0	0	1	50	50	100
NCMC		NSS	Non-credit mandatory Course						
		YOGA							
		PHYSICAL EDUCATION							
TOTAL			16	1	5	22	400	400	800

Note: PC: Professional Core Course, AE: Ability Enhancement Course, PE: Program Elective, PW: Project Work, HS: Humanities and Social Sciences, NCMC: Non-credit mandatory course



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Scheme of Instructions

Semester – VI

(With effect from the Academic Year 2024-25)

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
PC-13	23DS6PCCCT	Cloud Computing	2	1	0	3	50	50	100
PC-14	23DS6PCNGD	Next Gen Databases	3	0	1	4	50	50	100
PC-15	23DS6PCNLP	Natural Language Processing & Generative AI	3	0	1	4	50	50	100
PC-16	23DC6PCSEA	Software Engineering & Agile Methodologies	2	0	0	2	50	50	100
PE-2	23DS6PEOTD	Optimization Techniques for Data Science	3	0	0	3	50	50	100
	23DS6PECPPV	Computer Vision	3	0	0	3	50	50	100
	23DS6PEDPT	Design Patterns	3	0	0	3	50	50	100
	23DS6PEADA	Advanced Data Structures & Algorithms	3	0	0	3	50	50	100
OE-1	23DS6OEXXX	Open Elective -1	3	0	0	3	50	50	100
PW-2	23DS6PWPP1	Project work – Phase I	0	0	2	2	50	50	100
AE-4	23DS6AECPG	Competitive Programming	0	0	1	1	50	50	100
	23DS6AEXAI	Explainable AI	0	0	1	1	50	50	100
	23DS6AEDOP	DevOps	0	0	1	1	50	50	100
NCMC		NSS	Non-credit mandatory Course						
		YOGA							
		PHYSICAL EDUCATION							
TOTAL			16	1	5	22	400	400	800

Note: PC: Professional Core Course, AE: Ability Enhancement Course, PE: Program Elective, PW: Project Work, OE: Open Elective, NCMC: Non-credit mandatory course



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Computer Organization and Architecture

Sem	III		
Course Code:	23DC3ESCOA		
L-T-P:	3-0-0	Total Credits:	3

Unit No.	Topics	Hours
1	Basic Structure of Computers and Instruction Set Architecture: Functional Units, Basic Operational Concepts, Number Representation and Arithmetic Operations, Memory Locations and Addresses, Memory Operations, Instructions, and Instruction Sequencing, Addressing Modes, Stored program concept.	8
2	Introduction to Assembly Language Concepts, Stacks, Subroutines, Additional Instructions, Basic Input/Output: Accessing I/O Devices, Interrupts, Bus Structure, Bus Operation, Arbitration	8
3	Memory System: Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Direct Memory Access, Memory Hierarchy, Cache Memories: Mapping Functions, Virtual Memory	8
4	Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Unsigned Numbers, Multiplication of Signed Numbers Fast Multiplication: Bit-Pair Recoding of Multipliers, Carry-Save Addition of Summands, Summand Addition Tree using 3-2 Reducers, Integer Division, Floating-Point Numbers and Operations: Arithmetic Operations on Floating-Point Numbers, Guard Bits and Truncation, Implementing Floating-Point Operations	8
5	Basic Processing Unit: Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Hardwired Control Parallel Computer Architecture: Processor Architecture and Technology Trends, Flynn's Taxonomy of Parallel Architectures, Memory Organization of Parallel Computers: Computers with Distributed Memory Organization, Computers with Shared Memory Organization, Thread-Level Parallelism: Simultaneous Multithreading, Multicore Processors	8

Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year



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1.	Computer Organization and Embedded Systems	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian	6th Edition	McGraw-Hill	12
2.	Parallel Programming for Multicore and Cluster Systems	Thomas Rauber, Gudula Runger	2nd Edition	Springer	13

Reference Text Book

Sl. No.	Book Title	Authors	dition	Publisher	Year
1.	Computer Organization and Design - The Hardware /Software Interface	David A. Patterson, John L. Hennessy	5th Edition	Elsevier	2014
2.	Computer Organization & Architecture	William Stallings	11th Edition	Pearson	2018

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Computer Architecture and Organization	NPTEL	2022	https://onlinecourses.nptel.ac.in/noc22_cs88/preview

Course Outcomes

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

CO1	Apply the concepts of basic functional units to demonstrate the working of computational system.
CO2	Analyze the issues of the processor architecture to improve the efficiency in computer design.
CO3	Design Memory modules and Arithmetic Logic unit for a given specification by analysing performance issues.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		2										
CO3			2									

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	3	40



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AAT	2	10
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Mandatory	One Question to be asked for 20 Marks
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Data Structures

Semester	III		
Course Code:	23DC3PCDSC	Total Contact Hours: 40 hours	
L-T-P:	3-0-1	Total Credits:	4

Unit No.	Topics	Hours
1	<p>Introduction To Data Structure: Data Management concepts, Data types – primitive and non-primitive, Types of Data Structures- Linear & Non-Linear Data Structures. Structures and pointers</p> <p>Dynamic memory allocation: allocating a block of memory: Malloc, allocating multiple blocks of memory: Calloc, Releasing the used space: Free Altering the size of memory: Realloc.</p>	8
2	<p>Linear list: Singly linked list implementation, insertion, deletion and searching operations on linear list, circularly linked lists- insertion, deletion and searching operations for circularly linked lists, doubly linked list implementation, insertion, deletion and searching operations, maintaining directory of names, Manipulation of polynomials (addition), representing sparse matrices.</p>	8
3	<p>Stacks: Operations, array representations of stacks, stack applications - infix to postfix conversion, postfix expression evaluation, and function call tracing, recursion.</p> <p>Queues: Introduction, Basic concept, linear queue operations, circular queue, priority queues, double ended queues. Applications of Queues.</p> <p>Stack and queue implementation using linked lists</p>	8
4	<p>Trees: Definitions, tree representation, properties of trees, Binary tree, Binary tree representation, binary tree properties, binary tree traversals, binary tree implementation, Binary Search Tree operations and its implementation, applications of trees.</p>	8
5	<p>Balanced Trees: AVL Trees, Splay trees, Red- Black Trees – Definitions, Rotation and other basic operations.</p>	8



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Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Fundamentals of Data Structures in C	Horowitz, Sahni, Anderson Freed	Second	Universities Press	008
2.	Data Structures using C	Reema Thareja	Second	Oxford University press	014
Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Data Structures using C	Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein	Fifth	Pearson Education	2007
2	Data Structures - A Pseudocode Approach with C	Richard F. Gilberg Behrouz A. Forouzan	First	Cengage Learning	2005

E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Data Structures using C	E. Balaguruswamy		McGraw Hill	2013	https://dokumen.pub/data-structures-using-c-9781259029547-1259029549.html
2.	Data structures and program design in C	Robert L. Kruse, Clovis L. Tondo, Bruce P. Leung	Second	Prentice Hal	1997	https://cdn.preterhuman.net/texts/math/Data_Structure_And_Algorithms/Data%20Structures%20and%20Program%20Design%20in%20C++%20-%20Robert%20L.%20Kruse.pdf



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MOOC Courses				
Sl. No.	Course name	Course Offered By	Year	URL
1	Data Structures	Coursera	2023	https://www.coursera.org/learn/data-structures
2	Data Structures and Algorithms	NPTEL	2023	https://nptel.ac.in/courses/106102064/

Course Outcomes

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

CO1	Apply the concept of linear and nonlinear data structures for computing problems.
CO2	Analyse the appropriate data structure operations for a given problem
CO3	Design and develop solutions using the linear and nonlinear data structure for a given specification.
CO4	Conduct experiments for demonstrating the operations of different data structures.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			3									
CO4			3	3								3

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	20
QUIZ/AAT	1	5
Lab Component	CIE+ Two Lab Tests	25
Total		50



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Laboratory Plan

Instructions to Students to be followed in each lab:

1. Each Student should write down the program in the observation book and get it evaluated by the respective lab faculty in-charge and then execute the program.
2. Each Student should bring the lab record with the programs and output written for the programs completed in their respective previous week and get it evaluated by the lab faculty in-charge. In the record book students should - Handwrite the Program - Pasting of the printout of the Output or Handwriting of the Output (Output should be written for all the cases).
3. Students have to practice following list of programs and additional programming exercises will also be given in lab. Students will be made to solve coding challenges on programming platforms like LeetCode and HackerRank.

	Unit#	Program Details
1	2	<p>Write a program to implement Singly Linked List with following operations</p> <ul style="list-style-type: none">a) Create a linked list.b) Insertion of a node at first position, at any position and at end of list.c) Display the contents of the linked list.
2	2	<p>Write a program to Implement Singly Linked List with following operations</p> <ul style="list-style-type: none">a) Create a linked list.b) Deletion of first element, specified element and last element in the list.c) Display the contents of the linked list.
3	2	<p>Write a program to Implement Singly Linked List with following operations</p> <ul style="list-style-type: none">a) Sort the linked list.b) Reverse the linked list.c) Concatenation of two linked lists
4	2	<p>Write a program to Implement doubly linked list with primitive operations</p> <ul style="list-style-type: none">a) Create a doubly linked list.b) Insert a new node to the left of the node.c) Delete the node based on a specific valued) Display the contents of the list
5	3	<p>Write a program to simulate the working of stack using an array with the following:</p> <ul style="list-style-type: none">a) Pushb) Popc) Display <p>The program should print appropriate messages for stack overflow, stack underflow</p>
6	3	<p>Write a program to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide)</p>
7	3	<p>Write a program to simulate the working of a queue of integers using an array. Provide the following operations</p> <ul style="list-style-type: none">a) Insertb) Deletec) Display <p>The program should print appropriate messages for queue empty and queue overflow conditions</p>



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8	3	Write a program to simulate the working of a circular queue of integers using an array. Provide the following operations. a) Insert b) Delete c) Display The program should print appropriate messages for queue empty and queue overflow conditions
9	3	Write a program to implement Stack & Queues using Linked Representation
10	4	Write a program a) To construct a binary Search tree. b) To traverse the tree using all the methods i.e., in-order, preorder and post order c) To display the elements in the tree.
11	4	Write a program a. To construct a binary search tree b. To implement iterative in order traversal c. To delete a given element
12	5	Write a program to construct an AVL tree of integers

SEE Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Mandatory	One Question to be asked for 20 Marks
Unit-4	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-5	Mandatory	One Question to be asked for 20 Marks



Database Management Systems

Semester	III		
Course Code:	23DC3PCDBM		Total Contact Hours: 40 hours
L-T-P:	3-0-1	Total Credits:	4

Unit No.	Topics	Hours
1	<p>Introduction to Database Systems: Introduction, An Example, Characteristics of Database approach, Advantages of using DBMS approach, when not to use a DBMS.</p> <p>Database System Concepts and Architecture: Data models, Schemas and instances, Three schema architecture.</p> <p>SQL: SQL Data Definition and Data Types specifying basic constraints in SQL, Basic retrieval queries in SQL, Insert, Delete and Update statements in SQL, Additional features of SQL, more complex SQL Queries, Specifying Constraints as Assertions and Triggers, Views (Virtual Tables) in SQL, Schema Change Statement in SQL.</p>	8
2	<p>Entity Relation Model: Using High-Level Conceptual Data Models for Database Design, a sample Database Application, Entity types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity types, Refining the ER Design, ER Diagrams, Relationship Types of Degree Higher than two, Relational Database Design using ER to Relational Mapping.</p> <p>Relational Databases: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations, Functional Dependencies</p>	8
3	<p>Relation Algebra: Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra.</p> <p>Normalization: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multi-valued Dependencies and a Fourth Normal Form, Join Dependencies, Fifth Normal Form.</p>	8
4	<p>Transaction Processing Concepts: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Transaction Support in SQL, Two-Phase Locking Techniques for Concurrency Control.</p>	8



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<p>5 Storage Systems: Overview of Physical Storage Media, Storage Interfaces, Magnetic Disks, Flash Memory, RAID, Disk-Block Access, Database Backup and Recovery from Catastrophic Failures</p> <p>Indexing: Basic Concepts, Ordered Indices, B+-Tree Index Files, B+-Tree Extensions, Hash Indices, Multiple-Key Access, Creation of Indices, Write-Optimized Index Structures, Bitmap Indices, Indexing of Spatial and Temporal Data</p> <p>Query processing & operations</p>	<p>8</p>
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Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Fundamentals of Database Systems	Elmasri and Navathe	7th Edition	Pearson	2016
2.	Database System Concepts	Silberschatz, H Korth and S Sudarshan	7th Edition	McGrawHill	2019

Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Database Management Systems	Ramakrishnan and Gehrke	3 rd Edition	McGrawHill	2014
2.	Database Systems: Design, Implementation, and Management	Peter Rob and Carlos Coronel	8 th Edition	CENGAGE Learning	2009

E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	An Introduction to Relational Database	Hugh Darwen	Third Edition	Ventus Publishing ApS	2012	https://www.e-booksdirectory.com/details.php?ebook=3093



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	Theory						
2.	Database System The Complete Book	Hector GarciaMolina,JeffreyD. Ullman, Jennifer Widom	Second Edition	Pearson Education	2009	https://people.inf.elte.hu/miqaai/elektroModulatorDva.pdf	

MOOC Course

Sl. No.	Course name	Course offered by	Year	URL
1.	Database Management Systems	SWAYAM	2023	https://onlinecourses.swayam2.ac.in/cec23_cs10/preview
2.	Database Management Essentials	Coursera	2023	https://www.coursera.org/learn/database-management-essentials

Course Outcome

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

CO1	Apply the concepts of database management systems for various applications.
CO2	Analyse the given database concepts to its correctness.
CO3	Design and demonstrate conceptual models, query and optimization.
CO4	Ability to conduct experiments to demonstrate the various SQL query processing

CO-PO mapping



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Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	20
AAT	1	5
Lab Component	CIE+ Two Lab Tests	25
Total		50

Laboratory Plan

1. Each Student should write down the work carried out and the outputs in the observation book and get it evaluated by the respective lab faculty in-charge.
2. Students have to practice following SQL queries and additional exercises will also be given in the lab.

Sl.No.	Program Details
1	Sailor Database
2	Supplier Database
3	Salesman Database
4	Movie Database
5	Employee Database

PROGRAM 1: SAILOR DATABASE

Create tables for the following schema:

SAILOR (sid: integer, sname: string, rating: integer, age: real)

BOAT (bid: integer, bname:string, color:string)

RESERVES (sid: integer, bid: integer, day: date)

Queries:

- 1) Add the required constraints on the created tables.
- 2) Populate the relations with at least 5 tuples each.
- 3) Select names and ages of all sailors. Rename same as ‘Sailor Name’
- 4) Find all sailors with a rating above 7
- 5) Find the sid of sailors who have reserved a red boat
- 6) Find the colors of boats reserved by ‘Shyam’
- 7) Delete all boats which have never been reserved.

PROGRAM 2: SUPPLIER DATABASE

Create tables for the following schema:

SUPPLIER (sid: integer, name: string, address: string)

PART (pid: integer, name: string, color: string)

CATALOG (sid: integer, pid: integer, cost: real)



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Queries:

- 1) Add the required constraints on the created tables.
- 2) Populate the relations with at least 5 tuples each.
- 3) Select the ID and names of all the suppliers.
- 4) Select the most costly part available in the catalog.
- 5) Find the name's of parts for which there is some supplier.
- 6) Find the sids of suppliers who supply a red part and a green part.
- 7) Delete all parts of a given ID.

PROGRAM 3: SALESMAN DATABASE

Create tables for the following schema:

SALESMAN (Salesman_id:integer, Name:string, City:string, Commission:integer)
CUSTOMER (Customer_id:integer, Cust_Name:string, City:string)
ORDERS (Ord_No:integer, Purchase_Amt:real, Ord_Date:date, Customer_id:integer, Salesman_id:integer)

Queries:

- 1) Add the required constraints on the created tables.
- 2) Populate the relations with at least 5 tuples each.
- 3) Select the ID and names of all the customers.
- 4) Select the salesman with the highest commission.
- 5) List all the orders placed in descending order of their purchase amount.
- 6) Select customers who have salesmen in their cities.
- 7) Delete all orders placed before Jan 2018.

PROGRAM 4: MOVIE DATABASE

Consider the schema for Movie Database:

ACTOR(Act_id, Act_Name, Act_Gender)
DIRECTOR(Dir_id, Dir_Name, Dir_Phone)
MOVIES(Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id)
MOVIE_CAST(Act_id, Mov_id, Role)
RATING(Mov_id, Rev_Stars)

Queries:

- i.List the titles of all movies directed by 'Hitchcock'.
- ii.Find the movie names where one or more actors acted in two or more movies.



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- iii. List all actors who acted in a movie before 2000 and also in a movie after 2015 (use JOIN operation).
- iv. Find the title of movies and number of stars for each movie that has at least one rating and find the highest number of stars that movie received. Sort the result by movie title.
- vi. Update rating of all movies directed by ‘Steven Spielberg’ to 5.

PROGRAM 5: EMPLOYEE DATABASE

Create the following Tables:

LOCATION	
Location_ID	Regional_Group
122	NEW YORK
123	DALLAS
124	CHICAGO
167	BOSTON

DEPARTMENT		
Department_ID	Name	Location_ID
10	ACCOUNTING	122
20	RESEARCH	124
30	SALES	123
40	OPERATIONS	167

JOB	
Job_ID	Function
667	CLERK
668	STAFF
669	ANALYST
670	SALESPERSON
671	MANAGER
672	PRESIDENT

EMPLOYEE									
Employee_ID	Last_Name	First_Name	Middle_Name	Job_ID	Manager_ID	Hired_Ate	Salary	Comm	Department_ID
7839	MEGAN	JOHN	S	672	NULL	12-DEC-14	5500	NUL	30



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7369	SMITH	JOHN	Q	667	7521	17-DEC-18	800	NUL L	20
7499	ALLEN	KEVIN	J	670	7507	20-FEB-17	1600	300	30
7505	DOYLE	JEAN	K	671	7839	04-APR-15	2850	NUL L	30
7506	DENNIS	LYNN	S	671	7839	15-MAY-15	2750	NUL L	30
7507	BAKER	LESLIE	D	671	7839	10-JUN-15	2200	NUL L	40
7521	WARK	CYNTHIA	D	670	7505	22-FEB-15	1250	500	30

Queries based on the above tables:

Order By Clause:

1. List out the employee id, last name in ascending order based on the employee id.
2. List out the employee id, name in descending order based on salary column

Group By & Having Clause:

3. How many employees who are working in different departments wise in the organization
4. List out the department wise maximum salary, minimum salary, average salary of the employees
5. List out the job wise maximum salary, minimum salary, average salaries of the employees.
6. List out the no.of employees joined in every month in ascending order.
7. How many employees joined in 1985?
8. How many employees joined in March 1985.
9. Which is the department id, having greater than or equal to 3 employees joined in April1985.

Sub-Queries

10. Display the employee who got the maximum salary.
11. Display the employees who are working in Sales department
12. Display the employees who are working as “Clerk”.
13. Display the employees who are working in “New York”
14. Find out the number of employees working in the “Sales” department.
15. Delete the employees who are working in the accounting department.
16. Display the second highest salary drawing employee details.

Subquery operators: (ALL, ANY, SOME, EXISTS)

17. List out the employees who earn more than every employee in department 30.
18. List out the employees who earn more than the lowest salary in department 30.
19. Find out which department does not have any employees.

Simple join

20. List our employees with their department names
21. Display employees with their designations (jobs)
22. How many employees are working in the sales department?

Non – Equi Join:

23. Display employee details with salary grades.
24. List out the no. of employees on grade wise.

Self-Join:

25. Display the employee details with their manager names.
26. Display the employee details who earn more than their manager's salaries.

