Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA460	**Title of the Course**	DATA STRUCTURE AND ANALYSIS OF ALGORITHMS	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	CA453	**Co-requisite**	CA471				
Course Objectives	• To understand basics knowledge of data structure operations, algorithms and their application. • To understand the algorithms of Linked List and its type, Searching, Hashing and their application. • To design and implement the algorithms of linear data structure such as Queues, Stacks, Recursion and their application. • To understand basics of graphs, tree and their algorithms. • To learn various design techniques of algorithms and understand the real implementation of sorting, Greedy method and dynamic programming.						

Course Outcomes	
CO1	Analyze the problem and create appropriate algorithm
CO2	Understand basics knowledge of data structure operations like insertion, deletion etc for various data structure and their application.
CO3	Develop and implement various programs using C for linear data structure.
CO4	To understand basics of nonlinear data structure graphs, tree and their Algorithms.
CO5	To learn various Design Techniques of Algorithms and understand the real implementation of Sorting, Greedy Method and Dynamic Programming.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Introduction: Basic Terminology, Elementary Data Organization, Data Structure Operations, Arrays: Array Definition, Representation and Analysis, Single and Multidimensional Arrays, Address Calculation, Application of Arrays, Character String in C, Character String Operation, Array as Parameters, Sparse Matrices and Vector. Algorithm Analysis: Methodologies for Analyzing Algorithms, Asymptotic Notation, Growth of Functions, Recurrences: Substitution Method, Recursion Tree Method, Master's Theorem.	8	CO1
2	Linked List	Linked List: Introduction to Singly Linked List, Representation and Implementation of Singly Linked Lists, Types of Linked List, Circular and Doubly List, Operations of Linked List: Insertion, Deletion, Searching and Traversing of Linked List, Application of Linked List: Polynomial Representation and Addition Searching and Hashing: Sequential Search, Binary Search, Comparison and Analysis, Hash Table, Hash Function, Collision Resolution Strategies, Hash Table Implementation.	8	CO2
3	Queues	Queues: Array and Linked Representation and Implementation of Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular Queue, De-Queue and Priority Queue. Stacks: Array Representation and Implementation of Stack, Operations on Stacks: PUSH and POP, Linked Representation of Stack, Operations associated with Stacks, Application of Stack, Conversion of Infix to Prefix and Postfix Expressions, Evaluation of Postfix Expression using Stack. Recursion: Definition of Recursion, Principles of Recursion, Removal of Recursion, Tower of Hanoi Problem.	8	CO3
4	Trees	Trees: Basic Terminology, Binary Tree, Binary Tree Representation, Complete Binary Tree, Extended Binary Tree, Array and Linked Representation of Binary Trees, Traversing Binary Trees, Threaded Binary Trees, Application of Trees: Algebraic Expression Binary Search Trees: Binary Search Tree (BST), Insertion and Deletion in BST, Height Balancing Trees: AVL Tree, B-Trees. Elementary Graph Algorithms: Graphs: Terminology and Representations, Graphs & Multi-Graphs, Directed Graphs, Traversal of Graphs: Breadth First Search, Depth First Search. Minimum Spanning Trees: Kruskal and Prim's Algorithms.	8	CO4
5	Design Techniques	Design Techniques: Divide and Conquer, General Method, Strassen's Matrix Multiplication, Sorting: Insertion Sort, Bubble Sort, Quick Sort, Merge Sort, Heap Sort, Greedy Method: General Method, Knapsack Problem, Huffman Algorithm, Single Source Shortest Paths: Dijkstra's Algorithm, Bellman-Ford Algorithm. Dynamic Programming: General Method, Knapsack Problem, All Pair Shortest Paths: Floyd-Warshall Algorithm, Introduction to Backtracking	8	CO5

Reference Books:

1. Coreman, Rivest, Lisserson, "Algorithms", PHI.
2. A.M. Tenenbaum et aI, "Data Structures using C & C++", PHI.
3. Horowitz and Sahani, "Fundamentals of data Structures", Galgotia Publication
4. Horwitz and Sahani, "Fundamental of Computer Algorithm", Galgotia.
5. Brassard Brately, "Fundamental of Algorithms", PHI

e-Learning Source:

1. https://nptel.ac.in/courses/106102064
2. https://www.geeksforgeeks.org/data-structures/?ref=shm

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	1	3	3	2	2	2	1	1					1	2				
CO2	2	1		1		1	2						2	1				
CO3	1	1	3	2	3	1	2	1			1		2	1				
CO4	2	1		1		2	2						2	1				
CO5	2		2	2	1	1	2	1					2	1				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	CA461	**Title of the Course**	COMPUTER NETWORKS	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	• To understand the concepts of communicating channel in order to deal with the different transmission media. To learn different about the different approaches of networking through switching modes and different multiplexing techniques. • To learn the importance of IEEE standard to raise good results and modes to apply various protocols internally and externally in specified time domain. To deal with the problems arises due to channel allocation and ultimately to detect collisions so as to avoid them on priority basis. • To learn different models o transfer data through physical communicating medium with the help of routing algorithms. To analyze the features of different algorithms to find a short way to approach to the destination. • To understand significance of various layers in OSI as well as TCP/IP models to bring a data in segment form and to synchronize the interaction of source and destination using respective layers. • To draw elementary knowledge regarding different known systems that provide various characteristics, when number of protocols are applied to secure the data.						

