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BENGALURU CITY UNIVERSITY

# BENGALURU CITY UNIVERSITY

## Syllabus of Third and Fourth Semesters for

## Bachelor of Computer Applications
**(CBCS Scheme)**

## Under
## State Education Policy

**Effective from the Academic Year**
**2025 – 2026**

# Board of Studies in Computer Science for UG

No : BCU/BoS/Comp.Sci. & Appln.(PG & UG)/389/2024-25 dated 19-2-2025

| | | |
|---|---|---|
| 1 | Prof. Ramesh B Kudenatti<br>Department of Mathematics<br>Bengaluru City University,Bengaluru-560056 | Chairperson |
| 2 | Prof. Guru D S<br>Department of Studies in Computer Science<br>University of Mysore, Mysore-570006 | Member |
| 3 | Prof. Aziz Makandar<br>Department of Computer Science Karnataka State Akkamahadevi Women University, Jnanashakti Campus, Vijayapura-586109 | Member |
| 4 | Prof. Suneetha<br>Department of Computer Science, Karnataka State Open University, Muktha Gangothri, Mysuru-570006 | Member |
| 5 | Prof. Veena R<br>Department of MCA, Seshadripuram College, Seshadripuram, Bengaluru-560020 | Member |
| 6 | Prof. Kiran Kumar M N<br>Department of Computer Applications, BMS College of Commerce and Management, Bengaluru-560004 | Member |
| 7 | Prof. Latha B<br>Department of Computer Science Vijaya College, R V Road, Basavanagudi, Bengaluru-560004 | Member |
| 8 | Prof. R Shanthi Krishna<br>Department of Computer Applications, SSMRV College, Jayanagar, Bengaluru-560041 | Member |
| 9 | Prof. Roopa H R<br>Department of Computer Applications, Seshadripuram Institute of Commerce and Management, Seshadripuram, Bengaluru-560020 | Member |
| 10 | Sri Seby Kallarakkal<br>CEO-Nabler Web Solutions, Bengaluru-560052 | Member |

**Name of the Degree Program : Bachelor of Computer Applications (General)**

**Discipline Course : Computer Science**

**Starting Year of Implementation: 2024-25 (I & II Semesters)**
**2025-26 (III & IV Semesters)**
**2026-27 (V & VI Semesters)**

**Programme Outcome (PO):**

| | |
|---|---|
| PO 1 | Apply knowledge of computing fundamentals, programming, and theoretical foundations to solve real-world problems in various domains of computer applications. |
| PO 2 | Identify and analyze problems related to software and network systems. Apply standard algorithms to develop reliable computing solutions. |
| PO 3 | Develop and implement efficient, secure and maintainable software solutions using programming languages. |
| PO 4 | Use appropriate tools and techniques and open source platforms for programming, debugging and network management. |
| PO 5 | Understand the importance of cyber safety, security threats and best practices to ensure responsible and secure use of digital technologies. |
| PO 6 | Apply ethical principles and commit to professional responsibilities in the computing profession, including software licensing, privacy and user rights. |
| PO 7 | Effectively document, present and communicate technical information and solutions to peers, stakeholders and clients. |
| PO 8 | Function competently as an individual or as a part of team in software development, lab-based exercises and project environments. |
| PO 9 | Recognize the need for continuous learning and adopt evolving technologies and methodologies to stay relevant in the IT industry. |
| PO 10 | Gain foundational knowledge of emerging technologies and to explore interdisciplinary applications and career opportunities. |

## ASSESSMENT

**Weightage for the Assessments (in percentage)**

| Type of Course | Formative Assessment/IA | Summative Assessment (S.A) |
|---|---|---|
| Theory | 20% | 80 % |
| Practical | 20% | 80 % |

# Detailed Structure for BCA (General)

| Semester | Course Code | Paper Title | Teaching Hours / Week | Marks | | Duration of Exam in Hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | | Exam | IA | | |
| I | 24BCA11 | Discrete Structure | 03 | 80 | 20 | 03 | 03 |
| | 24BCA12 | Problem Solving Technique | 03 | 80 | 20 | 03 | 03 |
| | 24BCA13 | Computer Architecture | 03 | 80 | 20 | 03 | 03 |
| | 24BCA11P | Problem Solving Technique Lab | 04 | 40 | 10 | 03 | 02 |
| | 24BCA12P | Computer Architecture Lab | 04 | 40 | 10 | 03 | 02 |
| | 24BCA13P | Office Automation Tools | 04 | 40 | 10 | 03 | 02 |
| | 24BCAL11 | Language 1 | 04 | 80 | 20 | 03 | 03 |
| | 24BCAL12 | Language 2 | 04 | 80 | 20 | 03 | 03 |
| | 24BCACV1 | Constitutional Values - I | 02 | 40 | 10 | 1.5 | 02 |
| | | | | | | **Total Credits** | **23** |
| II | 24BCA21 | Data Structures | 03 | 80 | 20 | 03 | 03 |
| | 24BCA22 | Object Oriented Programming Using Java | 03 | 80 | 20 | 03 | 03 |
| | 24BCA23 | Operating System | 03 | 80 | 20 | 03 | 03 |
| | 24BCA21P | Data Structures Lab | 04 | 40 | 10 | 03 | 02 |
| | 24BCA22P | Java Programming Lab | 04 | 40 | 10 | 03 | 02 |
| | 24BCA23P | Unix & Shell Programming Lab | 04 | 40 | 10 | 03 | 02 |
| | 24BCAL21 | Language 1 | 04 | 80 | 20 | 03 | 03 |
| | 24BCAL22 | Language 2 | 04 | 80 | 20 | 03 | 03 |
| | 24BCACV2 | Constitutional Values - II | 02 | 40 | 10 | 1.5 | 02 |
| | 24BCAES | Environmental Studies | 02 | 40 | 10 | 1.5 | 02 |
| | | | | | | **Total Credits** | **25** |

