Department of Computer Science and Applications

BCA Course Structure

BCA (with specialization in Full Stack Development)

AS PER STATE EDUCATION POLICY

Sem	Course Code	Title of the Paper	Hours/Week	Semester End Exam	IA	Total	Credits
3	24BCACC2	Environmental Studies	02	40	10	50	2
	24BCA31	Database Management System	03	80	20	100	3
	24BCA32	Probability and Statistics	03	80	20	100	3
	24BCA33	Artificial Intelligence	04	80	20	100	5
	24BCA31P	Database Management System Lab	04	40	10	50	2
	24BCA32P	Artificial Intelligence Lab using Python	04	40	10	50	2
	24BCAE1	Elective: I Web Programming – I	02	40	10	50	2
	24BCAL31	Language L1	04	80	20	100	3
	24BCAL32	Language L2	04	80	20	100	3
4	24BCA41	Computer Networks	03	80	20	100	3
	24BCA42	Design and Analysis of Algorithms	03	80	20	100	3
	24BCA43	Software Engineering	05	80	20	100	5
	24BCA41P	Computer Networks Lab	04	40	10	50	2
	24BCA42P	Design and Analysis of Algorithms Lab	04	40	10	50	2
	24BCAE2	Elective: II Web Programming – II	02	40	10	50	2
	24BCAL41	Language L1	04	80	20	100	3
	24BCAL42	Language L2	04	80	20	100	3
	24BCASEC1	Office Management Tools	02	40	10	50	2

SEMESTER –III

24BCA31	Database Management Systems	45 Hours

Course Objectives

CO1: Understanding Core Concepts of DBMS

CO2: Proficiency in Database Design and SQL

CO3: Application of Advanced Database Techniques

Prerequisite: Basic knowledge of Set Theory, Operating systems, Discrete mathematics, Data structures, and Programming.

Course Content:

UNIT I: [11 Hours]

Introduction to Databases: Definition of Data, Database, and DBMS, Overview of Database Applications, Advantages and Disadvantages of DBMS, Roles of Database Users and Administrators

Data Models: Introduction to Data Models, Types of Data Models (Hierarchical, Network, Relational, Object-oriented), Importance of Data Models in DBMS

Database Design: Keys: Primary Key, Candidate Key, Super Key, Foreign Key, Composite Key, Alternate Key, Unique Key, Surrogate Key, Constraints in a table: Primary Key, Foreign Key, Unique Key, NOT NULL, CHECK, Entity-Relationship (ER) Model, Entities and Entity Sets, Attributes and Relationships, ER Diagrams, Key Constraints and Weak Entity Sets, Extended ER Features, Introduction to the Relational Model and Relational Schema

UNIT II: [12 Hours]

Relational Algebra and Calculus: Introduction to Relational Algebra, Operations: Selection, Projection, Set Operations, Join Operations, Division,Tuple and Domain Relational Calculus

Structured Query Language (SQL): SQL Basics: DDL and DML, Aggregate Functions (Min(), Max(), Sum(), Avg(), Count()), Logical operators (AND, OR, NOT), Predicates (Like, Between, Alias, Distinct), Clauses(Group By, Having, Order by, top/limit), Inner Join, Natural Join, Full Outer Join, Left Outer Join, Right outer Join, Equi Join

Normalization and Database Design: Functional Dependencies: Armstrong's Axioms, Definition, Properties (Reflexivity, Augmentation, Transitivity), Types (Trivial, Non-Trivial, Partial and Full Functional Dependency), Closure of Functional Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF), Denormalization.

UNIT III: [11 Hours]

Transaction Management:ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Support in SQL, Introduction to Crash Recovery, 2PL, Serializability, and Recoverability, Introduction to Lock Management, Dealing with Deadlocks

Database Storage and Indexing: Data on External Storage, File Organizations and Indexing, Index Data Structures, Comparison of File Organizations, Indexes and Performance Tuning, Guidelines for Index Selection, Basic Examples of Index Selection

UNIT IV: [11 Hours]

NoSQL Databases and Big Data: Introduction to NoSQL, Data Models: Document, Key value, Column family, Graph. Uses and Features of NO/SQL document databases. CAP theorem, BASE vs ACID, CRUD operations, MongoDB operators, Overview of Big Data Technologies: Hadoop, MongoDB, Cassandra.

Text Books

1. Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition Addison-Wesley, 2016.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", third edition, McGraw – Hill, 2018
3. Benjamin Rosenzweig, Elena Rakhimov, "Oracle PL/SQL by Example", fifth edition, Prentice Hall, 2015
4. Brad Dayley, "NoSQL with MongoDB in 24 Hours", 1st edition, Sams Publishing, 2024

Reference Books

1. Korth, Silbertz, Sudarshan," Database System Concepts", Seventh Edition, McGraw - Hill.(2019)
2. R.P. Mahapatra, Govind Verma, "Database Management Systems", Khanna Publishing House, 2025.

Web Resources

1. https://oracle-base.com/articles
2. https://forums.oracle.com/ords/apexds/domain/dev- community/category/sql_and_pl_sql
3. https://asktom.oracle.com/ords/f?p=100:1:0

24BCA32	Probability and Statistics	45 Hours

Course Objectives

CO1: This course aims to make the students trained to handle randomness scientifically using theory of probability.

CO2: This course intends to make the students able to represent the statistical data in a systematic way and analyze it to draw meaningful information from them.