Outer Join:

27. Display employee details with all departments.



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28. Display all employees in sales or operation departments.

Set Operators:

29. List out the distinct jobs in Sales and Accounting Departments.

30. List out the ALL jobs in Sales and Accounting Departments.

31. List out the common jobs in Research and Accounting Departments in ascending order.

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



Object Oriented Programming with Java

Semester	III		
Course Code:	23DS3PCOOJ	Total Contact Hours: 40 hours	
L-T-P:	3-0-0	Total Credits:	3

Unit No.	Topics	Hours
1	Introduction to Java: Java's Lineage, The Bytecode, The Java Buzzwords. An overview of Java: Object oriented programming, Structure of a Java Program, Datatypes and Arrays. Introducing classes: Class fundamentals, Declaring objects, Assigning object reference variables, Introducing methods, Constructors, this keyword, Garbage Collection, A Stack class. Methods and classes: Overloading methods, Objects as parameters, argument passing, Returning objects.	8
2	Inheritance: Basics, Using super, Multilevel hierarchy, When constructors are executed, Method overriding, Dynamic method dispatch, Abstract classes, Using final with inheritance. Packages and Interfaces: Packages, Access Protection, Importing packages, Interfaces, Default interface methods.	8
3	Exception Handling: Fundamentals, types, Uncaught exceptions, Try and catch blocks, multiple catch, nested try, throw, throws, finally, Creating own exceptions. Multithreaded programming: Java thread model, The main thread, Creating a thread and multiple threads, Using isAlive() and join(), Thread Priorities, Synchronization.	8
4	File I/O Basics: Reading console input, Writing console output, Print writer class, Reading and writing files, Closing a file. String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Changing the Case of Characters Within a String, Joining Strings, StringBuffer.	8
5	Generics: Type Wrappers, Auto boxing, A simple generic example, Generic Class with two type parameters, The General Form of a Generic Class. Collections Framework: Overview, Collection classes - ArrayList Class, LinkedList Class, HashSet Class, TreeSet Class, ArrayDeque Class.	8



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Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Java : The Complete Reference	Herbert Schildt	11 th Edition	McGraw-Hill Education	2018
2.	Programming with Java A Primer	E.BalaGuru Swamy	6 th Edition	McGraw-Hill Education	2014

Reference Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Java Programming	Y. Daniel Liang	11 th Edition	Pearson	2017
2.	Object Oriented Programming with Java: Essentials and Applications	Rajkumar Buyya, Thamarai Selvi, Xing	1 st Edition	Tata McGraw Hill Education	2009

E-Book

Sl. N o.	Book Title	Authors	Edition	Publisher	Year	URL
1.	The Art and science of Java	Eric S. Roberts	-	Greg Tobin	2007	http://people.reed.edu/~jerry/121/materials/artsciencejava.pdf
2.	Java Programming	Wikibooks Contributors	7th Edition	wikibooks.org	2016	https://upload.wikimedia.org/wikipedia/commons/e/e7/Java_Programming.pdf

MOOC Course

Sl. No.	Course name	Course Offered By	Year	URL
1.	Object Oriented Programming in Java	Udacity	2022	https://www.udacity.com/course/java-programming-basics--ud282
2.	Java	Swayam NPTEL	2023	https://onlinecourses.swayam2.ac.in/aic20_sp13/previe w



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Course Outcomes

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

CO1	Apply the knowledge of Java concepts to find the solution for a given problem.
CO2	Analyse the given Java application for correctness and functionalities.
CO3	Develop Java programs and applications for a given requirement.
CO4	Conduct practical experiments for demonstrating features of Java.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			3	2								
CO4			3		1				1	1		3

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	20
AAT	1	5
Lab Component	CIE+ Lab Tests	25
Total		50

Laboratory Plan

Instructions to Students to be followed in each lab:

1. Each Student should write down the work carried out and the outputs in the observation book and get it evaluated by the respective lab faculty in-charge.
2. Each Student should bring the lab record with the programs and output written for the programs completed in their respective previous week and get it evaluated by the lab faculty in-charge.



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3. Students have to practice following list of programs and additional programming exercises will also be given in lab. Students will be made to solve coding challenges on programming platforms like LeetCode and HackerRank.

	Program Details
1	Create a class to represent a bank account with data members : Account no, Account holder name, Address and Balance amount. Create member methods to assign initial value to the account, deposit an amount, withdraw an amount after checking balance and display account holders name and balance. Write a main method for the above class that reads the initial values from the keyboard and invokes the appropriate methods.
2	Create a class named RetailItem that holds data about an item in a retail store. The class should have the following fields: <ul style="list-style-type: none">• Description - The description field references a String object that holds a brief description of the item.• Units - The units field is an int variable that holds the number of units currently in inventory.• Price - The price field is a double that holds the item's retail price. Write a constructor that accepts arguments for each field, appropriate mutator methods that store values in these fields, and accessor methods that return the values in these fields. Write the main method which creates three RetailItem objects and invokes appropriate methods.
3	Write a program in java to define a class Shape which has data members and a member function showArea(). Derive two classes Circle and Rectangle from Shape class. Add appropriate data members and member functions to calculate and display the area of Circle and Rectangle.
4	Write a program that has an Interface I which is extended by I1 and I2. Interface I12 inherits from both I1 and I2. Each interface declares one constant and one method. Class DemoI implements I12. Instantiate DemoI and invoke each of its methods. Each method displays one of the constants.
5	Define Create a package named mypack, containing a class AreaTriangle in which a method Area() finds area of a triangle and returns area. Import this package in another class Triangle which is in package mypack1. The Triangle class invokes the Area() method from mypack and displays the area of triangle. Member variables can be considered as per the program requirement.
6	Create a base class called "Father" and derived class called "Son" which extends the base class. In Father class, implement a constructor which takes the age and throws the exception WrongAge() when the input age<0. In Son class, implement a constructor that checks both father and son's age and throws an exception if son's age is >=father's age.
7	Consider a bank offering online access to its customers to perform transactions. Suppose there are two transactions of deposit and withdrawal for a particular account



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	simultaneously which leads to race condition. Develop a solution to avoid unpredictable situations with a program.
8	Implement a class that checks whether a given number is a prime using both the Thread class and Runnable interface.
9	Write a program to copy the content of File1.txt to another file File2.txt. by reading the file name as command line arguments.
10	Illustrate the following string operations using String object. i) Difference of equals() method and == operator ii) Check whether the string is palindrome or not iii) To convert the string into character array
11	Create a Class Gen which implements a stack using generics. Ensure that the stack never overflows and the main method would invoke the stack methods in class Gen by passing integer and floating-point numbers.
12	Write a program to create a new array list, add some colors (string) and perform the following operations: i.Add elements of List to ArrayList i.Copy ArrayList to Array i.Reverse ArrayList content v.Get Sub list from an ArrayList. v.To sort a given ArrayList

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Mandatory	One Question to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Internal Choice	Two Questions to be asked for 20 Marks each



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Foundations of Data Science

Semester	III		
Course Code:	23DS3PCFDS	Total Contact Hours: 40 hours	
L-T-P:	3-0-0	Total Credits:	3

Unit No.	Topics	Hours
1	<p>Introduction to Data Science: Describing Data science, The data science Venn diagram, Python for Data Science, Data science case studies</p> <p>Types of Data: structured versus unstructured data, quantitative versus qualitative data, the four levels of data: nominal, ordinal, interval and ratio</p> <p>Total information awareness, Bonferroni's Principle, Rhine's paradox.</p> <p>The Data Science Process: Overview, defining research goals, retrieving data, Cleansing, integrating and transforming data, exploratory data analysis, Build the models, Presenting findings. Data Analytics Lifecycle.</p>	8
2	<p>Statistics & Probability: Statistics, Obtaining data, Sampling Data, Statistical measures, empirical rule. Points estimates, Sampling distributions, Confidence intervals, Hypothesis Tests: Conducting a hypothesis test, one sample t-tests, Type I and type II errors, Hypothesis testing for categorical variables</p> <p>Information Gain & Entropy, Probability Theory, Probability Types, Probability Distribution Functions, Bayes' Theorem, Inferential Statistics</p>	8
3	<p>Correlation Analysis: Types of correlation, correlation coefficient.</p> <p>Regression Analysis: Linear Regression: Simple Linear Regression, Multilinear Regression, p-values, Logistic Regression, Multinomial logistic regression, Time-Series Model, Receiver Operating Characteristic</p>	8
4	<p>Dealing with missing data: single and multiple data imputation, Entropy based techniques, Monte Carlo and MCMC simulations;</p> <p>Correcting inconsistent data: Deduplication, Entity resolution, Pairwise Matching; Fellegi-Sunter Model</p> <p>Dimensionality Reduction: Eigenvalues and Eigenvectors of Symmetric Matrices: Definitions, Computing Eigenvalues and Eigenvectors, Finding Eigenpairs by Power Iteration, Eigenvector matrix</p> <p>Principal-Component Analysis: Example, Using Eigenvectors for Dimensionality Reduction, The matrix of distances</p> <p>Singular-Value Decomposition: Definition, interpretation, Dimensionality Reduction Using SVD, Why Zeroing Low Singular Values Works, Querying Using Concepts, Computing the SVD of a Matrix</p>	8



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5	Data Analytics on Text: Major Text Mining Areas – Information Retrieval – Data Mining – Natural Language Processing NLP) – Text analytics tasks: Cleaning and Parsing, Searching, Retrieval, Text Mining, Part-of-Speech Tagging, Stemming, Text Analytics Pipeline. NLP: Major components of NLP, stages of NLP, and NLP applications.	8
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Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Principles of Data Science	Sinan Qzdemir, Sunil Kakade & Macro Tibaldeschi	Second Edition	Packt	2018
2.	Fundamentals of Data Science	Sanjeev Wagh, Manisha Bhende, Anuradha Thakare,	First Edition	CRC Press	2022
3.	Introducing Data Science: Big Data, Machine Learning, and More	Davy Cielen, Arno D.B. Meysman, Mohamed Ali	-	Manning	2016

Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Doing Data Science	Rachel Schutt, Cathy O'Neil	-	O'Reilly	2014
2.	Mining Massive Datasets	Jure Leskovec, Anand Rajaraman, Jeffrey D Ullman	2 nd	Dreamtech Press	2016

E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Data Science & Machine Learning	DirkP.Kroese, ZdravkoI Botev, ThomasTaimre, RadislavVaishman	-	University of Queensland	2023	https://people.smp.uq.edu.au/DirkKroese/DSML/DSML.pdf
2.	Becoming a Data Head	Alex J. Gutman Jordan Goldmeier	-	Wiley	2021	https://32net.id/bukaheula/share/QP2cf2JLdeOPn00y3Nyu8aXHp1Slq1bc6P4YcuI4.pdf



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MOOC Course

Sl. No.	Course name	Course Offered By	Year	URL
1.	IBM Data Science	Coursera	2023	https://www.coursera.org/professional-certificates/ibm-data-science
2.	Foundations of Data Science	SWAYAM	2023	https://onlinecourses.swayam2.ac.in/imb23_mg64/preview

Course Outcomes

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

CO1	Gain fundamental knowledge on data science		
CO2	Analyse and visualize data for knowledge representation.		
CO3	Demonstrate proficiency in data analysis.		
CO4	Conduct experiments to demonstrate the use of various data science tools		

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2		3										
CO3			3									
CO4					3				3	3		3



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Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	3	40
AAT	1	10
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Full Stack Web Development

Semester	III		
Course Code:	23DS3AEFWD	Total Contact Hours: 20 hours	
L-T-P:	0-0-1	Total Credits:	

Introduction:

1. This course focuses on developing comprehensive skills in Full Stack Web Application Development. Students will learn to develop both front-end and back-end components of web applications, integrate with databases and external services, and apply best practices in web development.
2. Under this project work, student should develop Advanced Web based Application using technologies such as PHP, Python, Node JS, React, Angular.
3. Students can form a group with minimum of two and maximum of four.
4. Teacher allotted for project work to students should teach full stack technologies like Node JS, React, etc., during Class/Lab hours as per the allotment. Teacher allotted for project work should guide the students in choosing the topic and towards carrying out project work and complete the evaluation of assigned students.

Course Outcomes

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

CO1	Apply full-stack web development technologies to solve real-world problems.
CO2	Design and develop user-centric web applications focused on social and environmental issues.
CO3	Integrate front-end and back-end components effectively with databases and external services.
CO4	Demonstrate teamwork and problem-solving skills in project development.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				3							
CO2			3		3	3	3					
CO3				3								
CO4								3	3		3	3



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Rubrics for Project Evaluation:

Criteria	Excellent	Good (3 Marks)	Satisfactory (2 Marks)	Needs Improvement (0-1 Marks)
Problem Identification & Relevance (10)	(10 Marks) Clearly articulates a significant social/environmental issue with insightful, innovative solutions.	(7 Marks) Recognizes a pertinent issue and offers practical solutions.	(5 Marks) Identifies a basic issue with standard solutions.	(0-2 Marks) Fails to identify a relevant issue or solution.
Technical Implementation (10)	(10 Marks) Exemplary implementation of full-stack technologies, showcasing efficiency, scalability, and technical excellence.	(7 Marks) Reliable and proficient technical performance, meeting key objectives.	(5 Marks) Basic implementation incorporating essential features and functionalities.	(0-4 Marks) Inadequate or incomplete technical implementation.
User Experience & Interface (10)	(10 Marks) Exceptional UI/UX design, prioritizing intuitiveness and user-friendliness, with a professional standard of execution.	(7 Marks) Competent UI design focused on usability and functionality.	(5 Marks) Basic UI design encompassing essential functions and user needs.	(0-4 Marks) Poor or non-functional user interface, lacking in user-centricity.
Group Participation (5)	(5 marks) Exhibits active engagement, exceptional collaboration, and effective teamwork throughout the project lifecycle.	(4 marks) Consistent participation and constructive collaboration within the group.	(2 marks) Minimal but noticeable participation and occasional contributions.	(0 marks) Lack of active participation and collaboration in the group.
Presentation (5)	(5 marks) Professional, engaging presentation with outstanding visuals and comprehensive content, demonstrating exceptional delivery skills.	(4 marks) Well-structured presentation with clear content and effective delivery.	(2 marks) Basic presentation with some structure and varying delivery quality.	(1 marks) Disorganized presentation lacking in coherence and adequate content.
Report & Documentation (10)	(10 marks) Comprehensive report covering all project aspects with meticulous documentation, including methodology, design, and future scope.	(7 marks) Well-structured report with detailed coverage of project implementation.	(5 marks) Basic report with limited content, covering essential project details.	(2-4 marks) Poorly structured and incomplete report, lacking essential details.

Laboratory Plan (if applicable)

Sl. No	Week	Activity	Content deliverables by the assigned teacher	Technologies/Skills to be Covered
1	1st	Formation of groups. Note:	Introduction to Full Stack Technologies & Issue Identification	<ul style="list-style-type: none"> Overview of full stack development tools and frameworks. Overview of web development (HTML, CSS, JavaScript),



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		Student groups of size 2 or 3 or 4		<ul style="list-style-type: none"> Introduction to full stack frameworks (MEAN, MERN), Identifying social/environmental issues for web solutions.
2	2nd	Project topic selection by each Group. Presentation: Student and Project topic introduction by each group	Conceptualizing a Web Application	<ul style="list-style-type: none"> Identifying problem and understanding social and environmental issues. Brainstorming and planning a web application focused on a chosen social/environmental issue. Tools for wireframing and prototyping (Figma, Sketch),
3	3rd	Design Layout of the Web Pages	Basic Front-end and Back-end Development	<ul style="list-style-type: none"> Define layouts based on project scope and objectives. Learning the basics of front-end (HTML, CSS, JavaScript) and back-end (Node.js, Python) development. Front-end: HTML5, CSS3, JavaScript basics. Back-end: Introduction to Node.js, Express.js, RESTful API development
4	4th ,5th , and 6th	Front end and back-end implementation	Data Management and Integration	<ul style="list-style-type: none"> Techniques for managing and integrating data in web applications. Database technologies (MongoDB, SQL), Integrating databases with back-end (Mongoose for MongoDB), Basic CRUD operations.
5	7th 8th and 9th	Design and Development of connecting among different web pages	Advanced Front-end & Back-end Technologies Project Development and Mid-term Review	<ul style="list-style-type: none"> Delving into advanced front-end technologies (React, Angular) and back-end technologies (databases, server management). Front-end: React.js/Angular for dynamic UI development. Back-end: Advanced Node.js, Authentication (JWT, OAuth), Server-side rendering.
6				Development of the project with guidance and a mid-term review to assess progress.
7	10th	Presentation by each group	Integrating Feedback & Refining Applications	<ul style="list-style-type: none"> Applying feedback from the mid-term review and refining the application for better performance and impact. Implementing feedback, Optimization for performance, Security best practices (HTTPS, data validation), User testing and UX improvements.



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8	11th	Complete Project Work Demonstration by each group	Final Project Presentations and Submissions	Students present their completed projects and submit their final work for assessment.
	12th	Project Report Preparation		

Prescribed Text Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	
1.	Modern Full-Stack Development: Using Type Script, React, Node.js	Frank Zammetti	1st Edition	Apress	2020	
2.	Beginning MERN Stack, Build and Deploy a Full Stack MongoDB, Express, React, Node.js App	Greg Lim			2021	

Tutorial Link:

Sl. No.	Links
1	https://www.springboard.com/resources/learning-paths/web-development-python-django/
2	https://www.coursera.org/learn/introduction-to-web-development-with-html-css-javascript
3	https://www.boardinfinity.com/micro-learning/full-stack-development-course-with-certification
4	https://www.udemy.com/course/next-js-the-complete-developers-guide/
5	https://www.udemy.com/course/nextjs-build-full-stack-apps-with-nextjs-using-redux/
6	https://www.udemy.com/course/beginning-javascript/



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

Theory of Computation

Sem	IV	
Course Code:	23DC4ESTOC	Total Contact Hours: 40 hours
L-T-P:	3-0-0	Total Credits: 3

Unit No.	Topics	Hours
1	Introduction to Finite Automata: Central Concepts of Automata Theory, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Finite Automata with Epsilon Transition, An Application Text Search. NP Problems solvable in Polynomial Time, Satisfiability Problem	8
2	Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Proving Languages Not to Be Regular, Closure Properties of Regular Languages, Equivalence and Minimization of Automata	8
3	Context Free Grammars and Languages Parse Trees: Context Free Grammars, Parse trees, Applications of Context Free Grammars, Ambiguity in Grammars and Languages, Eliminating Useless Symbols, Computing the Generating and Reachable Symbols, Eliminating Epsilon Productions, Eliminating Unit Productions, Chomsky Normal Form, Greibach Normal form	8
4	Pushdown Automata: Definition of the Pushdown Automaton, The Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata, The Pumping Lemma for Context Free Languages, Closure Properties of Context Free Languages	8
5	Introduction to Turing Machine: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Restricted Turing Machines, Turing Machines and Computers, Definition of Post Correspondence Problem, A Language That Is Not Recursively Enumerable, An Undecidable Problem That is RE, Other Undecidable Problems	8

Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Automata Theory, Languages and Computation	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman: education	3 rd Edition	Pearson	2007



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Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Languages and Automata Theory	John C Martin	3 rd Edition	Tata McGraw- Hill	2007
2.	An Introduction to formal Languages and Automata	Peter Linz	5 th Edition	Narosa Publishing House	2012

E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Introduction to Theory of Computation	Anil Maheshwari, Michiel Smid	-	Carleton University	2019	https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Automata Theory	edX	2022	https://www.edx.org/course/automata-theory
2.	Introduction to Automata, Languages and Computation	IITB	2022	https://onlinecourses.nptel.ac.in/noc21_cs19/preview
3.	Automata Theory	Stanford University	2022	https://online.stanford.edu/courses/soe-ycsautomata-automata-theory

Course Outcomes

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

CO1	Apply the knowledge of Automata Theory, Grammars & Regular Expressions for the given requirement of the formal language.
CO2	Analyze the given Automata to identify the formal language it represents.
CO3	Design Automata and Grammar for pattern recognition and syntax checking of the given formal language.