| Semester | Course Code | Paper Title | Teaching Hours / Week | Marks | | Duration of Exam in Hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | | Exam | IA | | |
| III | 24BCA31 | Database Management System | 04 | 80 | 20 | 03 | 03 |
| | 24BCA32 | Python Programming | 04 | 80 | 20 | 03 | 03 |
| | 24BCA33 | Computer Networks | 04 | 80 | 20 | 03 | 03 |
| | 24BCA34 | Cyber Security | 02 | 40 | 10 | 1.5 | 02 |
| | 24BCA31P | Database Management System Lab | 03 | 40 | 10 | 03 | 02 |
| | 24BCA32P | Python Programming Lab | 03 | 40 | 10 | 03 | 02 |
| | 24BCA33P | Computer Networks Lab | 03 | 40 | 10 | 03 | 02 |
| | 24BCAL31 | Language 1 | 04 | 80 | 20 | 03 | 03 |
| | 24BCAL32 | Language 2 | 04 | 80 | 20 | 03 | 03 |
| **Total Credits** | | | | | | | **23** |
| IV | 24BCA41 | Artificial Intelligence | 04 | 80 | 20 | 03 | 03 |
| | 24BCA42 | Design and Analysis of Algorithms | 04 | 80 | 20 | 03 | 03 |
| | 24BCA43 | Internet Technologies | 04 | 80 | 20 | 03 | 03 |
| | 24BCA44 | Ethical Hacking | 02 | 40 | 10 | 1.5 | 02 |
| | 24BCA41P | Artificial Intelligence Lab | 03 | 40 | 10 | 03 | 02 |
| | 24BCA42P | Design and Analysis of Algorithms Lab | 03 | 40 | 10 | 03 | 02 |
| | 24BCA43P | Internet Technologies Lab | 03 | 40 | 10 | 03 | 02 |
| | 24BCASE1 | Probability and Statistics | 02 | 40 | 10 | 1.5 | 02 |
| | 24BCAL41 | Language 1 | 04 | 80 | 20 | 03 | 03 |
| | 24BCAL42 | Language 2 | 04 | 80 | 20 | 03 | 03 |
| **Total Credits** | | | | | | | **25** |

| Semester | Course Code | Paper Title | Teaching Hours / Week | Marks | | Duration of Exam in Hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | | Exam | IA | | |
| V | 24BCA51 | Web Programming | 04 | 80 | 20 | 03 | 03 |
| | 24BCA52 | Data Analytics | 04 | 80 | 20 | 03 | 03 |
| | 24BCA53 | Software Engineering | 04 | 80 | 20 | 03 | 03 |
| | 24BCA54 | Operations Research | 04 | 80 | 20 | 03 | 03 |
| | 24BCA51P | Web Programming Lab | 03 | 40 | 10 | 03 | 02 |
| | 24BCA52P | Data Analytics Lab | 03 | 40 | 10 | 03 | 02 |
| | 24BCASE2 | Quantitative Techniques | 02 | 40 | 10 | 1.5 | 02 |
| | 24BCAPJ | Project | 08 | 120 | 30 | 03 | 06 |
| **Total Credits** | | | | | | | **24** |
| VI | 24BCA61 | Machine Learning | 04 | 80 | 20 | 03 | 03 |
| | 24BCA62 | Cloud Computing | 04 | 80 | 20 | 03 | 03 |
| | 24BCA63 | Data Mining | 04 | 80 | 20 | 03 | 03 |
| | 24BCA64 | Theory of Computation | 04 | 80 | 20 | 03 | 03 |
| | 24BCA61P | Machine Learning Lab | 03 | 40 | 10 | 03 | 02 |
| | 24BCAIS | Internship | -- | 80 | 20 | 03 | 06 |
| **Total Credits** | | | | | | | **20** |
| **Overall Total Credits** | | | | | | | **140** |

**SEMESTER – III**

| Theory | 24BCA31: Database Management System |
|---|---|
| Teaching Hours : 04 Hours/Week | Credits : 03 |
| Duration of Exam : 03 Hours | Maximum Marks : 100 (Exam 80 + IA 20) |

**Course Outcomes**

| COs | Description |
|---|---|
| CO1 | Understand the fundamental concepts of data, database systems, DBMS architecture, data models and the various types of DBMS along with their classifications. |
| CO2 | Design high-level conceptual data models using the Entity-Relationship approach, apply design principles and understand physical storage structures, file organization, and indexing mechanisms. |
| CO3 | Apply the relational model concepts, perform normalization using functional dependencies and write effective SQL queries to manage and manipulate data constraints and views. |
| CO4 | Utilize relational algebra to query databases, analyze query processing and optimization techniques and explain transaction management, concurrency control and recovery mechanisms in DBMS. Basics of PL/SQL. |

**UNIT – I Fundamentals of Database Systems and Architecture 14 Hours**

Introduction to Data and Database, History of Database. Characteristics of the Database Approach. Significance and Advantages of Database Management Systems. Actors on the Scene, Workers behind the Scene. System Structure: Instance and Schema, Data Models, Data Independence. Three Schema Architecture. Database Languages and Interfaces. The Database System Environment. Centralized and Client-Server Architecture. Classification of Database Management System.

**UNIT – II Database Design and Storage Structures 14 Hours**

High-Level Conceptual Data Models for Database Design. Entity Types, Entity Sets, Attributes and Keys. Relationship Types, Relationship Sets, Roles and Structural Constraints. Weak Entity Types. Extended ER Features. Refining the ER Design. Naming Conventions and Design Issues. ER to Relational Mapping. File Organization and Storage. Secondary Storage Devices. File Organization Techniques. Single-Level Ordered Index. Multi-Level Indexes. Indexes on Multiple Keys.