CO3: Through plentiful examples and exercises, this course provides the students scope to apply probabilistic and statistical techniques to deal with the real-life problems.

Course Content:

UNIT I: [11 Hours]

Basic concepts of Statistics, qualitative and quantitative data, classification of data, construction of frequency distribution, diagrammatic representation of data.

Measures of Central Tendency: Arithmetic mean, median and mode—their properties **Measures of Dispersion**: Range, mean deviation, quartile deviation, variance and standard deviation.

UNIT II: [12 Hours]

Correlation: Definition, scatter diagram, types of correlation, measures—Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient.

Regression: Linear regression-fitting by least square method and interpretation.

UNIT III: [11 Hours]

Concepts of probability: Experiment and sample space, events and operations with events, probability of an event, basic probability rules, applications of probability rules, conditional probability.

Random Variables: Discrete and continuous random variable**,** probability distribution of a random variable**,** probability mass function, probability density function, expectation and variance of a random variable.

Standard Probability Distributions: Binomial probability distribution, Poisson probability distribution, Normal probability distribution.

UNIT IV: [11 Hours]

Sampling Distribution: Concept of Population and Sample, parameter and statistic, sampling distribution of sample mean and sample proportion.
Statistical Inference: Estimation and Hypothesis Testing (only concept).

Text Books

1. Manish Sharma, Amit Gupta, The Practice of Business Statistics, Khanna Book Publishing Company, 2010 (AICTE Recommended Textbook)
2. Das N. G., Statistical Methods, Combined Edition, Tata McGraw Hill, 2010.
3. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 6th Edition, Elsevier, 2021.
4. Miller Irwin and Miller Marylees, Mathematical Statistics with Applications, Seventh Edition, Pearson Education, 2005

Reference Books

1. Pal Nabendu and Sarkar Sahadeb, Statistics: Concepts and Applications, Second Edition, PHI, 2013
2. Montgomery Douglas and Runger George C., Applied Statistics and Probability for Engineers, Wiley, 2016.
3. Reena Garg, Engineering Mathematics, Khanna Publishing House, 2024.

Web Resources

1. https://nptel.ac.in/courses/111106112
2. https://nptel.ac.in/courses/111105041

24BCA33	Artificial Intelligence	60 Hours

Prerequisites:
Basic understanding of computer science concepts, including data structures and algorithms. Proficiency in minimum one programming language, such as Python.

Course Content:

UNIT I: Introduction to Al [15 Hours]
What is AI? Intelligent Agents: Agents and environment, the concept of Rationality, the nature of environment, the structure of Agents. Knowledge-Based Agents**:** Introduction to Knowledge-Based Agents, The Wumpus World as an Example World. Problem-solving: Problem-solving agents.

UNIT II: Advanced Search Techniques [15 Hours]
Uninformed Search: DFS, BFS, Iterative Deepening Search. Informed Search: Best First Search, A* search, AO* search. Adversarial Search & Games: Two-player zero-sum games, Minimax Search, Alpha-Beta pruning. Constraints and Constraint Satisfaction Problems (CSPs), Backtracking search for CSP. Evolutionary Search Techniques**:** Introduction to evolutionary algorithms, Genetic algorithms, Applications of evolutionary search in AI.

UNIT III: Logical Reasoning and Uncertainty [15 Hours]
Logic: Propositional logic, First-order predicate logic, Propositional versus first-order inference, Unification and lifting. Inference: Forward chaining, Backward chaining, Resolution, Truth maintenance systems. Introduction to Planning: Blocks World problem,

Strips; Handling Uncertainties: Non-monotonic reasoning, Probabilistic reasoning, Introduction to Fuzzy set theory.

UNIT IV: Domains and Applications of AI [15 Hours]
Domains in AI: Introduction to Machine Learning, Computer Vision, Robotics, Natural Language Processing, Deep Neural Networks, and their Applications. Expert Systems: The architecture and role of expert systems include two case studies. Legal and Ethical Issues: Concerns related to AI.

Text Books:

1. M.C. Trivedi, *A Classical Approach to Artificial Intelligence*, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook).
2. Nilsson Nils J, *Artificial Intelligence: A new Synthesis*, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.
3. Dan W Patterson, *Introduction to Artificial Intelligence & Expert Systems*, PHI Learning 2010.
4. Rajiv Chopra, *Data Science with Artificial Intelligence, Machine Learning and Deep Learning*, Khanna Book Publishing Company, 2024.

Reference Books:

1. M.C. Trivedi, *Introduction to AI and Machine Learning*, Khanna Book Publishing Company, 2024.
2. Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall

3. Van Hirtum, A. & Kolski, C. (2020). *Constraint Satisfaction Problems: Algorithms and Applications*. Springer
4. Rajiv Chopra, Machine Learning and Machine Intelligence, Khanna Book Publishing Company, 2024.

Course Outcomes:

CO1: Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents.
CO2: Gain insights about Uninformed and Heuristic search techniques and apply them to solve search applications.
CO3: Appreciate the concepts of knowledge representation using Propositional logic and Predicate calculus and apply them for inference/reasoning.
CO4: Obtain insights about Planning and handling uncertainty through probabilistic reasoning and fuzzy sets.
CO5: Obtain a basic understanding of the AI domains and their applications and examine the legal and ethical issues of AI.