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CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3											
CO2		2										
CO3			2									

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	40
AAT	2	10
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



Operating Systems

Semester	IV		
Course Code:	23DC4PCOPS	Total Contact Hours: 40 hours	
L-T-P:	3-0-0	Total Credits:	3

Unit No.	Topics	Hours
1	Introduction to Operating Systems: What operating systems do, Operating System operations, Process management, Memory management, Storage management, Protection and security System Structures: Operating System Services, System calls, Operating System design and implementation, Operating System structure, System Boot.	8
2	Processes: Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication. Threads: Overview, Multi-core Programming, Multithreading Models, Implicit Threading, Threading Issues. Process Synchronization -Background, The Critical section problem, Synchronization hardware, Mutex Locks, Semaphores, Classical problems of synchronization.	8
3	CPU Scheduling- Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple-Processor scheduling. Deadlocks: System Model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock.	8
4	Memory Management Strategies: Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation. Virtual Memory Management- Background, Demand paging, Page replacement, Thrashing.	8
5	Virtual Machines: Overview, Benefits and features, Building Blocks, Types of Virtual Machines and their implementations, Virtualization and Operating System Components, Protection Rings Case Study: VMWare	8



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Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Operating System Concepts	Abraham Silberschatz, Peter Baer Galvin , Greg Gagne	9th Edition	John Wiley & Sons	2018
2.	Modern operating systems	Andrew Tanenbaum	4th Edition	Pearson Education	2009

Reference Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Operating System: Internals and Design Principles	William Stallings	8th Edition	Prentice Hall	2014
2.	Schaum's Outline of Operating Systems	J. Archer Harris	Kindle Edition	McGraw-Hill	2001

E-Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Operating Systems Course Notes	Dr. John T.Bell	-	University of Illinois Chicago	2013	https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/index.html
2.	Operating System Concepts	Abraham Silberschatz, Peter Baer Galvin , Greg Gagne	Ninth Edition	John Wiley & Sons	2018	https://drive.uqu.edu.sa/_/mskhayat/files/MySubjects/2017SS%20Operating%20Systems/Abraham%20Silberschatz-Operating%20System%20Concepts%20(9th,2012_12).pdf

MOOC Course

Sl. No.	Course name	Course Offered By	Year	URL
1.	Operating Systems	SWAYAM	2023	https://onlinecourses.nptel.ac.in/noc20_cs04/preview
2.	Introduction to Operating Systems	Coursera	2023	https://www.coursera.org/specializations/codio-introduction-operating-systems



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Course Outcomes

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

CO1	Apply the different concepts and functionalities of Operating System
CO2	Analyse various Operating system strategies and techniques
CO3	Demonstrate the different functionalities of Operating Systems.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			2									

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	40
QUIZ/AAT	2	10
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Computer Networks

Semester	IV		
Course Code:	23DS4PCCON	Total Contact Hours: 40 hours	
L-T-P:	3-0-0	Total Credits:	3

Unit No.	Topics	Hours
1	Introduction: Data Communications, Networks, Network Types, Network Models, Protocol Layering, Reference Models: The OSI Reference Model, The TCP/IP Reference Model, Physical Layer: Data and signals Digital Transmission, (D-D Conversion) Bandwidth Utilization, Multiplexing, Switching, Circuit Switched Networks, Packet Switching.	8
2	Data Link Layer: Link Layer Addressing, Error Detection and Correction, Block Coding, Cyclic Codes, Checksum. Data Link Control: DLC Services, Data-Link Layer Protocols, Media Access Control, Wired LANs, Ethernet protocol.	8
3	Network Layer: Network Layer Services, Packet Switching, Network Layer Performance, IPV4 Addresses. Network Layer Protocols: Internet Protocol, ICMPV4, Unicast Routing, Routing algorithms, Unicast routing protocols, Internet Structure, Routing Information Protocol (RIP), Next Generation IP: IPV6 Addressing, IPV6 Protocol, ICMPv6 Protocol, Transition from IPV4 to IPV6, Congestion Control Algorithms, QoS	8
4	Transport Layer: Transport Layer Protocols, User Datagram Protocol, Transmission Control Protocol.	8
5	Application Layer: Introduction, Standard Client Server Protocols, DNS—The Internet's Directory Service, SMTP, SNMP, FTP	8



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Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Data Communications and Networking	Behrouz A Forouzan	5 th Edition	McGraw Hill	2013
2.	Computer Networks	Andrew S. Tanenbaum, David J. Wetherall	5 th Edition	Pearson	2011

Reference Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Data and Computer Communication	William Stallings	8 th Edition	Pearson Education	2008
2.	Computer Networks – A Systems Approach	Larry L. Peterson and Bruce S. Davie	4 th Edition	Elsevier	2007

E-books:

Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	An Introduction to Computer Networks	Peter L Dordal	1 st Edition	-	2020	https://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
2.	A Top-Down Approach: Computer Networking	James F Kurose & Keith W Ross	8 th Edition	Pearson	2021	https://gaia.cs.umass.edu/kurose_ross/online_lectures.htm



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MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Computer Networking	Coursera	2023	https://www.coursera.org/learn/illinois-tech-computer-networking
2.	NOC: Computer Networks and Internet Protocol	NPTEL		https://nptel.ac.in/courses/106105183

Course Outcomes

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

CO1	Apply the fundamental concepts of communication in networking.
CO2	Analyze the various protocols, and techniques in TCP/IP network architecture
CO3	Develop applications that demonstrate the functionalities of physical, Data Link, Network, Transport or Application layer

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			3		1							

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	40
AAT	2	10
Total		50



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SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Question to be asked for 20 Marks each
Unit-3	Internal Choice	Two Question to be asked for 20 Marks each
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Machine Learning

Sem	IV	
Course Code:	23DS4PCMLG	Total Contact Hours: 40 hours
L-T-P:	3-0-1	Total Credits: 4

Unit No.	Topics	Hours
1	Machine Learning Landscape: Introduction, Types of Machine Learning, Challenges of Machine Learning, Testing and Validating. Supervised Learning Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, Issues in Decision tree learning, CART Training algorithm	8
2	Support Vector Machines: Linear SVM, Non Linear SVM, SVM Regression, Under the Hood. Instance Based Learning: Introduction, k-Nearest Neighbor learning	8
3	Probabilistic Learning Bayesian Learning: Bayes Theorem and Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian Belief Network, EM Algorithm.	8
4	Ensemble Learning and Random Forests: Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting, Stacking	8
5	Unsupervised Learning Techniques Clustering – Kmeans, DBSCAN, Other Clustering Algorithms, Gaussian Mixtures – Anomaly Detection, Selecting Clustering, Bayesian Gaussian Mixture Models, Other algorithms for anomaly and novelty detection Reinforcement Learning: Markov Decision Process, Introduction, Learning Task, Q Learning	8

Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Machine Learning	Tom M. Mitchell	First	McGraw Hill Education	2013
2	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow	Aurelien Geron	Second	O'Reilly	2020

Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year



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1.	Introduction to Machine Learning with Python	Andreas C Muller & Sarah Guido	First	Shroff Publishers	2019
2.	Thoughtful Machine learning	Mathew Kirk	First	Shroff Publishers	2019

E-Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	The Elements of Statistical Learning	Trevor Hastie, Robert Tibshirani, Jerome H. Friedman	Second	-	2009	https://web.stanford.edu/~hastie/Papers/ESLII.pdf
2.	Machine Learning in Action	Peter Harrington	First	Manning	2017	http://www2.ift.ulaval.ca/~chaib/IFT-4102-7025/public_html/Fichiers/Machine_Learning_in_Action.pdf

MOOC Course

Sl. No.	Course name	Course Offered By	Year	URL
1.	Machine Learning	Coursera	--	https://www.coursera.org/learn/machine-learning
2.	Introduction to Machine learning	NPTEL	2016	https://swayam.gov.in/nd_noc20_cs29/preview

Course Outcomes

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

CO1	Apply different learning algorithms for various complex problems
CO2	Analyze the learning techniques for given dataset
CO3	Design a model using machine learning to solve a problem.
CO4	Ability to conduct practical experiments to solve problems using appropriate machine learning techniques.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		2										
CO3			3									
CO4				3		3						3



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Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	20
AAT	1	5
Laboratory	CIE+ Lab Tests	25
Total		50

Laboratory plan

Sl. No	Unit#	Program Details
1	1	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.
2	2	Develop a program to construct Support Vector Machine considering a Sample Dataset
3	2	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions
4	3	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
5	3	Write a program to construct a Bayesian network considering training data. Use this model to make predictions.
6	3	Apply EM algorithm to cluster a set of data stored in a .CSV file. Compare the results of k-Means algorithm and EM algorithm.
7	4	Implement Boosting ensemble method on a given dataset.
8	4	Write a program to construct random forest for a sample training data. Display model accuracy using various metrics
9	5	Implement tic tac toe using reinforcement learning
10	5	Consider a sample application. Deploy machine learning model as a web service and make them available for the users to predict a given instance.



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SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20Marks
Unit-2	Mandatory	One Question to be asked for 20Marks
Unit-3	Internal Choice	Two Questions to be asked for 20Marks each
Unit-4	Internal Choice	Two Questions to be asked for 20Marks each
Unit-5	Mandatory	One Question to be asked for 20Marks



Design and Analysis of Algorithms

Semester	IV		
Course Code:	23DC4PCDAA		Total Contact Hours: 40 hours
L-T-P:	3-0-1	Total Credits:	4

Unit No.	Topics	Hours
1	Introduction to Algorithm, Fundamentals of Algorithmic Problem Solving. Analysis of Algorithm Efficiency: The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non Recursive Algorithm, Mathematical Analysis of Recursive Algorithms.	8
2	Brute-Force: String Matching, Exhaustive Search: TSP, Knapsack Problem, Assignment Problem, Depth-First Search and Breadth-FirstSearch. Decrease-and-Conquer: Topological Sorting, Algorithms for Generating Combinatorial Objects: Generating Permutations, Decrease by-a-Constant-Factor Algorithms: Binary Search, Russian Peasant Multiplication, Variable Size-Decrease Algorithms: Computing Median and the Selection Problem	8
3	Divide-and-Conquer: Merge sort, Quicksort, Multiplication of Large Integers and Strassen's Matrix Multiplication. Transform-and-Conquer: Presorting, Heaps and Heap sort, Horner's Rule. Space and Time Tradeoffs: Horspool Algorithm, Boyer-Moore Algorithm.	8
4	Dynamic Programming: Coin Problem, The Knapsack Problem, Warshall's and Floyd's Algorithms. Greedy Technique: Prim's Algorithm, Kruskal's Algorithm-Without disjoint subsets and Union Find algorithms, Dijkstra's Algorithm, Huffman Trees.	8
5	Backtracking: n -Queens Problem, Subset-Sum Problem. Branch-and-Bound: Knapsack Problem, Traveling Salesman Problem. NP-Completeness: Polynomial time, Polynomial-time verification, NP-completeness and reducibility. NP-Complete Problems: The Clique problem, The Vertex Cover problem, Approximation Algorithms: The Vertex-Cover problem.	8



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Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to the Design and Analysis of Algorithms	Anany Levitin	Third Edition	Pearson	2014
2.	Introduction to Algorithms	Charles E Leiserson, Ronald L Rivest, Clifford Stein	Third Edition	The MIT Press	2009

Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Fundamentals of Computer Algorithms	Ellis Horowitz,Satraj Sahni and Rajasekhara m	2ndEdition	University Press Pvt. Ltd,	2009
2.	Analysis and design of Algorithms	Padma Reddy		Sri Nandi Publications	2009

E-Books						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Introduction to Design & Analysis of Algorithms	K. Raghava Rao	-	Smash words	2013	https://www.smashwords.com/books/view/365630
2.	Data structures and Algorithm Analysis in C++	Allen Weiss	Fourth edition	Pearson education	2014	http://www.uoitc.edu.iq/images/documents/informatics-institute/Competitive_exam/DataStructures.pdf



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MOOC Courses				
Sl. No.	Course name	Course Offered By	Year	URL
1	Algorithms	Coursera	2023	https://www.coursera.org/course/alg4partI
2	Design and Analysis of Algorithms	NPTEL	2023	https://onlinecourses.nptel.ac.in/noc19_cs47/preview

Course Outcomes

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

CO1	Apply algorithmic design paradigms to basic computing problems.
CO2	Analyze the time complexity of different algorithms.
CO3	Design efficient algorithms using appropriate algorithm design techniques.
CO4	Conduct experiments to implement algorithms and provide valid conclusions.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			3									
CO4				3	1							

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	20
QUIZ/AAT	1	5
Lab Component	CIE+ Two Lab Tests	25
	Total	50

Laboratory Plan

Instructions to Students to be followed in each lab:

1. Each Student should write down the program in the observation book and get it evaluated by the respective lab faculty in-charge and then execute the program.
2. Each Student should bring the lab record with the programs and output written for the programs completed in their respective previous week and get it evaluated by the lab faculty in-charge. In the record book students should - Handwrite the Program - Pasting of the printout of the Output or Handwriting of the Output (Output should be written for all the cases).



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3. Students have to practice following list of programs and additional programming exercises will also be given in lab. Students will be made to solve coding challenges on platforms like LeetCode and HackerRank.

Lab Program	Unit#	Program Details
1	2	<p>Write program to do the following:</p> <p>a. Print all the nodes reachable from a given starting node in a digraph using BFS method.</p> <p>b. Check whether a given graph is connected or not using DFS method.</p>
2	2	Write program to obtain the Topological ordering of vertices in a given digraph.
3	2	Implement Johnson Trotter algorithm to generate permutations
4	3	Sort a given set of N integer elements using Merge Sort technique and compute its time taken. Run the program for different values of N and analyze its time complexity.
5	3	Sort a given set of N integer elements using Quick Sort technique and compute its time complexity.
6	3	Sort a given set of N integer elements using Heap Sort technique and analyze its time complexity.
7	4	Implement 0/1 Knapsack problem using dynamic programming.
8	4	Implement All Pair Shortest paths problem using Floyd's algorithm.
9	4	Find Minimum Cost Spanning Tree of a given undirected graph using Prim/Kruskal's algorithm.
10	4	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
11	5	Implement "N-Queens Problem" using Backtracking.

SEE Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Mandatory	One Question to be asked for 20 Marks
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Data Visualization using Tools

Semester	IV	
Course Code:	23DS4AEDVZ	Total Contact Hours: 20 hours
L-T-P:	0-0-1	Total Credits: 1

About the course: The course is designed to enhance programming and computation skills of students by exploring various features and extensive libraries of python programming language that are necessary for data science applications.

The students should work with a given dataset and create effective visualizations. The course will be executed in two cycles.

During Cycle 1, the students would be able to implement the key visualization techniques using Python tools like Matplotlib, Seaborn etc.

In Cycle 2, students will be exposed to industry-standard software tools like Tableau, Google Data Studio etc. to create compelling and interactive visualization of various types of data.

Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Python Data Science Handbook	Jake Vander Plas	2nd Edition	O'Reilly	2017
2.	Pro Tableau: A Step by Step Guide	Seema Acharya , Subhashini Chellappan	2nd Edition	Apress	2016

Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems	Sossama Embarak	-	Apress	2018
2.	Python Data Visualization Cookbook	Igor Milovanović , Dimitry Foures , Giuseppe Vettigl	Second Edition	O'Reilly	2015



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E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Data Visualization with Python and JavaScript	Kyran Dale	-	O'Reilly	2016	https://github.com/jllovet/dataviz-with-py-and-js
2.	Jumpstart Tableau: A Step-by-Step Guide to Better Data Visualization	Arshad Khan	-	Apress	2016	https://link.springer.com/book/10.1007/978-1-4842-1934-8

MOOC Course					
Sl. No.	Course name	Course Offered By	Year	URL	
1.	IBM Data Science	Coursera	2023	https://www.coursera.org/professional-certificates/ibm-data-science	
2.	Data Visualization with Tableau	Coursera	2023	https://www.coursera.org/specializations/data-visualization	



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Laboratory Plan

Lab-cycle-1

Sl. No.	Experiment
1	<p>Using the sales_data.csv, create the visualization report for the following using Matplotlib:</p> <p>a. Get total profit of all months and show line plot with the following Style properties.</p> <p>Generated line plot must include following Style properties:</p> <ol style="list-style-type: none">1. Line Style dotted and Line-colour should be green2. Show annotation3. Add a square marker.4. Add ticks for both X and Y axis <p>b. Read Bathing soap facewash of all months and display it using the Subplot</p>
2	<p>Using the sales_data.csv, create the visualization report for the following using Matplotlib:</p> <p>a. Get total profit of all months and show line plot with the following Style properties</p> <p>Generated line plot must include following Style properties: –</p> <ol style="list-style-type: none">1. Line Style dashed and Line-colour should be green2. Show legend at the lower right location.3. Add ticks for both X and Y axis4. Line width should be 2 <p>b. Read toothpaste sales data of each month and show it using a bar plot</p>
3	<p>Using the sales_data.csv, create the visualization report for the following using Matplotlib:</p> <p>a. Calculate total sale data for last year for each product and show it using a Pie chart</p> <ol style="list-style-type: none">1. Print the total sale inside each part2. Explode the highest sale3. Set the start angle=60 <p>b. Read face cream and facewash product sales data and show it using the horizontal bar chart</p>



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4	<p>Write a Python programming for the following:</p> <p>a. to display a horizontal bar chart of the sale of book. Use different color for each bar.</p> <p>Sample data: Programming languages: Fict, Tech, Moti, Business, Nutri, Dev Sale: 5.2,19.6, 8.7, 8, 7.7, 3.7</p> <p>1. Add ticks for both axes 2. Show legend at the upper right corner</p> <p>b. Write a Python program to create a stacked bar plot.</p> <p>Note: Use bottom to stack the women bars on top of the men bars. Sample Data: Means (men) = (22, 30, 35, 35, 26) Means (women) = (25, 32, 30, 35, 29)</p> <p>1. Add labels and ticks 2. Use annotation</p>
5	<p>Write a Python programming for the following:</p> <p>a. To create a pie chart with a title of the pass percentage of subjects.</p> <p>Sample data: Subjects: DSC, OOP, OPS, COA, MAT, Java Pass percentage (%): 40, 25.6, 8.8, 30, 7.7, 60.7</p> <p>1. Print percentage inside the chart 2. Use explode property</p> <p>b. Using the sales_data.csv, read the total profit of each month and show it using the histogram to see the most common profit ranges</p>



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6	<p>Using the dataset planets.csv, create the visualization report for the following using Seaborn:</p> <ol style="list-style-type: none">Get the distance covered year-wise and show scatter plot with the following properties<ol style="list-style-type: none">1. Add “mass” as additional features2. Use different markers3. Control the range of marker areas with sizesRead the orbital_period of each year and show it using the histogram.
7	<p>Using the dataset planets.csv, create the visualization report for the following using Seaborn:</p> <ol style="list-style-type: none">Get the distance covered year-wise and show scatter plot with the following properties<ol style="list-style-type: none">1. Add “mass” and “method” as additional features2. Change the default colour palette3. Display the complete legendRead the distance for each method and show it using the bar chart.
8	<p>Using the dataset titanic.csv, create the visualization report for the following using Seaborn:</p> <ol style="list-style-type: none">Demonstrate the use of “displot”Plot the distribution using Kernel density estimation.Use lineplot for any two suitable featuresGenerate scatter plot with different color palette
9	<p>Using the dataset titanic.csv, create the visualization report for the following using Seaborn:</p> <ol style="list-style-type: none">Demonstrate the subplots (2x1) on scatter plotsDemonstrate the use of violin plotGet different line plots for survival of passengers’ class wise.Create visualization for strip plot without jitter



