

ಡಾ. ಮನಮೋಹನ ಸಿಂಗ್
ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ



Dr. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

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No.MSBCU/BoS/BCA-UG/ /2026-27

Date:07.07.2026

NOTIFICATION

Sub: V & VI Semesters Syllabus of Dr. Manmohan Singh
Bengaluru City University-reg.

Ref: 1. Recommendations of Board of Studies in the Computer
Science and Applications [PG & UG]
2. Academic Council resolution No.05 dated.08.06.2026
3. Approval of the Vice-Chancellor dated.07.07.2026

In pursuance of the recommendation in the BoS in Computer Science and Applications (PG & UG) and as per the resolution of the Academic Council cited at ref (2) above and after consultation with Dean of Science Faculty & Chairperson of BoS, the Syllabus of following courses are hereby notified for information of the concerned, effective from the academic year 2026-27.

1.	B.Sc. Computer Science V & VI Semester
2.	BCA – V & VI Semester
3.	BCA- AI & ML – V & VI Semester
4.	BCA- Data Science– V & VI Semester
5.	B.Voc (IT) – V & VI Semester

The copy of the Syllabus is notified in the University Website: www.bcu.ac.in for information of the concerned.

REGISTRAR

To:

The Registrar (Evaluation), Dr. Manmohan Singh Bengaluru City University, Bengaluru.

Copy to;

1. The Dean, Faculty of Science, MSBCU.
2. The Chairman & Members of BoS in Computer Science and Applications (PG &UG), MSBCU.
3. Principals of all affiliated Colleges of MSBCU.
4. The P.S. to Vice-Chancellor/Registrar/Registrar (Evaluation), MSBCU.
5. Office copy / Guard file / University Website: www.bcu.ac.in



Dr. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM
[As per SEP]

Syllabus for BCA [General]

2026-27 onwards

BENGALURU CITY UNIVERSITY

Syllabus of Fifth and Sixth Semesters for

Bachelor of Computer Applications (CBCS Scheme)

Under State Education Policy

**Effective from the Academic Year
2026 – 2027**

Board of Studies in Computer Science for UG

No : BCU/BoS/Comp.Sci. & Appln.(PG & UG)/361/2025-26 dated 05-1-2026

1	Dr. Ashok S B Director, School of Computer Science Maharani Cluster University Bengaluru-560001	Chairperson
2	Prof. Guru D S Department of Studies in Computer Science University of Mysore, Mysore-570006	Member
3	Prof. Aziz Makandar Department of Computer Science Karnataka State Akkamahadevi Women University, Jnanashakti Campus, Vijayapura-586109	Member
4	Prof. Suneetha Department of Computer Science, Karnataka State Open University, Muktha Gangothi, Mysuru-570006	Member
5	Prof. Veena R Department of MCA, Seshadripuram College, Seshadripuram, Bengaluru-560020	Member
6	Prof. Kiran Kumar M N Department of Computer Applications, BMS College of Commerce and Management, Bengaluru-560004	Member
7	Prof. Latha B Department of Computer Science Vijaya College, R V Road, Basavanagudi, Bengaluru-560004	Member
8	Prof. R Shanthi Krishna Department of Computer Applications, SSMRV College, Jayanagar, Bengaluru-560041	Member
9	Prof. Roopa H R Department of Computer Applications, Seshadripuram Institute of Commerce and Management, Seshadripuram, Bengaluru-560020	Member
10	Sri Seby Kallarakkal 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	Cryptography and Network Security	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	03*	80	20	03	06
Total Credits							20
Overall Total Credits							140

***This is only for guidance, supervision and monitoring of internship and its report. The same is to be considered on par with the workload.**

SEMESTER – V

Theory	24BCA51: Web 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	Creating structured and attractive web pages using HTML, CSS and can design layouts and responsive interfaces for websites.
CO2	Add interactivity to web pages using JavaScript and perform form validation, event handling, and DOM manipulation.
CO3	Develop dynamic web pages using server-side scripting languages like PHP and can process user requests and manage sessions.
CO4	Connect web applications with databases for data storage and retrieval and perform CRUD operations in database-driven applications.

UNIT – I Introduction to Web Technologies and HTML

14 Hours

Basics of Internet and World Wide Web, Web Browsers and Web Servers, Client-Server Architecture, Introduction to HTML5, Structure of HTML Document, Text Formatting Tags, Hyperlinks, Images, Tables, Lists and Forms, Semantic HTML Elements.