Course Outcomes	
CO1	With a new approach of communication, a student shall be able to transfer data through respective medium; also he can opt various ways of networking using topologies. A student can also understand the difference between the time and frequency domain transmission in order to analyze various switching modes
CO2	For new IEEE standard, a student should overcome the previous phenomena for networking using different domains. He/ she should know the conditions regarding the channel allocations, collision detection and its avoidance
CO3	For a particular data transfer system, students shall be able to analyze which router is good for networking using different algorithms. A student shall able to differ between the approaches used in congestion control and protocols in network layer
CO4	He/she should be able to know the duties regarding respective layer. A student should be aware of the fact when to use TCP and when to use UDP for synchronization between hop points so that a student can analyze encryption and decryption techniques for proper data transfer
CO5	For securing data and a system, a student can evaluate different procedures and algorithms based on network security and he/she should learn about the protocols to used according to the format of data transfer.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introductory Concepts	Introductory Concepts: Goals and Applications of Networks, Network Structure and Architecture, OSI Reference Model, Network Topology, Physical Layer: Transmission, Switching Methods, Multiplexing, Introduction to Digital Communication: Line Coding Techniques	8	CO1
2	Medium Access Sub Layer	Medium Access Sub Layer: Channel Allocations, LAN Protocols, ALOHA Protocols, Carrier Sense Multiple Access Protocols, CSMA with Collision Detection, Collision Free Protocols, IEEE Standards (802.3, 802.4, 802.5, and 802.6), FDDI. Data Link Layer: Elementary Data Link Control Protocols, Sliding Window Protocols, Error Handling (Error-Correction and Detection), HDLC.	10	CO2
3	Network Layer	Network Layer: Point to Point Networks, Routing Algorithms, Congestion Control Algorithms, Leaky Bucket Algorithm. Internetworking: Overview, TCP/IP Model, Network Layer: IP Protocol, IP Addresses, IPv4, IPv6	8	CO3
4	Transport Layer	Transport Layer: Duties of Transport Layer, Connection Management, TCP Window Management, User Datagram Protocol, Transmission Control Protocol. Session Layer: Session and Transport Interaction, Synchronization Points, Session Protocol Data Unit. Presentation Unit: Translation, Encryption/ Decryption, Authentication, Data Compression.	8	CO4
5	Application Layer	Application Layer: Network Security, DES, RSA Algorithms, Domain Name System, Simple Network Management Protocol, Electronic Mail, File Transfer Protocol, Hyper Text Transfer Protocol, Cryptography and Compression Techniques.	6	CO5

Reference Books:

1. A. S. Tanenbaum, “Computer Networks, 3rd Edition”, PHI.
2. Forouzan, “Data Communication and Networking”, TMH.
3. W. Stallings, “Data and Computer Communication”, Macmillan Press.
4. Comer, “Computer Networks and Internet”, PHI.
5. Comer, “Internetworking with TCP/IP”, PHI.

e-Learning Source:

1. https://nptel.ac.in/courses/106105183
2. https://www.geeksforgeeks.org/basics-computer-networking/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	2	1			1	1							2	1				
CO2	1		1	2	1								2	1				
CO3	2	3		1	1	1		1					1	2				
CO4	1	2	2	1		2	1						2	1				
CO5		1	1	2	1	2		1					2	2				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	CA462	**Title of the Course**	DISTRIBUTED SYSTEM	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	• To understand distributed system architecture and also the limitations in designing the distributed operating systems along with its proposed solution. • To study distributed operating system concepts for Mutual exclusion and Deadlock handling algorithms and agreement protocols. • To study basics of agreement problem along with its solution and understand the concepts of distributed file system. • To know and implement the algorithms for distributed shared memory management and understand the concepts of load scheduling in distributed operating system. • To study communication in distributed system along with communication protocols in a broader sense.						

Course Outcomes	
CO1	Students will attain knowledge with distributed system architecture, design and its implementation.
CO2	Learn mutual exclusion and Deadlock management in distributed system.
CO3	Learn use of agreement protocols in distributed system and distributed file system management.
CO4	Learn different resource management techniques like distributed shared memory and scheduling for distributed systems.
CO5	Learn routing algorithms and their applicability in distributed system.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Distributed Systems	Introduction to Distributed Systems: Introduction, System Architecture, Issues in Distributed System, Global Knowledge, Naming, Scalability, Compatibility, Process Synchronization, Security, Theoretical Foundation for Distributed Systems. Limitation of Distributed Systems: Absence of Global Clock and Shared Memory, Lampert's Logical Clock, Vector Clocks, Causal Ordering of Messages, Global State, Termination Detection.	9	CO1
2	Distributed Mutual Exclusion	Distributed Mutual Exclusion: Introduction, Classification of Mutual Exclusion Algorithms, Requirement of Mutual Exclusion Algorithms, Non Token Based and Token Based Algorithms, Comparative Performance Analysis. Distributed Deadlock Detection: System Model, Resource Vs Communication Deadlock, Deadlock Handling Strategies: Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Resolution, Centralized and Distributed Deadlock Detection Algorithms.	9	CO2
3	Agreement Protocols	Agreement Protocols: Introduction, System Model. Classification of Agreement Problem: Byzantine Agreement Problem, Consensus Problem, Interactive Consistency Problem, Solution to Byzantine Agreement Problem, Application of Agreement Problem. Distributed File Systems: Introduction, Architecture, Building Mechanism: Mounting Caching, Hints, Bulk Data Transfer, and Encryption. Design Issues: Naming and Name Resolution, Caches on Disk or Main Memory, Writing Policy.	9	CO3
4	Distributed Shared Memory	Distributed Shared Memory: Introduction, Architecture and Motivation, Algorithm for Implementing DSM, Memory Coherence, Coherence Protocols. Distributed Scheduling: Issues in Load Distribution, Component of Load Distribution Algorithms, Load Distribution Algorithms, Performance Comparison, Task Migration, Introduction to Fault Tolerance, Data Security, Encryption, Multiprocessor Operating Systems.	9	CO4
5	Distributed Algorithms	Distributed Algorithms: Introduction to Communication Protocols, Balanced Sliding Window Protocol, Routing Algorithms, Destination Based Routing, APSP Problem, Deadlock Free Packet Switching, Introduction to Wave and Traversal Algorithms, Election Algorithms.	8	CO5

Reference Books:

1. Singhal, Shivratri, "Advanced Concept of Operating Systems", TMH.
2. Colourisis, "Distributed Systems", Addison Wesley.

e-Learning Source:

1. https://www.geeksforgeeks.org/what-is-a-distributed-system/
2. https://nptel.ac.in/courses/106106168

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	1									2	1				
CO2	1	2	1	1	1	1	1	1					2	1				
CO3	1	1	2	2	1	1	1						2	1				
CO4	2	2		2	1		1						2	1				
CO5	1	2	2	1	2			1					2	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA463	**Title of the Course**	DATABASE MANAGEMENT SYSTEM	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	CA472				
Course Objectives	• To learn the basic knowledge of Database Management System and various types of data models. • To learn the concept and syntax of ER Diagram and the extended ER features. • To learn various constraints and writing SQL queries. • To learn the basic structure of Oracle system. • To learn the concept of Normalization. • To learn the concept of Lossless decomposition and dependency preservation. • To learn the various issues in transaction processing and recovery system. • To learn the various techniques for concurrency control in Databases. • To learn the concepts and applications of Object-oriented DBMS (OODBMS).						