**UNIT – III Relational Model, Normalization and SQL 14 Hours**

Relational Model Concepts. Relational Model Constraints and Relational Database Schema. Update Operations and Dealing with Constraint Violations. Anomalies in a Database. Functional Dependency. Armstrong's Axioms. Closure of a Relation and Attributes. Lossless Join and Dependency Preservation. Normalization: 1NF, 2NF, 3NF, BCNF. Structure of Relational Databases. SQL: Data Definition and Data Types. Specifying Constraints in SQL. Schema Change Statements. Insert, Delete and Update Statements. Views (Virtual Tables). Assertions and Triggers.

**UNIT – IV Query Processing, Transactions and PL/SQL 14 Hours**

Unary Relational Operations: SELECT and PROJECT. Relational Algebra Operations. Binary Relational Operations: JOIN and DIVISION. Additional Relational Operations. Query Processing and Optimization: Evaluation of Relational Algebra Expressions. Query Equivalence. Introduction to Transaction Processing. Transaction and System Concepts. States of a Transaction. Desirable Properties of Transactions (ACID). Concurrency Control Techniques: Two-Phase Locking Techniques. Backup and Recovery from Failures, Basics of PL/SQL Programming.

**TEXT BOOKS:**


1. Elmasri R. and Navathe S.B., *Fundamentals of Database Systems*, 7th Edition, Addison-Wesley, 2016.
2. Silberschatz A., Korth H.F., and Sudarshan S., *Database System Concepts*, 7th Edition, Tata McGraw Hill, 2019.
3. Ivan Bayross, *SQL, PL/SQL – The Programming Language of Oracle*, 4th Edition, BPB Publications.


**REFERENCE BOOKS:**


1. C.J. Date, A. Kannan, S. Swamynathan, *An Introduction to Database Systems*, 8th Edition, Pearson Education, 2009.
2. Raghu Ramakrishnan and Johannes Gehrke, *Database Management Systems*, 3rd Edition, McGraw Hill, 2003.
3. Kevin Loney and George Koch, *Oracle 9i – The Complete Reference*, McGraw-Hill International Edition.

| Theory | 24BCA32: Python Programming |
|---|---|
| Teaching Hours : 04 Hours/Week | Credits: 03 |
| Duration of Exam: 03 Hours | Maximum Marks: 100 (Exam 80 + IA 20) |

**Course Outcomes**

| COs | Description |
|---|---|
| CO1 | Understand the basic concepts and apply them to develop programs. |
| CO2 | Demonstrate proficiency in handling Python's complex data structures and apply file handling for various formats. |
| CO3 | Apply object-oriented programming concepts in Python and use libraries for efficient data manipulation and analysis. |
| CO4 | Utilize Python packages and APIs for effective data visualization and apply them in real-time data analysis projects. |

**UNIT – I Foundations of Python Programming 14 Hours**

Introduction to Python: Python Interpreter/Shell, Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() function and is operator, Dynamic and Strongly Typed Language. Control Flow: Conditional blocks: if, else, elif, Nested if. Looping: while, for, range, loop manipulation using break, continue, else, pass. Functions: Function Definition and Calling, Built-In Functions, Return Statement, Default Parameters, Scope and Lifetime of Variables, Command Line Arguments. Strings: Creating and Storing Strings, String Operations, Slicing, Joining, String Methods.

**UNIT – II Data Structures and File Handling 14 Hours**

Lists: Creating Lists, Basic List Operations, Indexing and Slicing, List Methods, The del Statement. Dictionaries: Creating Dictionaries, Accessing and Modifying Key-Value Pairs, Dictionary Methods. Tuples: Creating Tuples, Tuple Operations, Indexing, Slicing, Tuple Methods, Relationships between Tuples, Lists, and Dictionaries. Sets and Frozensets: Creating Sets, Set Operations, Set Methods. Iterators and Iterables. File Handling: Types of Files, Reading and Writing Text and Binary Files, CSV File Handling, Pickle Module.

**UNIT – III Object-Oriented Programming and Data Handling Libraries 14 Hours**

Object-Oriented Programming: Classes and Objects in Python, Constructor Method, Multiple Objects, Class vs Data Attributes, Encapsulation, Inheritance, Polymorphism. Introduction to Python Libraries for Data Handling: NumPy – Arrays and Operations, Pandas – Series and DataFrames, Indexing and Querying, Handling Missing Values, Data Aggregation, Grouping, and Summarization.

**UNIT – IV Data Analysis and Visualization 14 Hours**

Importing and Exporting Data (CSV, JSON), Understanding and Formatting Data. Using Matplotlib and Plotly for Visualization, Generating and Plotting Data (Line Graphs, Bar Charts), Random Walks, Dice Simulation, Working with APIs, Downloading Data and Visualizing Repositories using Plotly, Mapping Global Datasets with JSON.

**TEXT BOOKS:**


1. Wesley J. Chun, *Core Python Applications Programming*, 3rd Edition, Pearson Education, 2016.
2. Yashavant Kanetkar and Aditya Kanetkar, *Let Us Python*, 3rd Edition, BPB Publications.
3. Jeeva Jose & P. Sojan Lal, *Introduction to Computing and Problem Solving with Python*, Khanna Publishers, New Delhi, 2016.
4. Eric Matthes, *Python Crash Course – A Hands-On, Project-Based Introduction to Programming*, 2nd Edition, No Starch Press, 2019.
5. Gowrishankar S, Veena A, *Introduction to Python Programming*, 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN: 978-0815394372.