UNIT – II Cascading Style Sheets (CSS)

14 Hours

Introduction to CSS , Need for CSS, , basic syntax and structure, Types of CSS: Inline, Internal, External, Selectors, Colors, Backgrounds, Fonts, Text Styling, Margins, Padding, Borders and Boxes, Positioning and Layout Techniques, Flexbox and Grid Layout, CSS2, Overview and features of of latest version of CSS.

UNIT – III JavaScript and Client-Side Programming

14 Hours

Introduction to JavaScript, Variables, Data Types, Operators, Control Statements and Loops, Functions and Arrays, Objects and Events, DOM Manipulation, Form Validation, Pop-up Boxes and Timing Functions, ES6 Features, Introduction to AJAX, Basics of JSON

UNIT – IV Server-Side Programming and Database Connectivity

14 Hours

Introduction to Server-Side Scripting, Introduction and basic syntax of PHP, Variables, Operators, Functions, Form Handling using PHP, Sessions and Cookies, File Handling, Introduction to MySQL Database, SQL Queries (CRUD Operations), Connecting PHP with MySQL .

TEXT BOOKS:

1. Jon Duckett, *HTML and CSS: Design and Build Websites*, John Wiley & Sons, 2011.
2. Jon Duckett, *JavaScript and jQuery: Interactive Front-End Web Development*, John Wiley & Sons, 2014.
3. Robin Nixon, *Learning PHP, MySQL & JavaScript*, 5th Edition, O'Reilly Media, 2018.

REFERENCE BOOKS:

1. Jennifer Robbins, *Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics*, 5th Edition, O'Reilly Media, 2018.
2. Thomas A. Powell, *HTML & CSS: The Complete Reference*, 5th Edition, McGraw-Hill Education, 2017.
3. John Dean, *Web Programming with HTML5, CSS, and JavaScript*, Jones & Bartlett Learning, 2018.

Theory	24BCA52: Data Analytics	
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 evolution, types, applications, and benefits of data analytics along with the essential skills required for business, web, and text analytics.
CO2	Analyze relationships between variables using correlation and regression techniques and solve problems using Pearson's and Spearman's methods.
CO3	Apply probability concepts, probability distributions, and hypothesis testing techniques such as t-test, ANOVA, and Chi-square in data analysis.
CO4	Develop interactive dashboards by importing, transforming, and visualizing data using Power BI tools for effective business intelligence reporting.

UNIT – I Introduction to Data Analytics 14 Hours
 Evolution of Data Analytics, Data Analytics Overview, Types of Data Analytics -Descriptive Analytics, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics. Importance and Benefits of Data Analytics. Different Applications of Analytics in Business, Text Analytics and Web Analytics, Skills for Business Analytics.

UNIT – II Correlation & Regression 14 Hours
 Introduction and Meaning of Correlation, Types of correlation ,probable error, Karl pearson's coefficient of correlation for individual series only, Spearman's Rank correlation for individual series only. Introduction and definition Regression, difference between correlation and regression, Simple linear regression, properties of regression coefficients, Regression equation x on y, Regression equation y on x , Simple Problems.

UNIT – III 14 Hours
 Sample Space, Types of Events, Measures of probability, conditional probability, Baye's theorem, Random variable. Probability Distributions: Binomial, Poisson and Normal Distributions – Definitions, means, variances and applications of these distributions. Simple problems. Estimation and Hypothesis Testing- t-test, Analysis of variance (ANOVA) and Chi-square test.

UNIT – IV 14 Hours
 Introduction to Power BI, Introduction to Business Intelligence (BI), Overview of Power BI and its components: Power BI Desktop, Service, and Mobile , Installing Power BI Desktop, Power BI Interface & Navigation, Data sources supported by Power BI. Data Loading & Transformation using Power Query : Understanding Power Query Editor, Loading data from various sources (Excel, Web, SQL),Cleaning and transforming data:Remove columns/rows, Rename columns, Merge and Append queries, Data types and formatting. Visualizations and Dashboards-Types of charts: Bar, Column, Pie, Line, Map, Matrix, Card, Gauge, etc., Creating interactive dashboards, Formatting visuals and tooltips, Using slicers and filters, Drill through and bookmarks.