Course Outcomes	
CO1	Understand the basic concepts of DBMS and ER Model and How to draw ER Diagrams.
CO2	Define constraints, writing queries using SQL syntax, applying the Relational algebra and Calculus to define expressions for queries in Databases.
CO3	Understand the purpose of Normalization to solve the problem of redundancy in tables and defining various Normal forms.
CO4	Understand the concepts of transactions, their processing to become familiar with issues like data integrity, security and recovery.
CO5	Understand the various Concurrency Control techniques and concepts of Object Oriented databases.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Introduction: An Overview of Database Management System, Database System Vs. File System, Database System Concepts and Architecture, Data Models Schema and Instances, Data Independence, Database Language and Interfaces, Data Definitions Language and Data Manipulation Language, Overall Database Structure. Data Modeling Using the Entity-Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model.	8	CO1
2	Relational Data Model and Language	Relational Data Model and Language: Relational Data Model Concepts, Integrity Constraints: Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra and Relational Calculus, Tuple and Domain Calculus. Introduction To SQL: Characteristics of SQL, Advantages of SQL, SQL Data Types and Literals, Types of SQL Commands, SQL Operators and their Procedure, Tables, Views, Indexes, Queries and Sub Queries, Aggregate Functions, Insert, Update and Delete Operations, Joins, Union, Intersection, Minus, Cursors, Triggers and Procedures in SQL, PL/SQL.	8	CO2
3	Database Design and Normalization	Database Design and Normalization: Functional Dependencies, Normal Forms, First, Second, Third Normal Forms, BCNF, Fourth Normal Form, Fifth Normal Form, Inclusion Dependencies, Lossless Join Decompositions, Normalization using FD, MVD and JDs, Alternative Approaches to Database Design.	8	CO3
4	Transaction Processing Concepts	Transaction Processing Concepts: Transaction System, Testing of Serializability, Serializability of Schedules, Conflict and View Seralizable Schedule, Recoverability, Recovery from Transaction Failures, Log-Based Recovery, Checkpoints, and Deadlock Handling.	8	CO4
5	Concurrency Control Techniques	Concurrency Control Techniques: Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi-Version Schemes, Recovery with Concurrent Transaction, Overview of Concurrency Control in Distributed Database, Basic Architecture and Case Study of Oracle. Object-Oriented Database: Introduction, Object-Oriented Database Concepts, Application of OODBMS, Comparison with RDBMS.	8	CO5

Reference Books:

1. Date C.J., "An Introduction to Database System", AddisonWesley.
2. Korth, Silbertz, Sudarshan, "Database Concepts", McGrawHill.
3. Elmasri, Navathe, "Fundamentals of Database Systems", Addison Wesley.
4. Majumdar& Bhattacharya, "Database Management System", TMH.

e-Learning Source:

1. https://nptel.ac.in/courses/106105175
2. https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	1	1	1	2						2	1				
CO2	2		1	2	2		1						2	2				
CO3	3	1	2		2	1	2	1					2	1				
CO4	2	1	1	1	1		1						2	1				
CO5	2	2		2	1	1		1					2	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA464	**Title of the Course**	OBJECT ORIENTED PROGRAMMING USING JAVA	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	CA473				
Course Objectives	● To get familiar with Java programming and to understand the importance of Classes and objects along with constructors, Arrays and Vectors. ● To learn basics of graphical user interfaces-based programming in Java using Applet, AWT and SWING that respond to different user events. ● To study the Java Database Connectivity (JDBC) to access database through Java programs. To study the Remote Method Invocation (RMI) based Client Server application. ● To learn the multi-tier architecture of web-based enterprise applications using Enterprise JavaBeans (EJB) and understanding of Stateful, Stateless and Entity Beans. ● To learn the server-side programming in the forms of Java Server pages (JSP) and Servlets.						

Course Outcomes	
CO1	Able to design and implement programs in the Java programming language that make strong use of classes and objects.
CO2	Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
CO3	Learn to access database Connectivity (JDBC).
CO4	Understand the multi-tier architecture of web-based enterprise applications using Enterprise JavaBeans (EJB) and development of stateful, Stateless and Entity Beans.
CO5	Expected to complete a project involving the design of a fairly complex Java program that consists of a GUI and utilizes at least two of the advanced programming areas.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Object Oriented System	Introduction to Object Oriented System: Object Oriented Concepts, Modelling as a Design Technique, Modelling Concepts, The Three Models, Object Model, Dynamic Model and Functional Model. Core Java: Introduction, Operators, Data Type, Variable, Arrays, Control Statements, Methods and Classes, Inheritance.	8	CO1
2	Core Java	Core Java: Package and Interface, Exception Handling, Multithread Programming and String Handling. Java Applets: Java Applet, Introduction to AWT, AWT Controls, Layout Managers, Menus, Images, Graphics, Event Handling, Networking.	8	CO2
3	Java Swings	Java Swings: Creating a Swing Applet and Applications, Programming using Panes, Scroll Panes, Layered Panes, Tabbed Panes, Split Panes, Swing Controls Labels, Text Fields, Buttons, Toggle Buttons, Checkboxes, Radio Buttons, View Ports, Scroll Bars, Lists, Combo Box, Progress Bar, Menus and Toolbars, Layouts, Dialog Boxes, Inner Frame.	8	CO3
4	JDBC	JDBC: The Connectivity Model, JDBC Drivers, Java SQL Package, Connectivity to Remote Database, Navigation in Database. RMI: Introduction to RMI (Remote Method Invocation), A simple Client-Server Application using RMI.	8	CO4
5	EJB	EJB: Introduction to Enterprise Java Beans (EJB), Session Beans, Entity Beans and Message Beans. Java Servlets: Servlet Basics, Servlet API Basic, Life Cycle of a Servlet, Running a Servlet, Cookies, Introduction to Java Server Pages (JSP).	8	CO5

Reference Books:

1. Margaret Levine Young, “The Complete Reference Internet”, TMH.
2. Naughton, Schildt, “The Complete Reference JAVA2”, TMH.
3. Balagurusamy E, “Programming in JAVA”, TMH.
4. Dustin R. Callway, “Inside Servlets”, Addison Wesley.