**REFERENCE BOOKS:**


1. Allen B. Downey et al., *How to Think Like a Computer Scientist: Learning with Python*, John Wiley, 2015.
2. John Zelle, *Python Programming: An Introduction to Computer Science*, 2nd Edition, Course Technology, Cengage Learning, 2013.
3. A.N. Kamthane & A.A. Kamthane, *Programming and Problem Solving with Python*, McGraw Hill Education, 2017.
4. Mark Lutz, *Learning Python*, 5th Edition, O'Reilly Publications, 2013. ISBN: 978-1449355739.
5. Ljubomir Perkovic, *Introduction to Computing Using Python – An Application Development Focus*, Wiley, 2012.

| Theory | 24BCA33: Computer Networks |
|---|---|
| Teaching Hours : 04 Hours/Week | Credits: 03 |
| Duration of Exam: 03 Hours | Maximum Marks: 100 (Exam 80 + IA 20) |

**Course Outcomes**

| COs | Description |
|---|---|
| CO1 | Understand the basics of data communication |
| CO2 | Explore data link layer protocols and understand channelization methods |
| CO3 | Analyse the functioning of the network layer, routing algorithms and protocols |
| CO4 | Comprehend transport layer protocols and application layer services |

**UNIT - I Introduction to Networking and Communication Principles 14 Hours**

Introduction: Data Communications, Networks, Network Types, Internet History, Network Models: Protocol Layering, The OSI Model, TCP/IP Protocol Suite, Introduction to Physical Layer: The types of Transmission media, Transmission Impairments, Data Rate Limits, Performance.

**UNIT - II Data Link Layer and MAC Techniques 14 Hours**

Introduction to Data Link Layer: Link-Layer Addressing. Error Detection and Correction: Block Coding, Cyclic Codes, Checksum. Data Link Control: Data-Link Layer Protocols, HDLC, Point-To-Point (PPP), MAC sublayer, Logical Link Control Layer, Random access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA, Scheduling approaches to medium access control: Reservation systems, Polling, Token Passing rings, Comparison of Random access and Scheduling access control, Comparison of Random access and scheduling medium access control, Channelization: FDMA, TDMA, CDMA.

**UNIT - III Network Layer Fundamentals and Routing Protocols 14 Hours**

Introduction to Network Layer: Network-Layer Services, Packet Switching, Network-Layer Performance, IPV4 Addresses, Network Layer Protocols: Internet Protocol (IP), ICMPv4, Mobile IP, Unicast Routing: Routing Algorithms, Unicast Routing Protocols, Next Generation IP: IPv6 Addressing.

**UNIT - IV Transport and Application Layer Protocols with QoS Mechanisms 14 Hours**

Introduction to Transport Layer: Transport-Layer Protocols, User Datagram Protocol, Transmission Control Protocol: TCP Services, TCP Features, Segment, TCP Connection, TCP Congestion Control, Flow Control, Error Control, Application Layer: WWW, E-MAIL, Domain Name System (DNS), Quality of Service: Flow Control To Improves QoS, Integrated Services.

**TEXT BOOKS**


1. Behrouz A. Forouzan, “Data Communications and Networking”, 5th Edition, McGraw Hill Education,2013.


**REFERENCE BOOKS**


1. Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, 5th Edition, Prentice Hall,2011.
2. Larry L. Peterson and Bruce S. Davie, “Computer Networks A System Approach”, 5th Edition,MKP, 2012.
3. James F. Kurose , Keith W. Ross, “ Computer Networking, A Top-Down Approach”, 5thEdition, Pearson, 2012.

| Theory | 24BCA34: Cyber Security |
|---|---|
| Teaching Hours : 02 Hours/Week | Credits : 02 |
| Duration of Exam : 1.5 Hours | Maximum Marks : 50 (Exam 40 + IA 10) |

**Course Outcomes**

| COs | Description |
|---|---|
| CO1 | Understand the fundamentals of cyber security, types of cyber threats and adopt safe internet practices and responsible digital behavior. |
| CO2 | Understand the basic concepts of cryptography, encryption techniques, password security and secure communication protocols used for data protection. |
| CO3 | Apply system and personal security measures to protect devices and data from threats, vulnerabilities and online attacks. |

**Unit I – Fundamentals of Cyber Security & Secure Communication 14 Hours**

**Introduction to Cyber Security**: Importance of cyber safety in the digital world, Common types of cyber threats: viruses, worms, trojans, phishing, ransomware, fake websites, social engineering, Real-life examples of cyber attacks. **Goals of Cyber Security**: Confidentiality, Integrity, Availability (CIA Triad),Difference between threats, vulnerabilities, and risks. **Security Concepts and Terminology**: Firewall, antivirus, malware, hacking. **Safe Internet Practices**: Responsible digital behaviour, Secure browsing and identifying fake/unsafe websites, Email safety: detecting phishing and spam, Use of public Wi-Fi and avoiding data leaks. **Introduction to Cryptography and Secure Communication**: Purpose of encryption and decryption, Difference between symmetric and asymmetric encryption, Role of HTTPS and SSL, Two-Factor Authentication (2FA), OTP-based logins, Importance of secure messaging and email

**Unit II – System, Personal, and Device Security Practices 14 Hours**

**System and Device Security Basics**: Operating System security basics, User authentication and access control, Password policies and best practices, Antivirus and anti-malware software. **Web and App Security**: Common web security issues: SQL injection, XSS, CSRF (overview only), Mobile app security – permissions and safe usage, Safe use of mobile devices, laptops, and social media, Software updates and patch management. **Network and Online Protection**: Introduction to firewalls and VPNs, Risks of pop-ups, cookies, and online tracking, Safe and responsible data sharing online

**TEXT BOOK:**

1. Chirag Shah (2018). A Hands-On Introduction to Cybersecurity. Wiley.

**REFERENCE BOOKS:**

1. Nina Godbole & Sunit Belapure (2011). Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives. Wiley India.
2. Rao, U. & Nayak, P. (2014). Cyber Security. Cengage Learning.
   Moeti J. (2021). Cybersecurity for Beginners. Amazon Digital Services (for simple reading-level coverage).

| Lab | 24BCA31P: DBMS Lab |
|---|---|
| Teaching Hours : 03 Hours/Week | Credits : 02 |
| Duration of Exam : 3 Hours | Maximum Marks : 50 (Exam 40 + IA 10) |

## Part A

**1.** Create a table STUDENT with the following fields: RollNo, Name, DOB, Department, Marks.
   Insert at least 5 records
   Display all records
   Update marks for a specific student
   Delete a student record

**2.** Create a table COURSE with CourseID, CourseName, Credits.
   Alter the table to add a field Department
   Drop the field Credits

3. Create two tables EMPLOYEE1 and EMPLOYEE2 with the following attributes: (FNAME, MNAME, LNAME, SSN, BDATE, ADDRESS, SEX, SALARY, SUPERSSN, DNO). Perform UNION, INTERSECT, and MINUS operations on them.