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10	<p>Using the dataset titanic.csv, create the visualization report for the following using Seaborn:</p> <ol style="list-style-type: none">Create a visualization using categorical plot and re-order the axis contentsDemonstrate the use of violin plotDemonstrate the subplots (1x3) on line plotsGenerate scatter plot with different color palette
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Lab-cycle-2

Sl. No.	Experiment
1	<p>Create the visualization using Tableau for the “Corriander_seed_2021.csv” dataset.</p> <ol style="list-style-type: none">Demonstrate the use of filters (General, wildcard, condition and limits)Demonstrate the group creation, removing and renaming a group.Demonstrate the creation of constant setCreate the visualization by using quick table calculationCustomize the data using any three number functions
2	<p>Create the visualization using Tableau for the “Corriander_seed_2021.csv” dataset.</p> <ol style="list-style-type: none">Demonstrate the use of cascading filter, calculation filter and data source filter.Demonstrate creating HierarchiesDemonstrate the creation of computed setsCreate a visualization using a calculated fieldCustomize the data using any three string functions
3	<p>Create the visualization using Tableau for the “Corriander_seed_2021.csv” dataset.</p> <ol style="list-style-type: none">Demonstrate the use of cascading filter, calculation filter and data source filter.Demonstrate the group creation, removing and renaming a group.Create a visualization using a calculated fieldCustomize the data using any three number functionsDemonstrate the creation of constant set



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4	Create the visualization using Tableau for the “supermarket_sales.csv” dataset. a. Demonstrate the use of filters (General, wildcard, condition and limits) b. Demonstrate the group creation, removing and renaming a group. c. Demonstrate the creation of constant set d. Create a visualization using a calculated field e. Customize the data using any three string functions
5	Create the visualization using Tableau for the “supermarket_sales.csv” dataset. a. Demonstrate the use of cascading filter, calculation filter and data source filter. b. Demonstrate creating Hierarchies c. Demonstrate the creation of computed sets d. Create the visualization by using quick table calculation e. Customize the data using any three number functions
6	Create the visualization using Tableau for the “supermarket_sales.csv” dataset. a. Demonstrate the use of filters (General, wildcard, condition and limits) b. Demonstrate creating Hierarchies c. Create the visualization by using quick table calculation d. Demonstrate the creation of constant set e. Customize the data using any three string functions
7	Create the visualization using Tableau for the “supermarket_sales.csv” dataset. a. Demonstrate the use of cascading filter, calculation filter and data source filter. b. Demonstrate the group creation, removing and renaming a group. c. Demonstrate the creation of constant set d. Create a visualization using a calculated field e. Customize the data using any three number functions

Course Outcomes

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

CO1	Design and create effective data visualizations using Python.
CO2	Apply data transformations such as Joins, filtering, sorting, aggregation etc., for visualization using industry-standard software tools.
CO3	Identify opportunities for application of data visualization in various domains and communicate the results for documentation and interpretation.



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CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2		2							
CO2	3											
CO3					2	2			2	3		3

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Laboratory	CIE and Lab tests	50
Total		50



Time Series Analysis

Sem	V		
Course Code:	23DS5PCTSA	Total Contact Hours: 40 hours	
L-T-P:	2-1-0	Total Credits:	3

Unit No.	Topics	Hours
1	<p>Time Series Data: Purpose, Time series: Plots , Trends, and seasonal variation, Decomposition of series, Characteristics of Time Series: Introduction, Examples, Objectives and its nature, Introduction to time series databases and applications, Measures of dependence, Stationary Time Series, Estimation of Correlation, VectorValued and Multi Dimensional Series</p> <p>Components of Time Series: Trends, Seasonality, Cycles, Noise, Mathematical Models: Additive and Multiplicative models. Resolving components of a Time Series - Measuring Trend: Graphic, Semi-Averages, Moving Average and Least Squares Methods.</p>	8
2	<p>Correlation: Expectation and the ensemble, correlogram, covariance of sum of random variables, Measuring Seasonal Variation: Method of Simple Averages, Ratio-to- Trend Method, Ratio-to-Moving Average Method and Link Relative Method, Cyclical and Random Fluctuations, Variate Difference Method.</p>	8
3	<p>Index Numbers and their Definitions: Construction and Uses of Fixed and Chain based Index Numbers, Simple and Weighted Index Numbers, Laspeyres, Paasche's, Fisher's, and Marshall - Edgeworth Index Numbers, Optimum Tests for Index Numbers, Cost of Living Index Numbers. Forecasting Strategies: Leading variables and associated variables, Bass Model, Exponential Smoothing and Holt-Winters method</p>	8
4	<p>Basic Stochastic Models: White Noise, Random Walks, Fitted models & diagnostic</p>	8



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	<p>plots, Autoregressive models: stationary and non-stationary Autoregressive process</p> <p>Time series Regression and Exploratory Data Analysis: Classical Regression, Exploratory Data Analysis, generalized least square method, linear models with seasonal variables, Harmonic seasonal models, logarithmic transforms.</p>	
5	<p>Linear Models: Moving Average models, Fitted MA Models, ARIMA Models: Autoregressive Moving Average Models, Differential Equations, Autocorrelation and Partial Correlation, Forecasting & Estimation, Non-stationary Models: Building non-seasonal ARIMA Models, ARCH Models, GARCH Models.</p>	8

Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Introductory Time series with R	Paul S.P. Cowpertwait, Andrew V. Metcalfe	1st Edition	Springer	2010
2.	Time Series Analysis and its Applications with R Examples	Robert H Shumway, David S Stoffer	4th Edition	O'Reilly	2020

Reference Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Time Series and Forecasting	Peter J Brokewell, Richard A Davis	Third	Springer	2016
2.	The Analysis of Time Series – An Introduction	Chris Chatfield	First	Chapman & Hall / CRC	1996



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E-book						
SI No	Book Title	Authors	Edition	Publisher	Year	URL
1	Time Series Analysis: Univariate and Multivariate methods	William W. S Wei	2nd Edition	Pearson	2007	https://civil.colorado.edu/~balajir/CVEN6833/lectures/wwts-book.pdf
2	Time Series Analysis: Forecasting and Control	Georgee.P.Box Gwilymm.Jenkins Gregoryc.Reinsel Gretam.Ljung	5th Edition	Wiley	2017	http://repo.darmajaya.ac.id/4781/1/Time%20Series%20Analysis_%20Forecasting%20and%20Control%20%28%20PDFDrive%20%29.pdf

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Intro to Time Series Analysis in R	Coursera	2024	https://www.coursera.org/projects/intro-time-series-analysis-in-r
2.	Applied Time-Series Analysis	SWAYAM	2024	https://onlinecourses.nptel.ac.in/noc21_ch28_preview
3	Time Series Analysis in R	DataCamp	2024	https://www.datacamp.com/courses/time-series-analysis-in-r



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Course Outcomes

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

CO1	Apply advanced statistical techniques to decompose time series data and implement effective forecasting methods.
CO2	Analyze and interpret time series data by identifying key components such as trends, seasonal variations, and stationarity.
CO3	Develop and evaluate time series models, including ARIMA and GARCH, to make accurate predictions and informed decisions.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			2								
CO2		3										
CO3				2	3					3		1

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	Best of 2	40
Quiz/AAT	2	10
Total		50



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SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Question each to be asked for 20 Marks
Unit-3	Internal Choice	Two Question each to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Big Data Analytics

Sem	V		
Course Code:	23DS5PCBDA	Total Contact Hours: 40 hours	
L-T-P:	3-0-1	Total Credits:	4

Unit No.	Topics	Hours
1	Introduction to Big Data Analytics: Introduction - Need of Big Data, Types of Digital Data, Definition of Big Data Analytics, Data intensive scientific discovery and the role of Big Data, Phases in Analytics, Characteristics of Big Data. Designing Data Architecture: Managing Data for Analysis, Architecture reference model, Big Data Stack, Case Study on Business Analytics for Emerging Trends and Future Impacts, Big Data Analytics standards - Process management framework for big data analytics- ISO/IEC 24668:2022	8
2	NoSQL: Data Store and Characteristic features, CAP theorem, NoSQL Data Architecture Patterns, Shared- Nothing Architecture for Big Data Tasks, MongoDB Databases - Features, Querying commands Apache Cassandra: Features and Components of Cassandra, Data types, Cassandra Data Model, CQL commands, Keyspaces, CRUD Operations, Time to Live (TTL), Alter Commands, Import and Export	8
3	Introduction to Hadoop: Introduction, Hadoop and its Ecosystem – Zookeeper, Ozie, Sqoop and Flume MapReduce Framework and Programming Model: Anatomy of MapReduce Job Run, Shuffle and Sort Map Tasks, MapReduce Execution Apache Yarn - How Yarn runs an application, Scheduling in Yarn, Scheduler options.	8



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4	The Hadoop Distributed File System: The design of HDFS, HDFS Concepts, Hadoop File Systems and Interface, Dataflow - Anatomy of a File read and write Essential Hadoop Tools, Using Sqoop, Flume, Oozie, HBase.	8
5	Spark and Big Data Analytics: Spark basic architecture, Overview of structured spark types, Structured API Execution Components, Data Frame Transformation Spark works with different types of data: Boolean, numbers, JSON, Dates and Timestamp. Spark SQL - Tables, Views, Databases	8

Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Big Data Science & Analytics – A Hands-on Approach	Arshdeep Bahga, Vijay Madisetti	First	ISBN: 978-1-949978-00-1	2019
2	Hadoop - The definitive Guide	Tom White	Fourth	O'Reilly	2015
3	Spark: The Definitive Guide - Big Data Processing made Simple	Bill Chambers and Matei Zaharia	First	O'Reilly	2018

Reference Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Big Data Analytics	Rajkamal, Preeti Saxena	First	McGraw Hill Education	2019
2.	Business Intelligence, A managerial Perspective on Analytics	Sharda, R, Delen D, Turban E	Tenth	Pearson	2015



MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Hadoop Starter Kit	Udemy	--	Free Hadoop Tutorial - Hadoop Starter Kit Udemy, 2023
2.	NPTEL IIT Patna 2023 https://nptel.ac.in/courses/10610418	NPTEL	2023	https://nptel.ac.in/courses/10610418

Course Outcomes

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

CO1	Apply the concepts of NoSQL, Hadoop, Spark for a given task
CO2	Analyze data analytic techniques for a given problem .
CO3	Conduct experiments using data analytics mechanisms for a given problem.
CO4	Ability to conduct practical experiments to solve problems using appropriate tools

CO-PO mapping



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Proposed Assessment Plan (for 50 marks of CIE)

Tool	Remarks	Marks
Internals	2	25
QUIZ	1	5
Lab Component	CIE + 2 Lab Tests	25
Total		50

Lab Programs

1. Demonstrate topic modeling with Latent Dirichlet Allocation (LDA) using Mahout with Hadoop.
2. Demonstrates the performance of Naive Bayes classification on a large dataset using Mahout with Hadoop.
3. Create a employee Database using Apache Hive to perform the following operations
 - a. Show the database
 - b. Add records
 - c. Delete a specific record
4. Demonstrate the streaming of files where the producer sends the files (PDF, CSV, PPT) to Kafka. Further the consumer can receive and process files from Kafka
5. Develop a MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year.
6. Develop a MapReduce to analyze the weather data set and print whether the day is shiny or cool.
7. Develop a MapReduce program to analyze Uber data set to find the days on which each basement has more trips using the following dataset. The Uber dataset consists of four columns as shown

dispatching_base_number	date	active_vehicles	trips
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8. XYZ.com is an online music website where users listen to various tracks, the data gets collected which is given below

UserId | TrackId | Shared | Radio | Skip



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Write a MapReduce program to get the following

- Number of unique listeners
 - Number of times the track was shared with others
 - Number of times the track was listened to on the radio
9. Develop a MapReduce program to analyze Titanic ship data and to find the average age of the people (both male and female) who died in the tragedy. How many people survived in each class. The titanic data will be..

Column 1 :Passenger I d Column 2 : Survived (survived=0 &died=1)

Column 3 :Pclass Column 4 : Name

Column 5 : Sex Column 6 : Age

Column 7 :SibSp Column 8 :Parch

Column 9 : Ticket Column 10 : Fare

Column 11 :Cabin Column 12 : Embarked

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Mandatory	One Question to be asked for 20 Marks
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Deep Learning

Sem	V		
Course Code:	23DS5PCDLG	Total Contact Hours: 50 hours	
L-T-P:	4-0-1	Total Credits:	5

Unit No.	Topics	Hrs
1	Introduction to Artificial Neural Networks: From Biological to Artificial Neurons: Biological Neurons, Logical Computations with Neurons, The Perceptron, The Multilayer Perceptron and Backpropagation, Regression and Classification MLPs, Implementing MLPs with Keras, Fine-tuning Neural Network Parameters Introduction to Deep Learning: Challenges motivating Deep Learning, Historical Trends in Deep Learning, Deep Feedforward Networks, Gradient-based Learning, and Efficient Computation.	10
2	Convolution Neural Networks(CNN): The Architecture of the Visual Cortex, Convolutional Layer, Pooling Layer, CNN Architectures- LeNet-5, AlexNet, GoogLeNet, VGGNet, ResNet, Xception, Pre-trained Models for Transfer Learning, Classification and Localization, Object Detection- Fully Convolutional Networks (FCNs), You Only Look Once (YOLO), Semantic Segmentation, Convolution Networks and the History of Deep Learning.	10
3	Training Deep Neural Networks: Vanishing/Exploding Gradients, Reusing Pretrained Layers, Faster Optimizers, Avoiding Overfitting Through Regularization. Recurrent Neural Networks(RNN): Recurrent Neurons and Layers, Training RNNs, Forecasting a Time Series, Handling Long Sequences- LSTM, GRU, Bidirectional RNNs, Recursive Neural Networks, Attention Mechanisms.	10
4	Representation Learning using Autoencoders: Stacked Autoencoders, Convolutional Autoencoders, Recurrent Autoencoders, Denoising Autoencoders, Sparse Autoencoders, Applications of Autoencoders, Transfer Learning, and Domain Adaptation.	10



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	Generative Adversarial Networks(GANs): Difficulties of training GANs, Deep Convolutional GANs, Progressive Growing of GANs, StyleGANs	
5	Deep Generative Models: Boltzmann Machines, Restricted Boltzmann Machines, Deep Belief Networks, Deep Boltzmann Machines, Boltzmann Machines for Real-Valued Data Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications.	10

Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	First	MIT Press	2016
2.	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow	Aurelien Geron	Second	O'Reilly	2020
Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Deep Learning with Tensor Flow and Keras	Amita Kapoor, Antonio Gulli, Sujit Pal	Third	Packt	2022
2.	Learning Deep Learning: Theory and Practice of Neural Networks, Computer Vision, NLP, and Transformers using TensorFlow	Magnus Ekman	First	Addison-Wesley Professional	2021
E-Book					



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Sl. No.	Book Title	Authors	Editio n	Publisher	Year	URL
1.	Dive into Deep Learning	Aston Zhang, Zachary C.Lipton, Mu Li, Alexander J. Smola	First	Cambridge University Press	2023	https://d2l.ai/d2l-en.pdf
2.	The Little Book of Deep Learning	François Fleuret	-	University of Geneva, Switzerland	2024	https://fleuret.org/public/lbdl.pdf

MOOC Course

Sl. No.	Course name	Course Offered By	Year	URL
1.	Deep learning – IIT Ropar	SWAYAM	2024	https://onlinecourses.nptel.ac.in/noc24_cs114/preview
2.	Neural Networks and Deep Learning	Coursera	2024	https://www.coursera.org/learn/neural-networks-deep-learning?specialization=deep-learning

Laboratory Plan

Sl. No.	Lab Program
1	Write a program to implement XOR gates using Perceptron.
2	Design a deep NN, optimize the network with Gradient Descent, and optimize the same with Stochastic gradient descent(SGD).



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3	Classification of MNIST Dataset using CNN.
4	Implement Region-Based CNN for object detection.
5	Implement RNN for handwriting digit recognition.
6	Implement Bidirectional RNNs for music generation.
7	Implement Bidirectional LSTM for sentiment analysis.
8	Implement Variational Autoencoders for image-denoising.
9	Implementation of a Restricted Boltzmann Machine (RBM) that demonstrates stacking.
10	Implement Generative Adversarial Networks to generate realistic photographs.

Course Outcomes

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

CO1	Apply the fundamentals of deep learning algorithms for various complex problems
CO2	Analyze appropriate deep learning concepts based on the characteristics of the problem and the data.
CO3	Design models using deep learning to solve real-world problems and present solution in a team
CO4	Conduct practical experiments and implement Deep Learning Models for Applications



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CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CO1	3											
CO2		2										
CO3			3			1			1	1		
CO4				2	2							

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	Best of 2	20
Lab Test + Project	1	25
QUIZ/AAT	1	5
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	One Question to be asked for 20 Marks
Unit-3	Internal Choice	One Question to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Programming With R

Sem	V		
Course Code:	23DS5PCPWR		Total Contact Hours: 24 hours
L-T-P:	0-0-1	Total Credits:	1

Module 1

SI no	Lab Program	No. of Hours
1	Introduction to R and RStudio: Install R and RStudio. Write and execute your first R script that includes basic arithmetic operations, variable assignments, and printing results. Document the steps to install R and RStudio and describe the purpose of each line of your script.	1
2	Basic Data Types and Operations: Design an R program to create and manipulate vectors, matrices, lists, and data frames. Include operations such as indexing, subsetting, and applying functions like sum(), mean(), and length(). Create a data frame from scratch, perform basic operations, and describe the structure and type of each element in the data frame.	1
3	Basic Statistical Operations: Design an R program to calculate mean, median, mode, standard deviation, and variance of a dataset. Use a sample dataset, calculate each statistical measure, and provide a detailed explanation of what each measure represents and how it can be interpreted in the context of the data.	1
4	Data Import and Export: Design an R program to import data from a CSV file, perform some basic cleaning (such as removing NA values), and export the cleaned data to a new CSV file. Include steps to check the structure of the imported data, summarize its contents, and verify the successful export of the cleaned data.	1
5	Basic Data Visualization: Design an R program to create simple plots including a histogram, bar plot, line plot, and scatter plot. Use a given dataset, generate each plot, customize the plots with titles, axis labels, and colors, and save the plots as	1



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	image files. Provide a brief interpretation of each plot in the context of the data.	
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Module 2

SI no	Lab Program	No. of Hours
1	Data Cleaning and Preparation: Design an R program to handle missing data, filter rows based on certain conditions, and select specific columns from a dataset. 1 Use a sample dataset with missing values, filter the data to include only relevant rows, and create a new dataset with selected columns. Document the cleaning process and the rationale behind each step.	1
2	Advanced Data Manipulation using dplyr: Design an R program to use dplyr functions to manipulate data frames. Include tasks such as selecting columns, filtering rows, creating new columns with mutate, summarizing data with summarize, and arranging rows. Apply these operations to a complex dataset and provide a detailed explanation of each operation and its outcome.	1
3	Data Visualization using ggplot2: Design an R program to create advanced plots using ggplot2. Include examples of faceting, customizing plot aesthetics, and adding annotations. Use a dataset with multiple variables, generate plots that show different aspects of the data, and explain the insights gained from each plot.	1
4	Descriptive Statistics and Data Summary: Design an R program to generate descriptive statistics and create a data summary report. Use a comprehensive dataset, calculate measures such as mean, median, range, quartiles, and create summary tables. Write a report that includes the calculated statistics and an interpretation of the data distribution.	1
5	Basic Data Analysis: Design an R program to perform simple linear regression analysis. Use a dataset with a clear dependent and independent variable, fit a linear model, plot the regression line, and interpret the results. Include diagnostic plots to check the assumptions of the linear model and provide a detailed analysis of the findings.	2