TEXT BOOKS:

1. Kumar, U.D. :Business Analytics – The Science of Data – Driven Decision Making, 1st Edition, Wiley, USA, 2014.
2. Dr Anil Maheshwari, Data Analytics Made Accessible, 1st Edition, Amazon.com Services LLC., USA, 2016.
3. Johnson, R.A., Miller, I. and Freund, Probability and Statistics for Engineers, 8th Edition, Pearson, USA, 2013.

REFERENCE BOOKS:

1. Gert, H.N., Thorlund, L. and Thorlund, J :Business Analytics for Managers – Taking Business Intelligence Beyond Reporting, 1st Edition, Wiley, USA, 2018.
2. Dr. Gaurav Aroraa , Chitra Lele , Dr. Munish Jindal ; “ Data Analytics: Principles, Tools, and Practices: A Complete Guide for Advanced Data Analytics Using the Latest Trends, Tools, and Technologies, 1st Edition, Amazon, USA, 2021.

Theory	24BCA53: Software Engineering
Teaching Hours : 04 Hours/Week	Credits: 03
Duration of Exam: 03 Hours	Maximum Marks: 100 (Exam 80 + IA 20)

Course Outcomes

COs	Description
CO1	Ability to understand software engineering concepts and SDLC models.
CO2	Analyze software requirements and prepare design models.
CO3	Apply testing, maintenance, and project management techniques.
CO4	Understand modern software engineering trends and tools

UNIT – I Introduction to Software Engineering **14 Hours**

Introduction to Software and Software Engineering, Software Products and Software process, Characteristics of Software, Software Crisis and Need for Software Engineering, Software Development Life Cycle (SDLC), Role of Software Engineer, Software Process Framework, Ethics in Software Engineering, Software Process Models: Waterfall Model, Prototype Model, Spiral Model, Incremental Model, Agile Model (Basics), Emerging Trends in Software Development.

UNIT - II Requirements Engineering and Software Design **14 Hours**

Requirement Engineering Process, Feasibility Study, Requirement Gathering Techniques, Software Requirement Specification (SRS), Functional and Non-Functional Requirements, Introduction to Software Design, Design Principles, Modular Design, Structured Design Tools, Introduction to UML Diagrams, Coding Standards and Documentation

UNIT - III Testing Strategies and Product Metrics **14 Hours**

Software Testing Basics, Unit Testing, Integration Testing, System Testing and Validation, Test strategies for conventional software, Black-box and White-box testing, Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance, Software Measurement, Metrics for software quality. Clean room software development.

UNIT - IV Software Maintenance and Project Management **14 Hours**

Software Maintenance Concepts, Types of Maintenance, Reverse Engineering and Re-engineering, Software Reliability, Software Quality Assurance, Software Project Planning, Cost Estimation Basics, Scheduling and Risk Management, Team Management, Introduction to CASE Tools

TEXT BOOKS

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, Mc Graw Hill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson Education.
3. The unified modeling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.

REFERENCE BOOKS

1. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley.
2. Software Engineering principles and practice- Waman S Jawadekar, The Mc Graw-Hill Companies.
3. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

Theory	24BCA54: Cryptography and Network Security	
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 fundamentals of cryptography, security goals, attacks, and mathematical concepts used in encryption.
CO2	Apply symmetric and asymmetric key algorithms for secure data communication.
CO3	Analyze hash functions, digital signatures, and key management techniques for authentication and integrity.
CO4	Understand network security protocols for secure communication

Unit I – Fundamentals and Mathematical Foundations of Cryptography 14 Hours

Basic Security Goals, Types of Cryptographic Attacks, Security Services and Mechanisms, Cryptographic Methods, Integer Arithmetic, Modular Arithmetic, Matrices, Linear Congruence.

Unit II – Symmetric Key Cryptography 14Hours

Classical Symmetric-Key Ciphers, Substitution and Transposition Techniques, Stream and Block Ciphers, Data Encryption Standard (DES), DES Structure and Security, Triple DES, Advanced Encryption Standard (AES), AES Operations, Key Expansion, Performance Analysis of AES.

Unit III - Public Key Cryptography and Hashing Techniques 14 Hours

Modern Block and Stream Ciphers, Prime Numbers, Primality Testing, Factorization, Chinese Remainder Theorem, RSA Cryptosystem, Rabin Cryptosystem, ElGamal Cryptosystem, Elliptic Curve Cryptography, Hash Functions, MD Family, Whirlpool, SHA-512.