**4.** Use the STUDENT table to perform Aggregate functions and Scalar functions

**5.** Using the STUDENT and COURSE tables,
   Find students who scored above average marks using a subquery.
   List students enrolled in 'Computer Science' using a subquery.

**6.** Create DEPARTMENT and STUDENT tables.
   Write queries to display student names along with their department names using JOIN operations.

**7.** Create a view to show student names and marks from the STUDENT table where Marks >75.
   Query the view and update the view.

**8.** Demonstrate the use of GRANT and REVOKE on the STUDENT table.
   Use COMMIT and ROLLBACK after INSERT and DELETE commands.

## Part B

**9.** Write a PL/SQL block to accept a number and check if it is even or odd.

**10.** Write a PL/SQL program to divide two numbers and handle the exception if the denominator is zero.

**11.** Use a parameterized cursor to display students based on department input.

**12.** Create a stored function to calculate grade based on marks:
   Above 80: Distinction
   60–79: First Class
   40–59: Second Class
   Below 40: Fail

**13.** Write a stored procedure to update the marks of a student given their RollNo and new marks.

**14.** Create a BEFORE INSERT trigger on STUDENT to ensure marks are not entered as negative.

**15.** Create a trigger to log changes into a table STUDENT_LOG whenever the marks are updated.

**16.** Use a cursor with a loop to count and display the number of students in each department.

| Lab | 24BCA32P: Python Programming Lab |
|---|---|
| Teaching Hours : 03 Hours/Week | Credits : 02 |
| Duration of Exam : 3 Hours | Maximum Marks : 50 (Exam 40 + IA 10) |

**Part A**

1. Write a Python program to declare variables, perform arithmetic operations, and display results.
2. Create a program to check if a number is even or odd using if-else.
3. Write a Python program to print the first n Fibonacci numbers using a for loop.
4. Implement a program that accepts a string and counts the number of vowels and consonants.
5. Create a program to store student details in a dictionary and retrieve details based on user input.
6. Demonstrate the use of break, continue, and pass in loops.
7. Write a program to create NumPy arrays, perform element-wise operations, and reshape arrays.
8. Create a Pandas Series and perform indexing, slicing, and querying operations.
9. Load a dataset into a Pandas Data Frame and perform sorting and filtering operations.
10. Write a program to handle missing values by filling them with mean/median values.

**Part B**

2. String Operations: Write a program to count the occurrences of each word in a given string.
3. Implement a program to insert, delete, and update elements in a list.
4. Create a dictionary with employee details and perform CRUD operations.
5. Implement a program to generate prime numbers up to n using a generator function.
6. Write a Python program to calculate the factorial of a number using recursion.
7. Write a program to read and write student marks into a text file and display the contents.
8. Plot a line graph and a bar chart using Matplotlib.
9. Write a program to load a CSV file into Pandas and perform basic data analysis.
10. Implement a program to group a dataset by category and calculate summary statistics.
11. Load a dataset from Scikit-learn and display its basic properties.

| Lab | 24BCA33P: Computer Networks Lab |
|---|---|
| **Teaching Hours : 03 Hours/Week** | **Credits : 02** |
| **Duration of Exam : 3 Hours** | **Maximum Marks : 50 (Exam 40 + IA 10)** |

1. Execute the following commands: arp, ipconfig, hostname, netdiag, netstat, nslookup, pathping, ping route, tracert
2. Study of different types of network cables.
3. Practically implement the cross-wired cable and straight wired cable using crimping tool.
4. Study of network IP address configuration: (Classification of address, static and dynamic address)
5. Study of network IP address configuration: (IPv4 and IPv6 , Subnet, Supernet)
6. Study of network devices: (Switch, Router, Bridge)
7. Configure and Connect the computer in LAN.
8. Block the website using "Windows Defender Firewall" in windows 10.
9. Share the folder in a system and access the files of that folder from other system using IP address.
10. Share the printer in Network, and take print from other PC.
11. Configuration of wifi hotspot, and connect other devices (mobile / laptop).
12. Configuration of switches.
13. Configuration of I/O box fixing.
14. Making your own patch cord.
15. Configuration of VLAN using Packet Tracer/ GNS3.
16. Configuration of VPN using Packet Tracer/ GNS3

**SEMESTER – IV**

| Theory | 24BCA41: Artificial Intelligence |
|---|---|
| Teaching Hours : 04 Hours/Week | Credits : 03 |
| Duration of Exam : 03 Hours | Maximum Marks : 100 (Exam 80 + IA 20) |

**Course Outcomes**

| COs | Description |
|---|---|
| CO1 | Understand the fundamental concepts of Artificial Intelligence and problem-solving strategies. |
| CO2 | Apply logical reasoning techniques, perform inferences, solve constraint satisfaction problems and basic learning methods. |
| CO3 | Design AI systems using planning techniques and reasoning, interpret data using perception models. |
| CO4 | Explore the application domains and evaluate ethical and societal implications of AI technologies. |

**UNIT – I Fundamentals of Artificial Intelligence and Search Techniques 14 Hours**

Definitions, Applications, and Scope. Intelligent Agents: Agents and Environments, Concept of Rationality, Nature of the Environment, Structure of Agents. Knowledge-Based Agents: Introduction, The Wumpus World as an Example. Problem Solving: Problem-Solving Agents, Formulating Problems. Search Techniques: Uninformed Search Strategies – Depth First Search (DFS), Breadth First Search (BFS), Iterative Deepening Search. Informed Search Strategies – Best First Search, A* Search, AO* Search, Means-End Analysis. Adversarial Search and Games: Two-Player Zero-Sum Games, Minmax Algorithm, Alpha-Beta Pruning.