24BCA31P	**Database Management Systems Lab**

List of Practicals:

1. Draw an ER Diagram of Registrar Office
2. Draw an ER Diagram of Hospital Management System
3. Reduce The ER diagram in question no 1 into tables
4. Reduce the ER diagram of question no 2 into tables

Consider the following Schema
Supplier(SID, Sname, branch, city, phone)
Part(PID, Pname, color, price)
Supplies(SID, PID, qty, date_supplied)

DDL Commands

5. Create the above tables
6. Add a new attribute state in supplier table
7. Remove attribute city from supplier table
8. Modify the data type of phone attribute
9. Change the name of attribute city to address
10. Change a table's name, supplier to sup
11. Use truncate to delete the contents of supplies table
12. Remove the part table from database

DML Commands

1. Insert at least 10 records in tables supplier, part and supplies
2. Show the contents in tables supplier, part and supplies

3. Find the name and city of all suppliers
4. Find the name and phoneno of all suppliers who stay in 'Delhi'
5. Find all distinct branches of suppliers
6. Delete the record of the supplier whose SID is 204001
7. Delete all records of supplier table
8. Delete all records of suppliers whose city starts with capital A.
9. Find the supplier names which have 'lk' in any position
10. Find the supplier name where 'R' is in the second position
11. Find the name of supplier whose name starts with 'V' and ends with 'A'
12. Change the city of all suppliers to 'BOMBAY'
13. Change the city of supplier 'Vandana' to 'Goa'

Queries with Constraints

1. Create the supplier table with Primary Key Constraint
2. Create supplies table with Foreign key Constraint
3. Create a part table with UNIQUE Constraint
4. Create supplier Table with Check Constraints
5. Create Supplier table with Default

Constraint Queries on TCL

1. Create Savepoints
2. Rollback to SavePoints
3. Use Commit to save on

Aggregate Functions:

1. Find the minimum, maximum, average and sum of costs of parts
2. Count the total number of parts present
3. Retrieve the average cost of all parts supplied by 'Mike'

Queries on GROUP BY, HAVING AND ORDER BY Clauses

1. Display total price of parts of each color
2. Find the branch and the number of suppliers in that branch for branches which have more than 2 suppliers
3. Find all parts sorted by pname in ascending order and cost in descending order
4. Find the branch and the number of suppliers in that branch

Queries on Analytical, Hierarchical, Recursive nature.

1. Find out the 5^{th} highest earning employee details.
2. Which department has the highest number of employees with a salary above $80,000, and what percentage of employees in that department have a salary above $80,000
3. Retrieve employee table details using the hierarchy query and display that hierarchy path starting from the top level indicating if it is a leaf and there exists a cycle.
4. What is the average salary for employees in the top 2 departments with the highest average salary, and what is the hierarchy of departments and sub-departments for these top 2 departments?

5. Use recursion to retrieve the employee table and display the result in breadth first and depth first order.
6. Write a recursive query to show the equivalent of level, connect_by_root and connect_by_path
7. Use recursion to retrieve the employee table and display the result in depth first order showing id, parent_id, level, root_id, path and leaf.

Queries on Operators

1. Find the pname, phoneno and cost of parts which have cost equal to or greater than 200 and less than or equal to 600.
2. Find the sname , SID and branch of suppliers who are in 'local' branch or 'global' branch
3. Find the pname, phoneno and cost of parts for which cost is between 200 and 600
4. Find the pname and color of parts, which has the word 'NET' anywhere in its pname.
5. Find the PID and pname of parts with pname either 'NUT' or 'BOLT'
6. List the suppliers who supplied parts on '1st may2000', '12 JAN 2021' ,'17 dec 2000' , '10 Jan 2021'
7. Find all the distinct costs of parts

Join Operators

1. Perform Inner join on two tables
2. Perform Natural Join on two tables
3. Perform Left Outer Join on tables
4. Perform Right Outer join on tables
5. Perform Full Outer Join on tables

Set Theory Operators

1. Show the use of UNION operator with union compatibility
2. Show the use of intersect operator with union compatibility
3. Show the use of minus operator with union compatibility
4. Find the cartesian product of two tables

Queries on Set Theory Operators

1. List all parts except 'NUT' and 'BOLT' in ascending order of costs
2. display all parts that have not been supplied so far
3. To display the supplier names who have supplied 'green' part with cost 500 Rupees AND 'red' part with cost 400 Rupees.
4. To display the supplier names who have supplied 'green' part with cost 500 Rupees OR 'red' part with cost 400 Rupees.
5. To Display the name of suppliers who have supplied all parts that are 'red' in color.

PL/SQL Programs

1. Write a PL/SQL Code to add two numbers
2. Write a PL/SQL code for Fibonacci series

3. Write a PL/SQL Code for greatest of 3 numbers
4. Write a PL/SQL code for area and circumference of a circle

MongoDB Queries

1. Create a collection and insert documents into it using insertOne() and insertMany()
2. Select all documents in collection
3. Find the count of all suppliers
4. Find all records that have city = 'Delhi'
5. Retrieve all documents that have color equal to 'red' or 'green'
6. Retrieve all documents where part_name is 'P1' or price is less than 200.
7. Update the record of 'Geeta' ,set city = 'Bombay' and phoneno = '11223344'
8. Delete all records where price is greater than 5000
9. Display only the name and city of the supplier
10. Sort all suppliers on city and display only the first two records.