Unit IV: Digital Signatures, Key Management and Network Security 14 Hours

Digital Signature Concepts, Signature Schemes and Uses, Key Distribution Methods, Symmetric and Public Key Management, Kerberos, Application Layer Security (PGP, S/MIME), Transport Layer Security (SSL, TLS), Network Layer Security (IPSec), Internet Key Exchange.

TEXT BOOK:

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, 8th Edition, Pearson Education, 2023.
2. Behrouz A. Forouzan, *Cryptography and Network Security*, McGraw-Hill Education, 2007.
3. Atul Kahate, *Cryptography and Network Security*, 4th Edition, McGraw-Hill Education, 2019.

REFERENCE BOOKS:

1. William Stallings, *Network Security Essentials: Applications and Standards*, 6th Edition, Pearson Education, 2017.
2. Debdeep Mukhopadhyay, *Cryptography and Network Security*, 2nd Edition, PHI Learning, 2011.

Lab	24BCA51P: Web Programming Lab	
Teaching Hours : 03 Hours/Week		Credits : 02
Duration of Exam : 3 Hours		Maximum Marks : 50 (Exam 40 + IA 10)

1. Create a basic HTML page displaying college name, heading, paragraph, and horizontal line.
2. Design a webpage using text formatting tags such as bold, italic, underline, superscript, and subscript.
3. Create a webpage containing hyperlinks to different websites and internal page links.
4. Develop a webpage to display images with proper height, width, and alternate text.
5. Design a timetable using HTML tables with rowspan and colspan.
6. Create ordered, unordered, and definition lists for course details.
7. Develop a student registration form using HTML form controls.
8. Create a webpage using semantic HTML tags such as header, nav, section, article, and footer.
9. Design a webpage using Inline, Internal, and External CSS.
10. Create a webpage to demonstrate CSS selectors, colors, fonts, and background properties.
11. Design a webpage using margin, padding, border, and box model concepts.
12. Create a responsive webpage layout using Flexbox or CSS Grid.
13. Write a JavaScript program to perform arithmetic operations using operators.
14. Write a JavaScript program to find whether a number is even or odd using conditional statements.
15. Write a JavaScript program to generate factorial of a number using loops.
16. Develop a JavaScript program for form validation (name, email, mobile number).

Lab	24BCA52P: Data Analytics Lab	
Teaching Hours : 03 Hours/Week	Credits : 02	
Duration of Exam : 3 Hours	Maximum Marks : 50 (Exam 40 + IA 10)	

Part - A

- From the given dataset players_info.csv ,
 - What is the probability distribution of genders among the players?
 - What is the probability of each batting style?
 - What is the probability of each bowling style?
 - What is the probability distribution of player positions?
 - What is the probability distribution of countries among the players?
- 80% of all the visitors to Museum of Goa end up buying souvenirs from the souvenir shop at the museum. On the coming Sunday, if a random sample of 10 visitors is picked, Find the Probability that every visitor will end up buying from the souvenir shop. Find the Probability that a maximum of 7 visitors will buy souvenirs from the souvenir shop.
- A testing agency wants to analyze the complexity of SAT exam 2022. They have collected the SAT scores of 1000 students in "sat_score.csv". Calculate the probability that a student will score less than 800 in SAT exam. Calculate the probability that a student will score more than 1300 in SAT exam.
- A Marketing services company reported that the typical American spends a mean of 144 minutes (2.4 hours) per day accessing the Internet via a mobile device. Select a sample of 30 friends and family members whose mobile access time is stored in a CSV file "InternetMobileTime.csv". Is there evidence that the population mean time spent per day accessing the Internet via mobile device is different from 144 minutes? (Level of Significance $\alpha = 0.05$)
- A hotel manager looks to enhance the initial expression that hotel guests have when they check in. Contributing to initial impressions is the time it takes to deliver a guest's luggage to the room after Check in. A random sample of 20 deliveries on a particular day is selected in Wing A of the hotel and a random sample of 20 deliveries is selected in Wing B. The results are stored in "Luggage.csv". Analyze the data and determine whether there is a difference between the mean delivery time in the 2 wings of the hotel.(Use $\alpha = 0.05$)
- The file „Concrete.csv“ contains the compressive strength in thousands of pounds/square inch, of 40 samples of concrete taken 2 and 7 days after pouring. At the 0.01 level of significance, is there evidence that the mean strength is lower at 2 days than at 7 days?
- Two companies A and B were merged. After the first appraisal cycle post-merger, employees originally belonging to company B have put an allegation that the management favours employees who were originally a part of company A. At 95% confidence perform a hypothesis test to validate if the claim holds good.