**UNIT – II Knowledge Representation, Reasoning, and Learning Paradigms 14 Hours**

Propositional Logic, First-Order Predicate Logic, Differences between Propositional and First-Order Inference. Inference Techniques: Unification and Lifting, Forward Chaining, Backward Chaining, Resolution, Truth Maintenance Systems. Constraint Satisfaction Problems (CSPs): Definition, Examples, Backtracking Search. Learning Concepts: Rote Learning, Learning by Taking Advice, Learning in Problem Solving, Learning from Examples. Decision Trees and Winston's Learning Program.

**UNIT – III Planning, Reasoning and Perception 14 Hours**

Introduction to Planning: Planning Problem, State-Space Search, The Blocks World Problem, STRIPS Representation. Handling Uncertainty: Non-Monotonic Reasoning, Probabilistic Reasoning, Introduction to Fuzzy Logic and Fuzzy Set Theory. Introduction to Perception: Computer Vision – Image Classification, Object Detection. Natural Language Processing (NLP): Introduction, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing.

**UNIT – IV Machine Learning, Neural Networks, and AI Ethics 14 Hours**

Types of Learning – Supervised, Unsupervised, and Reinforcement Learning. Neural Networks: Basics of Artificial Neural Networks (ANN), Deep Learning Concepts , Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM) Networks and their Applications. Expert Systems: Architecture, Components, and Role of Expert Systems with Two Case Studies. Legal and Ethical Issues in AI: Societal Impact, Bias, Privacy, and Accountability in AI Systems.

**TEXT BOOKS:**


1. M.C. Trivedi, *A Classical Approach to Artificial Intelligence*, Khanna Book Publishing Company, 2024 (AICTE Recommended).
2. Nilsson Nils J., *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann Publishers Inc., ISBN: 978-1-55860-467-4.
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.
5. Russell, S. and Norvig, P., *Artificial Intelligence – A Modern Approach*, 3rd Edition, Prentice Hall.


**REFERENCE BOOKS:**


1. M.C. Trivedi, *Introduction to AI and Machine Learning*, Khanna Book Publishing Company, 2024.
2. Van Hirtum, A. & Kolski, C., *Constraint Satisfaction Problems: Algorithms and Applications*, Springer, 2020.
3. Elaine Rich, Kevin Knight, Shivasankar B. Nair, *Artificial Intelligence*, 3rd Edition, McGraw Hill, 2019.
4. Rajiv Chopra, *Machine Learning and Machine Intelligence*, Khanna Book Publishing Company, 2024.

| Theory | 24BCA42: Design And Analysis of Algorithms |
|---|---|
| Teaching Hours : 04 Hours/Week | Credits : 03 |
| Duration of Exam : 03 Hours | Maximum Marks : 100 (Exam 80 + IA 20) |

**Course Outcome**

| COs | Description |
|---|---|
| CO1 | Understand the fundamental principles of algorithm design and analyze algorithm efficiency. |
| CO2 | Apply classical algorithm design paradigms to solve computational problems. |
| CO3 | Employ optimization techniques to design efficient solutions for complex problems. |
| CO4 | Analyze the computational complexity of problems and Problem-Solving Methods. |

**UNIT - I Fundamentals of Algorithm Design and Computational Efficiency 14 Hours**

Introduction: Algorithms, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamental Data Structures. Fundamentals of the Analysis of Algorithm Efficiency: The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms, Empirical Analysis of Algorithms.

**UNIT – II Algorithm Design Techniques 14 Hours**

Brute Force Method: Selection Sort and Bubble Sort, Sequential Search, Brute-Force String Matching, Depth-First Search and Breadth-First Search. Decrease and Conquer: Insertion Sort, Topological Sorting, Algorithms for Generating Combinatorial Objects, Decrease by-a-Constant-Factor Algorithms. Divide and Conquer: Merge Sort, Quick Sort, Binary Tree Traversals and Related Properties.

**UNIT - III Optimization Techniques 14 Hours**

Space and Time Tradeoffs: Sorting by Counting, Input Enhancement in String Matching, Hashing. Dynamic programming: Binomial Coefficient, Principle of Optimality, Optimal Binary Search Trees, Knapsack Problem and Memory Functions. Warshall's and Floyd's Algorithms. Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees.

**UNIT – IV Understanding Algorithmic Complexity & Problem-Solving Methods**

Limitations of Algorithm Power: Lower-Bound Arguments, Decision Trees, P, NP and NP Complete Problems. Limitations of Algorithm Power, Backtracking: 4-Queens problem, Hamiltonian Circuit Problem, Sum of Subset Problem. Branch-and-Bound: Assignment Problem, Knapsack Problem, Traveling Salesman Problem. **14 Hours**

**TEXT BOOKS:**


1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson, 2012.
2. Horowitz, Sahni, Rajasekaran, "Fundamentals of Computer Algorithms", 2/e, Universities Press, 2007.


**REFERENCE BOOKS:**


1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, The MIT Press, 2009.
2. A.V. Aho, J.E. Hopcroft, J.D. Ullmann, "The design and analysis of Computer Algorithms", Addison Wesley Boston, 1983.
3. Jon Kleinberg, Eva Tardos, "Algorithm Design", Pearson Education, 2006.

| Theory | 24BCA43: Internet Technologies |
|---|---|
| Teaching Hours : 04 Hours/Week | Credits : 03 |
| Duration of Exam : 03 Hours | Maximum Marks : 100 (Exam 80 + IA 20) |

**Course Outcome**

| COs | Description |
|---|---|
| CO1 | Understand the fundamental concepts of the Internet, its services, applications, organizations and apply ethical practices in cyberspace. |
| CO2 | Understand the workings of web technologies and basic concepts of web information retrieval. |
| CO3 | Design and develop web applications. |
| CO4 | Work with web application frameworks and databases and explore current research trends. |

**UNIT - I Internet Fundamentals, Services and Cyber Ethics** **14 Hours**

INTERconnected NETwork (Internet): The Giant Wide Area Network, Communicating over the Internet, Accessing the Internet, Internet Organisations, Cyber Ethics, Internet Applications: Internet services, Electronic Mail(E-Mail), File Transfer, Real-Time User Communication, Remote Login, Usenet, World Wide Web: Introduction, Working Web, Web Terminology, Web Architecture, World Wide Web Challenges.

**UNIT - II Web Technologies and Evolution** **14 Hours**

Hypertext Transfer Protocol (HTTP): HTTP, HTTP Version, HTTP connections, HTTP Communication, Hypertext Transfer Protocol Secure, Hypertext Transfer Protocol State Retention: Cookies, Hypertext Transfer Protocol Cache, Evolution of Web: The Generations of Web, Web 1.0, Web 2.0, Web 3.0, Information Retrieval on the Web (Web IR): Web Information Retrieval, Web Information Retrieval Tools, Web Information Retrieval Architecture (Search Engine Architecture), Web Information Retrieval Performance Metrics, Web Information Retrieval Models.

**UNIT - III Web Development Technologies and Architectures** **14 Hours**

Web Development: Basics of Web Development, Elements of Web Development, Client-Side and Server-Side Scripting, Model-View-Controller Architecture for Web Application Development, Client-Side Technologies: HTML, CSS, JavaScript, Bootstrap Framework, AngularJS Framework, Server-Side Technologies: Server-Side Scripting, Node.js.

**UNIT - IV Frameworks and Databases for Web Applications with Research Insights**

Web Application Frameworks: Django, Ruby on Rails, Structured Query Language: Relational Databases, Web Databases: NoSQL Databases, Non-relational and Distributed Data, Understanding Popular Databases. Research Trends on the Web: Contextual Information Retrieval, Web Mining. **14 Hours**

**TEXT BOOKS:**

1.Rajkamal, “Internet and Web Technologies”, Tata McGraw-Hill Education.
2. Robert W. Sebesta, “Programming the World Wide Web”, Pearson, 8th Edition

**REFERENCE BOOKS:**

1. Randy Connolly, Ricardo Hoar, “Fundamentals of Web Development”, Pearson
2. Valerie Lampkin, “Modern Web Development with HTML5 and CSS”, Cengage Learning.

| Theory | 24BCA44: Ethical Hacking |
|---|---|
| Teaching Hours : 02 Hours/Week | Credits : 02 |
| Duration of Exam : 1.5 Hours | Maximum Marks : 50 (Exam 40 + IA 10) |

**Course outcomes**

| COs | Description |
|---|---|
| CO1 | Understand the scope, phases and legal aspects of ethical hacking and recognize various cyber attacks and the role of ethical hackers in cyber security. |
| CO2 | Apply reconnaissance, scanning and enumeration techniques using tools to gather and analyze system and network information for vulnerability assessment. |
| CO3 | Identify and explain common system hacking methods, malware types and social engineering attacks and suggest preventive strategies. |
| CO4 | Understand web and network security threats, secure browsing practices and the use of firewalls, VPNs and IDS/IPS for ethical hacking and protection. |

**Unit-I Foundations of Ethical Hacking and Cyber Attacks 14 Hours**

Definition and scope of ethical hacking, Difference between hacking and ethical hacking, Types of hackers – white hat, black hat, grey hat. Ethical hacking process and phases – planning, scanning, gaining access, maintaining access, clearing tracks. Common attack types – phishing, malware, password cracking, social engineering attacks such as phishing, baiting, and shoulder surfing. Introduction to attacks including Trojans, worms, viruses, and ransomware. Basics of keyloggers, spyware, backdoors, and rootkits. Introduction to sniffing and packet capturing. Role of ethical hacking in cyber security. Basic prevention strategies and the importance of user awareness.

**Unit-II Footprinting, Scanning, Enumeration and System Exploitation 14 Hours**

Introduction to reconnaissance and information gathering. Footprinting techniques – search engines, social networks, WHOIS, DNS, email tracking. Tools for passive and active footprinting. Scanning networks – IP scanning, port scanning, vulnerability scanning. Overview of common tools: Nmap, Angry IP Scanner. Enumeration basics: Windows and Linux enumeration, identifying users, shares, services and open ports, interpreting scan results and identifying risks. Basics of system hacking including password cracking, privilege escalation, keylogging, and techniques used to gain unauthorized access.

**TEXT BOOK*:***

1. Bachaalani, P., & Mehta, N. (2020). *Fundamentals of Ethical Hacking*. BPB Publications.

**REFERENCE BOOKS*:***

1. EC-Council (2019). *Ethical Hacking and Countermeasures: Attack Phases*. Cengage Learning.
2. Kimberly Graves (2010). *CEH: Official Certified Ethical Hacker Review Guide*. Wiley.
3. Jon Erickson (2008). *Hacking: The Art of Exploitation*. No Starch Press.

| Lab | 24BCA41P: Artificial Intelligence Lab |
|---|---|
| **Teaching Hours : 03 Hours/Week** | **Credits : 02** |
| **Duration of Exam : 3 Hours** | **Maximum Marks : 50 (Exam 40 + IA 10)** |

1. Demonstrate basic problem-solving using Breadth-First Search on a simple grid.
2. Implement Depth-First Search (DFS) on a small graph.
3. Solve the Water Jug Problem using Breadth First Search (BFS).
4. Implement a Hill Climbing search to find the peak in a numeric dataset.
5. Apply the A* Search algorithm to find the shortest path in a 4x4 grid.
6. Implement the Minmax search algorithm for 2-player games. You may use a game tree with 3 plies. .
7. Use constraint propagation to solve a Magic Square puzzle.
8. Apply optimization techniques to find the maximum value in a list.
9. Represent and evaluate propositional logic expressions.
10. Implement a basic rule-based expert system for weather classification.
11. Implement a basic AI agent with simple decision-making rules.
12. Implement a basic Rule-Based Chatbot.
13. 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)

| Lab | 24BCA42P: Design and Analysis of Algorithms Lab |
|---|---|
| Teaching Hours : 03 Hours/Week | Credits : 02 |
| Duration of Exam : 3 Hours | Maximum Marks : 50 (Exam 40 + IA 10) |