24BCA32P	**Artificial Intelligence Lab**

Prerequisites: Basic understanding of algorithms and data structures (e.g., trees, graphs, lists). Proficiency in Python programming, including libraries like NLTK for NLP tasks.

LAB Experiments

The lab experiments may be implemented in Python. Libraries like NLTK, Tensorflow and Keras may be used for Machine learning experiments.

1. Write a Python program which accepts a number and prints its prime factors.
2. Write a Python that checks whether a given password is valid.
   An acceptable password:
   a) Should have minimum 8 characters
   b) Must have at least one digit and one special character
   c) Must contain at least one alphabet which is in uppercase
3. Write a program that creates a list and performs the following operations on the list.
   a) mean, median and mode
   b) maximum and minimum values in the list
   c) Sort the list
   d) Remove duplicate values from the list
4. Create a dictionary with student names (minimum 5) as keys and a list of (subject, marks) tuples as values.
   For e.g. { "Akash": [("Math", 90), ("English", 85)…], …}
   Display student details along with total marks and percentage of each student.
5. Implement Depth-First Search (DFS) on a small graph.
6. Solve the Water Jug Problem using Breadth First Search (BFS).
7. Apply the A* Search algorithm to find the shortest path in a 4x4 grid.
8. Implement the Minimax search algorithm for 2-player games. You may use a game tree with 3 plies.
9. Implement a basic rule-based expert system for weather classification.

10. Using Python NLTK, perform the following Natural Language Processing (NLP) tasks for text content.
    a) Tokenizing
    b) Filtering Stop Words
    c) Stemming
    d) Part of Speech tagging
    e) Chunking
    f) Named Entity Recognition (NER)
11. Perform Image classification for a given dataset using CNN. You may use Tensorflow/Keras. (Not for Lab examinations)

Course outcomes:

CO1: Apply Uninformed Search Algorithms and Implement Heuristic Search techniques
CO2: Analyze and Solve Constraint Satisfaction Problems
CO3: Develop Rule-Based Systems
CO4: Implement and Evaluate Optimization Techniques
CO5: Apply and illustrate the NLP concepts

******

SEMESTER –IV

24BCA41	Computer Networks	45 Hours

Course Objectives:

CO1: Understand the fundamental concepts of Computer Networks and their applications.
CO2: Develop problem-solving skills related to network design, implementation, and troubleshooting.
CO3: Implement network protocols and configure network devices.

Prerequisites:

1. Programming Skills: Ability to write basic programs and scripts in languages such as Python or C.
2. Operating Systems: Understanding of OS concepts related to networking, such as process management and memory allocation

Course Content:

UNIT I: Introduction to Computer Networks [11 Hours]

Overview of Computer Networks: Definition and Objectives, Applications and Examples Network Components and Architecture

Network Models: OSI Model: Layers and Functions, TCP/IP Model: Layers and Functions Comparison between OSI and TCP/IP Models

Network Topologies: Physical vs. Logical Topologies, Common Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology

Data Transmission: Analog vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency

Networking Devices: Routers, Switches, Hubs, Bridges, Gateways, Functions and Configurations of Each Device.

UNIT II: Data Link Layer and Networking Protocols [12 Hours]

Data Link Layer Fundamentals: Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms.

Ethernet: Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods

Network Protocols: Introduction to TCP/IP Protocol Suite, IP Addressing: IPv4 and IPv6 Subnetting and CIDR Notation

Address Resolution Protocol (ARP): ARP Operation and Table, ARP Spoofing and Security Considerations

Virtual LANs (VLANs): Concept of VLANs, VLAN Tagging and Configuration, Benefits and Use Cases

UNIT III: Network Layer and Transport Layer [11 Hours]

Network Layer: IP Routing: Static vs. Dynamic Routing, Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT)

Transport Layer: TCP vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP

Congestion Control Algorithms: Techniques: Slow Start, Congestion Avoidance, Fast Retransmit, Fast Recovery, TCP Variants: TCP Reno, TCP Vegas.

Network Security Fundamentals: Threats and Vulnerabilities, Basic Security Mechanisms: Firewalls, VPNs, Encryption

UNIT IV: Application Layer and Emerging Technologies [11 Hours]
Application Layer Protocols: HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and Resolution
Network Applications: Web Browsing, Email Communication, File Transfer, Voice over IP (VoIP) and Streaming.
Emerging Technologies: Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) and Its Impact on Networking

Text Books:
1. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011.
2. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021.

Reference Books:
1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012.
2. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019.
3. Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House, 2023.
4. Mastering PC Hardware & Networking, Khanna Publishing House, 2024.

Web Resources:
1. Cisco Networking Academy - Online Courses and Resources
2. NetworkLessons.com - Tutorials on Various Networking Topics

24BCA42	Design and Analysis of Algorithms	45 Hours

Course Objectives
CO1: This course envisions to impart to students the understanding of basic algorithm designing paradigms.
CO2: This course introduces the basic knowledge on how to analyse an algorithm.
CO3: This course expects to enable a student to synthesize efficient algorithms in common design situations and real-life problems.
Prerequisite: Knowledge of Data Structures

Course Content:

UNIT I: [11 Hours]
What is an algorithm? Design and performance analysis of algorithms, time complexity, space complexity.
Asymptotic notations (O, Ω, Θ) to measure growth of a function and application to measure complexity of algorithms.
Analysis of sequential search, bubble sort, selection sort, insertion sort, matrix multiplication.

Recursion: Basic concept. Analysis of recursive algorithms, Master's theorem.