Module 3

SI no	Lab Program	No. of Hours
1	Advanced Data Analysis: Design an R program to perform multiple linear regression analysis. Use a dataset with multiple predictor variables, fit a multiple regression model, interpret the coefficients, and evaluate the model's performance. Include steps to check for multicollinearity, perform model selection, and validate the model using cross-validation techniques.	2
2	Introduction to Machine Learning with R: Design an R program to implement a basic k-means clustering algorithm. Use a dataset with multiple features, normalize the data, perform k-means clustering, visualize the clusters, and interpret the results. Provide an analysis of the optimal number of clusters and discuss the practical applications of clustering in data analysis.	3
3	Time Series Analysis: Design an R program to analyze and forecast time series data using ARIMA models. Use a time series dataset, perform exploratory data analysis, fit an ARIMA model, and make future forecasts. Include steps to check for stationarity, select model parameters, and evaluate the model's forecasting accuracy. Provide a detailed interpretation of the time series components and the forecast results.	4
4	Creating Interactive Visualizations: Design an R program to create interactive plots using the plotly package. Use a complex dataset, generate interactive visualizations such as scatter plots, line charts, and bar charts, and customize the interactivity features. Include examples of how to incorporate tooltips, hover effects, and interactive legends. Discuss the advantages of using interactive visualizations for data exploration.	2
5	Data Reporting with RMarkdown: Design an R program to generate a comprehensive report using RMarkdown. Include sections that combine code,	2



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	text, and visualizations to create a dynamic and reproducible report. Use a case study to demonstrate the end-to-end data analysis process, from data cleaning and manipulation to analysis and visualization. Provide the final RMarkdown document and the rendered report, highlighting the key findings and insights.	
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Prescribed Textbook					
SI No	Book Title	Authors	Edition	Publisher	Year
1.	R for Data Science	Hadley Wickham & Garrett Grolemund	First	O'Reilly Media, Inc	2017
2.	An Introduction to R	W. N. Venables, D. M. Smith and the R Core Team	First	R Core Team	2023

Reference Textbook					
SI No	Book Title	Authors	Edition	Publisher	Year
1	R in Action	Robert Kabacoff	2nd Edition	Manning	2015
2	The Art of R Programming	Norman Matloff	1st Edition	No Starch Press	2011

E-book						
SI No	Book Title	Authors	Edition	Publisher	Year	URL
1	Hands-On	Garrett	1st	O'Reilly	2014	https://rstudio-



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	Programming with R	Grolemund	Edition			education.github.io/hopr/index.html
2	R Graphics Cookbook	Winston Chang	2nd Edition	O'Reilly	2018	https://r-graphics.org/

MOOC Course				
SI No	Course Name	Offered By	Year	URL
1	Data Science: Foundations using R	Coursera (Johns Hopkins University)	2023	https://www.coursera.org/specifications/jhu-data-science
2	R Programming	Coursera (Johns Hopkins University)	2023	https://www.coursera.org/learn/r-programming
3	Foundations of R	IIT Kanpur	2024	https://onlinecourses.nptel.ac.in/noc22_ma69/preview

Course Outcomes

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

CO1	Develop proficiency in R programming to perform data manipulation and basic statistical analysis.
CO2	Formulate advanced data manipulation, cleaning techniques, and comprehensive data visualizations using R.
CO3	Apply complex data analysis techniques, including machine learning, time series analysis, and generate dynamic interactive reports.



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CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3	3							
CO2		3										
CO3	3								2	2		

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Lab Internal	2	40
Project	1	10
Total		50

Final Programs

1. Carry out the following exploratory time series analysis in R using either the chocolate or the beer production data.
 - a. Produce a time plot of the data. Plot the aggregated annual series and a boxplot that summarizes the observed values for each season, and comment on the plots.
 - b. Decompose the series into the components trend, seasonal effect, and residuals, and plot the decomposed series. Produce a plot of the trend with a superimposed seasonal effect.
2. The following data are the volumes, relative to nominal contents of 750 ml, of 16 bottles taken consecutively from the filling machine at the Serendipity Shiraz vineyard: 39, 35, 16, 18, 7, 22, 13, 18, 20, 9, -12, -11, -19, -9, -2, 16. The following are the volumes, relative to nominal contents of 750 ml, of consecutive bottles taken from the filling machine at the Cagey



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Chardonnay vineyard: 47, -26, 42, -10, 27, -8, 16, 6, -1, 25, 11, 1, 25, 7, -5, 3 The data are also available from the website in the file ch2ex2.dat.

- a. Produce time plots of the two time series.
- b. For each time series, draw a lag 1 scatter plot.
- c. Produce the acf for both time series and comment.
3. Carry out the following exploratory time series analysis using the global temperature series.
 - a. Decompose the series into the components trend, seasonal effect, and residuals. Plot these components. Would you expect these data to have a substantial seasonal component? Compare the standard deviation of the original series with the deseasonalized series. Produce a plot of the trend with a superimposed seasonal effect.
 - b. Plot the correlogram of the residuals (random component) from part (a). Comment on the plot, with particular reference to any statistically significant correlations.
4. Continue the following exploratory time series analysis using the global temperature series.
 - a. Produce a time plot of the data. Plot the aggregated annual mean series and a boxplot that summarizes the observed values for each season, and comment on the plots.
 - b. Decompose the series into the components trend, seasonal effect, and residuals, and plot the decomposed series. Produce a plot of the trend with a superimposed seasonal effect.
 - c. Plot the correlogram of the residuals from question 7b. Comment on the plot, explaining any ‘significant’ correlations at significant lags.
 - d. Fit an appropriate Holt-Winters model to the monthly data. Explain why you chose that particular Holt-Winters model, and give the parameter estimates.
 - e. Using the fitted model, forecast values for the years 2005–2010. Add these forecasts to a time plot of the original series. Under what circumstances would these forecasts be valid? What comments of caution would you make to an economist or politician who wanted to use these forecasts to make statements about the potential impact of global warming on the world economy?
5. Simulate a time series of length 1000 for the following model, giving appropriate R code and placing the simulated data in a vector x: $xt = 5 + 6xt-1 - 1.6xt-2 + wt$ (4.25)
 - a. Plot the correlogram and partial correlogram for the simulated data. Comment on the plots.
 - b. Fit an AR model to the data in x giving the parameter estimates and order of the fitted AR process.



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- c. Construct 95% confidence intervals for the parameter estimates of the fitted model.
Do the model parameters fall within the confidence intervals? Explain your results.
- d. Is the model in Equation (4.25) stationary or non-stationary? Justify your answer.
- e. Plot the correlogram of the residuals of the fitted model, and comment on the plot.
6. A hydrologist wishes to simulate monthly inflows to the Font Reservoir over the next 10-year period. Use the data in Font.dat (§2.3.3) to answer the following:
 - a. Regress inflow on month using indicator variables and time t, and fit a suitable AR model to the residual error series.
 - b. Plot a histogram of the residual errors of the fitted AR model, and comment on the plot. Fit back-to-back Weibull distributions to the errors.
 - c. Simulate 20 realizations of inflow for the next 10 years.
 - d. Give reasons why a log transformation may be suitable for the series of inflows.
 - e. Regress log(inflow) on month using indicator variables and time t (as above), and fit a suitable AR model to the residual error series.
 - f. Plot a histogram of the residual errors of the fitted AR model, and comment on the plot. Fit a back-to-back Weibull distribution to the residual errors.
7. Global Temperature Series Analysis using Global temperature dataset.
 - a. Plot the global temperature series and aggregate it to annual data. Summarize the seasonal patterns using a boxplot.
 - b. Decompose the series into trend, seasonal, and residual components. Plot the decomposed series.
 - c. Fit a Holt-Winters model and forecast the global temperatures for the next 5 years. Add the forecasted values to the original series.
 - d. Analyze the residuals by plotting the correlogram and comment on any statistically significant correlations.
8. ARIMA Modeling and Forecasting of Stock Prices using Stock price dataset.
 - a. Plot the daily stock prices and log-transformed stock prices to compare. Test for stationarity using the Augmented Dickey-Fuller test (ADF).
 - b. Fit an ARIMA model to the stock price data, determine the optimal order, and estimate the parameters.
 - c. Forecast the stock prices for the next 12 months. Plot the forecasted values along with the original series.



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- d. Perform residual diagnostics using the ACF plot of residuals and comment on the validity of the model.



Research Methodologies and IPR

Sem	V	
Course Code:	23DC5AERMI	Total Hours: 40 hours
L-T-P:	3-0-0	Total Credits: 3

Unit No.	Topics	Hrs
1	Research Methodology: An Introduction - Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research methods vs Methodology, Research and scientific method, Research Process, Criteria of Good Research. Define the Research Problem - What is research problem, Selecting the problem, Necessity of Defining the problem, Technique involved in Defining a Problem Research Design - Meaning of Research Design, Need for Research Design, Features of Good Design, Important concepts Relating to Research Design, Different Research Design.	8
2	Design of Sample Surveys - Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey vs Census Survey, Types of Sampling Designs Chi-Square Tests - Test of Difference of more than Two proportions, Test of Independence of Attributes, Test of Goodness of Fit Analysis of Variance - The ANOVA technique, The Basic principle of ANOVA, One way ANOVA, Two way ANOVA, Latin-square Design.	8
3	Nature of Intellectual property, IPRs- Invention and Creativity - Importance and Protection of Intellectual Property Rights (IPRs) – procedure for grant of patents and patenting under PCT-types of patents- technological research and innovation- international cooperation on IP.	8
	A brief summary of Patents-Copyrights-Trademarks, patent rights- licensing and transfer of technology-patent databases-case studies on IPR-Geographical indications-new developments in IPR-protection of IPR rights.	



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4		8
5	Interpretation and Report Writing - Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different steps in Writing Report, Layout of the Research Report, Types of Reports, Oral presentation, Mechanics of writing a research Report, Precautions of Writing Research Report.	8

Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Research Methodology: Methods and Techniques	C R Kothari, Gaurav Garg	Multicolor (Fourth)	New Age International Publishers	2019
2	An introduction to Research Methodology	Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K	Fourth	RBSA Publishers	2002
3	Handbook of Intellectual property law and practise	Subbaram NR	First	S Viswanathan Printers and Publishing Private Limited	1998



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MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Understanding Research Methods	Coursera	2024	https://www.coursera.org/learn/research-methods
2.	Fundamentals of Research Methodology	Udemy	2024	https://www.udemy.com/course/fundamentals-of-research-methodology/

Course Outcomes

CO1	Apply appropriate research techniques to conduct studies and present findings.
CO2	Apply ethical principles in conducting research and intellectual property rights, ensuring the integrity and credibility of scientific inquiry.
CO3	Analyze various research problems and their solutions critically.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3							2				3
CO3		3										

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	Best of 2	40
QUIZ/AAT	2	10
Total		50



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SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Software Testing

Semester	V		
Course Code:	23DS5PESWT	Total Contact Hours: 40 hours	
L-T-P:	3-0-0	Total Credits:	3

Unit No.	Topics	Hours
1	Basic Concepts and Preliminaries - Software Quality and Its standards, Role of Testing, Verification and Validation, Failure, Error, Fault, and Defect, Notion of Software Reliability, Objectives of Testing, What Is a Test Case?, Expected Outcome, Concept of Complete Testing, Central Issue in Testing , Testing Activities, Test Levels, Sources of Information for Test Case Selection, White- Box, Black-Box and Gray-Box Testing, Test Planning and Design, Monitoring and Measuring Test Execution, Test Tools and Automation, Test Team Organization and Management.	8
2	A Perspective on Testing - Basic Definitions, Test Cases, Insights from a Venn Diagram, Identifying Test Cases, Specification-Based Testing, Code-Based Testing, Specification-Based versus Code-Based Debate, Fault Taxonomies, Levels of Testing. Unit Testing: Concept of Unit Testing, Static Unit Testing, Defect Prevention, Dynamic Unit Testing, Mutation Testing, Debugging, Unit Testing in eXtreme Programming, JUnit: Framework for Unit Testing and Diffblue cover.	8
3	Boundary Value Testing- Normal Boundary Value Testing, Robust Boundary Value Testing, Worst-Case Boundary Value Testing, Test Cases for the Triangle Problem, Random Testing. Equivalence Class Testing- Equivalence Classes, Traditional Equivalence Class Testing, Improved Equivalence Class Testing, Equivalence Class Test Cases for the Triangle Problem. Introduction to Selenium Automation tool and AppliTools.	8
4	Data Flow Testing- General Idea, Data Flow Anomaly, Overview of Dynamic Data Flow Testing, Data Flow Graph, Data Flow Terms, Data Flow Testing Criteria, Comparison of Data Flow Test Selection Criteria. System Integration Testing -Concept of Integration Testing, Different Types of Interfaces and Interface Errors, Granularity of System Integration Testing, System Integration Techniques, Test Plan for System	8



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	Integration. Integration Testing with Katalon and Functional testing with Jmeter	
5	<p>User Acceptance Testing: What Is User Acceptance Testing? When Is It Performed? Who Performs UAT? Need for User Acceptance Testing, User Acceptance Testing Process, UAT Test Planning, User Acceptance Testing Design, Test Execution. UI testing using Testim.</p> <p>SOFTWARE QUALITY- Five Views of Software Quality, McCall's Quality Factors and Criteria, ISO 9126 Quality Characteristics, ISO 9000:2000 Software Quality Standard.</p>	8

Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Software Testing and Quality Assurance Theory and Practice	Kshirasagar Naik and Priyadarshi Tripathy	Second Edition	John Wiley & Sons	2010
2.	Software Testing, A Craftsman's Approach	C Paul C. Jorgensen	Fourth Edition	Auerbach Publications	2014
Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Foundations of Software Testing	Aditya P Mathur, Pearson	Second Edition	Pearson	2013
2.	Software Testing and Analysis – Process, Principles and Techniques	Mauro Pezze, Michal Young	First Edition	John Wiley & Sons	2008



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E-Book						
Sl. No	Book Title	Authors	Editio n	Publishe r	Year	URL
1.	The Art of Software Testing	Glenford J. Myers	Third Edition	John Wiley & Sons	2012	https://malenezi.github.io/malenezi/SE401/Books/114-the-art-of-software-testing-3-edition.pdf
2.	Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation	Jez Humble and David Farley	First Edition	Pearson	2011	https://proweb.md/ftp/carti/Continuous-Delivery-Jez%20Humble-David-Farley.pdf

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Introduction to Software Testing	Cousera	2024	https://www.coursera.org/learn/introduction-software-testing
2.	Software Testing	SWAYAM	2024	https://onlinecourses.nptel.ac.in/noc24_c_s91/preview



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Course Outcomes

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

CO1	Apply the knowledge of software testing strategies and methodologies for various types of testing.
CO2	Analyze the given problem using various types of testing such as Unit Testing, Boundary value testing, Equivalence testing, data flow testing, object oriented testing, System integration testing , Functional testing and user acceptance testing.
CO3	Leverage modern software testing tools and techniques to design, develop, and execute effective test cases, ensuring the delivery of high-quality software products.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CO1	3											
CO2		3										
CO3		2			2							

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	Best of 2	40
QUIZ/AAT	2	10
Total		50



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SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Internet of Things

Sem	V		
Course Code:	23DS5PEIOT	Total Contact Hours: 40 hours	
L-T-P:	3-0-0	Total Credits:	3

Unit No.	Topics	Hrs
1	Introduction to Internet of Things: Introduction: Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT, Logical Design of IoT: IoT Functional Blocks, IoT Communication Models, IoT Communication APIs. IOT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Embedded Systems, IoT Levels and Deployment Templates.	8 Hrs
2	Introduction to Embedded Systems for IoT: Embedded Computing Basics - Microcontrollers, System-on-Chips, Choosing Your IoT Development Platform, Working with Arduino: Introduction to Arduino, Setting Up and Developing on the Arduino, Working with Raspberry Pi, Introduction to Raspberry Pi. Sensors and Actuators in IoT: Working Principles and Types of Sensors, Working Principles and Types of Actuators. Smart Objects - Overview and Trends.	8 Hrs
3	IoT and M2M Communications: Introduction, M2M, Differences between M2M and IoT, SDN and NFV for IoT. Connecting smart things: Communication Criteria, IoT access Technologies (IEEE 802.15.4, IEEE 802.15.4g and IEEE 802.15.4e, IEEE 1901.2a, IEEE 802.11ah, LoRaWAN, NB-IoT)	8 Hrs
4	IP as the IoT Network Layer: The business case for IP, The need for Optimization, Optimizing IP for IoT -From 6LoWPAN to 6Lo, 6TiSCH, RPL. Application Protocols for IoT: Transport Layer, IoT Application Layer Protocols: CoAP, MQTT.	8 Hrs



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5	IoT Applications: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, and Healthcare. Case Studies – Home Intrusion Detection, Smart Parking, Weather Monitoring System, Air Pollution Monitoring, Forest Fire Detection, and Smart Irrigation.	8 Hrs
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Prescribed Text Books				
Book Title	Authors	Edition	Publisher	Year
Internet Of Things - A Hands-On Approach	Arsheep Bahga, Vijay Madisetti	First Edition	Universities Press	2023
Designing the Internet of Things	Adrian McEwen and Hakim Cassimally	First Edition	John, Wiley & Sons	2014
IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things	David Hanes, Gonzalo Salgueiro	First Edition	CISCO Press	2022

Reference Text Books				
Book Title	Authors	Edition	Publisher	Year
Internet of Things	Surya S. Durba	First Edition	Oxford University Press	2021
Internet of Things: Principles and Paradigms	Rajkumar buyya	First Edition	Todd Green	2016

E-Book						
Sl. No .	Book Title	Authors	Edition	Publisher	Yea r	URL
1.	IoT Fundamentals: Networking Technologies, Protocols, and	David Hanes, Gonzalo	First	CISCO Press	2022	https://nibmehub.com/opac-service/pdf/read/IoT%20Fundamentals.pdf



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	Use Cases for the Internet of Things	Salgueir o				
2.	Using the Web to build IOT	Dominique Guinard and Vlad Trifa ,	First	Manning	2016	https://www.manning.com/books/using-the-web-to-build-the-iot

Course Outcomes

CO1	Understand characteristics such as design, communication model, prototyping and enabling technologies required to develop application of IOT
CO2	Apply knowledge of Internet of Things in identifying the appropriate sensors and actuators with microcontrollers
CO3	Design and develop IOT applications for solving real world problems.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2	3	2										
CO3			3									

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Introduction to Internet of Things	IIT Kharagpur	2018	https://nptel.ac.in/courses/106/105/106105166/



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2.	The Arduino Platform and C Programming	Coursera	2016	https://www.coursera.org/learn/arduino-platform
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Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	40
QUIZ/AAT	2	10
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



Cryptography And Network Security

Sem	V	
Course Code:	23DS5PECNS	Total Contact Hours: 40 hours
L-T-P:	3-0-0	Total Credits: 3

Unit No.	Topics	Hrs.
1	<p>Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security.</p> <p>Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques – Caesar Cipher, Monoalphabetic Ciphers, Play fair Cipher, Hill Cipher, Polyalphabetic Ciphers, One-Time Pad, Transposition Techniques.</p>	8
2	<p>Block Ciphers: Traditional Block Cipher Structure – Stream Ciphers and Block Ciphers, Motivation for the Feistel Cipher Structure, The Feistel Cipher, Block Cipher Design Principles, The Simplified Data Encryption Standard (S-DES) – S-DES Encryption, S-DES Decryption, SDES Key Generation.</p> <p>Stream Ciphers: StreamCiphers, RC4 – Initialization of S, StreamGeneration, Strength ofRC4</p>	8
3	<p>Public-Key Cryptosystems: Principles of Public-Key Cryptosystems – Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptosystems, Public-Key Cryptanalysis, The RSA Algorithm – Description of the Algorithm, Computational Aspects, The Security of RSA, Diffie-Hellman Key Exchange – The Algorithm, Key Exchange Protocols, Man-in-the-Middle Attack.</p> <p>Cryptographic Hash Functions: Secure Hash Algorithm (SHA) – SHA-512 Logic, SHA-512 Round Function, Examples.</p>	8