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc22_cs47/
2. https://nptel.ac.in/courses/101105077

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																		
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	1	1	1	2						2	1				
CO2	2		1	2	2		1						2	2				
CO3	3	1	2		2	1	2	1					2	1				
CO4	2	1	1	1	1		1						2	1				
CO5	2	2		2	1	1		1					2	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA465	**Title of the Course**	DATA WAREHOUSING AND DATA MINING	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	● To provide the understanding of data warehousing in terms of components, architecture, models and concepts. ● To explore the knowledge of mapping between operational database, data warehousing and business analytics using various analytical tools. ● To provide knowledge of data mining used various applications such as multimedia web mining and retrieval of information for decision making in business. ● Provide the view for increasing the data quality, recognition, find & speedup data extraction and adjustable reporting. ● Provide the skill for finding the hidden pattern, co-relational study, prediction and structure the unstructured data.						

Course Outcomes	
CO1	Understanding the concept of data warehousing in terms of components, architecture and major aspects.
CO2	Learning of proper mapping between operational database and data warehouse and to identify hidden pattern, co-relational study.
CO3	Find the ability for finding information and take decision for enhancing the business with intelligence.
CO4	Learning of various methods of data mining such Artificial Neural Network, Web mining and multimedia mining.
CO5	Get the view for increasing the data quality, recognition, find & speedup data extraction and adjustable reporting for better business decision.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Data Warehousing,	DSS Uses, Definition, Operational Database, Introduction to Data Warehousing, Data Mart, Concept of Data Warehousing, Multi Dimensional Database Structures, Client/Server Computing Model and Data Warehousing, Parallel Processors and Cluster Systems, Distributed DBMS Implementations.	8	CO1
2	Data Warehousing Components	Data Warehousing, Data Warehousing Components, Building a Data Warehouse, Warehouse Database, Mapping the Data Warehouse to a Multiprocessor Architecture, DBMS Schemas for Decision Support, Data Extraction, Cleanup and Transformation Tools, Metadata.	8	CO2
3	Reporting and Query Tools,	Business Analysis, Reporting and Query Tools, Applications, Online Analytical Processing (OLAP), Patterns and Models, Statistics, Artificial Intelligence.	8	CO3
4	Knowledge Discovery,	Knowledge Discovery, Data Mining, Introduction to Data Mining, Techniques of Data Mining, Decision Trees, Neural Networks, Nearest Neighbor and Clustering, Genetic Algorithms, Rule Introduction, Selecting and using the Right Technique.	8	CO4
5	Multimedia Data Mining	Multimedia Data Mining, Multimedia Databases, Mining Multimedia Data, Data Mining and the World Wide Web, Web Data Mining, Mining and Meta Data, Data Visualization and Overall Perspective, Data Visualization, Applications of Data Mining	8	CO5

Reference Books:

1. Berson, “Data Warehousing, Data-Mining and OLAP”, TMH.
2. Mallach, “Decision Support And Data Warehousing System”, TMH.
3. Bhavani Thura-Is-Ingham, “Data-Mining Technologies, Techniques Tools and Trends”, CRC Press.
4. Navathe, “Fundamental of Database System”, Pearson Education.
5. Margaret H. Dunham, “Data-Mining. Introductory and Advanced Topics”, Pearson Education.
6. Pieter Adriaans, Dolf Zantinge, “Data-Mining”, Pearson Education.

e-Learning Source:

1. https://nptel.ac.in/courses/106105174
2. https://www.geeksforgeeks.org/data-warehousing/

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1		2	1	2	1						2	1				
CO2	2	1	1	3		1	1	1			1		2	1				
CO3	2	1	1	2	1		2						2	2				
CO4	1	3	2	2	1	2	2	1					2	1				
CO5	1	1		3		2	2				1		1	2				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA466	**Title of the Course**	DATA SCIENCE	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	● To learn, understand, and practice basic concept of data science and data analytics. ● To conceptualize and summarize data using appropriate data modeling approach. ● To learn and implement various machine learning approach using programming language. ● To develop proficiency with statistical analysis of data. ● To apply data science concepts and methods to solve problems in real-world contexts.						

Course Outcomes	
CO1	Ability to analyze and identify best practices to handle data science.
CO2	Ability to identify the characteristics of datasets and apply appropriate data model to handle data for various applications.
CO3	Ability to select and implement machine learning techniques for the various applications using appropriate programming language.
CO4	Ability to implement various data analytics techniques to analyze the data.
CO5	Ability to recognize and implement various ways of selecting suitable model for text mining by using suitable mathematical and statistical tools.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Data Science	Introduction to Data Science: Basic terminology, Why data science, Defining data science, The data science Venn diagram, Benefits and uses of data science, Data science case studies. Data Science Road Map: Recognizing the different types of data: Structured, Unstructured, Natural language, Machine-generated, Graph-based, Audio, video, and images, Streaming. Levels of Data: Nominal level, Ordinal level, Interval level, Ratio level.	8	CO1
2	The Data Science Process	The Data Science Process: Overview and steps of the data science process: Setting the research goal, Retrieving data, Data preparation, Data exploration, Data modeling or model building, Presentation and automation, Case Study: Global Innovation Network and Analysis (GINA). Handling Large Data: Problems in handling large data, General techniques for handling large volumes of data, General programming tips for dealing with large data sets.	8	CO2
3	Machine Learning	Machine Learning: Define machine learning, Applications for machine learning in data science, Use of machine learning in the data science process, Modeling process used in machine learning, Types of machine learning, Case study. Programming Languages for Data Science: Python, R programming, MATLAB, Octave, SAS, Scala, General programming tips for dealing with large data sets, why use a programming language? Basic Mathematics Used in Data Science: Basic symbols/terminology, Logarithms/exponents, Set theory, Calculus, Matrix (linear) algebra.	8	CO3
4	Basic Data Analytic Methods	Basic Data Analytic Methods: Exploratory data analysis: Visualization before analysis, Dirty data, visualizing a single variable, Examining multiple variables, Data exploration versus presentation. Statistical Methods for Evaluation: Hypothesis Testing, Difference of Means, Type I and Type II Errors, ANOVA Advanced Analytical Methods: Regression Analysis: Linear regression, Logistic regression, Reasons to choose and cautions, Additional regression models.	8	CO4
5	Text Mining and Text Analytics	Text Mining and Text Analytics: Importance of text mining, Text mining in the real world, Applications text mining, Text mining techniques: Bag of words, Stemming and lemmatization, Decision tree Classifier, Case study: Classifying Reddit posts. Advanced Analytical Methods for Text Analysis: Text analysis Steps, A text analysis example, Collecting raw text. Representing text, Term frequency— (TFIDF), Categorizing documents by topics, Determining sentiments.	8	CO5