UNIT II:

The Divide & Conquer Design Technique: [12 Hours]

The general concept. Binary search, finding the maximum and minimum, merge sort, quick sort. Best and worst case analysis for the mentioned algorithms. Strassen's matrix multiplication.

Lower bound for comparison-based sorting.

The Greedy Design Technique:

The general concept. Applications to general Knapsack problem, finding minimum weight spanning trees: Prim's and Kruskal's algorithms, Dijkstra's algorithm for finding single source shortest paths problem.

UNIT III: [11 Hours]

The Dynamic Programming Design Technique:

The general concept. Computation of Fibonacci series and Binomial coefficients, all pair shortest paths problem (Floyd-Warshall's algorithm), 0/1 Knapsack problem.

Algorithms on Graphs:

Breadth First Search, Depth First Search, finding connected components, depth first search of a directed graph, topological sorting.

UNIT IV: [11 Hours]

Limitations of Algorithmic Power:

Backtracking Method: n-Queen problem; sum of subsets problem/ Hamiltonian circuit problem/vertex cover problem.

Computational Intractability: Overview of non-deterministic algorithms, P, NP, NP-Complete and NP-hard problems.

Text Books

1. Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson, 2012
2. Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook)
3. Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009.
4. Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd., 2012.

Reference Books

1. Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston, 1983.
2. Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education, 2006.

Web Resources

1. https://nptel.ac.in/courses/106101060
2. https://www.cs.umd.edu/~mount/451/Lects/451lects.pdf

24BCA43	Software Engineering	60 Hours

Course Objectives

CO1: To Acquire a comprehensive understanding of the software development lifecycle and its application in contemporary software engineering practices.

CO2: To Develop proficiency in project management methodologies and strategic decision-making for successful software project execution.

CO3: To Master the art of software design, development, and testing to produce robust and efficient software solutions.

Prerequisites: Basic understand of Software, Applications, Programming fundamentals.

Course Content:

UNIT I: [15 Hours]

The evolving role of software, changing nature of software, layered technology, a process framework, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process.

Agile software development: Agility Principles, Agile methods, Plan-driven and agile development, Extreme programming, Scrum, A Tool Set for the Agile Process.

UNIT II: [15 Hours]

Software Requirements Engineering: Functional and non-functional requirements, the software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan.

Project planning- Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques.

UNIT III: [15 Hours]

Design: Design process and design quality, design concepts, the design model, software architecture, data design, architectural design, Basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.

Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.

UNIT IV: [15 Hours]

Quality Management: Quality concepts, software quality assurance, software reviews, formal

technical reviews, statistical software quality assurance, software reliability.

Release Management: Release planning, development and build plans, release strategies, risk management, and post-deployment monitoring.

Product sustenance: Maintenance, updates, End of life, migration strategies.

Text Books

1. Software Engineering, N.S. Gill, Khanna Publishing House, 2023 (AICTE Recommended Textbook)
2. Software Engineering, Ian Somerville, 9th edition, Pearson education.
3. Software Engineering A practitioner's Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGraw Hill Education, 2015.

Reference Books

1. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007
2. Software Engineering: Principles and Practice Hans van Vliet

24BCA41P	**Computer Networks Lab**

Lab Programs:

1.Configure Basic Network Settings:
   a. IP Address Configuration
   b. Subnet Mask and Gateway Settings
2. Implement Network Protocols:
   a. Write a simple Python script to perform DNS resolution.
   b. Implement a basic HTTP client-server application.
3. Network Simulation:
   a. Use network simulation tools (e.g., Cisco Packet Tracer) to design and simulate network topologies.
   b. Configure routers and switches in a simulated environment.
4. Performance Measurement:
   a. Measure network performance using tools like `ping`, `traceroute`, and `iperf`.
   b. Analyze network traffic using Wireshark.
5. Implement VLANs:
   a. Configure VLANs on a switch and verify using simulation tools.
6. Set Up a Simple Web Server:
   a. Deploy a basic web server and configure HTTP/HTTPS access.
7. Network Security Lab:
   a. Implement basic firewall rules and VPN configurations.
   b. Perform vulnerability scanning and analyze results.
8. Network Troubleshooting:
   a. Diagnose and resolve common network issues.
   b. Use troubleshooting commands and techniques to fix connectivity problems.

24BCA42P	Design and Analysis of Algorithms Lab

Solve the following problems, and find the complexity of the best and worst case:

1. Write a program to implement linear search algorithm
2. Write a program to implement binary search algorithm.
3. Write a Program to sort a given set of numbers using Selection sort algorithm.
4. Write a program to sort a given set of numbers using Bubble sort algorithm.
5. Write a program to sort a given set of numbers using Insertion sort algorithm.
6. Write a program to sort a given set of numbers using Merge sort algorithm.
7. Write a program to implement matrix multiplication.
7. Write a program to find the factorial of a number using recursive function.
8. Write a program to find the factorial of a number using recursive function.
9. Write a program to find the minimum spanning tree of a given graph using Prim's algorithm.
10. Write a program to find the minimum spanning tree of a given graph using Kruskal's algorithm.
11. Write a Program to find the binomial co-efficient C(n, k), [where n and k are integers and n > k] using brute force based algorithm and also dynamic programming based algorithm.
12. Write a program to implement BFS traversal algorithm.
13. Write a program to implement DFS traversal algorithm.