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4	<p>Key Management and Distribution: Symmetric Key Distribution using Symmetric Encryption, Symmetric Key Distribution using Asymmetric Encryption, Distribution of Public Keys.</p> <p>Transport-Level Security: Transport Layer Security – Architecture, Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol, Cryptographic Computations, Heartbeat Protocol, SSL/TLS Attacks, HTTPS – Connection Initiation, Connection Closure</p>	8
5	<p>Digital Signatures: Digital Signatures – Properties, Attacks and Forgeries, Digital Signature Requirements, Direct Digital Signature, SCHNORR Digital Signature Scheme, NIST Digital Signature Algorithm.</p> <p>IP Security: IP Security Overview – Applications, Benefits, Routing Applications, IPsec Documents, IPsec Services, IP Security Policy – Security Associations and its Database, Security Policy Database, IP Traffic Processing, Encapsulating Security Payload – ESP Format, Encryption and Authentication Algorithms.</p>	8

Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Cryptography and Network Security – Principles and Practice	William Stallings	7th Edition	Pearson	2017

Reference Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Network Security Essentials Applications and Standards	William Stallings	4th Edition	Pearson	2012



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2.	Network Security Private Communication in a Public world	Charlie Kaufman, Radia Perlman and Mike Speciner	Second	PHI	2013
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MOOC Course

Sl. No.	Course name	Course Offered By	Year	URL
1.	Cryptography I	Coursera	2024	https://www.coursera.org/learn/crypto
2.	Cryptography and System Security	Udemy	2024	https://www.coursera.org/specializations/agile-development

Course Outcomes

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

CO1	Understand the fundamental concepts of computer security, including security architecture, attacks, services, and mechanisms.
CO2	Apply classical encryption techniques and block cipher structures to ensure data confidentiality and integrity.
CO3	Analyze the principles and algorithms of public-key cryptosystems and cryptographic hash functions for secure communication.
CO4	Make an effective communication and presentation in a team on different algorithms or tools used in cryptography and network security.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2	3											
CO3		3										
CO4									1	1		



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Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	40
QUIZ/AAT	2	10
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



Responsible AI

Sem	V		
Course Code:	23DS5PERAI	Total Contact Hours: 40 hours	
L-T-P:	3-0-0	Total Credits:	3

Unit No.	Topics	Hrs
1	<p>An Ethical Framework for a Good AI Society: opportunities, Risks, principles and Recommendations. Establishing the rules for building trustworthy AI.</p> <p>Translating principles into practices of digital ethics: five risks of being Unethical The Ethics of Algorithms: Key problems and Solution How to Design AI for Social Good: Seven Essential Factors.</p>	8
2	<p>How to design AI for social good: seven essential factors From What to How: An Initial Review of publicly available AI Ethics tools, Methods and Research to Translate principles into Practices</p> <p>Innovating with Confidence: Embedding AI Governance and fairness in financial Services Risk management framework, What the near future of AI could be.</p> <p>Human-AI Relationship: AI and Workforce, Autonomous Machines and Moral Decisions, AI in HealthCare: balancing Progress and Ethics</p>	8
3	<p>Responsible AI :Need for ethics in AI. AI for Society and Humanity, ISO/IEC 42001: A New Standard for Ethical and Responsible AI Management</p> <p>Fairness and Bias : Sources of Biases, Exploratory data analysis, limitation of a dataset, Preprocessing, inprocessing and postprocessing to remove bias, Group fairness and Individual fairness, Counterfactual fairness</p>	8
4	<p>Interpretability and explainability: Interpretability through simplification and visualization, Intrinsic interpretable methods, Post Hoc interpretability, Explainability through causality, Model agnostic Interpretation</p>	8



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5	Privacy preservation: Attack models, Privacy-preserving Learning, Differential privacy, Federated learning, HIPAA Compliance Standards with AI Relevance: Case study: Recommendation systems, Medical diagnosis, Hiring/Education	8
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Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Ethics, governance and Policies in Artificial Intelligence	Luciano Floridi	1st Edition	Springer	2021
2.	Ethics and AI	Aaron Aboagye	1st Edition	kindle	2023
3.	Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way	Virginia Dignum	ISBN-10 : 3030303705, ISBN-13 : 978-3030303709	Springer Nature	2019
4	Interpretable Machine Learning	Christoph Molnar	1st edition	Lulu	2019

Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Responsible AI in the Enterprise	Adnan Masood, Heather Dawe	1st	Packt	2023

E-Book						
Sl. No	Book Title	Authors	Edition	Publisher	Year	URL
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1.	Responsible AI - Interdisciplinary perspectives	Silja Voeneky, Philipp Kellmeyer, Oliver Mueller, Wolfram Burgard,	1st	Cambridge University Press	2022	https://doi.org/10.1017/9781009207898
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MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Responsible AI in Generative AI era	Coursera	2024	https://www.coursera.org/learn/responsible-ai-in-generative-ai?action=enroll
2.	Responsible & Safe AI systems	NPTEL	2024	https://onlinecourses.nptel.ac.in/noc24_cs132/preview

Course Outcomes

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

CO1	Apply ethical frameworks and principles to the development and use of AI systems, ensuring they align with societal values and address potential risks.
CO2	Design AI systems for social good by understanding the seven essential factors and translating ethical principles into practical tools and methodologies.
CO3	Develop skills to address issues of fairness and bias in AI systems, including techniques for bias detection, data preprocessing, and ensuring both group and individual fairness.
CO4	Implement AI models that cater to standards, including methods for simplification, visualization, and post hoc interpretation to make AI decisions transparent and understandable



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CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CO1	3					2	2	3				
CO2		2				2	2	3				
CO3			3									
CO4	2							2				

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	3	40
QUIZ/AAT	2	10
Alternate Assessment Tool	-	-
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Mobile Application Development

Course Code	23DS5PWMAD	Credits	2	L-T-P	0-0-2
Contact Hours/ Week	4		Total Lecture Hours		48

I. Cycle -1

Programs based on Android Components and Layouts:

- Overview of Android Architecture, Android Activity Life Cycle, Android Manifest File.
- Layout Manager: Linear Layouts, Relative Layouts and Constraint Layouts.
- Android Widgets : UI development in Android, Working with Button, TextView, EditText, AutoCompleteTextView, DatePicker, TimePicker, Toast, CustomToast, ToggleButton, Switch, Checkbox, Custom Checkbox, RadioButton, AlertDialog, ProgressBar.
- Spinner, drawing custom shapes on Canvas.
- Intents: Explicit and Implicit Intents.

II. Cycle - 2

Programs based on:

- RecyclerView.
- Android Animation.
- Android Menu: Options Menu, Context Menu, Popup Menu.
- Android Fragments.
- Android Services.

III. Cycle-3

- Programs based on Android Shared Preferences primitives.
- Programs based on SQLite/Room to store and fetch the data from the database application.



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- Introduction to Networking with Android using HTTP/Retrofit/Volley.

IV. Projects on APP Development.

Text Book					
SI No	Book Title	Authors	Edition	Publisher	Year
1	Android Programming with Kotlin for Beginners	John Horton	First	Packt	2019
2	Programming Android with Kotlin	Pierre-Olivier Laurence, Amanda Hinchman-Dominguez, Mike Dunn, G. Blake Meike	First	O'Reilly	2021
Reference Text Book					
SI No	Book Title	Authors	Edition	Publisher	Year
1	Pro Android 5	Dave MacLean, Satya Komatineni, Grant Allen	Fifth	Apress	2015
2	Jetpack Compose 1.2 Essentials: Developing Android Apps with Jetpack Compose 1.2, Android Studio, and Kotlin	Neil Smyth	First	Payload Media	2022

E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL



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1.	Android Development with Kotlin	Marcin Moskala, Igor Wojda	First	Packt	2017	https://www.shabakeh-mag.com/sites/default/files/files/attachment/1397/04/1530550032.pdf
2.	Learn Kotlin for Android Development	Peter Spath	First	Apress	2019	https://dl.ebooksworld.ir/motoman/Apress.Learn.Kotlin.for.Android.Development..www.EBooksWorld.ir.pdf

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Android Basics with Compose	Developer.Android	2022	https://developer.android.com/courses/android-basics-compose/course
2.	Android app using Kotlin – IIT, Bombay	SWAYAM	2024	https://onlinecourses.swayam2.ac.in/aic20_sp02/preview

Course Outcomes

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

CO's		PO's
CO1	Apply the knowledge of android user interfaces and components for a given problem.	PO1
CO2	Design mobile Apps to provide solutions for real world problems.	PO3, PO5
CO3	Collaboratively work for a project in a team, ensuring comprehensive documentation, effective communication, and lifelong learning principles.	PO9, PO10, PO12



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CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2			3		3							
CO3									2	2		2

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Lab Test	2	20
Project	Two Reviews	30
Total		50



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE) Environmental Studies

Sem	V		
Course Code:	23DC5HSEVS	Total Contact Hours: 13 hours	
L-T-P:	1-0-0	Total Credits:	1

Unit No.	Topics	Hrs.
1	Introduction to Environment: Definition, About Earth i.e Atmosphere, Hydrosphere, Lithosphere and Biosphere, Structure of Atmosphere, Internal structure of Earth, Ecology & Ecosystem, balanced ecosystem, types of ecosystem.	2
2	Effect of Human activities on Environment: i) Agriculture ii) Housing iii) Industries iv) Mining and v) Transportation activities. Sustainability Standards: ISO 14001, LEED, REACH, ISO 50001, UN's Sustainable Development Goals (SDGs).	2
3	Natural Resources: Definition, Water resources – its availability, quality, water borne & water induced diseases. Mineral resources, Forest resources, Energy resources – conventional & non - conventional energy resources, Hydroelectric, wind power, solar, Biogas. Fossil fuel-based energy resources- Coal, Oil & Gas, Nuclear power. Hydrogen as an alternate future source of energy.	3
4	Environmental pollution: Introduction and its types, Water pollution – definition, effects, control methods. Land pollution - definition, effects, Solid waste management. Noise pollution - definition, effects, control methods. Current environmental issues & importance: Population growth, effects & control, climatic changes, Global warming, Acid rain, ozone	3



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	layer depletion & effects, Environmental protection, Role of government, legal aspects.	
5	Green Computing- Sustainable IT Practices and Metrics: Introduction to Sustainable Information Systems, Environmental Impacts of IT- E-waste, Carbon footprint, Energy footprint, Water footprint. Green IT- Green Data Centers, Green Data Storage, Applying IT for Enhancing Environmental Sustainability, Green IT Standards and Eco-Labelling of IT.	3

TEXT BOOKS:

Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Environmental studies	Dr. Geetha Balakrishnan	Seventh	SUNSTAR	2016
2	Harnessing Green IT Principles and Practices	San Murugesan, G.R. Gangadharan	First	John Wiley & Sons	2016

Reference Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Environmental studies	Benny Joseph	Second	Tata McGraw-Hill	2019

E-Books

Sl. No.	Book Title	Publisher	Year	URL



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1.	Environmental studies	University Grants Commission (UGC)	2019	https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf
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MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Environmental studies	Swayam	2019	https://onlinecourses.swayam2.ac.in/cec19_bt03/preview
2	Sustainable Software Development	Microsoft	2022	https://learn.microsoft.com/en-us/training/modules/sustainable-software-engineering-overview

Course Outcomes

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

CO1	Apply the environmental concepts for conservation and protection of natural resources
CO2	Identify and establish relationships between social, economic and ethical values from environmental perspectives.
CO3	Analyze the impact of Computing solutions in the environmental context and realize the need for sustainable development

CO-PO-PSO mapping

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2											
CO2		2						1				
CO3		2					2					2



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Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	1	25
QUIZ/AAT	2	25
Total		50



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Cloud Computing

Semester	VI		
Course Code:	23DS6PCCCT		
L-T-P:	2-1-0	Total Credits:	3

Unit No.	Topics	Hours
1	Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.	8
2	Cloud Computing: Application Paradigms: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.	8
3	Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems	8
4	Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Stability of a two level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems	8
5	Cloud Security: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Cloud Application Development: Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust	8



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	management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis .Exercises and problems.	
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Prescribed Text Book				
Sl. No.	Book Title	Authors	Publisher	Year
1.	Cloud Computing : Theory and Practice	Dan C Marinescu Elsevier	Morgan Kaufmann	2013
2.	Computing Principles and Paradigms	RajkumarBuyya , James Broberg, Andrzej Goscinsk,	John Wiley & Sons	2014

Reference Text Book				
Sl. No.	Book Title	Authors	Publisher	Year
1.	Cloud Computing Implementation, Management and Security	John W Rittinghouse, James F Ransome	CRC Press	2013

E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Cloud Computing : Theory and Practice	Dan C Marinescu Elsevier	-	Morgan Kaufmann	2013	https://eclass.uoa.gr/modules/document/file.php/D416/CloudComputingTheoryAndPractice.pdf
2.	Computing Principles and Paradigms	RajkumarBuyya , James Broberg, Andrzej Goscinsk,	-	John Wiley & Sons	2014	https://dphoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Introduction to Cloud Computing	Coursera	2024	https://www.coursera.org/learn/introduction-to-cloud
2.	Cloud Computing Foundations	Coursera	2024	https://www.coursera.org/learn/cloud-computing-foundations-duke



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Course Outcomes

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

CO1	Apply cloud computing models and services to solve practical problems.
CO2	Analyze cloud resource management and virtualization techniques to evaluate their impact on performance and security.
CO3	Demonstrate the working of VM and VMM on any cloud platforms(public/private), and run a software service on that.
CO4	Develop cloud-based solutions for different applications using appropriate cloud technologies.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2			1				2			
CO2	2	1	2	2	2				3			
CO3		2	1	2	1				2			
CO4		2	3	2	2				2			

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	40
QUIZ/AAT	2	10
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Next Gen Databases

Sem	VI		
Course Code:	23DS6PCNGD	Total Contact Hours: 40 hours	
L-T-P:	3-0-1	Total Credits:	4

Unit No.	Topics	Hrs.
1	Early Database Management Systems - Database revolutions: First, second and Third generation - Big Data Revolution - Google: Pioneer of Big Data, Hadoop: Open-Source Google Stack. Introduction to Sharding - CAP Theorem	8
2	Object Oriented Database: Introduction, properties and applications. PostgreSQL , Relations, CRUD and Joins, starting with SQL, Working with tables, Join Reads, The outer limits, Fast Lookups with Indexing, Advanced queries, Code and Rules, Aggregate functions, Grouping, Window Functions, Transactions, Stored procedures, Pull the triggers, View, Full Text and Multidimensions, Fuzzy searching, PostgreSQL's Strengths and Weaknesses	8
3	Document Database : Introduction and its types. Couch DB , CRUD, Futon and cURL Redux, Getting Comfortable with Futon, Performing RESTful CRUD Operations with cURL, Creating a Document with POST, Updating a Document with PUT, Removing a Document with DELETE, Creating and Querying Views, Accessing Documents Through Views, Importing Data Into CouchDB Using Ruby, Creating Advanced Views with Reducers, CouchDB's Strengths and Weaknesses	8
4	Graph Database : Introduction and its architecture Neo4J : Graphs, Groovy, and CRUD, Neo4j's Web Interface, Neo4j via Gremlin, The Power of Pipes, Pipeline vs. Vertex, Schemaless Social, Domain-Specific Steps, Update, Delete, Done, REST, Indexes, Creating Nodes and Relationships Using REST, Indexing, Distributed High Availability, Transactions, Neo4J's Strengths and Weaknesses, NEo4J on CAP	8
5	Key Value Database : Introduction, features and advantages Redis : Data Structure Server Store, CRUD and Datatypes, Transactions, Complex Data Types, Expiry, Database Namespaces, Advanced Usage, Distribution, publish-subscribe , Redis Configuration, Master-Slave Replication, Data Dump, Redis Cluster, Bloom Filters , Redis's Strengths and Weaknesses SSD & In-Memory Databases —SAP HANA, Berkeley Analytics Data Stack and Spark.	8



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Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1	Next Generation Databases	Guy Harrison	First	Apress	2015
2	Seven Databases in Seven Weeks - A Guide to Modern Databases and the NoSQL Movement	Erick Redmond, Jim R Wilson	Second	Pragmatic Bookshelf	2018

Reference Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1 .	NoSQL for Dummies	Adam Fowler	First Edition	John Wiley & Sons	2015
2	Fundamentals of Database Systems	Ramez Elmasri and Shamkant Navathe	Sixth Edition	Pearson	2011

E-Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Seven Databases in Seven Weeks	Eric Redmond , Jim R. Wilson	First	O'Reilly	2012	https://lib.fbtuit.uz/assets/files/8.-EricRedmondJimRWilson-SevenDatabasesinSevenWeeks-EN.pdf
2.	NoSQL for Mere Mortals	Dan Sullivan	Second	Addison-Wesley Professional	2015	https://datubaze.wordpress.com/wp-content/uploads/2021/03/nosql-for-mere-mortals.pdf

MOOC Courses

Sl. No.	Course name	Course Offered By	Year	URL
1	Introduction to NoSQL Databases	Course era	2024	https://www.coursera.org/learn/introduction-to-nosql-databases
2	Introduction to Graph Databases using Neo4J	Udemy	2024	https://www.udemy.com/course/introduction-to-graph-databases-using-neo4j/



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Course Outcomes

CO1	Understand the foundational concepts of various database systems.
CO2	Apply appropriate database operations and queries effectively.
CO3	Analyze different database architectures and their use cases.
CO4	Ability to conduct experiments to demonstrate the various Next Generation Databases

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			3		2							
CO4				3	3							

Assessment Plan

Assessment Tool	Number of Assessments	Marks
Internals	TWO	20
QUIZ/AAT	ONE	5
Lab Component	CIE + Lab Test	25
Total		50

Laboratory Plan

Lab Program	Program Details
1	<p>PostgreSQL Query Questions - Hospital Management System</p> <p>Create a database for a hospital management system with tables: Patients (PatientID, Name, Age, Gender, AdmissionDate) and Doctors (DoctorID, Name, Specialization, Experience).</p> <ul style="list-style-type: none"> a) Fetch Patient Details: b) List Patients Admitted on a Specific Date ('2024-06-15'); c) List Patients by Age Group: d) Update Patient Details (Change Name for PatientID = 1): e) List Doctors by Specialization ('Cardiology'); f) Count Patients per Doctor: g) Calculate Average Experience of Doctors:
2	CRUD operations in CouchDB Student Database



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	<p>Create a student database with the fields: (SRN, Sname, Degree, Sem, CGPA)</p> <ul style="list-style-type: none">a) Display all the documentsb) Display all the students in BCAc) Display all the students in ascending orderd) Display first 5 studentse) Display students 5,6,7f) List the degree of student "Rahul"g) Display students details of 5,6,7 in descending order of percentageh) Display all the BCA students with CGPA greater than 6, but less than 7.5
3	<p>CRUD operations in CouchDB Library Database</p> <p>Create a library database with the fields: (ISBN, Title, Author, Genre, PublicationYear, CopiesAvailable, Rating).</p> <ul style="list-style-type: none">a) Display all the documents in the library database.b) Display all the books in the genre "Fiction".c) Display all books sorted by their Title in alphabetical order.d) Display the first 3 books.e) Display books 4, 5, and 6.f) List the Author of the book titled "The Great Gatsby".
4	<p>CRUD Operations in Neo4j - Social Network Database</p> <p>Create a social network database with nodes: User (UserID, Username) and relationships: (FOLLOW).</p> <ul style="list-style-type: none">a) Write a query to display all users.b) Write a query to display users followed by a specific user with Username "Jane".c) Write a query to display all users in ascending order by Username.d) Write a query to find users who follow both "Alice" and "Bob".e) Write a query to find users with the most number of followers.f) Display first 5 users:
5	<p>CRUD Operations in Neo4j - Movie Recommendation Database: where we have nodes: Movie (MovieID, Title) and User (UserID, Username), and relationships: (LIKES) indicating a user likes a specific movie.</p> <ul style="list-style-type: none">a) Write a query to display all movies liked by a specific user with Username



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	<p>"John".</p> <ul style="list-style-type: none">b) Write a query to find all users who like the movie titled "Inception".c) Write a query to display all movies in ascending order by Title.d) Write a query to find users who like both "The Matrix" and "Inception".e) Write a query to find the most liked movie.f) Write a query to display the top 5 users who like the most movies.
6	<p>Redis Query Questions - Product Catalog Scenario</p> <p>Create a product catalog database with products having attributes: (ProductID, Name, Category, Price)</p> <ul style="list-style-type: none">a) Insert products into Redis with keys like product:{ProductID} and values as JSON objects containing Name, Category, and Price.b) Retrieve details of a specific product by ProductID.c) Fetch all products belonging to a specific category.(Electronics)d) List Products in a Price Range (500 - 1000):e) Update Product Price:f) Delete a Product:
7	<p>Consider an employee management system where each employee has attributes: (EmployeeID, Name, Department, Position, Salary).</p> <p>Questions:</p> <ul style="list-style-type: none">a) Insert Employee Details into Redis: Insert employee records into Redis with keys like employee:{EmployeeID} and values as JSON objects containing Name, Department, Position, and Salary.b) Retrieve All Employees in a Specific Department (e.g., "HR"): Write a Redis query to fetch all employees belonging to a specific department, such as "HR."c) List Employees with a Salary Above a Certain Amount (e.g., \$50,000): Write a Redis query to list all employees whose salaries are above a certain threshold (e.g., \$50,000).d) Update an Employee's Position: Write a Redis query to update the position of a specific employee identified by their EmployeeID.



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SEE Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-3	Mandatory	One Question to be asked for 20 Marks
Unit-4	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Natural Language Processing and Generative AI

Sem	VI		
Course Code:	23DS6PCNLP	Total Contact Hours: 40 hours	
L-T-P:	3-0-1	Total Credits:	3

Unit No.	Topics	Hrs
1	<p>Introduction: What is Natural Language Processing (NLP), Origins of NLP, Phases of NLP, Ambiguities in NLP. Why is NLP hard?</p> <p>Text Processing: Regular Expressions, Word normalisation - Lemmatization, Stemming, Tokenizations - Word Tokenization, Character Tokenization, Byte Pair Encoding, Word piece</p>	8
2	<p>Sequence Labeling for Parts of Speech and Named Entities: English Word Classes, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging</p> <p>Vector Semantics and Embeddings: Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI), Word embeddings.</p> <p>Parsing: Constituency Parsing, Dependency Parsing: Transition-Based Dependency Parsing</p>	8
3	<p>Language Modeling: Types of language models, Statistical Language Models</p> <p>The Transformer: A Self-Attention Network, Multihead Attention, Transformer Blocks, The Residual Stream view of the Transformer Block, The input: embeddings for token and position, The Language Modeling Head, Large Language Models with Transformers, Large Language Models: Generation by Sampling, Large Language Models: Training Transformers</p> <p>Introduction to Pre-trained Language Models, Masked Language Model - BERT. Fine-tuning LLMs for specific tasks</p>	8



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4	Generative Modeling: What is Generative Modeling? Probabilistic Generative Models Variational Autoencoders: Building a VAE, Using VAE to generate faces. Transformer based Generative Models (GPT and T5), Potential Harms from Language Models.	8
5	Teaching Machines to Paint, Write and Compose: Creating CycleGAN to paint, LSTM Network to generate text, Music generating RNN	8

Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition	James H Martin	Third	Pearson Education India	2024
2.	Generative Deep Learning	David Foster	Second	O'Reilly	2023

Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Natural Language Processing and Information Retrieval	Tanveer Siddiqui, U.S. Tiwary	First	Oxford University Press	2008
2.	Natural Language Understanding	James Allen	Second	Benjamin /Cummings publishing company	1995



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3.	Generative AI with Python and Tensorflow2	Raghav Bali	First	Packt	2021
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E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Natural Language Processing Recipes	Akshay Kulkarni Adarsha Shivananda	First	APRESS	2019	https://www.aitskadapa.ac.in/e-books/CSE/DEEP%20LEARNING/Natural%20Language%20Processing%20Recipes_%20Unlocking%20Text%20Data%20with%20Machine%20Learning%20and%20Deep%20Learning%20using%20Python%20(%20PDFDrive%20).pdf
2.	HANDBOOK OF NATURAL LANGUAGE PROCESSING	NITIN INDURKHY A FRED J. DAMERAU	Second	CRC Press	2010	https://karczmarczuk.users.greyc.fr/TEACH/TAL/Doc/Handbook%20Of%20Natural%20Language%20Processing,%20Second%20Edition%20Chapman%20&%20Hall%20Crc%20Machine%20Learning%20&%20Pattern%20Recognition%202010.pdf
3	Natural Language Processing with Python	Steven Bird, Ewan Klein, and Edward Loper	First	O'Reilly	2011	https://www.nltk.org/book/

MOOC Course					
Sl. No.	Course name	Course Offered By	Year	URL	



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1.	Natural Language Processing	SWAYAM	2024	https://onlinecourses.nptel.ac.in/noc19_cs56/preview
2.	Natural Language Processing	Coursera	2024	https://www.coursera.org/specializations/natural-language-processing
3	Generative AI Fundamentals Specialization	Coursera	2024	https://www.coursera.org/specializations/generative-ai-for-everyone

Laboratory Plan

Sl. No.	Lab Program
1	Write a Python program using nltk to perform tokenization, eliminate stopwords, perform stemming and lemmatization
2	Implement traditional machine learning algorithms to perform Parts of Speech tagging and Named entity recognition.
3	Write a python program to find Term Frequency and Inverse Document Frequency (TF-IDF).
4	Write a python program to find all unigrams, bigrams and trigrams present in the given corpus.
5	Build traditional machine learning models for sentiment analysis. Compare the performance with a transformer model fine tuned on a dataset like IMDb or Twitter
6	Implement a VAE on the MNIST dataset and generate new images by sampling from the latent space.
7	Fine-tune a pre-trained language model (e.g., GPT, BERT) using transfer learning techniques on a domain-specific dataset and evaluate its performance for text generation tasks.



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8	Implement a Long Short-Term Memory (LSTM) model on a dataset of text sequences and generate new text samples.
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Course Outcomes

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

CO1	Apply existing mathematical models and machine learning algorithms to build NLP applications.
CO2	Analyze NLP tasks like text pre-processing, part-of-speech tagging, syntax parsing using existing algorithms and frameworks.
CO3	Design and develop applications using Natural Language Processing and Generative AI.
CO4	Conduct experiments to implement applications based on statistical NLP and Deep learning based NLP

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			2		2							
CO4				3	2							

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	Best of 2	20
Lab Test + Project	2	25
QUIZ/AAT	1	5
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	One Question to be asked for 20 Marks



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Unit-3	Internal Choice	One Question to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Software Engineering & Agile Methodologies

Sem	VI	
Course Code:	23DC6PCSEA	Total Contact Hours: 26 hours
L-T-P:	2-0-0	Total Credits: 2

Unit No.	Topics	Hrs.
1	Introduction - Software metrics, Overview of Software Development Projects, Emergence of Software Engineering Software Life Cycle Models - Basic Concepts, Waterfall Model and its Extensions, Rapid Application Development, Agile Development Models: Essential Ideas Behind Agile Models, Agile vs. Other Models, Spiral Model, Comparison of Different Life Cycle Models	5
2	Requirements Analysis and Specification - Requirements Gathering and Analysis, Software Requirements Specification (SRS) Case Study - IEEE SRS Software Design - Overview of the Design Process, Characteristics of Good Software Design: Cohesion and Coupling, Approaches to Software Design Function-Oriented Software Design - Overview of SA/SD Methodology, Structured Analysis: Developing the DFD Model of a System, Structured Design and Detailed Design	5
3	Software Project Management - Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques: Empirical Estimation Techniques, COCOMO (A Heuristic Estimation Technique), Scheduling and Team Structures	5
4	Understanding Agile - What is Agile?, The Agile Manifesto and Principles, Why Agile Works Better than Traditional Models Kanban and Lean - Introduction to Kanban Method, Lean Principles in Agile Jira Fundamentals - Overview of Jira: Project Boards, Enrich Issues, Kanban Boards, Scrum Projects, Quick Search and Basic Search, JQL (Jira Query Language), Filters, Epics, Dashboards	6
5	Understanding XP - The XP Life cycle, The XP Team, XP Concepts, Software Configuration Management - Configuration Management Process, Version Control Systems, Change Management and Control	5

Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year



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DEPARTMENT OF CSE (Data Science)

1.	Fundamentals of Software Engineering	Rajib Mall	5th Edition	PHI Learning	2018
2	Agile Foundations: Principles, Practices, and Frameworks	Peter Measey	Fourth	BCS Learning & Development Limited	2015
3	Atlassian Jira Service Desk A Complete Guide	Gerardus Blokdyk	First	S Viswanathan Printers and Publishing Private Limited	2020

Reference Text Book

Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Essential Scrum: A Practical Guide to the Most Popular Agile Process	Kenneth Rubin	First	Pearson	2017
2.	The Art of Agile Development	James Shore & Shane Warden	Second	O'Reily	2007

MOOC Course

Sl. No.	Course name	Course Offered By	Year	URL
1.	Agile Scrum Tutorial: A Step-by-Step Guide for Beginners	Simplilearn	2024	https://www.simplilearn.com/tutorials/agile-scrum-tutorial
2.	Agile Development Specialization	Coursera	2024	https://www.coursera.org/specializations/agile-development

Course Outcomes

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

CO1	Understand the principles of software engineering and agile methodologies, including key frameworks and processes.
CO2	Apply agile practices and software engineering techniques to manage and develop software projects using agile tools.
CO3	Analyze different software development models and agile practices to select the most effective approach for specific project requirements.

CO-PO mapping



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SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	One Question to be asked for 20 Marks
Unit-3	Internal Choice	One Question to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Optimization Techniques for Data Science

Sem	VI		
Course Code:	23DS6PEOTD		
L-T-P:	3-0-0	Total Credits:	4

Unit No.	Topics	Hours
1	Introduction to Optimization: Definition, Need for optimization algorithms, Optimization Process, Basic Optimization Problem, Constraints, Handling huge matrices in Python, Mathematical Formulation, Example: A Transportation Problem One-Dimensional Search Methods: Golden Section Search, Fibonacci Search	8
2	Approaches of optimization: Continuous versus Discrete Optimization, Constrained and Unconstrained Optimization, Global and Local Optimization, Stochastic and Deterministic Optimization Convexity Convex optimization: Convex Functions, Convex Optimization Problems	8
3	Gradient Descent: Variants of Gradient Descent: Projected, Stochastic, Proximal, Accelerated, Coordinate Descent, Cauchy's steepest descent method, Newton's Method – Optimization in practice, conjugate gradient method Function optimization: interpolation, extrapolation	8
4	Optimizing Model Performance Using Optimization Algorithms: Batch Normalization, Grid Search, RMSProp optimizer Random Search, derivative-free optimization algorithms Hyperparameter Tuning: Evolution algorithms, Bayesian optimization	8
5	Particle Swarm Optimization: Particle Swarm Optimization (PSO) Algorithm, PSO System Parameters, Particle Swarm Optimization versus Evolutionary Computing. Ant colony Optimization: The Invisible Manager, The Pheromone, Ant Colonies and Optimization, Ant Colonies and Clustering, Applications	8

Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Algorithms for Optimization	Mykel J. Kochenderfer Tim A. Wheeler	-	MIT Press Cambridge	2019
2	Numerical Optimization	Jorge Nocedal Stephen J. Wright	Second	Springer	2006



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Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Computational Intelligence An Introduction	Andries P. Engelbrecht	-	John Wiley & Sons, Ltd	2002
2.	An Introduction to Optimization	Edwin K. P. Chong, Stanislaw H. Zak	Second	John Wiley & Sons, Ltd	2004

E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Optimization Algorithms for Machine Learning Models	Lovekush Chaurasia, Amol Borse	-	Global Logic	2020	https://www.globallogic.com/wp-content/uploads/2020/02/Optimization-Algorithms-for-Machine-Learning-1.pdf

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Optimization for Machine Learning	NPTEL	2024	https://nptel.ac.in/courses/106106245

Course Outcomes

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

CO1	Apply computation techniques for single variable functions and multiple variable functions
CO2	Analyse concept of search space and optimality through tuning approaches
CO3	Analyse population-based metaheuristic for social behavior and other engineering problems

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			3		3							

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	40
QUIZ/AAT	2	10
Total		50



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SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20Marks
Unit-2	Mandatory	One Question to be asked for 20Marks
Unit-3	Internal Choice	Two Questions to be asked for 20Marks each
Unit-4	Mandatory	One Questions to be asked for 20Marks
Unit-5	Internal Choice	Two Question to be asked for 20Marks each



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Computer Vision

Sem	VI	
Course Code:	23DS6PECPV	Total Contact Hours: 40 hours
L-T-P:	3-0-0	Total Credits: 3

Unit No.	Topics	Hrs
1	<p>Introduction to Computer Vision: Overview of Computer Vision, Brief History, Applications of Computer Vision</p> <p>Image Formation: Introduction to Basic 2D, 3D Primitives (points, lines, and planes), 2D and 3D computer vision transformations, Overview of 3D rotation representations, 3D to 2D projections, Photometric image formation, A Simple Model of Digital Camera Image Processing or Image Formation Pipeline in Digital Cameras.</p>	8
2	<p>Image Processing: Pixel Transform, Color Transform, Separable filtering and Examples of Linear Filtering. Fourier Transforms- Two dimensional Fourier Transforms, Application: Sharpening, blur, and noise removal.</p> <p>Multi-Resolution Image Processing: Pyramids, Decimation, decomposition of an image using wavelet and Application: Image blending.</p> <p>Geometric Transformations: Forward Warping and Basic 2D Geometric Transformations, Inverse Warping and Resampling in Geometric Transformations, Image Morphing.</p>	8
3	<p>Model fitting and Optimization: Scattered data interpolation, Radial basis functions, Overfitting and underfitting, and Robust data fitting. Variational methods and regularization, Discrete energy minimization, Total variation, and Bilateral solver. Markov random fields, Conditional random fields, and Application: Interactive segmentation</p> <p>Recognition: Instance recognition, Image classification (feature-based methods and deep networks), and Object detection (face detection and pedestrian detection).</p>	8
4	<p>Feature detection and matching: Points and patches-Feature detectors, descriptors and matching; Edges and contours detection, Contour tracking Lines- Snakes and scissors, level sets and vanishing points Segmentation</p> <p>Image alignment and stitching: Pairwise alignment using least squares, Image stitching- parametric motion models, rotational panoramas, Global alignment- Bundle adjustment, Parallax removal.</p>	8



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5	<p>Segmentation using the clustering method: Human vision: Grouping and Gestalt, Applications: Shot Boundary Detection, Background Subtraction and Skin Finding-Background Subtraction, Shot Boundary Detection, Finding Skin Using Image Color; Image Segmentation by Clustering Pixels- Simple Clustering Methods, Segmentation Using Simple Clustering Methods, Clustering and Segmentation by K-means; Segmentation by Graph-Theoretic Clustering- Basic Graphs, The Overall Approach, Affinity Measures, Eigenvectors and Segmentation, Normalized Cuts.</p> <p>Motion estimation: Translational alignment, Parametric motion, Optical flow, Layered motion</p>	8
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Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Computer Vision: Algorithms and Applications	Richard Szeliski	Second	Springer	2021
2.	Computer Vision: A Modern Approach	David Forsyth and Jean Ponce	Second	Pearson	2015
Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Multiple View Geometry in Computer Vision	Richard Hartley and Andrew Zisserman	Second	Cambridge University Press	2003
2.	Modern Computer Vision with PyTorch	V Kishore Ayyadevara, Yeshwanth Reddy	Second	Packt	2024

E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Algorithms for Image Processing and Computer Vision	J R Parker	Second	Wiley	2011	http://kiwi.bridgeport.edu/cpe/g585/Algorithms_for_Image_Processing_and_Computer_Vision.pdf
2.	Programming Computer Vision with Python	Jan Erik Solem	-	Creative commons	2012	http://programmingcomputervision.com/downloads/ProgrammingComputerVision_CC_draft.pdf



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MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Computer Vision and Image Processing - Fundamentals and Applications	SWAYAM	2024	https://onlinecourses.nptel.ac.in/noc23_ee39/preview
2.	Introduction to Computer Vision and Image Processing	COURSERA	2024	https://www.coursera.org/learn/introduction-computer-vision-watson-opencv

Course Outcomes

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

CO1	Apply various methods for image transformation
CO2	Analyze the different methods for image detection, segmentation and enhancement.
CO3	Design and develop a model using Computer Vision Algorithms

CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			2									

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	3	40
QUIZ/AAT	2	10
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	One Question to be asked for 20 Marks
Unit-3	Internal Choice	One Question to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Design Patterns

Sem	VI		
Course Code:	23DS6PEDPT		Total Contact Hours: 40 hours
L-T-P:	3-0-0	Total Credits:	3

Unit No.	Topics	Hrs
1	<p>Introduction to UML: The Essential Principles of Software Development, Importance of Modeling, Principles of Modeling, Object-Oriented Modeling, Overview of UML, A Conceptual Model of the UML, UML Architecture Overview, Software Development Life Cycle Overview.</p> <p>Key UML Diagrams: Structural Modeling- Class Diagrams, Object Diagrams Behavioral Modeling- Use Case Diagrams, Interaction Diagrams, State Machines Diagram. Architectural Modeling- Component Diagrams, Deployment Diagrams. Overview of UML tools and their applications.</p>	8
2	<p>Introduction to Design Patterns: What is a Design Pattern, Design Patterns in Smalltalk MVC, Describing design patterns, the catalog of design pattern, Organizing the catalog, How design patterns solve design problems, How to select a design pattern, How to use a design pattern.</p>	8
3	<p>A Case Study: Designing a Document Editor- Design Problems, Document Structure, Formatting, Embellishing the User Interface, and Supporting Multiple Look – and - Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation.</p> <p>Creational Patterns: Overview, Types of Creational Patterns with its Applicability, Benefits, and Constraints. Case Studies: Implementing the Singleton Pattern for Ensuring Unique Object Instances, Applying the Builder Pattern for Flexible RTF Document Conversion, Using the Factory Method Pattern for Document Creation in Frameworks (with sample code implementation).</p>	8



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4	Structural Patterns: Overview, Types of Structural Patterns with its Applicability, Benefits, and Constraints. Case Studies: Integrating Incompatible Interfaces Using the Adapter Pattern, Decoupling Abstraction and Implementation with the Bridge Pattern, Simplifying Complex Diagram Creation with the Composite Pattern, Implementing the Decorator Pattern for Dynamic Object Enhancement, Using the Facade Pattern to Simplify Subsystem Interfaces (with sample code implementation).	8
5	Behavioral Patterns: Overview, Types of Behavioral Patterns with its Applicability, Benefits, and Constraints. Case Studies: Enhancing Request Management and Decoupling with the Command Pattern, Managing Consistency and Notification with the Observer Pattern, Applying the Strategy Pattern for Flexible Linebreaking Algorithms, Using the Template Method Pattern to Standardize Document Processing (with sample code implementation).	8

Prescribed Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	The unified modeling language user guide	Grady Booch, James Rumbaugh and Ivar Jacobson	Second	Pearson Education	2017
2.	Design Patterns: Elements of Reusable Object-Oriented Software	Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides	First	Pearson Education	2016

Reference Text Book

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Object-Oriented Analysis, Design and Implementation	Brahma Dathan, Sarnath Ramnath	Second	Springer	2015
2.	Head First Design Patterns	Eric Freeman, Bert Bates, Kathy Sierra, and Elisabeth Robson	Second	O'Reilly	2020



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E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Object-Oriented Analysis, Design and Implementation	Brahma Dathan, Sarnath Ramnath	Second	Springer	2015	https://warin.ca/ressources/books/2015_Book_Object-OrientedAnalysisDesignA.pdf
2.	Head First Design Patterns	Eric Freeman, Bert Bates, Kathy Sierra, and Elisabeth Robson	Second	O'Reilly	2020	https://learning.oreilly.com/library/view/head-first-design/9781492077992/

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Object Oriented System Development using UML, Java and Patterns	SWAYAM	2020	https://onlinecourses.nptel.ac.in/noc20_cs84/preview
2.	Design Patterns	Coursera	2018	https://www.coursera.org/learn/design-patterns

Course Outcomes

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

CO1	Apply the principles of UML and object-oriented modeling to construct various UML diagrams for the given software system requirements.
CO2	Analyze the applicability of various design patterns to solve specific design problems within the context of object-oriented software development.
CO3	Design software solutions using appropriate design patterns to address the given problem, ensuring code reusability, maintainability, and scalability.