Reference Books:

1. Davy cielen, Arno D. B. Meysman and Mohamed Ali, “Introducing Data Science”, Manning Publications Co.
2. SinanOzdemir, “Principles of Data Science”, Packt Publishing Ltd.
3. David Dietrich, Barry Heller and Beibei Yang,“Data Science & Big Data Analytics”, John Wiley & Sons, Inc.
4. T. H. Davenport and D. J. Patil, “Data Scientist: The Sexiest Job of the 21st Century,” Harvard Business Review, October 2012.

e-Learning Source:

1. http://en.wikipedia.org/wiki/Scientific_method.
2. http://www.rproject.org/Licenses/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1		1		2	1						1	2				
CO2	3	1		2	1	1	2		1				2	1				
CO3	1	2	3	2	2	1	2	1			1		2	1				
CO4	2	1		2		2	2	1			1		2	2				
CO5	1	3	3	2	2	2	1	2			1		2	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA467	**Title of the Course**	ERP SYSTEMS	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	● To learn the need and evolution of ERP Systems and related technologies. ● To learn ERP benefits and classification and implementation of ERP Life Cycle. ● To learn Analytical Hierarchy Process & its applications and ERP implementation approaches and its strategies. ● To learn factors affecting ERP success and effectiveness. ● To learn extend ERP and its learning and emerging issues.						

Course Outcomes	
CO1	Make basic use of enterprise software and its role in integrating business functions and also create reengineered business processes for successful ERP implementation.
CO2	Analyze the strategic options for ERP identification and adoption and classify different processes of the organization.
CO3	Design the ERP implementation strategies and to be able to map business processes using process mapping techniques.
CO4	To understand management concern for ERP Success and its useful guidelines for proper implementations.
CO5	To demonstrate knowledge of SAP and Oracle Apps.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Enterprise-wide Information System	Enterprise-wide Information System, Custom Built and Packaged Approaches, Needs and Evolution of ERP Systems, Common myths and evolving realities, ERP and related Technologies, Business Process Reengineering and Information Technology, Supply Chain Management, Relevance to Data Warehousing, Data Mining and OLAP, ERP Drivers, Decision support system.	8	CO1
2	ERP	ERP Domain, ERP Benefits Classification, Present Global and Indian Market Scenario, Milestones and Pitfalls, Forecast, Market Players and Profiles, Evaluation Criterion for ERP Product, ERP Life Cycle: Adoption Decision, Acquisition, Implementation, Use and Maintenance, Evolution and Retirement phases, ERP Modules.	8	CO2
3	Framework for evaluating ERP acquisition	Framework for evaluating ERP acquisition, Analytical Hierarchy Processes (AHP), Applications of AHP in evaluating ERP, Selection of Weights, Role of consultants, Vendors and users in ERP implementation; Implementation vendors evaluation criterion, ERP Implementation approaches and methodology, ERP implementation strategies, ERP Customization, ERP-A manufacturing Perspective.	8	CO3
4	Critical Success and Failure Factors for Implementation	Critical Success and Failure Factors for Implementation, Model for Improving ERP Effectiveness, ROI of ERP Implementation, Hidden Costs, ERP Success Inhibitors and Accelerators, Management concern for ERP success, Strategic Grid, Useful guidelines for ERP Implementations.	8	CO4
5	Technologies in ERP Systems	Technologies in ERP Systems and Extended ERP, Case Studies of Development and Analysis of ERP Systems, Implementations in focusing the various issues discussed in above units through Soft System approaches or qualitative Analysis tools, Learning and Emerging Issues, ERP and E-Commerce.	8	CO5

Reference Books:

1. Lexis Leon, “Enterprise Resource Planning”, TMH.
2. Brady, Manu, Wegner, “Enterprise Resource Planning”, TMH.

e-Learning Source:

1. https://nptel.ac.in/courses/110105148
2. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-mg20/

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	2	1	2	1		1	2				1		2	1				
CO2	1	3	1	2		1	1	1					1	2				
CO3		1	3	1	2	2	1	1			1		2	1				
CO4	2		3	1	1		2						2	1				
CO5	1		2	2	3	1					1		2	2				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA468	**Title of the Course**	STORAGE TECHNOLOGY AND MANAGEMENT	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	● To study the basic concepts of storage technology and its components. ● To understand the storage system architecture and Physical/Logical disk organization. ● Study storage technologies: SAN, NAS, IP storage etc., which will bridge the gap between the emerging trends in industry and academics. ● To learn the concepts of information availability and business continuity at the time of disaster. ● To study managing and monitoring of storage through industry standards and metrics by the application of various tools.						