24BCASEC2	Computer Assembly and Repair Lab

1. Demonstration of Hardware peripherals: CPU, RAM, SMPS, Motherboard, NIC card, Processor, Processor cooling fan, PCI card, HDD.
2. Demonstration of various ports: CPU, VGA port, PS/2 (keyboard, mouse) ,USB, LAN, Speaker, Audio.
3. Identify the Computer Name and Hardware Specification (RAM capacity, Processor type, HDD, 32 bit/ 64 bit)
4. Identify and Troubleshoot the problems of RAM (beep sound with blue screen), SMPS and motherboard (CPU is not switched ON)
5. Configure BIOS settings- disable and enable USB and LAN.
6. Identify, how to recover the hidden files from corrupted pendrive using command.
7. Recover the contents from crashed Hard Disk using Disk Drill software.
8. Install Operating System – Windows family (Windows 7/ Windows 10) and also make partitions.

9. Install Operating System - Unix family (Linux/UBUNTU)
10. Install Application software – python 3.8, MS- Office 2010/2013, MySQL, TOAD, Openoffice, etc.,
11. Install any one of the antivirus software (Avast, Kaspersky, etc.,) and observe the variations before and after installation.
12. Add new Hardware device (keyboard, mouse, Speaker, Microphone)
13. Connect the LCD Projector with Laptop / CPU.
14. Adding additional RAM to the system.(expanding RAM size).
15. Graphic Card insertion.
16. Assemble and Disassemble Desktop System.

References:

1. Dan Gookin ,Troubleshooting & Maintaining Your PC ALL-IN-ONE, 3rd Edition,2017, John Wiley & Sons.
2. Mike Meyers, Scott Jernigan, Dan Lachance, "CompTIA Fundamentals + Exam Guide (All-in-One), 2nd Edition, 2019, Mc Graw Hill Education.

Web References:

1.https://www.youtube.com/watch? v=ItxwyMR0SnY&list=PLeH4ngtDM7eE-1_mdWuXWyZrI_FMHnyJ0&index=5
2. https://www.cleverfiles.com/howto/crashed-hard-drive-recovery.html

******

SEMESTER –III

(Electives)

24BCAE1	Feature Engineering (AI & ML)	30 Hours

Prerequisite: familiarity with any programming language.

Course Content:

UNIT I: Introduction to Feature Engineering [15 Hours]

Introduction to Data and Features: Importance of Features in Machine Learning. Data types and features: Numerical, Categorical, Ordinal, Discrete, Continuous, Interval and Ratio.Basic Feature Preprocessing: Handling Missing Data, Data Cleaning, Feature Scaling, Normalization, and Transformation.

UNIT II: Feature Engineering Techniques [15 Hours]

Techniques for Numerical Data: Binning and Discretization, Polynomial and Interaction Features. Categorical Data Techniques: One Hot Encoding, Label Encoding. Feature extraction vs. feature selection, Steps in feature selection. Feature Selection Methods: Filter, Wrapper, and Hybrid. Feature Reduction: Introduction and application of Principal Components Analysis.

Text Books

1. M.C. Trivedi, Data Science and Data Analytics Using Python Programming, Khanna Publishing House, 2024.
2. Zheng, Alice, & Casari, Amanda. (2018). Feature engineering for machine learning: Principles and techniques for data scientists. O'Reilly Media, Inc.
3. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN-13: 9780323917780.

Reference Books:

1. Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
2. N. Bhaskar, Vasundhara, Machine Learning, Khanna Publishing House, 2024.
3. M.C. Trivedi, Deep Learning and Neural Network_MC Trivedi, Khanna Publishing House, 2024.
4. Ng, Andrew. (2018). Machine learning yearning (Draft, MIT Licensed). GitHub. ISBN- 10: 199957950X, ISBN-13: 978-1999579500.
5. Han, Jiawei, Kamber, Micheline, & Pei, Jian. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann Publishers. ISBN 978-0123814791.
6. Tan, Pang-Ning, Steinbach, Michael, Karpatne, Anuj, & Kumar, Vipin. (2021). Introduction to data mining (2nd ed.). Pearson. ISBN 978-9354491047.
7. Provost, Foster, & Fawcett, Tom. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. O'Reilly Media, Inc.
8. Galli, Soledad. (2020). Python feature engineering cookbook: Over 70 recipes for creating, engineering, and transforming features to build machine learning models. Packt Publishing, Limited.
9. Nielsen, Aileen. (2019). Practical time series analysis: Prediction with statistics and machine

learning. O'Reilly Media.
10. Rajiv Chopra, Deep Learning, Khanna Publishing House, 2024.
11. Jeeva Jose, Machine Learning, Khanna Publishing House, 2024.
12. Chollet, François. (2017). Deep learning with Python. Manning Publications. ISBN 9781617294433.

Course Outcomes

CO1:Understand the importance of features in machine learning and differentiate between various types of data and features (structured vs. unstructured, categorical, numerical, text, and date-time).

CO2: Apply basic feature preprocessing techniques such as handling missing data, data cleaning, and feature scaling and normalization.

CO3:Implement feature engineering techniques for numerical data, including binning, discretization, polynomial and interaction features, and log transformation.

CO4:Utilize categorical data techniques, such as one-hot encoding and label encoding, and understand feature selection methods, including filter and wrapper methods.

CO5: Perform feature transformation using techniques like Principal Component Analysis (PCA) and understand its application in machine learning.