Promotion Status

Company	P	NP	Total
A	15	9	24
B	16	15	31
Total	31	24	55

8. Traffic management inspector in a city wants to understand whether carbon emissions from different cars are different. For this reason, the inspector has taken random samples from all registered cars on the road in that city and would like to test if the amount of carbon emission release depends on fuel type at 5% significance level.
Dataset – AOVDData.csv
9. Find the relationship between the price of a laptop with other factors of the dataset
“laptops.csv”.

Part - B

1. Install Power BI Desktop, explore the interface, and load data from an Excel file.
2. Use Power Query Editor to clean and transform a dataset.
3. Use Power Query Editor to combine data from multiple tables.
4. Visualize data using basic chart types - Bar Chart, Column Chart and Pie Chart by loading a dataset.
5. Use cards, maps, and matrices for advanced visuals by loading a dataset.
6. Enhance dashboard interactivity using slicers and filters.
7. Use drill-through pages and bookmarks for navigation and detail views.

Lab	24BCASE2: Quantitative Techniques	
Teaching Hours : 03 Hours/Week		Credits : 02
Duration of Exam : 3 Hours		Maximum Marks : 50 (Exam 40 + IA 10)

Course Outcomes

COs	Description
CO1	Understand fundamental quantitative concepts such as number systems, percentages, ratios, and algebra required for solving aptitude problems.
CO2	Apply arithmetic and algebraic techniques to solve problems related to time, speed, distance, work, and real-life business scenarios.
CO3	Analyze data using tables, charts, and graphs to interpret and solve data interpretation and data sufficiency problems.
CO4	Evaluate different problem-solving approaches and select appropriate strategies such as approximation, elimination, and shortcut methods to improve speed and accuracy.

UNIT – I Core Arithmetic and Algebra 14 Hours

Number System - Divisibility rules; LCM & HCF; Remainders (basic concepts). Percentages and Applications - Percentage calculations; Profit and Loss; Discount problems. Ratio and Proportion - Direct & inverse proportion; Partnership problems. Averages - Simple and weighted averages. Time, Speed and Distance - Basic concepts; Relative speed; Problems on trains. Time and Work - Work efficiency; Pipes and cisterns. Algebra Basics - Linear equations; Quadratic equations (basic problems).

UNIT – II Data Interpretation and Advanced Aptitude 14 Hours

Data Interpretation – Tables; Bar charts; Pie charts; Line graphs. Permutations and Combinations - Basic counting principles. Probability - Basic probability concepts; Simple applications. Logarithms (Basics) - Rules and applications. Sequences and Series - Arithmetic Progression (AP); Geometric Progression (GP). Geometry (Basics) - Areas and volumes. Problem-Solving Strategies - Approximation techniques; Time-saving tricks; Elimination methods.

Text Books

1. Aggarwal, R. S., Quantitative Aptitude for Competitive Examinations, S. Chand Publishing, 2025 Revised Edition.
2. Sharma, Arun, Quantitative Aptitude for CAT, McGraw Hill Education, 2026 Edition.

Reference Books

1. Guha, Abhijit, *Quantitative Aptitude for Competitive Examinations*, McGraw Hill Education, 2023 Edition.
2. Verma, Sarvesh K., *Quantum CAT: Quantitative Aptitude*, Arihant Publications, 2024 Edition.
3. Tyra, Nishit K., *Magical Book on Quicker Maths*, BSC Publishing, 2023 Edition.
4. Verma, Rajesh, *Fast Track Objective Arithmetic*, Arihant Publications, 2023 Edition.
5. Singh, Ajay, *Objective Arithmetic*, Arihant Publications, 2023 Edition.

Project Work	24BCAPJ: Project
Teaching Hours : 08 Hours/Week	Credits : 06
Duration of Exam : 3 Hours	Maximum Marks : 150 (Exam 120 + IA 30)

- a. The project shall be either research-oriented or application-based in the emerging areas of Computer Technology.
- b. Project work may be carried out individually or in a group consisting of a maximum of three students.
- c. A hardbound project report must be submitted as part of the project work.
- d. The use of open-source or licensed software tools is encouraged, and all such tools utilized must be properly acknowledged and cited in the report.