Course Outcomes	
CO1	Students will analyze the limitations of the client-server architecture and evaluate the need for data protection and storage centric architectures such as Intelligent storage system.
CO2	Students will be able to do memory mapping and operations based on RAID.
CO3	Students will understand, interpret and examine various SAN, DAS, CAS, NAS technologies.
CO4	Students will understand and evaluate different SAN management strategies to fulfill business continuity requirements.
CO5	Students will classify the applications as per their requirements and select relevant solutions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Storage Technology	Introduction to Storage Technology: Data Proliferation and the varying value of Data with time and usage, Sources of Data and States of Data Creation, Data Center need and its requirements, Evolution of Storage, Overview of basic Storage Management skills and activities, The five pillars of Technology, Overview of Storage Infrastructure Components, Information Lifecycle Management Concept, Data Categorization within an Enterprise.	8	CO1
2	Storage Systems Architecture	Storage Systems Architecture: Intelligent Disk Subsystems Overview, Contrast of Integrated vs. Modular Arrays, Component Architecture of Intelligent Disk Subsystems, Disk Physical Structure Components, Properties, Performance and Specifications, Logical partitioning of Disks, RAID and Parity Algorithms, Hot Sparing, Physical vs. Logical Disk Organization, Protection and Back End Management, Array Caching Properties and Algorithms, Front End Connectivity and Queuing properties, Front End to Host Storage Provisioning, Mapping and Operation, Interaction of File Systems with Storage, Storage System Connectivity Protocols.	8	CO2
3	DAS (Direct Attached Storage)	DAS (Direct Attached Storage): Elements, Connectivity and Management. NAS (Network Attached Storage): Elements, NFS, CiFS, FTP, Filers and Appliances, Configuration and Management. SAN (Storage Area Network): Elements, FCP, ISCSI, FCIP, SAN Configuration and Management. CAS (Content Addressable Storage): Elements, Connectivity and Management Storage Interfaces: SCSI, SATA, IDE, Storage Virtualization at various layers, HA Solutions, Advantages and uses.	8	CO3
4	Introduction to Information Availability	Introduction to Information Availability: Business Continuity and Disaster Recovery Basics, Local Business Continuity Techniques, Remote Business Continuity Techniques, Disaster Recovery Principles and Techniques.	8	CO4
5	Managing and Monitoring	Managing and Monitoring: Management Philosophies (Holistic vs. System and Component), Industry Management Standards (SNMP, SMI-S, CIM), Standard Framework Applications, Key management Metrics (Thresholds, Availability, Capacity, Security, Performance), Metric analysis Methodologies and Trend Analysis, Reactive and Pro-active Management Best Practices, Provisioning and Configuration Change Planning, Problem Reporting, Prioritization and Handling Techniques, Management Tools Overview.	8	CO5

Reference Books:

1. Barry Mellish , Jure Arzensek, Christian Demmer, “Fiber Array Storage Technology A FAST Introduction”, Noam Rosen Publisher: IBM Redbooks.
2. Greg Schulz, “Resilient Storage Networks: Designing Flexible Scalable Data Infrastructure” ,Greg Schulz Publisher: Elsevier Science and Technology Books.

e-Learning Source:

1. https://nptel.ac.in/courses/106108058
2. https://www.geeksforgeeks.org/storage-management/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
PSO CO																		
CO1	1	3	1	2	1	2	1						1	2				
CO2	2		1	1	2	1	2				1		1	1				
CO3	2	2	1	2	1	2	1	1					2	2				
CO4	2	1		2		1	2	1			1		2	2				
CO5	1	1		3	1	2	1						1	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA469	**Title of the Course**	AUTOMATA THEORY	**L**	**T**	**P**	**C**
Year	1	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	• To learn the concepts of the finite automata, and automata with their output. • Learn the concepts of regular expression and grammars. • Able to understand the notations of CFG. • Know the basic concept of the pushdown automata. • Know the basic concept of the Turing machines and recursive function.						

Course Outcomes	
CO1	Analyze and design the finite automata, Mealy and Moore machine with their output.
CO2	Understands the regular expression, formal languages, and grammars.
CO3	Demonstrate the understanding notations of context free grammar.
CO4	To analyze and design the pushdown automata.
CO5	To understand the design of Turing machines and recursive function.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction of Automata	Introduction of Automata: Definition, Description of a Finite Automata, Alphabet, Symbol, String, Formal Languages, Deterministic Finite Automaton (DFA) and Representation, Acceptability of a String and Language, Non-Deterministic Finite Automaton (NFA), Equivalence of DFA and NFA, NFA with ε-Transition, Equivalence of NFA's with and without ε-Transition. Finite Automata with output: Moore Machine, Mealy Machine, Equivalence of Moore and Mealy Machine, Minimization of Finite Automata.	8	CO1
2	Regular Expressions and Languages	Regular Expressions and Languages: Regular Expressions, Transition graph, Kleen's theorem, Finite Automata and regular expression- Arden's theorem, Algebraic method Using Arden's theorem, Construction of finite automata Equivalent a regular expression, Equivalence of two regular expression, Pumping Lemma, Application of Pumping Lemma, Regular sets and regular grammar.	8	CO2
3	Context Free Grammar (CFG)-	Context Free Grammar (CFG)-Definition, Derivations, Languages, Derivative trees and ambiguity, Construction of reduced grammars, Elimination of null production, Elimination of unit production, Conversion of FA into CFG and Regular grammar into FA, Normal Forms- Chomsky Normal Form (CNF), Greibach Normal Form (GNF), Chomsky hierarchy.	8	CO3
4	Push Down Automata (PDA)	Push Down Automata (PDA): Definition, Acceptance by PDA, Push Down automat for context languages, Context Free grammars (CFG) for pushdown automata, Two stack pushdown automata, Pumping Lemma for CFL, Closure properties of CFL, Decision problems of CFL, Programming problems based on the properties of CFLs.	8	CO4
5	Turing Machines and Recursive Function	Turing Machines and Recursive Function: Basic Turing machine model, Representation of Turing machines, Language acceptability of Turing machines, Techniques for Turing machine construction, Modifications of Turing machine, Turing Machine as computer of integer functions, Universal Turing machine, recursively enumerable language, Post's Correspondence Problem, Introduction to recursive function theory.	8	CO5

Reference Books:

1. E.Hopcraft, R.Motwani, and Ullman," Introduction to Automata theory, Languages and Computation", 2nd edition, Pearson Education Asia, 2001.
2. J. C. Martin, "Introduction to languages and the theory of computation", 3rd Edition, Tata McGraw Hill Education, New Delhi, 2013.
3. K.L.P. Mishra and N. Chandrasekaran," Theory of Computer Science Automata, Languages and Computation", 3rd edition, PHI LearningPrivate Limited, New Delhi, 2012
4. Y.N.Singh,"Mathematical Foundation of Computer Science", New Age InternationalPrivate Limited, 2005.

e-Learning Source:

1. https://nptel.ac.in/courses/106106049
2. https://onlinecourses.nptel.ac.in/noc21cs19/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO																		
CO1	1	3	3	1	2	1	1	1					2	2				
CO2	3	1		2		2	2						2	1				
CO3	1	2	1	3		1	1	1			1		2	1				
CO4	1	3	3	2	3		1	1					1	2				
CO5	3	1	1	1		2	2						2	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA470	**Title of the Course**	ANDROID PROGRAMMING	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	• This course facilitates classroom and laboratory learning. • Letting students develop competence and confidence in android programming. • Understand the entire Android Apps Development Cycle. • Enable the students to independently create Android Applications. • Access and work with databases under the Android operating system.						