******

24BCAE1	Basics of Data Analytics using Spreadsheet (Data Science)	30 Hours

Course Objectives

CO1: Understand the basics of data analytics and its applications.

CO2: Develop proficiency in using spreadsheet software for data manipulation and analysis.

CO3: Build and use spreadsheet models for decision making & Communicate data insights effectively

Prerequisite: Knowledge on basics of mathematical & Statistical concepts such as arithmetic, percentages, averages, and basic algebra.

Course Content:

UNIT I: Introduction to Data Analytics [15 Hours]

Understanding data and its types (structured, unstructured, semi-structured)-What is Data Analytics- Types of data Analytics-Importance of Data Analytics- Applications of Data Analytics.

UNIT II: Data, Ethics, and Industry: Case Studies [15 Hours]

Data Collection Methods - Different Data Sources & format - Data Cleaning and Transformation - Handling Missing Data and Outliers. - Ethical considerations in data analytics. - Real-world Applications of Data Analytics- Industry-specific applications (finance, marketing, operations) - Case Study

Note: Case study is for discussion not to be considered for evaluation.

Text Books

1. “Beginner's Guide for Data Analysis using R Programming” by Jeeva Jose, Khanna Publishing House, 2024.
2. “Data Analytics” by V.K. Jain, Khanna Book Publishing Company, 2024.
3. “Excel Data Analysis For Dummies" by Stephen L. Nelson and E. C. Nelson, John Wiley & Sons; 3rd edition, 2016
4. "Data Analysis Using Microsoft Excel" by Michael R. Middleton, Thomson, Brooks/Cole, 3rd edition , 2004

Reference Books

1. "Excel 2019 Bible" by Michael Alexander, Richard Kusleika, and John Walkenbach, John Wiley & Sons, 25 Sept 2018
2. "Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics" by Cliff T Ragsdale, Cegage learning asia pet. 2015
3. “Mastering Excel” by WebTech Solutions, Khanna Publishing House, 2024.

****

24BCAE1	Web Programming-I (Full Stack Development)	30 Hours

Course Objectives

1. To understand the concepts and architecture of the World Wide Web, Markup languages along with Cascading Style Sheets.
2. To understand the concepts of event handling and data validation mechanisms.
3. To understand the concepts of embedded dynamic scripting on client and server-side Internet Programming and basic full stack web development.
4. To develop modern interactive web applications

Prerequisite:

1. Proficiency in at least one programming language, such as C, C++. Understanding of programming concepts such as loops, conditionals, functions, and data structures like arrays, lists.
2. Familiarity with Object-Oriented Programming (OOP) principles, including classes, objects, inheritance, and polymorphism.

UNIT I: [15 hours]

Introduction to HTML: history of HTML, Objective, basic Structures of HTML, Header Tags, body tags, Paragraph Tags.
Tags for FORM Creation, TABLE, FORM, TEXTAREA, SELECT, IMG, IFRAME FIELDSET, ANCHOR.
Lists in HTML, Introduction to DIV tag, NAVBAR Design.
Introduction to CSS, types, Selectors, and Responsiveness of a web page.
Introduction to Bootstrap, downloads/linking, using classes of Bootstrap, understanding the Grid System in Bootstrap.
Introduction to www, Protocols and Programs, Applications and development tools, web

browsers, DNS, Web hosting Provider, Setting up of Windows/Linux/Unix web servers, Web hosting in cloud, Types of Web Hosting.

UNIT II: [15 hours]

Introduction to JavaScript: Functions and Events. Document Object model traversing using JavaScript. Output System in JavaScript i.e. Alert, throughput, Input box, Console. Variables and Arrays in JavaScript. Date and String handling in JavaScript.
Manipulating CSS through JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events and buttons, controlling your browser.
Introduction to AJAX: Purpose, advantages and disadvantages, AJAX based Web applications and alternatives of AJAX.
Introduction to XML: uses, Key concepts, DTD schemas, XSL, XSLT, and XSL Elements and transforming with XSLT. Introduction to XHTML.
JSON: Introduction to JSON, Keys and Values, Types of Values, Arrays, Objects

Text Books

1. Laura Lemay, Mastering HTML, CSS & Java Script Web Publishing, BPB Publications, 2016
2. Thomas A. Powell, The Complete Reference HTML & CSS, Fifth Edition, 2017

Reference Books

1. Silvio Moreto, Bootstrap 4 By Example, ebook, 2016.

Web Resources

1. www.javatpoint.com
2. www.w3schools.com
3. https://www.geeksforgeeks.org/web-technology/

****

SEMESTER –IV

(Electives)

24BCAE2	Introduction to Machine Learning (AI&ML)	30 Hours

Prerequisites: Basic knowledge of statistics and probability. Familiarity with fundamental programming concepts and proficiency in Python.

Course Content:

UNIT I: Introduction to Machine Learning [15 Hours]

Introduction: Definition, History and Application of Machine Learning, *Types of Machine Learning*: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabelled Dataset. *Supervised Learning Tasks*: Regression vs. Classification, *Learning Framework*: Training, Validation and Testing of ML models. *Performance Evaluation Parameters*: Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC.

UNIT II: Supervised Learning and Unsupervised Learning [15 Hours]

Regression: Linear and non-linear Regression, Logistic Regression. *Classification*: Naïve Bayes, K-Nearest Neighbors, *Clustering*: K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. *ML Applications:* Ethical Considerations in Machine Learning, Case study and Real-world Applications.