Summative Assessment Criteria	
Writing	20
Demonstratiom	60
Vivavoce	20
Report	20
Total	120

Formative Assessment Criteria	
Review Meeting-1	10
Review Meeting-2	10
Review Meeting-3	10
Total	30

SEMESTER – VI

Theory	24BCA61: Machine Learning
Teaching Hours : 04 Hours/Week	Credits : 03
Duration of Exam : 03 Hours	Maximum Marks : 100 (Exam 80 + IA 20)

Course Outcomes

COs	Description
CO1	Learn the basics of machine learning, understanding its uses, challenges and various applications.
CO2	Build practical data skills, covering data collection, analysis, visualization and preparation.
CO3	Become skilled in using classification and regression algorithms, including selecting, training, and evaluating models.
CO4	Dive into advanced clustering and specialized applications, using methods like K- Means, DBSCAN and others.

UNIT 1: Fundamentals of Machine Learning

(14 hours)

Introduction to Machine Learning: What is Machine Learning? Why Use Machine Learning? , Types of Machine Learning Systems, Main Challenges of Machine Learning, Applications of Machine Learning. Why Python, scikit-learn, Essential Libraries and Tools.

UNIT 2: Data Preparation

(14 hours)

Working with Real Data, look at the Big Picture, Get the Data, Discover and Visualize the Data to Gain Insights, Prepare the Data for Machine Learning Algorithms, Select and Train a Model.

UNIT 3: Supervised Learning

(14 hours)

Classification and Regression, Some Sample Datasets, k-Nearest Neighbours, Linear Models, Naive Bayes Classifiers, Decision Trees.

UNIT 4: Unsupervised Learning

(14 hours)

Clustering, K-Means, Limits of K-Means, using clustering for image segmentation, Using Clustering for Preprocessing, Using Clustering for Semi-Supervised Learning, DBSCAN, Other Clustering Algorithms.

TEXT BOOKS:

1. Andreas . C. Müller and S. Guido, "Introduction to Machine Learning with Python," O'Reilly, 2017 (Unit-1)
2. Amanda . Casari and Alice . Zheng, "Feature Engineering for Machine Learning," O'Reilly Media, Inc., 2018, p. 218. (Unit-2)
3. A. Géron, "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow," O'Reilly Media, Inc., 2022.
4. Ian Goodfellow, Yoshua. Bengio, and Aaron. Courville, "Deep Learning," MIT Press, 2016. (Unit-4)

REFERENCE BOOKS:

1. S. Rashka and V. Mirdzhalili, "Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2," Packt, Birmingham and Mumbai, 2020.
2. S. Shalev-Shwartz and S. Ben-David, "Understanding Machine Learning: From Theory to Algorithms," Cambridge University Press, 2014.

Theory	24BCA62: Cloud Computing
Teaching Hours : 04 Hours/Week	Credits : 03
Duration of Exam : 3 Hours	Maximum Marks : 100 (Exam 80 + IA 20)

Course outcomes

COs	Description
CO1	Understand the basic concepts, characteristics, and deployment models of cloud computing.
CO2	Compare the different cloud service models such as SaaS, PaaS, and IaaS.
CO3	Describe the working of cloud infrastructure, storage, virtualization, and security mechanisms.
CO4	Apply cloud computing concepts in real-world areas such as business, education, healthcare, and e-commerce.

UNIT-I Fundamentals of Cloud Computing (14 Hours)

Introduction to Cloud Computing, Importance of Cloud Computing, Characteristics of Cloud Computing, Benefits and Limitations, Types of Clouds – Public, Private, Hybrid, Community, Cloud Architecture, Basics of Virtualization, Applications of Cloud Computing.

UNIT-II Cloud Service Models (14 Hours)

Overview of Service Models, Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Benefits of Service Models, Comparison of SaaS, PaaS and IaaS, Examples of Cloud Providers – AWS, Microsoft Azure, Google Cloud.

UNIT-III IaaS and PaaS Concepts (14 Hours)

Virtual Machines, Cloud Storage, Basic Networking, Resource Management, Scalability, Security Features in IaaS, Development Platforms, Runtime Environment, Database Services, Application Deployment, Applications of IaaS and PaaS.

UNIT-IV Cloud Security and Uses (14 Hours)

Introduction to Cloud Security, Data Safety, Access Control, Backup and Recovery, Service Level Agreements (SLA), Cost Control, Cloud Migration, Uses of Cloud Computing in Business, Education, Healthcare and E-Commerce.