Course Outcomes	
CO1	Use the development tools in the Android development environment.
CO2	Use the major components of Android API set to develop their own apps.
CO3	Describe the life cycles of Activities, Applications and Fragments.
CO4	Use the Java programming language to build Android apps.
CO5	Make UI-rich apps using all the major UI components.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Basic of Android Programming	Basic of Android Programming: Introduction to Android OS, Flavors of Android operating systems, setting up the Android Application Development Environment, Creating, Testing and Debugging Applications, Android Stack, Android applications structure, Challenges of developing for Android, Activity life cycle: Activity lifecycle callback methods, Activity instance state, Understanding implicit and explicit intents.	8	CO1
2	User Interface in Android	User Interface in Android: Adaptive and responsive user interfaces, User Input Controls: Getting user input , Changing keyboards , Buttons , Dialogs and pickers , Spinners, checkboxes, and radio buttons , Gestures , Speech recognition, Sensors, Menus: Options menu, contextual menus, and popup menu, Adding menu items, Handling on Clicks from menus, Screen Navigation: Different ways a user can navigate through an app, Action bar, Settings menu, Navigation drawer, Directed workflow, Recycler View,Themes and Styles: Best practices for themes and styles, Performance benefits for themes, Fragments: Fragment Life Cycle, Introduction to Material Design, Testing the user interface.	8	CO2
3	Background tasks	Background tasks: AsyncTask, AsyncTaskLoader: Introduction to Async Task Loader, load In Background(), Async Task Loader callbacks, Benefits of loaders, Connecting App to Internet, Broadcast receivers: Broadcast Receiver and Broadcast Intent, Broadcast Receiver Security and Lifecycle, Services: Difference between Activity and Service , Start and 10 stop services, Lifecycle methods, Foreground services, Intent Service class, App priority (critical, high, low), Notifications: Notification Design Guidelines, Alarm managers	8	CO3
4	Sensor, Location and Maps	Sensor, Location and Maps: Sensor Basic, Motion and Position Sensors, Location services, Google maps API, Google Places API. Working with data in Android: Shared Preferences, App Setting, SQLite primer, Store data using SQLite database, Content Providers, Content Resolver, Loader	8	CO4
5	Performance Improvement of App	Performance Improvement of App: Performance Parameters, Profiling Tools, Rendering and Layout, Garbage Collection and Memory Leaks, Best Practices. Publishing Your App: Preparing for publishing, Signing and preparing the graphics, Publishing to the Android Market	8	CO5

Reference Books:

1. J.F. DiMarzio, “Android: A Programmer’s Guide”, McGraw-Hill Education; 1 Editio
2. Ian G. Clifton, “Android User Interface Design: Turning Ideas and Sketches into Beautifully Designed Apps”, Addison-Wesley Professional
3. Reto Meier, “Professional Android 4 Application Development”, Wrox Publications

e-Learning Source:

1. https://onlinecourses.swayam2.ac.in/nou21_ge41/
2. https://nptel.ac.in/courses/106106147

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1		1	3	2	3	2	1						2	1				
CO2	1	2	3	2	2	1	2	1					2	1				
CO3	2	1		1		2	1						2	1				
CO4	1	1	3	2	3	1		1					2	1				
CO5	2	1	1		2	1							1	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA471	**Title of the Course**	DATA STRUCTURE AND ALGORITHMS LAB	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	0	0	3	2
Pre-Requisite	NONE	**Co-requisite**	CA460				
Course Objectives	• To understand basics knowledge of data structure operations, algorithms and their application. • To understand the algorithms of Linked List and its type, Searching, Hashing and their application. • Design and implement the algorithms of linear data structure such as Queues, Stacks, Recursion and their application. • To understand basics of graphs, tree and their algorithms. • To learn various design techniques of algorithms and understand the real implementation of sorting, Greedy method and dynamic programming.						

Course Outcomes	
CO1	Analyze the problem and create appropriate algorithm.
CO2	Understand basics knowledge of data structure operations like insertion, deletion etc for various data structure and their application.
CO3	Develop and implement various programs using C for linear data structure.
CO4	To understand basics of nonlinear data structure graphs, tree and their Algorithms.
CO5	To learn various Design Techniques of Algorithms and understand the real implementation of Sorting, Greedy Method and Dynamic Programming.

Unit No.	**Title of the Experiments**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Experiment-1	Implementing Concept of Sorting Using C Programming Language, Program to demonstrate the working of Bubble sort, Insertion sort, Selection sort, Program to demonstrate the working of Merge sort., Program to demonstrate the working of Quick sort., Program to demonstrate the working of Heap sort.	3	CO1
2	Experiment-2	Implementing Concept of Searching Using C Programming Language Program to demonstrate the working of Linear Search. Program to demonstrate the working of Binary Search.	3	CO2
3	Experiment-3	Implementing Concept of Linear Data Structure C Using Programming Language Program to demonstrate array implementation of Stack, Queue, Circular Queue, and Linked List. Program to demonstrate Implementation of Stack, Queue, Circular Queue, and Linked List using Dynamic Memory Allocation.	6	CO3
4	Experiment-4	Implementing Concept of Non-Linear Data Structure Using C Programming Language Program to demonstrate the working of Binary tree		CO4
5	Experiment-5	Program to demonstrate the working of Tree Traversals (Preorder, In order, Post order). Program to demonstrate the working of Graph Traversal (BFS, DFS).	3	CO5