Text Books:

1.Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House.
2.Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House.
3.Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill.
4.Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780

Reference Books:

1. Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012.
2. Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
3. Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning.
4. Chollet, F. (2018). Deep Learning with Python. Manning Publications.
5. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.
6. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
7. Géron, A. (2017). Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems* (1st ed.). O'Reilly Media.

Course Outcomes

CO1: Define and explain machine learning concepts, types, and basic metrics.
CO2:Implement and apply supervised learning techniques (e.g., KNN, Linear Regression, Logistic Regression).
CO3:Apply unsupervised learning methods (e.g., K-Means, Hierarchical Clustering, Association Rules).
CO4: Develop and evaluate simple machine learning models (e.g., Perceptron, single-layer neural networks).
CO5:Analyze and apply appropriate machine learning algorithms depending on the problems with some real-world data.

24BCAE2	Data Visualization (Data Science)	30 Hours

Course Objectives

CO1:Understand the fundamentals of data visualization and its importance.
CO2:Learn about visual perception and its impact on data interpretation.
CO3:Explore the ethical considerations and challenges in data visualization.
CO4:Study different types of visualizations and their appropriate uses.
CO5:Utilize Power BI to create and customize various types of visualizations.

Prerequisite:

Familiarity with using a computer, including file management and basic software navigation. Basic knowledge of data structures, such as tables and databases. Basic understanding of data analysis concepts and familiarity with data types.

Course Content:

UNIT I: Introduction to Data Visualization [15 Hours]

Definition and importance of data visualization-Role of data visualization in decision making-Types of data (numerical, categorical, temporal, geographical)-Data visualization process (data collection, exploration, analysis, visualization, interpretation)-Challenges and limitations of data visualization

UNIT II: Visualization tools & Data Storytelling [15 Hours]

Overview of Visualization Tools (e.g., Excel, Tableau, Power BI, Python)- Comparing and contrasting features and Use Cases among these tools.

Principles of Data Storytelling: Narrative and Context-Best Practices for Dashboard Layout and Interactivity

Principles of Good Visualization Design - Understanding and Using Color in Visualizations – Importance of Data Modelling in Visualization.

Text Books

1. "Storytelling with Data: A Data Visualization Guide for Business Professionals" Cole Nussbaumer Knaflic, Wiley; 1st edition, 2015.
2. “The Visual Display of Quantitative Information” by Edward Tufte, Graphics Press USA; 2nd edition, 2001.

Reference Books

1. "Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press, 2018.
2. "Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017.
3. "Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018.

******

24BCAE2	Web Programming-II (Full Stack Development)	30 Hours

Course Objectives

1. To develop dynamic web applications that can interact with users and respond dynamically using PHP
2. To implement server-side scripting to perform operations like validations, calculations, and content generation on the server
3. To use PHP with databases to perform CRUD operations, and display data on web pages
4. To implement session and cookie handling
5. To develop secure web applications such as input validation, sanitization, and protection against SQL injection.
6. To integrate PHP with HTML, CSS, and JavaScript
7. To understand file handling operations Read, write, upload, and manage files using PHP scripts.

Prerequisite:

1. Understand HTML tags, forms, inputs, and structure of a webpage.
2. Familiarity with CSS
3. Understanding of Basic Programming Concepts
4. Basics of Client-Server Architecture

UNIT I: [15 hours]

Introduction to PHP: Server-Side Scripting – Advantages of PHP – Installation & Configuration. Evaluation of PHP, Basic Syntax, Defining variable and constant, PHP Data types, Operators and Expressions

Decisions and Loop: Making Decisions, Doing Repetitive task with looping, Mixing Decisions and looping with HTML.

Function: Define a function, Call by value and Call by reference, Recursive function.

String: Creating and accessing, String Searching & Replacing String, Formatting String, String Related Library function

Array: Anatomy of an Array, Creating index based and Associative array, Accessing array, Element Looping with Index based array, Looping, Some useful Library function

Exception Handling: Understanding Exception and error, try, catch, throw. error tracking and debugging

UNIT II: [15 hours]

Handling HTML Form with PHP: Capturing Form, Data Dealing with Multi-value filed, and Generating File uploaded form, redirecting a form after submission.

Working with file and Directories: Understanding file & directory, Opening and closing, a file, Copying, renaming and deleting a file, working with directories, Creating and deleting folder, File Uploading & Downloading.

Session and Cookie: Introduction to Session Control, Session Functionality, Cookie, Setting Cookies with PHP. Using Cookies with Sessions, Modify Cookies, Deleting Cookies, Registering

Session variables, Destroying the variables and Session.

Database Connectivity with MySQL: Connection with MySQL Database, performing basic database operation (DML:Insert, Delete, Update, Select), Setting query parameter, Executing query Join (Cross joins, Inner joins, Outer Joins, Self joins.)

Text Books

1. PHP and MySQL Web Development - Welling – (Pearson Education)-Fourth Edition
2. Learning PHP, MySQL, books by ‘ O’ riley Press
3. Core PHP Programming. Leon Atkinson, Prentice Hall.

Reference Books

1. Programming PHP. RasmusLerdorf, Kevin Tatroe. O'Reilly.
2. Learning PHP 5. David Sklar, O'Reilly.

Web Resources

1. www.w3schools.com
2. https://www.geeksforgeeks.org/web-technology/

****