CO-PO-PSO mapping



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Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	40
QUIZ/AAT	2	10
Total		50

SEE Exam Question paper format

Unit-1	Mandatory	One Question to be asked for 20 Marks
Unit-2	Internal Choice	One Question to be asked for 20 Marks
Unit-3	Internal Choice	One Question to be asked for 20 Marks
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Advanced Data Structures and Algorithms

Semester	VI	
Course Code:	23DS6PEADA	Total Contact Hours: 40 hours
L-T-P:	3-0-0	Total Credits: 3

Unit No.	Topics	Hours
1	Balanced Search Trees: B-Trees Tree structures for Set of Intervals: Interval trees and Segment trees. Data Structures for String: Tries, Suffix trees.	8
2	Advanced Lists: Memory efficient doubly linked list, XOR Linked List, Skip Lists, Self-Organizing List , Unrolled Linked List. Heaps: Leftist Heap, Binomial heaps.	8
3	Hashing: Rehashing, Dynamic Hashing, Direct-address tables, Hash tables, Hash functions, Open addressing and separate chaining. Dynamic Programming: Rod cutting, Matrix-chain multiplication, Longest common subsequence, Multistage graph, Edit Distance, Egg Dropping Puzzle.	8
4	Graph Algorithms: Flow networks, The Ford-Fulkerson method, Bellman - Ford Algorithm, Maximum bipartite matching. Multithreaded Algorithms: The basics of dynamic multithreading, Multithreaded matrix multiplication, Multithreaded merge sort.	8
5	String matching: The Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm. Number -Theoretic Algorithms: GCD, The Chinese remainder theorem.	8



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Prescribed Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Advanced Data Structures	Peter Brass	First Edition	Cambridge university Press	2019
2.	Introduction to Algorithms	Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein	Fourth Edition	The MIT Press	2022

Reference Text Book					
Sl. No.	Book Title	Authors	Edition	Publisher	Year
1.	Data Structures and Algorithms Analysis in C++	Mark Allen Weiss	Fourth Edition	Pearson	2014
2.	Algorithms	Jeff Erickson	First Edition	Cambridge University Press	2019

E-Book						
Sl. No.	Book Title	Authors	Edition	Publisher	Year	URL
1.	Data Structures and Algorithms	John Bullinaria	-	-	2019	https://www.cs.bham.ac.uk/~jxb/DSA/dsa.pdf
2.	Introduction to Algorithms	T. H Cormen, C. E. Leiserson and R. L. Rivest	Fourth Edition	The MIT Press	2022	https://dl.ebooksworld.ir/books/Introduction.to.Algorithms.4th.Leiserson.Stein.Rivest.Cormen/MIT.Press.9780262046305.EBooksWorld.ir.pdf

MOOC Course				
Sl. No.	Course name	Course Offered By	Year	URL
1.	Advanced Data Structures in Java	Coursera	2019	https://www.coursera.org/learn/advanced-datastructures
2.	Data Structures and Algorithms in Java	NPTEL	2023	https://onlinecourses.nptel.ac.in/noc23_cs85/prevew



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Course Outcomes

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

CO1	Apply principles of advanced Data Structures and Algorithm design techniques for solving complex problems.
CO2	Analyze and develop operations on advanced non-linear data structures.
CO3	Analyze different algorithms and its suitability to solve complex problems.
CO4	Design solutions to computing problems using appropriate data structures and algorithm design techniques
CO5	Demonstrate and present algorithms design skill

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3	2									
CO3			3									
CO4				3								
CO5			2									

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals	2	40
QUIZ/AAT	2	10
Total		50

SEE Exam Question paper format

Unit-1	Internal Choice	Two Question to be asked for 20 Marks each
Unit-2	Mandatory	One Questions to be asked for 20 Marks
Unit-3	Internal Choice	Two Questions to be asked for 20 Marks each
Unit-4	Mandatory	One Question to be asked for 20 Marks
Unit-5	Mandatory	One Question to be asked for 20 Marks



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Competitive Programming

Semester	VI		
Course Code:	23DS6AECPG	Total Contact Hours: 24 hours	
L-T-P:	0-0-1	Total Credits:	1

	Programming Challenges on the topics listed below	Hours
1	Getting Started : Programming Fundamentals	2
2	Arithmetic & Algebra	2
3	Sorting and Searching Algorithms	2
4	Tree Queries	2
5	Range Queries	2
6	Divide and Conquer	2
7	Greedy Algorithms - I	2
8	Greedy Algorithms - II	2
9	Dynamic Programming - I	2
10	Dynamic Programming - II	2
11	Graph Algorithms	2
12	String Algorithms	2

Prescribed Text Book				
Sl. No.	Book Title	Authors	Publisher	Year
1.	Competitive Programming in Python: 128 Algorithms to Develop Your Coding Skills	Christoph Dürr and Jill-Jênn Vie	Cambridge University Press	2021
2.	Guide to Competitive Programming	Antti Laaksonen	Springer	2017

Reference Text Book				
Sl. No.	Book Title	Authors	Publisher	Year



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1.	Introduction to Algorithms	Thomas H . Cormen, Charles E. Leiserson	MIT Press	2022
2.	Programming Challenges	Steven S. Skiena Miguel A. Revilla	Springer	2003

E-Book

Sl. No.	Book Title	Authors	Publisher	Year	URL
1.	Competitive Programming 3	Steven Halim, Felix Halim	Lulu	2013	https://files.gitter.im/SamZhangQingChuan/sam/DA1g/Steven-Halim_-Felix-Halim-Competitive-Programming-3_-The-New-Lower-Bound-of-Programming-Contests-Lulu.com-_2013_.pdf
2.	Algorithms	Jeff Erikson	-	2019	https://jeffe.cs.illinois.edu/teaching/algorithms/

MOOC Course

Sl. No.	Course name	Course Offered By	Year	URL
1.	Getting started with Competitive Programming	NPTEL	2024	https://onlinecourses.nptel.ac.in/noc24_cs103/preview
2	Competitive Programming Essentials, master Algorithms	Udemy	2024	https://www.udemy.com/course/competitive-programming-algorithms-coding-minutes/

Course Outcomes

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

CO1	Develop problem solving skills like analytical and algorithmic thinking
CO2	Implement efficient solutions to programming challenges on competitive programming platforms



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CO3	Exhibit qualities of precision, error handling and resilience developed through competitive programming
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CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3									
CO2					3							1
CO3												3

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Internals (MCQ)	2	25
Coding Tests	5	25
Total		50



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Explainable AI

Sem	VI		
Course Code:	23DS6AEXAI	Total Contact Hours: 24 hours	
L-T-P:	0-0-1	Total Credits:	1

SI. No	Program	No of Hours
1	Introduction to Explainable AI: Build a simple classification model on a tabular dataset (e.g., Titanic dataset). Implement LIME (Local Interpretable Model-Agnostic Explanations) to explain the model's predictions. Explanation: This program introduces students to the core concepts of model interpretability using LIME, which provides local explanations for black-box models. Dataset: Titanic Dataset	2
2	Anchors for Classification: Develop a classification model on tabular data and use Anchors to generate human-understandable rules that explain predictions. Extend the previous exercise by using Anchors to create rule-based explanations. Explanation: Anchors help in identifying conditions that are crucial for the model's predictions, making explanations more intuitive. Dataset: Adult Income Dataset	2
3	SHAP (Shapley Values) for Feature Importance: Train a Random Forest model on the House Prices dataset. Use SHAP values to compute and visualize feature importance, exploring how different features influence the predictions. Explanation: SHAP values provide a global perspective on model interpretability by showing the contribution of each feature to predictions. Dataset: House Prices Dataset	2
4	Prediction Difference Analysis (PDA) and Break-Down Analysis: Implement PDA on a linear regression model using the California Housing Prices dataset, followed by Break-Down analysis for a detailed feature contribution study. Explanation: PDA and Break-Down provide insights into feature importance and how changes in features influence predictions.	2

	Dataset: California Housing Prices	
5	Layer-wise Relevance Propagation (LRP) and Deep Taylor Decomposition (DTD): Train a CNN on the MNIST dataset and implement LRP. Extend the LRP implementation with DTD to refine prediction visualizations. Explanation: LRP and DTD provide pixel-level explanations, enhancing interpretability in deep learning models. Dataset: MNIST Dataset	2
6	Grad-CAM and Meaningful Perturbations: Use Grad-CAM on a CNN trained on the CIFAR-10 dataset to generate class-specific heatmaps, followed by applying meaningful perturbations to analyze model robustness. Explanation: Grad-CAM and meaningful perturbations visualize how models make predictions and assess model sensitivity. Dataset: CIFAR-10 Dataset	2
7	GraphLIME and Explainable Graph Neural Networks (XGNN): Implement a GNN on the Cora dataset and use GraphLIME for node-level explanations. Extend this to XGNN to generate interpretable subgraphs for predictions. Explanation: GraphLIME and XGNN enhance model interpretability in graph-structured data. Dataset: Cora Dataset	2
8	Textual Explanations for Visual Models and Transformers Interpret: Implement a model on the MS COCO dataset that generates textual explanations for visual models using attention mechanisms. Apply transformer interpretability on the IMDB Reviews dataset. Explanation: This program covers cross-modal explanations and sequential model interpretability using attention mechanisms. Datasets: MS COCO Dataset, IMDB Reviews Dataset	2
9	Testing with Concept Activation Vectors (TCAV) and Integrated Gradients: Implement TCAV and Integrated Gradients on a pre-trained CNN using the ImageNet dataset to understand how high-level concepts influence predictions. Explanation: TCAV and Integrated Gradients provide insights into the relationship between concepts and model predictions. Dataset: ImageNet Dataset	4
10	EXplainable Neural-Symbolic Learning (X-NeSyL) and Logic Tensor Networks (LTN): Develop a hybrid model on the Car Evaluation dataset that combines neural networks and symbolic reasoning, and extend this to LTN using the Wine Quality dataset. Explanation: X-NeSyL and LTN explore hybrid approaches for explainable AI by integrating symbolic reasoning with neural networks. Datasets: Car Evaluation Dataset, Wine Quality Dataset	4

Prescribed Textbook					
SI No	Book Title	Authors	Editi on	Publisher	Year
1.	Interpretable Machine Learning	Christoph Molnar	First	Lean Publishing	2019
2.	Explainable AI for Practitioners	Michael Munn, David Pitman	First	O'Reilly	2022

Reference Textbook					
SI No	Book Title	Authors	Edition	Publisher	Year
1	Explainable AI: Interpreting, Explaining and Visualizing Deep Learning.	Samek, Montavon et al	1st Edition	Springer	2019
2	Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning	Uday Kamath , John Liu	1st Edition	Springer	2021

E-book						
SI No	Book Title	Authors	Edition	Publisher	Year	URL
1	xxAI - Beyond Explainable AI	Andreas Holzinger · Randy Goebel	1st Edition	Springer	2020	https://www.researchgate.net/publication/360002587_Explainable_AI_Methods_-A_Brief_Overview
2	Explainable AI: Foundations, Methodologies and Applications	Mayuri Mehta, Vasile Palade , Indranath Chatterjee	2nd Edition	Springer	2023	https://link.springer.com/book/10.1007/978-3-031-12807-3

MOOC Courses				
SI No	Course Name	Offered By	Year	URL
1	Explainable Artificial Intelligence	Harvard University	2023	https://interpretable-ml-class.github.io/
2	Explainable Artificial Intelligence (XAI) Concepts	Datacamp	2023	https://datacamp.com/courses/explainable-artificial-intelligence-xai-concepts
3	Explainable deep learning models	Coursera	2024	https://www.coursera.org/learn/cds-s3

Course Outcomes

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

CO1	Develop an understanding of various Explainable AI (XAI) techniques and apply them to build interpretable machine learning models on tabular, image, and text data.
CO2	Implement advanced XAI methods, including LIME, SHAP, and Grad-CAM, to generate local and global explanations, enhancing model transparency and understanding.
CO3	Analyze and visualize the decision-making process in complex models, including deep learning and reinforcement learning, using XAI tools to interpret and explain predictions comprehensively.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			2	2							
CO2	3											
CO3	3			2						3	3	

Proposed Assessment Plan (for 50 marks of CIE)

Assessment Tool	No. of Assessments	Marks
Lab Component	CIE and 2 Lab Tests	50
Total		50



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DevOps

Sem	VI		
Course Code:	23DSAEDOP		Total Contact Hours: 2 hours/week
L-T-P:	0-0-1	Total Credits:	1

A **Introduction:**

1. This course develops skills in DevOps practices, including CI/CD, infrastructure as code, configuration management, and containerization.
2. Students will develop a DevOps pipeline using technologies such as Jenkins, Docker, Kubernetes, Ansible, Terraform, and cloud platforms like AWS, GCP, or Azure.
3. Groups should consist of 2 to 4 students.
4. The teacher allotted for project work should teach DevOps technologies like Jenkins, Docker, Kubernetes, etc., during Class/Lab hours as per the allotment. The teacher allotted for project work should guide the students in choosing the project topic and in carrying out the project work, as well as completing the evaluation of assigned students.

A **Course Outcomes**

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

CO1	Apply CI/CD pipelines using industry-standard tools.
CO2	Design and develop containerized and orchestrated applications with automated infrastructure.
CO3	Acquire skills in monitoring, logging, and security for high availability and security.
CO4	Enhance communication and teamwork through group projects and presentations.

C **CO-PO-PSO mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
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CO 1	3				3								
CO 2			3		3	3	3						
CO 3			3		3								
CO 4								3	3	3			

D Assessment Plan (for 50 marks of CIE)

Tool	Remarks	Marks
Lab Test	2	20
Project Reviews	2	30
Total		50

Laboratory Plan:

Project Topics:

E-commerce Platform with CI/CD Pipeline, Social Media Analytics Dashboard, Online Learning Management System, Real-time Chat Application, Personal Finance Management App, Content Management System (CMS), Smart Home IoT Dashboard, Healthcare Appointment Booking System, Weather Forecasting Application, Online Voting System

Note: Apart from the above-mentioned project topics if student groups come up with any innovative project ideas which are useful for the Department / College academic purpose will be considered based on the approval and acceptance from class teacher.



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Week	Activity	Content Delivered by Assigned Teacher	Technologies/Skills to be Covered
1	Lecture and discussion, Formation of groups, Basic setup of a lab environment	Introduction to DevOps, History and evolution of DevOps, Key concepts and principles, DevOps lifecycle, Importance and benefits of DevOps, Group Formation, Lab Setup	DevOps Fundamentals, Group Collaboration, Lab Setup
2	Hands-on exercises with Git, Creating and managing a repository	Introduction to version control, Basic Git commands (clone, commit, push, pull), Branching and merging, Using GitHub for collaboration, Git Repository Management	Git, Version Control, GitHub
3	Installing Docker, Creating and running Docker containers	Introduction to containers, Docker architecture and components, Basic Docker commands (build, run, images), Dockerfile and containerization of applications, Docker Container Management	Containerization, Docker
4	Setting up a Kubernetes cluster, Deploying a sample application	Introduction to container orchestration, Kubernetes architecture, Basic Kubernetes objects (pods, services, deployments), Deploying applications on Kubernetes, Kubernetes Application Deployment	Container Orchestration, Kubernetes
5	Jenkins installation and setup, Configuring a simple CI pipeline	Introduction to CI/CD, Setting up Jenkins, Creating and running basic Jenkins jobs, Integrating Jenkins with GitHub, CI Pipeline Configuration	Continuous Integration, Jenkins, CI/CD Pipeline
6	Installing and configuring Ansible, Writing simple playbooks	Introduction to configuration management, Basics of Ansible, Writing and running Ansible playbooks, Managing infrastructure with Ansible, Ansible Playbook Creation	Configuration Management, Ansible
7	Installing Prometheus and Grafana, Configuring basic monitoring and alerts	Importance of monitoring and logging in DevOps, Introduction to Prometheus and Grafana, Setting up monitoring with Prometheus, Visualizing metrics with Grafana, Prometheus and Grafana Configuration	Monitoring, Prometheus, Grafana
8	Installing Terraform, Creating and applying Terraform scripts	Introduction to IaC, Basics of Terraform, Writing and applying Terraform configurations, Managing infrastructure with Terraform, Terraform Scripting	Infrastructure as Code, Terraform



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9	Setting up security scanning tools, Running security scans on applications	Introduction to DevSecOps, Security best practices in DevOps, Tools for security scanning (e.g., OWASP ZAP, Snyk), Integrating security into CI/CD pipelines, Security Scanning Procedures	DevSecOps, Security Scanning
10	Setting up an account on a chosen cloud provider, Deploying a simple application on the cloud	Overview of cloud computing, Introduction to AWS/GCP/Azure (choose one), Using cloud services in DevOps workflows, Cloud Application Deployment	Cloud Computing, AWS/GCP/Azure, Cloud Deployment
11	Groups work on their DevOps projects	Project Work	Project Management, DevOps Practices
12	Project presentations and demonstrations by each group, Submission of project reports	Presentation of Projects, Project Report Submission	Presentation Skills, Documentation, Project Showcase

Text Book					
SL .N o	Book Title	Authors	Edition	Publisher	Year
1	The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations	Gene Kim, Patrick Debois, John Willis, and Jez Humble	1st Edition	IT Revolution Press	2016
2	DevOps for Dummies	Emily Freeman	1st Edition	John Wiley & Sons	2019
Reference Text Book					
SL .N o	Book Title	Authors	Edition	Publisher	Year
1	DevOps: A Software Architect's Perspective	Len Bass, Ingo Weber, and Liming Zhu	1 st Edition	Addison-Wesley Professional	2015

-Book				
SL No	Authors	Author	Edition	URL
1	The DevOps Handbook	Gene Kim, Patrick Debois, John Willis, and Jez Humble	1st Edition	https://dl.faghatketab.ir/Books/Computer/Programming/WebProgramming/The.DevOps.Handbook_faghatketab.ir.pdf

MOOC Course				
SL No	Course Name	Course Offered By	Year	URL
1	DevOps for Software Development – IIT Madras	NPTEL	2021	https://nptel.ac.in/courses/128106012