Text Books:

1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Pearson Education, 1st Edition, 2013.
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill Education, 2013.
3. Kris Jamsa, Cloud Computing, Jones & Bartlett Learning, 1st Edition, 2012.

Reference Books:

1. Thomas Erl, Eric Barceló Monroy, Cloud Computing: Concepts, Technology, Security and Architecture, Pearson Education, 2nd Edition, 2023.

2. Lizhe Wang, Rajiv Ranjan, Jinjun Chen, Boualem Benatallah, Cloud Computing: Methodology, Systems, and Applications, CRC Press, 2011.
3. Kumar Saurabh, Cloud Computing – Insights into New Era Infrastructure, Wiley India, 2011.

Theory	24BCA63: Data Mining
Teaching Hours : 04 Hours/Week	Credits : 03
Duration of Exam : 3 Hours	Maximum Marks : 100 (Exam 80 + IA 20)

Course outcomes

COs	Description
CO1	Understand the basic concepts, processes, and applications of data mining.
CO2	Apply data preprocessing techniques and association rule mining methods to datasets.
CO3	Demonstrate classification and clustering techniques for data analysis.
CO4	Analyze real-world problems using data mining tools and techniques in various domains.

UNIT-I Fundamentals of Data Mining (14 Hours)

Overview of Data Mining, Importance of Data Mining, Applications of Data Mining, Basics of Data Warehousing, Difference between Database and Data Warehouse, Knowledge Discovery in Databases (KDD), Steps in Data Mining Process, Types of Data, Issues in Data Mining.

UNIT-II Data Preparation and Association Mining (14 Hours)

Data Cleaning, Data Integration, Data Transformation, Data Reduction Techniques, Handling Missing Data, Introduction to Association Rule Mining, Frequent Itemsets, Apriori Algorithm, Market Basket Analysis, Uses of Association Rules.

UNIT-III Classification and Clustering Techniques (14 Hours)

Basics of Classification, Decision Tree Method, Naive Bayes Technique, k-Nearest Neighbor (KNN), Basics of Clustering, Partitioning Methods, K-Means Algorithm, Hierarchical Clustering, Applications of Classification and Clustering.

UNIT-IV Recent Trends and Applications (14 Hours)

Outlier Detection, Prediction Methods, Introduction to Web Mining, Text Mining, Basics of Big Data Analytics, Performance Evaluation of Data Mining, Ethical Issues in Data Mining, Applications in Business, Healthcare, Education, and E-Commerce.

Text Books:

1. Jiawei Han, Jian Pei, Hanghang Tong, *Data Mining: Concepts and Techniques*, 4th Edition, Elsevier / Morgan Kaufmann, 2022.
2. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, *Introduction to Data Mining*, 2nd Edition, Pearson Education, 2018.
3. Ian H. Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, *Data Mining: Practical Machine Learning Tools and Techniques*, 5th Edition, Elsevier / Morgan Kaufmann, 2025.

Reference Books:

1. Mohammed J. Zaki, Wagner Meira Jr., *Data Mining and Machine Learning: Fundamental Concepts and Algorithms*, 2nd Edition, Cambridge University Press, 2020.
2. Florin Gorunescu, *Data Mining: Concepts, Models and Techniques*, Springer, 2011.
3. Galit Shmueli, Peter C. Bruce, Kuber R. Deokar, Nitin R. Patel, *Data Mining for Business Analytics*, Wiley, 2023.

Theory	24BCA64: Theory of Computation
Teaching Hours : 04 Hours/Week	Credits : 03
Duration of Exam : 3 Hours	Maximum Marks : 100 (Exam 80 + IA 20)

Course outcomes

COs	Description
CO1	Understand the basic concepts, processes, and applications of data mining.
CO2	Apply data preprocessing techniques and association rule mining methods to datasets.
CO3	Demonstrate classification and clustering techniques for data analysis.
CO4	Analyze real-world problems using data mining tools and techniques in various domains.

UNIT-I Fundamentals of Finite Automata (14 Hours)

Introduction to Automata Theory, Basic Principles of Automata, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Finite Automata with Epsilon Moves, Applications of Finite Automata.

UNIT-II Regular Languages and Automata (14 Hours)

Regular Expressions, Connection between Finite Automata and Regular Expressions, Uses of Regular Expressions, Regular Languages, Closure Properties of Regular Languages, Decision Properties, Equivalence and Minimization of Automata, Pumping Lemma for Regular Languages.

UNIT-III Context Free Languages and Pushdown Automata (14 Hours)

Context Free Grammars (CFG), Derivations, Parse Trees, Ambiguity in Grammars, Applications of CFG, Pushdown Automata (PDA), Languages Recognized by PDA, Equivalence of CFG and PDA, Normal Forms of CFG.

UNIT-IV Turing Machines and Computability (14 Hours)

Introduction to Turing Machines, Construction of Turing Machines, Programming Techniques for Turing Machines, Recursive and Recursively Enumerable Languages, Undecidable Problems, Problems Beyond Computation, Post Correspondence Problem (PCP), Basics of Computational Complexity.

Text Book

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman: Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson Education, 2011.

Reference Books

1. John C Martin: Introduction to Languages and Automata Theory, 3rd Edition, Tata McGraw-Hill, 2007.
2. Daniel I.A. Cohen: Introduction to Computer Theory, 2nd Edition, John Wiley & Sons, 2009.
3. Thomas A. Sudkamp: An Introduction to the Theory of Computer Science, Languages and Machines, 3rd Edition, Pearson Education, 2006.

Lab	24BCA61P: Machine Learning Lab
Teaching Hours : 03 Hours/Week	Credits : 03
Duration of Exam : 3 Hours	Maximum Marks : 50 (Exam 40 + IA 10)

1. Install and set up Python and essential libraries like NumPy and pandas.
2. Introduce scikit-learn as a machine learning library.
3. Install and set up scikit-learn and other necessary tools.
4. Write a program to Load and explore the dataset of .CSV and excel files using pandas.(Use auto-mpg.csv , churn.xlsx) Functions to be implemented: read_csv(), read_excel(), head(),shape, info(),describe()
5. Write a program to Visualize the dataset to gain insights using Matplotlib or Seaborn by plotting boxplot,scatter plots, bar charts.(Use Admission_Predict.csv file)
6. Write a program to Visualize the dataset to gain insights using Seaborn by plotting Pairplot and Heatmap.(Use Admission_Predict.csv file)
7. Write a program to Handle missing data, encode categorical variables and perform feature scaling. Use survival.csv
8. Write a program to implement a k-Nearest Neighbours (k-NN) classifier using scikitlearn and train the classifier on the dataset and evaluate its performance on the dataset Social_Network_Ads.csv
9. Write a program to implement a k-Nearest Neighbours (k-NN) classifier using scikitlearn and train the classifier on the dataset and evaluate its performance on the dataset iris.csv
10. Write a program to implement a linear regression model for regression tasks and Train the model on a dataset with continuous target variables. Use auto-mpg-9.csv.
11. Write a program to implement a decision tree classifier using scikit-learn and visualize the decision tree and understand its splits. credit_data.csv
12. Write a program to implement Naïve Bayes classifier using scikitlearn and train the classifier on the dataset and evaluate its performance on the dataset. Use diabetes.csv
13. Use iris flower dataset and form clusters of flowers using petal width and length features. Draw elbow point and figure out the optimal values of 'K'.
14. Implement Image Segmentation using clustering algorithm by taking any image as per your choice.

Internship	24BCAIS: Internship
Teaching Hours : 02 Hours/Week	Credits : 06
Duration of Exam : 3 Hours	Maximum Marks : 100 (Exam 80 + IA 20)

Guidelines

- Students in the VI Semester must undertake an internship, which will be supervised and monitored by both internal and external mentors.
- Internships can be carried out in organizations of any scale, including small, medium, or large enterprises, which includes online/offline mode.
- Student attendance must comply with university regulations, requiring a minimum of 75%.
- Students are required to complete at least 30 hours of internship work during the semester.
- The internship report should include details such as the company profile, functions and operations, nature of the work undertaken, learning outcomes.
- The report should be approximately 30–50 pages long and must include the internship certificate and a log sheet issued by the company. It should be submitted before the end of the semester for evaluation and viva-voce.
- All reports must be authenticated with the official seal and signed by the Head of the Department (HOD).
- The internship evaluation will be carried out externally by the university.

Summative Assessment Criteria	
Report	30
Log Book Maintenance	20
Viva Voce	30
Total	80

Formative Assessment Criteria	
Review Meeting-1	10
Review Meeting-2	10
Total	20

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