1. Write a program to implement linear search algorithm. Repeat the experiment for different values of n, the number of elements in the list to be searched and plot a graph of the time taken versus n.
2. Write a program to implement binary search algorithm. Repeat the experiment for different values of n, the number of elements in the list to be searched and plot a graph of the time taken versus n.
3. Write a program to solve towers of Hanoi problem and execute it for different number of disks
4. Write a Program to Sort a given set of numbers using selection sort algorithm. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
5. Write a program to find minimum and maximum value in a given array using divide and conquer.
6. Write a Program to Sort a given set of elements using quick sort algorithm. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n.
7. Write a Program to implement dynamic programming algorithm for the optimal binary search tree.
8. Write a Program to implement Floyd's algorithm and find the lengths of the shortest paths from every pair of vertices in a given weighted graph.
9. Write a Program to solve the string matching problem using Boyer-Moore approach.
10. Write a program to implement BFS traversal algorithm.
11. Write a program to find the minimum spanning tree of a given graph using Prim's algorithm.
12. Write a program to find the minimum spanning tree of a given graph using Kruskal's algorithm.
13. Write a Program to obtain the topological ordering of vertices in a given digraph. Compute the transitive closure of a given directed graph using Warshall's algorithm.
14. Write a program to implement backtracking algorithm for solving 4 queens problem.
15. Write a Program to Find a subset of a given set S = {s1, s2…sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1,2,6} and {1,8}. A suitable message is to be displayed if the given problem instance doesn't have a solution.

| Lab | 24BCA43P: Internet Technologies Lab |
|---|---|
| **Teaching Hours : 03 Hours/Week** | **Credits : 02** |
| **Duration of Exam : 3 Hours** | **Maximum Marks : 50 (Exam 40 + IA 10)** |

1. Demonstrate E-Mail working (Sending ,Receiving, forward).
2. How to create, organize meeting in Zoom/ GoogleMeet.
3. Create a form by using various attributes of the input tags (text box, multiline textbox, option button, check box).
4. Create a simple HTML page by using some of the basic tags (hyperlink, marquee, image).
5. Create a web page with multiple types of style sheet used in a single page.
6. Write a CGI sample program to send output back to the user.
7. Create Time-Table using table tag.
8. Creation of Frames in browser window using HTML.
9. Write a java script program to create dialogue boxes using alert, confirm and prompt methods.
10. Write a java script program on Form Validations.
11. Write a java script program to perform four arithmetic operations: Addition, Subtraction, Multiplication and Division on two numbers.
12. Create a web site of your College.

| Theory : Skill Enhancement Course-I | 24BCASE1: Probability and Statistics |
|---|---|
| Teaching Hours : 02 Hours / Week | Credits : 02 |
| Duration of Exam : 1.5 Hours | Maximum Marks : 50 (Exam 40 + IA 10) |

**Course Outcomes**

| COs | Description |
|---|---|
| CO1 | Knowledge to conceptualize the probabilities of events including frequent and axiomatic approach. Simultaneously, they will learn the notion of conditional probability. |
| CO2 | Knowledge related to concept of discrete and continuous random variables and their probability distributions including expectation and moments |
| CO3 | Knowledge related to concept of random variable, Probability mass function and probability density function. |

**UNIT - I Fundamentals of Probability and Theorems 14 Hours**

Introduction to Probability: Basic concepts of Probability, random experiment, trial, outcome, sample space, event, mutually exclusive event, equally likely events. Conditional probability, Independent events, Addition and multiplication theorems of probability for 2 events (Statement without proof) and problems, Addition and multiplication theorems of probability for n events (Statement without proof) and problems, Bayes' theorem Statement and its applications.

**UNIT - II Random Variables and Probability Distributions 14 Hours**

Random variable: Definition of Random variable, discrete and continuous random variables, functions of random variable, probability mass function, probability density function, distribution function and its properties. For a given probability mass function calculation of mean and variance. For a given probability density function calculation of mean and variance. Mathematical Expectation of random variable and function of random variable.

**TEXT BOOKS:**

1. S.P.Gupta, "Statistical Methods" Sultan Chand and Sons Publishers, 2020
2. S.C. Gupta & V.K.Kapoor " Fundamentals of Mathematical statistics", Sultan Chand and Sons Publishers, 2020.

**REFERENCE BOOKS:**

1. Sambavyatha – "Fundamentals of statistics" , Goon, Gupta and Das Gupta, 2010

| BLUEPRINT FOR QUESTION PAPER | | | | | | |
|---|---|---|---|---|---|---|
| **FOR 03 CREDITS** | | | | | | |
| **Marks** | **Unit I** | **Unit II** | **Unit III** | **Unit IV** | **Number of questions to be answered** | **Total** |
| **2** | **3** | **3** | **3** | **3** | **10** | **20** |
| **6** | **2** | **2** | **2** | **2** | **5** | **30** |
| **10** | **1** | **1** | **1** | **1** | **3** | **30** |
| | | | | | **Total** | **80** |
| **FOR 02 CREDITS** | | | | | | |
| **Marks** | **Unit I** | **Unit II** | **Number of questions to be answered** | | | **Total** |
| **2** | **3** | **3** | **5** | | | **10** |
| **5** | **3** | **3** | **4** | | | **20** |
| **10** | **1** | **1** | **1** | | | **10** |
| | | | | | **Total** | **40** |

## Formative Assessment - 03 Credits

| Category | Marks Allotted |
|---|---|
| Tests | 10 |
| Assignments | 10 |
| **Total Marks** | **20** |

## Formative Assessment - 02 Credits

| Category | Marks Allotted |
|---|---|
| Tests | 5 |
| Assignments | 5 |
| **Total Marks** | **10** |