Reference Books:

1. Coreman, Rivest, Lisserson, “Algorithms”, PHI.
2. Horowitz and Sahani, "Fundamentals of data Structures", Galgotia Publication.

e-Learning Source:

1. https://nptel.ac.in/courses/106102064
2. https://www.geeksforgeeks.org/fundamentals-of-algorithms/?ref=shm

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	1	3	3	2	2	2	1	1					2	1				
CO2	2	1		1		1	2						1	2				
CO3	1	1	3	2	3	1	2	1			1		2	1				
CO4	2	1		1		2	2						2	1				
CO5	2		2	2	1	1	2	1					2	2				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA472	**Title of the Course**	DBMS LAB	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	0	0	3	2
Pre-Requisite	NONE	**Co-requisite**	CA463				
Course Objectives	• To explain basic database concepts like creating database, tables and Insertion, Deletion, Updating and Retrieval of data from the tables. • To demonstrate the use of constraints, relational algebra operations and Grouping (Group by clause, Having Clause). • To familiarize with Introduction of PL/SQL, PL/SQL character set & Data Types, Executing PL/SQL. Control structure Conditions and Loops. • To develop an understanding of Procedures and Functions (Definition, creating, Parameters), Concept of Cursors and Trigger. • To demonstrate the concept of Indexing, Views, Rollback, Commit, Grant and Revoke Permission.\						

Course Outcomes	
CO1	Create Databases, tables and query a database using SQL DML/DDL commands.
CO2	Demonstrate the use of constraints, relational algebra operations and Grouping.
CO3	Develop PL/SQL programs using control statements and loops.
CO4	Develop an understanding of Procedures and Functions (Definition, creating, Parameters), Concept of Cursors and Trigger.
CO5	Understand the concept of Indexing, Views, Rollback, Commit, Grant and Revoke Permission.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Experiment-1	Overview of RDBMS, Create Table, Drop Table, Delete Table, Alter and Truncate Table commands.	3	CO1
2	Experiment-2	Insertion, Deletion, Updating and Retrieval of data, Operators, Expressions, Where Clause, AND & OR Clauses.	3	CO1
3	Experiment-3	Like Clause, Order By, Group By, Having Clause, Distinct Keyword, Functions (Aggregate and Scalar).	3	CO2
4	Experiment-4	Constraints, Joins, Union Clause, NULL Values, Alias Syntax.	3	CO2
5	Experiment-5	PL/SQL - Introduction of PL/SQL, Advantages of PL/SQL, PL/SQL character set & Data Types, Executing PL/SQL.	3	CO3
6	Experiment-6	Control structure Conditions and Loops.	3	CO3
7	Experiment-7	Procedures and Functions- Definition, creating, Parameters.	3	CO4
8	Experiment-8	Concept of Cursors and Triggers.	3	CO4
9	Experiment-9	Concept of Indexing and Views.	3	CO5
10	Experiment-10	Concept of Rollback and Commit, Grant and Revoke Permission.	3	CO5

Reference Books:

1. Date C.J., "An Introduction to Database System", AddisonWesley.
2. Korth, Silbertz, Sudarshan, "Database Concepts", McGrawHill.

e-Learning Source:

1. https://nptel.ac.in/courses/106105175
2. https://onlinecourses.nptel.ac.in/noc20_cs03/

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	1	1	3	2	3	2	1						2	1				
CO2	2	1	2	1	2	1		1					2	2				
CO3	1	1	3	2	3	2	1	1			1		2	1				
CO4	2	1	2	2		1	2						1	1				
CO5	3	1		1	1	1	2						2	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	CA473	**Title of the Course**	JAVA LAB	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	0	0	3	2
Pre-Requisite	NONE	**Co-requisite**	CA464				
Course Objectives	• To introduce the object-oriented programming concepts using JAVA and apply them in solving problems. • Gain knowledge about the principles of inheritance, polymorphism, exception handling, multithreading and also introduce the implementation of packages and Interfaces in JAVA. • To introduce the concepts of JDBC and its applications in JAVA programming. • To learn the design of Web applications using Applets, AWT and Swing controls using Event handling. • To introduce the concept of Socket Programming, understanding the concept of Remote Method Invocation, Servlet Programming and JSP.						

Course Outcomes	
CO1	Able to implement Object oriented concepts in JAVA.
CO2	Able to develop JAVA applications using the concepts of inheritance, polymorphism, exception handling, multithreading and implementation of packages and Interfaces in JAVA.
CO3	Able to develop JAVA applications using JDBC.
CO4	Able to design web applications using Applets, AWT and Swings controls.
CO5	Able to develop web-based applications using RMI, Java Servlet and JSP.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Experiment-1	Program illustrating overloading methods and various forms of Inheritance.	3	CO1
2	Experiment-2	Program to create Packages and Interface in Java.	3	CO1
3	Experiment-3	Program to create multiple Threads in Java.	3	CO2
4	Experiment-4	Program to handle exceptions in Java.	3	CO2
5	Experiment-5	Understand and handle Mouse Events, Keyboard Events using Layout Manager using AWT and Java Swings.	3	CO3
6	Experiment-6	Adding Text area, Canvas, Scroll Bars, Frames and Menus using AWT and Java Swings.	3	CO3
7	Experiment-7	Writing Java Applets.	3	CO4
8	Experiment-8	Client Server interaction with stream socket connections (Use Net Package).	3	CO4
9	Experiment-9	Client Server application using RMI.	3	CO4
10	Experiment-10	Writing Java Servlets.	3	CO5
11	Experiment-11	Program using JDBC.	3	CO5
12	Experiment-12	Develop a Mini Project using advance concepts of Java.	3	CO5

Reference Books:

1. Margaret Levine Young, “The Complete Reference Internet”, TMH.
2. Naughton, Schildt, “The Complete Reference JAVA2”, TMH.

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc22_cs47/
2. https://nptel.ac.in/courses/106105191

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	2	1	2	2		2	1						2	2				
CO2		1	3	2	3	1		1			1		2	1				
CO3	1		3	2	3	2	1	2					2	1				
CO4	1	2	3	1	3	2	1	2			1		2	1				
CO5	1	1	3	1	3	1	1	1			1		2	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation