

Scheme & Syllabus of Bachelor of Computer Applications (BCA)

Batch 2025 onwards



**GURU NANAK DEV ENGINEERING
COLLEGE, LUDHIANA**

Program Outcomes (POs)

PO1: Communicational knowledge: Apply the knowledge of mathematics, computer science and domain-specific principles to solve defined computing problems and meet use requirements.

PO2: Problem analysis: Identify, analyze, and interpret computing problems using fundamental principles of mathematics and computer science, and apply research-based knowledge to derive effective solutions.

PO3: Design and Development of Solutions: Design and develop software applications or components that meet societal, cultural, environmental, or public health needs, considering user specifications and system constraints

PO4: Investigation of Complex Computing Problems: Use research-based methods including data analysis and experimentation, to investigate complex computing issues and draw valid conclusions.

PO 5: Modern tool usage: Select and apply appropriate modern computing tools, techniques and resources to solve real-world problems, while recognizing their limitations.

PO 6: Societal and Environmental Awareness: Understand the impact of professional computing solutions in societal and environmental contexts, and demonstrate knowledge of relative responsibilities, including health, safety, legal, and cultural concerns.

PO 7: Innovation and Entrepreneurship: Demonstrate a mindset for innovation and entrepreneurship by developing computing solutions that address real-world challenges, emphasizing quality, scalability, and a holistic approach.

PO 8: Professional Ethics: Understand and commit to ethical practices, legal responsibilities and professional norms in the field of computer Applications.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, with a focus on collaborative learning and productivity.

PO 10: Communication Efficacy: Communicate effectively with computing community and society by writing clear reports, designing effective documentation, delivering impactful presentations, and following structured instructions.

PO 11: Project management and finance: Apply knowledge of management principles and computing skills to manage projects efficiently either individually or as a team member or leader, in multidisciplinary environments.

PO 12: Life-Long Learning: Demonstrate the ability to engage in independent and lifelong learning in the context of technological change and continuous professional development.

Program Specific Outcomes (PSOs)

PSO1: Graduates will be able to design, develop, test and deploy software solutions and application using appropriate programming languages, development tools, and frameworks to address real-world problems.

PSO2: Graduates will be prepared for careers in the Computer and IT industry by providing them with the Technical Skills and knowledge needed to analyze, design and implement computer systems.

GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA
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DEPARTMENT OF COMPUTER APPLICATIONS

Study Scheme and Syllabus 2025- BCA

FIRST SEMESTER											
Course Category	Module Name	Course Code	Course Title	Theory/ Practical	Contact hours per week			Credits	Marks Distribution		Total Marks
					L	T	P		CA Marks	ESE Marks	
Core Course	Mathematics	BCA101	Mathematics Foundations to Computer Science	Theory	3	1	0	4	40	60	100
Skill Enhancement course	Programming	BCA104	Programming for Problem Solving	Theory	2	0	2	3	90	60	150
Core Course	Computer Basics	BCA102	Fundamentals of Computer and IT	Theory	3	0	2	4	90	60	150
Skill Enhancement course	Web System and Technologies	BCA103	Web Designing	Theory	3	0	4	5	90	60	150
Value added course	Environmental Studies	BCA106	Environmental Science and Sustainability	Theory	2	0	0	2	40	60	100
Ability Enhancement course	Communication Skills	BCA105	General English	Theory	1	1	0	2	40	60	100
Mentoring & Professional Development	Life Skills	NEMPD101	Mentoring and Professional Development	Practical	0	0	1	-	-	-	-
Total					14	2	9	20	390	360	750

- Final Evaluation of NEMPD101 will be done on the combined assessment of odd and even semester of respective year of study.

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DEPARTMENT OF COMPUTER APPLICATIONS

Study Scheme 2025- BCA

SECOND SEMESTER											
Course Category	Module Name	Course Code	Course Title	Theory/ Practical	Contact hours per week			Credits	Marks Distribution		Total Marks
					L	T	P		CA Marks	ESE Marks	
Core Course	Mathematics	BCA107	Probability and Statistics	Theory	3	0	0	3	40	60	100
Core Course	Digital Systems	BCA108	Digital Electronics and Computer Architecture	Theory	3	0	0	3	40	60	100
Core Course	Software Development	BCA109	Software Engineering	Theory	3	0	2	4	90	60	150
Core Courses	Advanced Computing	BCA110	Artificial Intelligence	Theory	3	0	2	4	90	60	150
Skill Enhancement course	Programming	BCA111	Object Oriented programming Using C++	Theory	3	0	2	4	90	60	150
Value Added courses	Constitutional Studies	UGNE101	Indian Constitution	Theory	2	0	0	2	40	60	100
Mentoring & Professional Development	Life Skills	NEMPD101	Mentoring and Professional Development	Practical	0	0	1	1	100	0	100
Total					17	0	07	21	490	360	850

- Final Evaluation of NEMPD101 will be done on the combined assessment of odd and even semester of respective year of study.

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THIRD SEMESTER											
Course Category	Module Name	Course Code	Course Title	Theory/ Practical	Contact hours per week			Credits	Marks Distribution		Total Marks
					L	T	P		CA Marks	ESE Marks	
Core Course	Problem Solving and Implementation	BCA112	Data Structures-I	Theory	3	0	2	4	90	60	150
Core Course	Data Storage and Management	BCA113	Introduction to Cloud Computing	Theory	3	0	2	4	90	60	150
Core Course	Networking	BCA116	Computer Networks	Theory	3	0	2	4	90	60	150
Skill Enhancement course	Programming	BCA114	Basics of Python Programming	Theory	3	0	2	4	90	60	150
Core Course	Advanced Computing	BCA115	Machine Learning	Theory	3	0	2	4	90	60	150
Mentoring & Professional Development	Life Skills	NEMPD102	Mentoring and Professional Development	Practical	0	0	1	-	-	-	-
Total					15	0	11	20	450	300	750

- Final Evaluation of NEMPD102 will be done on the combined assessment of odd and even semester of respective year of study.

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FOURTH SEMESTER											
Course Category	Module Name	Course Code	Course Title	Theory/ Practical	Contact hours per week			Credits	Marks Distribution		Total Marks
					L	T	P		CA Marks	ESE Marks	
Core Course	System Software	BCA117	Operating System	Theory	3	0	2	4	90	60	150
Discipline Specific Elective	Machine Learning & AI/ Full Stack/ Cloud Computing	EBCAXXX	Professional Elective-I	Theory	3	0	2	4	90	60	150
Core Course	Problem Solving and Implementation	BCA118	Data Structures-II	Theory	3	0	2	4	90	60	150
Core Course	Data Storage and Management	BCA119	Database Management System-I	Theory ..	3	0	2	4	90	60	150
Core Course	Networking	BCA120	Cryptography and Network Security	Theory	3	0	0	3	40	60	100
Value Added Course	Indian Knowledge	UGNE102	Indian Knowledge System	Theory	2	0	0	2	40	60	100
Mentoring & Professional Development	Life Skills	NEMPD102	Mentoring and Professional Development	Practical	0	0	1	1	100	-	100
Total					17	0	9	22	540	360	900

- Final Evaluation of NEMPD102 will be done on the combined assessment of odd and even semester of respective year of study.
- At the end of the fourth semester every student shall undergo summer training for 120 hours in the industry/institute. This component will be evaluated during the fifth semester.
- The proposed track with Discipline Specific- Artificial Intelligence and Machine learning/Full Stack/ Cloud Computing and Visualization will be offered depending upon the availability of Faculty and Resources. The track chosen for an academic session by the student in the beginning of the fourth semester will remain unchanged throughout the remaining period of course.

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FIFTH SEMESTER											
Course Category	Module Name	Course Code	Course Title	Theory/ Practical	Contact hours per week			Credits	Marks Distribution		Total Marks
					L	T	P		CA Marks	ESE Marks	
Core Course	Data Storage and Management	BCA121	Database Management System-II	Theory	3	0	2	4	90	60	150
Discipline Specific Elective	Machine Learning and AI/ Full Stack/ Cloud Computing	EBCAXXX	Professional Elective-II	Theory	3	0	2	4	90	60	150
Skill Enhancement course	Career Preparation	FSCA101	Professional Skills and Aptitude Development	Theory	2	0	0	2	40	60	100
Core Course	Problem Solving and Implementation	BCA122	Java Programming	Theory	3	0	4	5	90	60	150
Skill Enhancement course	Experiential Learning	PRBCA101	Minor project	Practical	0	0	4	2	60	40	100
Skill Enhancement course	Experiential Learning	TRBCA101	Training	Practical	0	0	4	2	60	40	100
Mentoring & Professional Development	Life Skills	NEMPD301	Mentoring and Professional Development	Practical	0	0	1	-	-	-	
Total					11	0	17	19	430	320	750

- Final Evaluation of NEMPD103 will be done on the combined assessment of odd and even semester of respective year of study.

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SIXTH SEMESTER											
Course Category	Module Name	Course Code	Course Title	Theory / Practical	Contact hours per week			Credits	Marks Distribution		Total Marks
					L	T	P		CA Marks	ESE Marks	
Open Elective Course	Entrepreneurship	OBCE101	Entrepreneurship Development	Theory	3	0	0	3	40	60	100
Skill Enhancement course	Problem Solving and Implementation	BCA123	Android Programming	Theory	3	0	4	5	90	60	150
Core Course	Networking	BCA124	Cyber Law and IPR	Theory	3	0	2	4	90	60	150
Value Added Course	Emergency Preparedness Essentials	BCA125	Disaster Management and Preparedness	Theory	2	0	0	0	50	0	50
Discipline Specific Elective	Machine Learning and AI/ Full Stack/ Cloud Computing	EBCAXXX	Professional Elective –III	Theory	3	0	2	4	90	60	150
Skill Enhancement course	Experiential Learning	PRBCA102	Major Project	Practical	0	0	8	4	120	80	200
Mentoring & Professional Development	Life Skills	NEMPD103	Mentoring and Professional Development	Practical	0	0	1	1	100	-	100
Total					12	0	17	21	580	320	800

- Final Evaluation of NEMPD103 will be done on the combined assessment of odd and even semester of respective year of study.
- For non-credit courses, students have to obtain at least 40% marks in CA component to qualify and attain satisfactory level (S) as these courses will be graded with Satisfactory/ Unsatisfactory level (S/US).

Discipline Specific Elective

TRACK 1: Artificial Intelligence and Machine learning

S.No.	Elective	Professional Elective Code	Professional Elective
1	Elective-I	EBCA101	Neural Network
2	Elective-II	EBCA104	Big Data
3	Elective-III	EBCA107	Deep Learning

TRACK 2: Full Stack development

S.No.	Elective	Professional Elective Code	Professional Elective
1	Elective-I	EBCA102	Web Technologies
2	Elective-II	EBCA105	Full-Stack Web Development with MERN
3	Elective-III	EBCA108	Web App Security and Deployment

TRACK 3: Cloud Computing and Virtualization

S.No.	Elective	Professional Elective Code	Professional Elective
1	Elective-I	EBCA103	DevOps
2	Elective-II	EBCA106	Applied Cloud Computing
3	Elective-III	EBCA109	Cloud based Automation and Edge computing

Open Elective course to be offered to other departments:

OBCA101: Management Information System

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Course Code: BCA101

Course Title: Mathematics Foundations to Computer Science

Programme: BCA	L: 3 T: 1 P: 0	Credits: 4
Semester: 1	Theory/Practical: Theory	Teaching Hours: 45(L)+15(T) = 60 hrs
Total Max. Marks: 100	Continuous Internal Assessment (CIA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 100%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Discuss the concepts of sets, relations, and functions with the help of Venn diagrams and logical laws.
2	Apply matrix algebra to solve systems of linear equations using matrix operations and Cramer's rule.
3	Evaluate solutions to problems involving differentiation and integration of algebraic functions.
4	Analyze various types of graphs and their applications in real-world problems.
5	Evaluate mathematical concepts to solve numerical/statistical problems in computing and data analysis.

Contents

Part-A

Unit –I Set, Relation and Functions

12(L) hrs

Elements of set, methods of describing a set, types of sets, operation on sets – union, intersection and difference of sets, Venn diagrams, statement problems, Associative laws, Distributive laws, DeMorgan's laws, duality, partitioning of a set. Basic definition of Relation and types of relations, reflexive, symmetric, transitive, equivalence, Functions, properties of functions (domain, range, inverse and composite functions).

Unit-II Matrix Algebra

9(L) hrs

Introduction and definition of matrices , types of matrices, symmetric function, skew symmetric, orthogonal matrix, matrix addition and scalar multiplication , transpose and inverse of matrix, solution of system of linear equations using matrices by Cramer rule, definition and properties of determinants.

Part-B

Unit-III Differentiation and Integration:

18(L) hrs

Laws of derivative, Chain rule, Differentiation using log, repeated derivatives, derivatives of implicit functions. Integration of algebraic, Logarithmic and Exponential function, trigonometric function, Integration of functions using partial fraction, Integration of functions by parts.

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Unit-IV

6(L) hrs

Graph and planar graphs – Basic Terminology, Multi-graphs, Weighted Graphs, Paths and Circuits, Shortest Paths, Eulerian Paths and Circuits, Travelling Salesman Problem, Planar Graphs, Trees, Properties of trees, concept of spanning tree.

Text Books

1. D. R. Sharma, Mathematics BCA Semester I, Sharma Publications.
2. F. Ayres, Schaum's Outline of College Mathematics, Fourth Edition, New Delhi, India: Tata McGraw-Hill, 2020
3. S. Lipschutz and M. Lipson, Schaum's Outline of Discrete Mathematics, 4th Edition. New York, NY, USA: McGraw-Hill, 2022

Reference Books

1. K. H. Rosen, "Discrete Mathematics and Its Applications", McGraw-Hill, Edition: 8th 2021.
2. R. D. Sharma, "Elementary Mathematics", Edition: 6th Edition 2024.
3. Parmanand Gupta, "Comprehensive Mathematics", Edition: 6th Edition 2024.
4. M. L. Bhargava, "Elements of Mathematics", Edition: 25th Edition 2024.

Online Learning Materials

1. <https://www.geeksforgeeks.org/set-theory/> Accessed on 07 April, 2025
2. <https://www.geeksforgeeks.org/algebra/> Accessed on 07 April, 2025
3. <https://www.geeksforgeeks.org/math-trigonometry/> Accessed on 08 April, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Discrete Mathematics	Prof. Sudarshan Iyengar, Prof. Prabuchandran K.J	IIT Ropar, IIT Dharwad	https://onlinecourses.nptel.ac.in/noc22_cs3/3/preview

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Course Code: BCA102

Course Title: Fundamentals of Computer and IT

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 1	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Describe the history, characteristics, classification, and generations of computers and their basic organization.
2	Analyze the functions and interrelation of the CPU, memory, motherboard, and hardware components in a computer system.
3	Evaluate different programming languages and operating system features to determine their suitability for various applications.
4	Create documents by applying word processing tools for formatting and content management.
5	Apply spreadsheet tools to organize data, perform calculation and create charts for data analysis.
6	Design presentations using multimedia and graphic software.

Contents

Part-A

Unit –I

12(L) hrs

Introduction to Computers: History of computers, characteristics of computer, Classification of computers on size (Micro, Mini, Mainframe and super computers), Generations, Applications of computers, Basic Computer Organization: Block diagram of computer system.

Devices: Input devices (mouse, keyboard, track ball, scanner, light Pen scanner, digital camera), Output devices (Monitor, Printer, Plotter), Memory devices, main memory (RAM, ROM, EROM, EPROM) secondary memory, sequential access memory, direct access memory (magnetic disk, floppy disk, optical disks, flash drive, memory card)

Unit-II

9(L) hrs

Functional Units of Computer System: CPU, registers, system bus, main memory unit, cache memory, Inside a computer, SMPS, Motherboard, Ports and Interfaces, expansion cards, ribbon cables, memory chips, processors.

Hardware components: Need of hardware for computer to work, different hardware components within a computer and connected to a computer as peripheral devices, different processors used for personal computers and notebook computers.

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Part-B

Unit-III

12(L) hrs

Types of Languages: Machine, assembly and High level Language, Operating system and its types, Operating system as user interface, utility programs.

Word processing: Editing features, renaming documents, deleting documents, formatting features, saving, printing, Working with text: select, cut, copy, paste, table handling, page settings, spell-checking, macros, mail-merge, equation editors.

Unit-IV

12(L) hrs

Spreadsheet: Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, creating formulas, using formulas, Spreadsheet: Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, creating formulas, using formulas, cell references, replication, sorting, filtering, functions, Charts & Graphs.

Presentation Graphics: Basics of creating a presentation, Parts of main window, workspace views, creating a presentation, Incorporation of Animation.

Presentation Graphics Software: Templates, views, formatting slide, slides with graphs, animation, using special features, presenting slide shows.

Laboratory Work:

Experiment No.	Experiment Title
1	Identify the functioning and purpose of various input/output devices.
2	Disassembly and examination of internal components of various peripherals.
3	Installation of utility tools.
4	Install or simulate Windows/Linux.
5	Creating a resume in Microsoft word by using basic formatting (font size, bold, italics, and underline), spell check, and text alignment features.
6	Record a macro to automate a task.
7	Generate a mail merge document using address database.
8	Use the equation editor to insert mathematical expressions.
9	Make a new workbook, enter data according to various data types and apply cell formatting.
10	Demonstrate relative, absolute and mixed Cell References.
11	Use sort and filter features to apply functions like SUM, AVERAGE etc.
12	Construct various charts (bar, pie, line) based on given data in MS excel.
13	Understand the basic interface of Power Point Presentation and parts of the main window (Ribbon/Toolbar, Slide Pane, Notes Pane Slide Sorter View).
14	Create slides with text, images and bullet points using templates.
15	Add animations to objects, transitions between slides and rehearse timings.
16	Build a professional slideshow with charts, tables, multimedia, and slide show settings.

Text Books

1. A. Goel, Computer Fundamentals, Pearson Education, 2010
2. P. K.Sinha & P. Sinha, Fundamentals of Computers, New Delhi, India: BPB Publishers, 2007

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3. R.K. Jain, IT Tools, New Delhi, India: Khanna Publishing House
4. Satish Jain, Ambrish Rai & Shashi Singh, "Introduction to Information Technology", Paperback Edition. New Delhi, India: BPB Publications, 2014.

Reference Books

1. P. Norton, "Introduction to Computers", 8th Edition New York: McGraw-Hill, 2021.
2. P.K. Sinha and P. Sinha, "Computer Fundamentals", 6th Edition New Delhi: BPB Publications, 2018.
3. D. Morley and C.S. Parker, "Understanding Computers: Today and Tomorrow", 15th Edition Boston: Cengage Learning, 2020.

Online Learning Materials

1. <https://testbook.com/computer-awareness/computer-fundamentals> Accessed on 08 May, 2025
2. <https://www.geeksforgeeks.org/computer-fundamentals-tutorial/> Accessed on 08 April, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Fundamentals of Computer System	Dr. Mangala Prasad Mishra	Indira Gandhi National Open University	https://onlinecourses.swayam2.ac.in/nou20_cs03/preview

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Course Code: BCA103

Course Title: Web Designing

Programme: BCA	L: 3 T: 0 P: 4	Credits: 5
Semester: 1	Theory/Practical: Theory	Teaching Hours: 45(L)+60(P) = 105 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain the basic concepts of the internet and related protocols.
2	Analyze static web page structures using HTML elements such as text, media, lists and forms for effective layout.
3	Apply CSS to style and structure web pages using selectors, responsive design and layout techniques.
4	Implement dynamic functionalities on client-side using JavaScript, including event handling and form validation
5	Create basic server-side web application using PHP, including form handling and logic control

Contents

Part-A

UNIT-1

12(L) hrs

Internet Basics

History and Evolution of Internet Protocols (TCP/IP, HTTP/HTTPs, FTP, SMTP), Basic concepts, communication on the Internet, internet domains, establishing connectivity on the internet client IP address, ISP, Cookies, Web server and web client, URL, DNS

HTML

Introduction to HTML and DHTML, History of HTML, Structure of HTML: Paired tags, singular tags, commonly used HTML commands, Text Styles, Basic formatting tags, color coding, adding lists, graphics, tables, lists, audio, video, frame and forms

Unit-II

12(L) hrs

Cascading Style Sheet

Introduction, Need, Basic Structure and syntax of CSS, Types-Inline, Internal and External, CSS Selectors (ID, Class), Background Image, Padding, Page Structure, Responsive Design.

Part-B

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Unit-III

12(L) hrs

JavaScript

Introduction, Syntax, Client-side scripting, JS Design Principles, JS Objects, DOM, Variables, Datatypes, Operators, Functions, Arrays, Events and JS validations

UNIT-IV

9(L) hrs

PHP

Introduction to Server- side development with PHP, Web Server's responsibilities, Quick Tour of PHP: Basic syntax, Datatypes, variables, functions, decision-making statement, looping, string, arrays and form processing.

Laboratory Work

Experiment No.	Experiment Title
1	Identify your system's IP address using browser and command prompt.
2	Configuration and administration of Apache Web Server
3	Create a simple HTML page to demonstrate the use of different tags, link to different html page, insert image.
4	Design index page of a book on web designing.
5	Design Time Table of your department and highlights of most important periods.
6	Write a program to create a web page using table tag a)create a table of 3 rows and columns (b)having border, border size, border color (c)image in a particular cell
7	Embed Audio and Video into your web page.
8	Write a code to create a web page using image tag with height and width & also use for background image.
9	Develop Registration form by using various form elements like input box, text area, radio buttons, checkboxes etc. Also embed border and text styling using CSS
10	Create HTML file to implement styles related to text, fonts, links using CSS
11	Write HTML program to demonstrate Ordered, Unordered and Definition List. Also use CSS styling
12	Create an HTML file to implement the concept of document object model using JavaScript
13	Create an HTML page including JavaScript that takes a given set of integer numbers and shows them after sorting in descending order
14	Create a form for Employee information. Write JavaScript code to find DA, HRA, PF, Tax, Gross pay, Deduction and Net Pay.
15	Create a form for Student information. Write JavaScript code to find Total, Average, Result and Grade.
16	Write an HTML code to create your Institute website/Department website/ Tutorial Website for specific subject. Also use Java Script for validation.
17	Create a PHP file to print any text using variables.
18	Design a simple calculator that performs addition, subtraction, multiplication and division &returns the result page.
19	Write a PHP program to perform String Operation.
20	Write a program in PHP to compute, the Average and Grade of students marks

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Text Books

1. Rajkamal, “Internet and Web Technology”, 1st Edition, Tata McGraw Hill.
2. Ray Rischpater, “JavaScript JSON Cookbook”, 1st Edition, Packt Publishing,
3. Laura Lemay, Rafe Colburn, Jennifer Kyrnin, “Mastering Html, CSS and Javascript”, 1st Edition BPB Publications.

Reference Books

1. Jeffery C Jackson, “Web Technology-A computer Science Perspective”, 1st Edition, Pearson Education, 2007.
2. Chris Bates, “Web Programming-Building Internet Applications”, 2nd Edition, Wiley India, 2006.
3. Godbole and Khate, “Web Technologies”, 3rd Edition, Tata McGraw Hill

Online Learning Materials

1. Web Designing and Technology https://onlinecourses.swayam2.ac.in/ntr25_ed64/preview
Accessed on 08 May, 2025
2. Web design for beginners <https://www.udemy.com/share/1013yI/> Accessed on 18 April, 2025
3. HTML https://onlinecourses.swayam2.ac.in/aic20_sp11/preview Accessed on 19 May, 2025
4. PHP and MySQL https://onlinecourses.swayam2.ac.in/aic20_sp32/preview Accessed on 04 April, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Web Design and Technology	Dr.B.Yogameena	NITTTR, Chennai	https://onlinecourses.swayam2.ac.in/ntr25_ed64/preview

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Course Code: BCA104

Course Title: Programming for Problem Solving

Programme: BCA	L: 2 T: 0 P: 2	Credits: 3
Semester: 1	Theory/Practical: Theory	Teaching Hours: 52 hrs
Total Max. Marks: 150	Continuous Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 60%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Design simple algorithms and flowcharts for problem solving.
2	Demonstrate modular programs involving input output operations, decision making and looping constructs by choosing the appropriate data types for writing programs.
3	Test and execute programs and correct syntax and logical errors.
4	Implement conditional branching, iteration and recursion.
5	Apply the concept of arrays and string handling in problem solving
6	Use concept of structures and union in problem solving.

Contents

Part-A

Unit-1 Introduction to Computer Fundamentals

4(L) hrs

Computer System Components: Input and Output Devices, Memory and Storage Devices, Block diagram of Computer System, Types of Software, Operating System with its types, Compiler, Interpreter, Assembler, Linker, Loader.

Unit-2 Basics of Programming

6(L) hrs

Idea of Algorithm: Steps to solve logical and numerical problems. Algorithms, Flowchart, Pseudocode with examples. Basic C++ Program, Compile and Execute C++ program, Character Set, Tokens-Identifiers, Keywords, Variables, Literals, Constants, Data Types, Different types of errors.

Unit-3 Operators

8(L) hrs

Different types of Operators: Assignment Operators, Numeric operators, Prefix and postfix operators, Binary number system, Bitwise operators, Logical operators, Relational operators, Short-circuit operators, sizeof operator, Operator precedence and associativity. Type conversion.

Unit-4 Control Structures

8(L) hrs

Conditional Statements: if, if-else, conditional operator (? :), switch and nested decision statements; Looping Statements: for, while, do-while, Nested Loops, and Controlling loop execution keywords: break, continue, goto keyword and labeled statements multiple-selection keywords: switch, case, default keywords

BACHELORS OF COMPUTER APPLICATIONS

Part-B

Unit-5 Functions

6(L) hrs

Functions: Need of functions, Components of Functions, Built-in and User Defined Functions, Parameter passing in function: Call by value, Call by reference, Scope rules, Default Arguments, Function Overloading, Recursion: Base case and recursive case, Recursion versus Iteration.

Unit-6 Arrays

6(L) hrs

Arrays: Single-Dimensional and Multi-Dimensional arrays, Array operations, Character array and strings literals, string literals declaring, initializing, and using strings basic string operations, comparing strings; Pointers: declaring and initializing pointers.

Unit-7 Structures and Unions

7(L) hrs

Structures: Need and syntax of structures, Structure Operations- Passing and returning structures from functions, Nested Structures, Array of Structures, typedef, Union, Structure versus Union.

Laboratory Work

To implement programs in C++ Language for various kinds of problems related to the above topics.

Text Books

1. D. Ravichandran, Programming with C++, Tata McGraw-Hill Education
2. Harvey M. Deitel and Paul J. Deitel, C++ How to Program, Pearson Education

Reference Books

1. Herbert Schildt, "C++: The Complete Reference", Mc-Graw Hill.
2. E. Balagurusamy, "Object Oriented Programming with C++", Mc-Graw Hill.
3. Yashavant Kanetkar, "Let Us C++", BPB Publication.

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA105
Course Title: General English

Programme: BCA	L: 1 T: 1 P: 0	Credits: 2
Semester: 1	Theory/Practical: Theory	Teaching Hours: 15(L)+15(T) = 30 hrs
Total Max. Marks: 100	Continuous Internal Assessment (CIA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply the basics of Grammar, Sentences and their usage.
2	Utilize the effective techniques to be a good listener.
3	Present in academic as well as professional environment
4	Grasp the concepts of effective writing skills.
5	Develop vital speaking skills, so that they can become independent users of English language.

Contents

Part-A

UNIT-I: Grammar and Reading **4(L) hrs**

Basic Grammar: Parts of speech, Sentence structure, Tenses and their usage. Common Errors, Subject-verb agreement, Pronoun usage, Prepositions and conjunctions. Vocabulary Building: Word formation, Synonyms and antonyms, Usage of idioms and phrases. Reading Comprehension: Techniques for effective reading, Practice of grammar usage with various remedial exercises.

UNIT-II: Listening Skills **3(L) hrs**

Importance of Listening: Role of listening in communication, Difference between hearings and listening. Listening Techniques: Active listening strategies, Note-taking methods. Listening Practice: Audio and video materials (lectures, interviews, discussions).

Practice Exercises to improve listening accuracy and comprehension.

Part-B

UNIT-III: Speaking Skills **4(L) hrs**

Basics of Effective Speaking: Pronunciation and intonation, Clarity and fluency. Public Speaking: Structure of a speech, Techniques for engaging the audience.

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Interpersonal Communication: Conversational skills, Group discussions and role-plays. Presentation Skills: Preparing effective presentations, Use of visual aids.

Practice exercises to improve speaking and presentation skills.

UNIT-IV: Writing Skills

4(L) hrs

Writing Basics: Sentence and paragraph structure, Coherence and cohesion in writing. Formal Writing: Business letters and emails, Report writing. Creative Writing: Essay writing, Writing articles and blogs. Revising and Editing: Techniques for proof reading Common errors in writing and how to correct them.

Tutorial hours will be used for practice sessions for problems/presentations /case- studies etc.

Text Books

1. K. Nair, "Fluency in English- Part II", 4th Edition, Oxford University Press, 2006.
2. G. Mishra, R.Kaul and B. Biswas, "Language through Literature (forthcoming)" 3rd Edition, 2014

Reference Books

1. W. Zinsser, "On Writing Well", 1st Edition, Harper Resource Book, 2001.
2. Liz Hamp-Lyons and Ben Heasley, "Study Writing", 2nd Edition, Cambridge University Press, 2006.

Online Learning Materials

1. <https://ellalanguage.com/general-english/> Accessed on September 10, 2024.

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Practical English: Learning and Teaching	Dr. Bhaskar Dasgupta	IIT Kanpur	https://nptel.ac.in/courses/109104090

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA106

Course Title: Environmental Science and Sustainability

Programme: BCA	L: 2 T: 0 P: 0	Credits: 2
Semester: 1	Theory/Practical: Theory	Teaching Hours: 30(L) = 30 hrs
Total Max. Marks: 100	Continuous Internal Assessment (CIA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Develop an understanding about environmental problems at local and national level through literature and general awareness.
2	Understand how an ecosystem works and how humans can help in maintaining a better ecosystem.
3	Apply interdisciplinary approach to understand key environmental issues and critically analyze them.
4	Analyze the roles of mankind as citizens, consumers and environmental actors in a complex, interconnected world.
5	Gain Practical knowledge by visiting wildlife areas, environmental institutes.

Contents

Part-A

UNIT-I

8(L) hrs

Introduction to Environmental Studies: State of Environment, Need for Sustainable Development, Traditional conservation systems in India, Need for an attitudinal change and ethics, Need for Environmental Education, Multidisciplinary nature of Environmental Studies: Scope & Importance
Need for Public Awareness.

Biodiversity: Species, Genetic & Ecosystem Examples of Endangered & Endemic species of India, Red data book.

UNIT-II

8(L) hrs

Ecosystems and Natural Resources: Concept of an Ecosystem: Structure & functions of an ecosystem (Producers, Consumers & Decomposers) Food Chain, Food web and Ecological Pyramids, Natural Resources: Their uses, functions, Deforestation, Water Resources: Their uses, functions & values, Pollution of Ground Water, Rainwater Harvesting, Land Resources: Land as a resource; Land

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degradation, Energy Resources: Renewable & non-renewable energy resources, use of alternate energy resources (Solar, Wind, Biomass, Thermal)

Part-B

UNIT-III

6(L) hrs

Environmental Pollution & Social Issues: Types, Causes, Effects & Control of Air, Water, Soil & Noise Pollution. Nuclear Global Climate Change: Global warming. Environmental disasters: Earthquakes, Floods, Cyclones, Landslides

UNIT-IV

8(L) hrs

Sustainability And Management : Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols Sustainable Development Goals-targets, indicators and intervention areas Climate change-Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. **Field Work:** Visit to a National Park, Biosphere Reserve, Wildlife Sanctuary Documentation & preparation of a Biodiversity (flora & fauna)

Text Books

1. E. Bharucha, "Text Book for Environmental Studies", 4th Edition, University Grants Commission, New Delhi, 2012.
2. K.C. Agarwal, "Environmental Biology" 2001 Edition, Nidi Publ. Ltd. Bikaner.
3. E. Bharucha, "The Biodiversity of India", 6th Edition, Mapin Publishing Pvt. Ltd., Ahmedabad, India, 2017.

Reference Books

1. R.C. Brunner, "Hazardous Waste Incineration", 2nd Edition, McGraw Hill Inc., 2007.
2. R.S. Clark, "Marine Pollution", 4th Edition, Clanderson Press Oxford (TB), 2009.
3. W.P. Cunningham, T.H. Cooper, E. Gorhani, and M.T. Hepworth, "Environmental Encyclopedia", 3rd Edition, 2010.

Online Learning Materials

1. <https://www.pdfdrive.com/business-communication-e18729927.html> Accessed on September 10, 2024

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Environment Management	Prof. T.V. Ramachandra	IISc Bangalore	https://nptel.ac.in/courses/120108004

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA107
Course Title: Probability and Statistics

Programme: BCA	L: 3 T: 0 P: 0	Credits: 3
Semester: 2	Theory/Practical: Theory	Teaching Hours: 45(L) = 45 hrs
Total Max. Marks: 100	Continuous Internal Assessment (CIA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 75%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Compute measures of central tendency and dispersion such as mean, median, mode, and standard deviation.
2	Elaborate relationships between variables using correlation and regression techniques.
3	Analyze conditional probability and Bayes' theorem to solve real-world and theoretical problems.
4	Compare discrete and continuous random variables in standard probability distributions.
5	Perform hypothesis testing for single population parameters using appropriate statistical methods.

Contents

Part-A

Unit –I **12(L) hrs**

Measures of Central Tendency: Arithmetic mean, median and mode—their properties.

Measures of Dispersion: Range, mean deviation, variance and standard deviation—their properties.

Unit-II **9(L) hrs**

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.

Part-B

Unit-III **18(L) hrs**

Concepts of probability: Experiment and sample space, events and operations with events, probability of an event, addition theorem, multiplication theorem, basic probability rules, applications of probability rules, conditional probability, Baye's Theorem.

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

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

Unit-IV

6(L) hrs

Sampling Distribution: Concept of Population and Sample, parameter and statistic, sampling, errors, critical region, hypothesis.

Hypothesis Testing for a Single Population: Concept of a hypothesis testing, tests involving a population mean and variance (t test and f test).

Text Books

1. R. K. Narula, "Engineering Mathematics II", Computer Science Engineering & Information Technology, Sharma Publications.
2. S. C. Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics", 11th ed. New Delhi, India: Sultan Chand and Sons, 2002

Reference Books

1. A. Abebe, J. Daniels, and J. W. McKean, "Statistics and Data Analysis", Dec. 2000 Latest Edition: 3rd Edition 2020
2. G. K. Bhattacharya and R. A. Johnson, "Statistical Concepts and Methods", New York: John Wiley & Sons, 1997 Latest Edition: 1st Edition 1997.
3. N. A. Weiss, "Introductory Statistics", Addison Wesley, 1999 Latest Edition: 5th Edition 2015.
4. G. M. Clarke and D. Cooke, "A Basic Course in Statistics", Arnold, 1998 Latest Edition: 5th Edition 2024.

Online Learning Materials

1. <https://www.geeksforgeeks.org/statistics/> Accessed on 07 April, 2025
2. <https://www.geeksforgeeks.org/probability-in-maths/> Accessed on 16 May, 2025
3. <https://www.geeksforgeeks.org/standard-deviation-formula/> Accessed on 18 April, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Discrete Mathematics	Prof. Somesh Kumar	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc21_ma74/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA108

Course Title: Digital Electronics and Computer Architecture

Programme: BCA	L: 3 T: 0 P: 0	Credits: 3
Semester: 2	Theory/Practical: Theory	Teaching Hours: 45(L) = 45 hrs
Total Max. Marks: 100	Continuous Internal Assessment (CIA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply number system conversion and binary arithmetic operations to solve problems in digital systems.
2	Use various binary codes and logic gates to represent and process digital information.
3	Simplify Boolean expression using laws of Boolean algebra and K-maps for efficient implementation.
4	Evaluate combinational and Sequential logic circuits to implement digital systems.
5	Design digital systems using flip-flops and latches.

Contents

Part-A

Unit –I **10(L) hrs**

Number Systems and Codes: Introduction to Digital Electronics, Binary, Octal, Decimal, Hexadecimal, Conversion between number systems. Binary arithmetic: Addition, Subtraction, Division, Multiplication. 1's, 2's, complement.

Binary Codes: Weighted BCD, Gray code, Excess 3 code, ASCII code.

Unit-II **13(L) hrs**

Logic Gates: AND, OR, NOT, NAND, NOR, XOR, XNOR gates, Logic gates applications.

Boolean algebra: Boolean postulates and Laws-De Morgan's theorem. Principle of Duality, Simplification of Boolean Expressions, Sum Of Products(SOP), Product Of Sum(POS), Minterm, Maxterm, K-map(2,3,4) variables, K-map Minimization.

Part-B

Unit-III **10(L) hrs**

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Combinational Logic Circuits: Half Adder & Half Subtractor, Full Adder & Full Subtractor, Parallel Binary Adder.

Combinational Logic Circuits: Multiplexers & Demultiplexers, Implementation of Boolean equations using Multiplexer and Demultiplexer, Encoders and Decoders.

Unit-IV

12(L) hrs

Sequential Logic Circuits: Latch, Flip Flops- R-S Flip-Flop, J-K Flip-Flop, Race Around Condition, Removing Race Around Condition, Master-Slave J-K Flip-Flop, D Flip-Flop, T Flip-Flop, Applications of Flip-Flops.

Introduction to Computer Organization: Introduction to Computer Organization, Computer Design and Computer Architecture, Stored Program Concept, RISC and CISC Architecture, Introduction to Common Bus System, Types of Buses (Data Bus, Control Bus, Address Bus).

Text Books

1. Morris Mano M, Michael D. Ciletti, "Digital Design", Pearson Education, 4th Edition,
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage
3. Floyd and Jain, "Digital Fundamentals", Pearson Education, 8th Edition, 2007.

Reference Books

1. Donald P Leach, Albert Paul Malvino, Goutam Saha, "Digital Principles and Applications", Tata McGraw Hill, 6th Edition, 2008
2. William H. Gothmann, "Digital Electronics", 2nd Edition, PHI.
3. Anand Kumar, "Fundamental of Digital Circuits" 3rd Edition, PHI, 2014

Online Learning Materials

1. <https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/> Accessed on March 26, 2025
2. https://www.electronics-tutorials.ws/boolean/bool_1.html Accessed on May 21, 2025
3. <https://www.tutorialspoint.com/digital-electronics/index.htm> Accessed on May 21, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Digital Electronics	Prof. Goutam Saha	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc20_ee32/preview

GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA
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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA109
Course Title: Software Engineering

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 2	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Implement the principles, characteristics, and models of Software Development Life Cycle (SDLC).
2	Identify software requirements and document those using SRS.
3	Apply software design principles and tools like DFDs, data dictionaries, and charts.
4	Analyze advanced project planning, cost estimation, and scheduling techniques to optimize performance.
5	Evaluate software testing methods, maintenance strategies and software metrics based on project requirements.

Contents

Part-A

Unit –I

11(L) hrs

Definition, Components of Software Engineering, Characteristics of Software Engineering, Importance of Software Engineering, Principle of Software Engineering

Software Process Models: Software Development Life Cycle (SDLC), Waterfall model, Incremental model, Prototyping model, Spiral Model, RAD model and V-model.

Unit-II

11(L) hrs

Software Requirements: System analyst, Role of a system analyst, SRS, Components of SRS, Properties of a good SRS document, Types of requirements: Functional and Non- functional requirements, Requirements gathering techniques.

Part-B

Unit-III

13(L) hrs

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Software Design: Objectives, Design process, Design concepts, Characteristics of a good software design, Coupling and Cohesion and its types, Function oriented design: Data Flow Diagram (DFD), Data Dictionaries, Structure Charts, Pseudo code. Object oriented design: Objects, Classes, Messages, Abstraction, Encapsulation, Inheritance, and Polymorphism.

Project management: Project Planning, Cost Estimation Techniques: Empirical estimation, Heuristic estimation, Analytical estimation.

Project monitoring and control– Work breakdown structure, Activity chart, Gantt charts, PERT charts, Critical path method.

Unit-IV

10(L) hrs

Testing: Testing Fundamentals, principle of Testing, Unit testing, Integration testing, System testing, Acceptance testing, White-box testing, Black-box testing, Alpha testing, Beta testing, Verification and validation, Cyclomatic Complexity.

Maintenance and Metrics: Definition of Maintenance and metrics and its types.

Laboratory Work

Experiment No.	Experiment Title
1.	Identify project scope and objective of given problem: a. Library management system. b. Railway Reservation System.
2.	Design the waterfall model, prototype model and spiral model of the product
3.	Explain with reason which model is best suited for the product
4.	Design software requirements specification for experiment 1 (a) and 1(b) problem.
5.	Identify Functional and Non-Functional Requirements for above problem.
6.	Generate DFD model (level-0, level-1 DFD and Data dictionary) of the Library Management System and Railway Reservation system.
7.	Draw ER Diagrams for Railway Reservation System.
8.	Develop UML Use case model for Library Management System.
9.	Generate Class diagrams for Library Management System.
10.	Build Sequence Diagram for Railway Reservation system
11.	Assemble Structured design for experiment 1 (a) and 1(b)
12.	Use any model for estimating the effort, schedule and cost of software project.
13.	Create a Gantt Chart and Work Breakdown Structure (WBS) for Library Management System.
14.	Use LOC, FP and Cyclomatic Complexity Metric for Railway Reservation System.
15.	Prepare a Software Maintenance and Metrics report for experiment 1 (a) and 1(b)

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Text Books

1. Roger S Pressman, “Software Engineering: A practitioner’s approach”, 9th Edition, McGraw Hill Education, 2020.
2. Rajib Mall, “Fundamentals of Software Engineering”, Prentice Hall of India, 5th Edition Revised 2018

Reference Books

1. Ian Sommerville, “Software Engineering”, 11th Edition, Pearson India, 2018.
2. Jalote P., —An Integrated Approach to Software Engineering, Naros 2nd Edition, 2020

Online Learning Materials

1. <https://www.geeksforgeeks.org/software-engineering/> Accessed on 26 April, 2025
2. https://www.tutorialspoint.com/software_engineering/index.htm Accessed on 08 May, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Software Engineering	Prof. Rajib mall	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc19_cs69/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA110
Course Title: Artificial Intelligence

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 2	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply the concepts of intelligent agents to simulate AI systems using agent-based models.
2	Implement search strategies to solve well-defined problems.
3	Evaluate decision-making in games using Minmax algorithm, and heuristic strategies.
4	Design logic-based reasoning systems using propositional, FOPL, forward/backward chaining, and theorem proving.
5	Analyze machine learning models for prediction and classification tasks.

Contents

Part-A

Unit –I

8(L) hrs

Introduction to AI- What is Artificial Intelligence, Foundations of AI, History, Intelligent Agents-Environments, Properties of task environments, Agent based programs, Structure of Agents, Types of agents- Simple reflex agents, Model-based reflex agents, Goal-based agents; and Utility-based agents.

Unit-II

12(L) hrs

Problem Solving and Search Techniques- Problem-Solving Agents, Well-defined problems and solutions, Uninformed Search Strategies-Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Informed (Heuristic) Search Strategies - Greedy best-first search, A* Search, Heuristic Functions.

Game Playing: Perfect Information game, Imperfect Information game, Evaluation function, Minimax algorithm.

Part-B

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Unit-III **9(L) hrs**

Knowledge Representation- Knowledge-Based Agents, Propositional Logic, Propositional Theorem Proving, First Order Logic-Syntax and Semantics of First-Order Logic, Substitution, Unification and Forward Chaining, Backward Chaining, Frames, Semantic Nets.

Unit-IV **9(L) hrs**

Learning– Forms of Learning, Supervised Learning, Machine Learning - Decision Trees, Regression and Classification with Linear Models, Artificial Neural Networks.

Unit-V **7(L) hrs**

Expert Systems: Characteristics, Rule-Based System Architectures, Case study of existing expert systems

AI Applications and Ethical Consideration- Natural Language Processing basics, AI in computer vision and Robotics, Case studies: Chatbots, recommendation systems, Ethical issues in AI.

Laboratory Work

Experiment No.	Experiment Title
1.	Write Python functions to simulate basic AI tasks like calculator or guess game.
2.	Write a program to solve water jug problem.
3.	Write a program to solve tower of Hanoi problem.
4.	Write a program to simulate 4-Queen / N-Queen problem.
5.	Apply Depth first search to solve a maze problem
6.	Apply Breadth first search to solve 8-puzzle problem.
7.	Implement A* algorithm for optimal path finding in a grid or puzzle.
8.	Create a tic-tac-toe game using min-max algorithm.
9.	Represent knowledge using First Order Predicate Logic (FOPL) and infer relations.
10.	Create Semantic Network and visualize relationships using <i>networkx</i> in Python
11.	Implement a basic Decision Tree classifier using a small dataset.
12.	Develop a Rule-Based Chatbot using Python.
13.	Develop a simple medical diagnosis expert system.
14.	Mini Project integrating any 2AI techniques learned (search + logic, ML + chatbot).

Text Books

1. Ethem Alpaydin, *Introduction to Machine Learning*, 3rd Edition, MIT Press, 2014.

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2. Daniel Jurafsky, James H. Martin, *Speech and Language Processing*, 2nd Edition (or latest 3rd Edition draft online), Pearson Education, 2009.

Reference Books

1. Stuart Russel, Peter Norvig: *Artificial Intelligence: A Modern Approach*, 2nd Edition, Pearson Education, 2003.
2. Tom Mitchell, "Machine Learning", 1st Edition, McGraw-Hill, 2017.
3. Elaine Rich, Kevin Knight, Shivashankar B Nair: *Artificial Intelligence*, Tata McGraw Hill 3rd edition, 2013.

Online Learning Materials

1. https://www.youtube.com/watch?v=KMO0pXmsyf4&list=PLFW6lRTa1g82ijdcyhI_dLSDk_Mb6pR3 Accessed on May 24, 2025
2. <https://www.youtube.com/watch?v=uB3i-qV6VdM&list=PLxCzCOWd7aiHGhOHVnwb0HR5US5GFKFI> Accessed on May 24, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	An Introduction to Artificial Intelligence	Prof. Mausam	IIT Delhi	https://onlinecourses.nptel.ac.in/noc22_cs56/preview

GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA
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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA111

Course Title: Object Oriented programming Using C++

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 2	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply class and object concepts to implement real-world entities using C++.
2	Implement classes with constructors and destructors.
3	Analyze and implement inheritance and polymorphism in C++ for code reusability and flexibility.
4	Identify the use of dynamic memory management using pointers and manage resources efficiently in C++.
5	Implement exception handling and file operations in C++ to ensure robust and persistent applications.

Contents

Part-A

Unit –I

8(L) hrs

Object Oriented Programming Concepts

Introduction to OOP, Procedure oriented programming (POP) Vs Object-oriented programming (OOP). Features of object-oriented programming- Class, Objects, Encapsulation, Abstraction, Data hiding, Polymorphism and Inheritance. Structure of a C++ Program, Simple C++ Program without class, compiling and running C++ program.

Unit-II

9(L) hrs

Classes and Objects

Introduction, Specifying a class, Creating Class objects, Access specifiers (Private, Public, Protected), Defining member functions: Inside class and Outside class, Accessing class members, Constructor and destructor, Types of constructors, Nested class. Friend function, Inline function. Friend class, Static members.

Part-B

BACHELORS OF COMPUTER APPLICATIONS

Unit-III

14(L) hrs

Inheritance: Introduction, defining derived classes, visibility modes and effects Types of inheritance, Ambiguity in inheritance, Virtual base class, Overriding member functions.

Polymorphism

Concept of binding – Early binding and late binding, Virtual functions, Pure virtual functions, Abstract class. Function overloading, Constructor overloading, Operator Overloading, Rules for overloading operators, Overloading of various operators.

Unit-IV

14(L) hrs

Dynamic Memory Management using Pointers

Declaring and initializing pointers, Accessing data through pointers, Pointer arithmetic, Memory allocation –Static and Dynamic, Dynamic memory management using new and delete operators, Pointer to an object, this pointer.

Exceptions Handling and File Handling

Review of traditional error handling, Basics of exception handling, Exception handling mechanism, Throwing and catching mechanism, Rethrowing an exception, Specifying exceptions. File streams, Error handling during file operations, Reading/writing of files, accessing records randomly, Updating files.

Laboratory Work

Experiment No.	Experiment Title
1.	Write a C++ program to define a class and create objects.
2.	Demonstrate the use of constructors and destructors.
3.	Implement a program using friend functions and friend classes.
4.	Create a program with static data members and member functions.
5.	Implement single, multilevel, and multiple inheritance using base and derived classes.
6.	Create a program to demonstrate hierarchical and hybrid inheritance.
7.	Resolve ambiguity in multiple inheritance using scope resolution and virtual base classes.
8.	Demonstrate function overriding and use of virtual and pure virtual functions.
9.	Demonstrate function overloading
10.	Implement operator overloading (e.g., +, -, ==, etc.).
11.	Write a C++ program to demonstrate pointer arithmetic.
12.	Demonstrate exception handling using try, catch, throw.
13.	File handling: Create a program to read/write text from/to a file.
14.	Use seekg(), seekp() for reading/updating specific records.

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Text Books

1. E. Balagurusamy, “Object Oriented Programming with C++”, 8th edition, Tata McGraw Hill, 2020.
2. R. Lafore, “Object Oriented Programming in C++”, 4th edition, Waite Group, 2002.
3. P Yashavant Kanetkar, “Let Us C++”, 3rd edition, BPB Publications, 2019.

Reference Books

1. Paul Deitel and Harvey Deitel, “C++ How to Program”, 10th edition, Pearson, 2016.
2. Herbert Schildt, “The Complete Reference to C++ Language”, 5th edition McGraw Hill-Osborne, 2015

Online Learning Materials

1. <https://www.geeksforgeeks.org/object-oriented-programming-in-cpp/> Accessed on 15 May, 2025
2. <https://www.simplilearn.com/tutorials/cpp-tutorial/oops-concepts-in-cpp> Accessed on 26 January, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Fundamentals of Object Oriented Programming	Balasubramanian Raman	IIT Roorkee	https://onlinecourses.nptel.ac.in/no_c25_cs34/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: UGNE101
Course Title: Indian Constitution

Programme: BCA	L: 2 T: 0 P: 0	Credits: 2
Semester: 2	Theory/Practical: Theory	Teaching Hours: 30(L) = 45 hrs
Total Max. Marks: 100	Continuous Internal Assessment (CIA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Acquaint the students with legacies of constitutional development in India and help those to understand the most diversified legal document of India and Philosophy behind it.
2	Explain the Preamble & Directive principles of State Policy.
3	Recognize the students Fundamental Rights and duties
4	Describe the structure of the Union Government and outline the role of President, Vice President, Prime Minister and Council of Ministers.
5	Describe the structure of State Government and analyze the role of Governor and Chief Minister, Election Commissioner, NHRC.

Contents

Part-A

Unit –I

8(L) hrs

Historical Background- Constituent Assembly of India- Philosophical foundations of the Indian Constitution- Salient features and nature of the constitution – Preamble - Directive Principles of State Policy – Citizenship- Constitutional Remedies for citizens.

Unit-II

7(L) hrs

Fundamental Rights: Introduction & its scheme, Right to Equality (Art.14), Right to Fundamental Freedoms (Art. 19), Right to Life (Art. 21), Directive Principles of State Policy: importance and implementation, Fundamental Duties and its legal status.

Part-B

Unit-III

8(L) hrs

Union Government and its Administration Structure: President and Vice President: Role, power and

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position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions.

Unit-IV

7(L) hrs

State Government and its Administration: Governor - Role and Position - CM and Council of ministers, Relation between the Union and the States. Elections: Election Commission of India, National Human Rights Commission, National Commission for Women.

Text Books

1. Durga Dass "Introduction to The Constitution of India", 26st Edition, Hall of India Pvt.Ltd.
2. Subash Kashyap "Our Constitution", 27th Edition.
3. J.N. Pandey, Constitutional Law of India, Central Edition, 52nd Edition, 2015.
4. Indian Polity "M. Laxmikant, Tata Mcgraw Hill, 12th Edition.

Reference Books

1. D.C. Gupta, "Indian Government and Politics", 8th Edition Vikas Publishing, 2018.
2. H.M. Seervai, "Constitutional Law of India", 4th Edition, Law & Justice Publishing, 2022.
3. V.N. Shukla, Constitution of India, Eastern Book Company, 10th Edition, 2006

Online Learning Materials

1. https://mrcet.com/downloads/digital_notes/EEE/24082023/INDIAN%20CONSTITUTION%20DIGITAL%20NOTES.pdf Accessed on July 23, 2024
2. https://www.kpscvaani.com/media/study_materials/Indian%20Constitution/Indian%20Constitution/Indian_Constitution_r8nYyhV.pdf Accessed on July 25, 2024

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Constitutional Studies	Prof. Sudhir Krishnaswami	National Law School of India University	https://onlinecourses.nptel.ac.in/noc20_lw03/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA112
Course Title: Data Structures-I

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 3	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply fundamental concepts of data structures and algorithm analysis to solve computational problems.
2	Implement arrays, pointers in a programming language to solve practical problems
3	Analyze stack operations (push, pop) to solve expression-related problems, including infix-to-postfix/prefix conversion and postfix evaluation.
4	Develop various types of linked lists and search algorithms to manage and retrieve data efficiently.
5	Evaluate different queue implementations(linear, circular, priority)
6	Design recursive algorithms to solve complex problems like Tower of Hanoi.

Contents

Part-A

Unit –I

12(L) hrs

Introduction to Data Structures: Concept of data, problem analysis, data structures and data structure operations, Types of data structures, Applications of data structures.

Problem Solving: Flowchart Definition and notations, Steps to design a flowchart.

Algorithm Definition and Specification: Analysis Framework, Performance Analysis: Space complexity, Time complexity. Mathematical notation and functions Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ) and Little-oh notation (o), Mathematical analysis of Non-Recursive and recursive Algorithms with Examples algorithmic complexity.

Unit-II

11(L) hrs

Understanding and Implementation of various Data Structures with applications: Overview of Arrays, Pointers, Pointer Arithmetic, Array of pointers, Arrays in terms of pointers, Static and Dynamic Memory Management

Stack: Introduction to Stack, Definition, Stack Implementation using array, Operations of Stack: like push, pop, Peek, isEmpty(), isFull(). Applications of stack: conversion from infix to postfix and prefix expressions, evaluation of postfix expression using stacks

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Part-B

Unit-III

12(L) hrs

Linked Lists: Introduction, Representation and Operations of Linked Lists, Types of linked list: Singly Linked List, Doubly Linked List, Circular Linked List and Circular Doubly Linked List along with the implementation of operations, Applications of linked list.

Searching: Introduction to Searching Technique, Linear and Binary search algorithms.

Unit-IV

10(L) hrs

Queues: Introduction to Queue, Definition, Queue Implementation using array, Queue operations, Types of Queue: Simple Queue, Circular Queue, De-queue and Priority Queue along with the implementation of operations, Applications of queue.

Recursion: Definition, Recursive functions and Application: Tower of Hanoi.

Laboratory Work

Experiment No.	Experiment Title
1	Design a flowchart to enter three numbers and find the largest number amongst them.
2	Make a flowchart to find the sum and average of n numbers using loops.
3	Write a program to insert, traverse and delete elements from an array.
4	Program to implement an array pointer and pointers in term of arrays.
5	Demonstrate dynamic memory allocation and deallocation by writing a program using malloc(), calloc(), realloc() and free().
6	Implement a stack data structure that supports insertion (push), traversal, and deletion (pop) operations.
7	Use a stack to convert an infix expression into postfix form.
8	Construct a singly linked list with operations to insert, traverse, and delete nodes.
9	Develop a doubly linked list structure with forward and backward traversal, as well as node insertion and deletion.
10	Create a circular linked list with insertion, traversal, and deletion functions that reflect its circular nature.
11	Implement linear search in a program to locate a specified element in an array.
12	Apply binary search to efficiently find a target value in a sorted array.
13	Design a queue data structure supporting enqueue, dequeue, and traversal operations.
14	Use recursion in a program to solve a problem like finding the factorial of a number.
15	Analyze the recursive structure of the Tower of Hanoi problem and implement a program to solve it using recursion.

Text Books

1. S. Lipschutz, *Data Structures*, special ed., adapted by R. Rajan, New Delhi, India: Tata McGraw Hill Education (India) Pvt. Ltd., 2008.
2. E. Horowitz, S. Sahni, and S. Anderson-Freed, *Fundamentals of Data Structures in C*, 2nd ed., New Jersey, USA: Silicon Press, 2008.
3. N. Karumanchi, *Data Structures and Algorithms Made Easy*, 2nd ed., Hyderabad, India: Career Monk Publications, 2011.

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Reference Books

1. Y. Kanetkar, *Data Structures through C*, 5th ed., New Delhi, India: BPB Publications, 2023.
2. V. H. Patil, *Data Structures Using C++*, Illustrated ed., New Delhi, India: Oxford University Press, 2012.

Online Learning Materials

1. <https://www.geeksforgeeks.org/data-structures/> Accessed on 12 April 2025.
2. <https://people.iitism.ac.in/~download/lab%20manuals/cse/CSC204.pdf>.
3. <https://www.programiz.com/dsa> Accessed on 23 May, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Data Structures	Dr.S.Sasikala	University of Madras	https://onlinecourses.swayam2.ac.in/cec19_cs04/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA113
Course Title: Introduction to Cloud Computing

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 3	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply the vision and core concepts of cloud computing to real-world computing environments.
2	Demonstrate the use of virtualization technologies and explain their importance in cloud-based systems.
3	Evaluate different cloud security services and design principles for secure cloud architecture.
4	Assess risks associated with cloud service providers.
5	Perform operations using CloudSim simulator and VMware Workstation.

Contents

Part-A

Unit –I

12(L) hrs

Origins of Cloud computing: Concept of Cloud computing, Characteristics, Features and Applications, Cloud Architecture, Service models, Deployment models, Scope of Cloud in Data Science domain, Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges, Cloud computing vs. Cluster computing vs. Grid computing.

Unit-II

11(L) hrs

Introduction to Infrastructure, Virtualization, Taxonomy of Virtualization techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization Hypervisors, Server virtualization, Desktop Virtualization, Storage Virtualization, Network and Storage Infrastructure, Network Virtualization, Application Virtualization, Database Services, Virtual Firewall and Security Groups.

Part-B

Unit-III

12(L) hrs

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Cloud Computing Software Security: Cloud Information Security Objectives, Confidentiality, Integrity, Availability, Cloud Security Services, Relevant Cloud Security Design Principles, Approaches to Cloud Software Requirement Engineering, Cloud Security Policy Implementation.

Cloud Computing Risk Issues: Privacy and Compliance Risks, Threats to Infrastructure, Data and Access Control, Cloud Access Control Issues, Cloud Service Provider Risks

Unit-IV

10(L) hrs

Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava), Basics of VMWare, advantages of VMware virtualization, using VMware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

Laboratory Work:

Experiment No.	Experiment Title
1	Identify various Realtime Examples of Cloud Computing Services and work with them.
2	Identify and Explain Design Challenges of cloud infrastructure (scalability, availability, load balancing, etc.) with real examples.
3	Install Virtualbox/VMware Workstation with different flavors of Linux or windows OS on top of windows7 or8.
4	Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
5	Draw network infrastructure using tools like Cisco Packet Tracer
6	Case study: Compare and analyze google app engine, Microsoft azure.
7	Install Google App Engine. Create hello world app and other simple web applications using python/java
8	Use GAE launcher to launch the web applications.
9	Identify and analyze privacy and compliance risks in a sample cloud scenario.
10	Compare security and compliance features of major cloud providers (AWS, Azure, GCP).
11	Perform different operations using Google Cloud and Amazon Elastic Compute Cloud(EC2)
12	Download and configure CloudSim in Eclipse or NetBeans
13	Run a basic simulation scenario using CloudSim.
14	Find a procedure to transfer the files from one virtual machine to another virtual machine.
15	Find a procedure to launch virtual machine using trystack (Online Openstack DemoVersion)

Text Books

1. R. Buyya, C. Vecchiola, and T. Selvi, *Mastering Cloud Computing*. New Delhi, India: Tata McGraw Hill, Feb. 2013, ISBN: 978-1-25-902995-0.
2. B. Sosinsky, *Cloud Computing Bible*. New Delhi, India: Wiley India Pvt. Ltd, 2011, ISBN: 978-81-265-2980-3.

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3. R. Buyya, J. Broberg, and A. M. Goscinski, *Cloud Computing: Principles and Paradigms*. New Delhi, India: Wiley India Pvt. Ltd, 2011, ISBN: 978-81-265-4125-6.

Reference Books

1. F. Halper, M. Hurwitz, R. Bloor, and M. Kaufman, *Cloud Computing for Dummies*. New Delhi, India: Wiley India Pvt. Ltd, 2011, ISBN: 978-0-470-59742-2.
2. S. Kumar, *Cloud Computing: Insights into New-Era Infrastructure*. New Delhi, India: Wiley India Pvt. Ltd, 2011, ISBN: 978-81-265-2883-7.

Online Learning Materials

1. <https://www.geeksforgeeks.org/cloud-computing-tutorial/> Assessed on 4 April, 2025
2. https://www.w3schools.com/aws/aws_cloudessentials_cloudcomputing.php Assessed on 1 May, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Cloud computing	Prof. Soumya Kanti Ghosh	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc21_cs14/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA114
Course Title: Basics of Python Programming

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 3	Theory/Practical: Theory	Teaching Hours: 45(L)+60(P) = 105 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand the basics Python programming concepts to develop programs using variables, data types, and operators.
2	Apply Python constructs such as functions, loops, and conditional statements to solve computational problems.
3	Implement built-in data structures such as lists, tuples, sets, and dictionaries.
4	Design user defined functions, modules, files, and packages.
5	Utilize file handling and exception handling mechanisms to manage real-world data and ensure robust code.

Contents

Part-A

Unit-I

12(L) hrs

Introduction to Python Programming Language: Programming Language, History and Origin of Python Language, Features of Python, Limitations, Major Applications of Python, Getting, Installing Python, Setting up Path and Environment Variables, Running Python, First Python Program, Python Interactive Help Feature, Python differences from other languages.

Python Data Types & Input/Output: Keywords, Identifiers, Python Statement, Indentation, Documentation, Variables, Multiple Assignment, Understanding Data Type, Data Type Conversion, Python Input and Output Functions, Import command.

Operators and Expressions: Operators in Python, Expressions, Precedence, Associativity of Operators, Non Associative Operators.

Unit-II

10(L) hrs

Control Structures: Decision making statements, Python loops, Python control statements.

Python Native Data Types: Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary, Strings with their methods and operations.

Part-B

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Unit-III

12(L) hrs

Python Functions: Functions, Advantages of Functions, Built-in Functions, and User defined functions, Anonymous functions, Pass by value Vs. Pass by Reference, Recursion, Scope and Lifetime of Variables.

Python Modules: Module definition, Need of modules, creating a module, Importing module, Path Searching of a Module, Module Reloading, Standard Modules, Python Packages.

Unit-IV

11(L) hrs

Exception Handling: Exceptions, Built-in exceptions, Exception handling, User defined exceptions in Python.

File Management in Python: Operations on files (opening, modes, attributes, encoding, closing), read () & write () methods, tell () & seek () methods, renaming & deleting files in Python, directories in Python.

Laboratory Work

Experiment No.	Experiment Title
1	Install and Configure Python IDE.
2	Write Python program to display a message on screen using input output functions.
3	Write Python program using operators: Arithmetic Operators Bitwise Operators Logical Operators
4	Write Python program to demonstrate the use of conditional and looping statements.
5	Perform following operations on a list and dictionary 1) Insert an element 2) delete an element 3) sort the list 4) delete entire list
6	Perform following operations on tuple and set 1) Insert 2) delete 3) change
7	Write a Python function that accepts a string and calculates number of upper case letters and lower case letters available in that string.
8	Print Fibonacci series using recursion.
9	Take input of two numbers from the user and swap the given numbers using Call by Value and Call by Reference
10	Enter a range of numbers and take input of a number to check whether it is in a given range or not using functions.
11	Write a program to create a module of factorial in Python.
12	Create a package named calculator with operations of addition and subtraction and use it in a main program.
13	Write a program to demonstrate Exception Handling using division by zero.
14	Create a custom exception Invalid Age Error that is raised when a user inputs an age less than 18 for eligibility.
15	Write a Python program to read an entire <i>text file</i> .

Text Books

1. P. Sharma, *Programming in Python*, 1st ed., New Delhi, India: BPB Publications, 2017.
2. R. N. Rao, *Core Python Programming*, 2nd ed., Dreamtech, 2010

Reference Books

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1. M. C. Brown, *Python: "The Complete Reference"*, McGraw-Hill Education Latest Edition: 2nd Edition 2018.
2. A. Martelli, A. Ravenscroft, and S. Holden, *"Python in a Nutshell"*, O'Reilly Media Latest Edition: 2nd Edition 2019.

Online Learning Materials

- | | |
|--|------------------------------|
| 1. https://www.geeksforgeeks.org/python-operators/ | Accessed on 17 May, 2025 |
| 2. https://www.geeksforgeeks.org/file-handling-python/ | Accessed on 14 January, 2025 |
| 3. https://www.geeksforgeeks.org/python-exception-handling/ | Accessed on 02 April, 2025 |

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	The Joy of Computing using Python	Prof. Sudarshan Iyengar	IIT Ropar	https://onlinecourses.nptel.ac.in/noc19_cs41/preview

GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA
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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA115
Course Title: Machine Learning

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 3	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply appropriate machine learning techniques to solve domain-specific problems.
2	Compare the performance of various supervised learning algorithms using relevant evaluation metrics.
3	Design machine learning models using regression and classification algorithms for real-world problems.
4	Analyze the role of distance functions and clustering methods in unsupervised learning to identify inherent data patterns.
5	Evaluate dimensionality reduction techniques like PCA to enhance model performance.
6	Formulate reinforcement learning models using Q-learning and Markov Decision Processes for decision-making tasks.

Contents

Part-A

Unit –I

8(L) hrs

Introduction to Machine Learning: History of ML, Difference between Machine Learning and traditional programming, Types of Machine Learning (Supervised, Unsupervised, and Reinforcement Learning), Applications of Machine Learning, Machine Learning Pipeline.

Unit-II

15(L) hrs

Supervised Learning

Regression: Linear and non-linear Regression, Logistic Regression.

Classification: Linear, Non-linear, Multi-class and Multi-label classification, K-Nearest Neighbors (KNN), Decision tree (basics of splitting criteria like Entropy and Gini), Naïve Bayes, Support Vector Machine(SVM), Random Forest Classification.

Model Evaluation and Validation: Train-Test Split, Cross Validation, Evaluation Metrics: Accuracy, Confusion Matrix, Recall, F-1 Score, Precision.

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Part-B

Unit-III

10(L) hrs

Unsupervised Learning: Introduction to Clustering, K-means Clustering, Different distance functions for clustering, Hierarchical clustering, Dimensionality Reduction: PCA(Principal Component Analysis)

Unit-IV

12(L) hrs

Reinforcement Learning: Introduction to Reinforcement Learning, Elements of Reinforcement Learning, Exploration vs Exploitation dilemma, Epsilon Greedy Algorithm, Markov Decision Process (MDP), Q – Learning, Application of RL.

Laboratory Work

Experiment No.	Experiment Title
1	Implementation of Python Basic Libraries such as Statistics, Math and Numpy a) Usage of methods such as floor(), ceil(), sqrt(), gcd() etc. b) Usage of attributes of array such as ndim, shape, size, methods such as sum(), mean(), sort(), sin() etc.
2	Implementation of Python Libraries for ML application such as Pandas and Matplotlib. a) Create a Series using pandas and display b) Access the index and the values of our Series c) Compare an array using Numpy with a series using pandas
3	a) Creation and Loading different types of datasets in Python using the required libraries. i. Creation using pandas ii. Loading CSV dataset files using Pandas iii. Loading datasets using sklearn b) Write a python program to compute Mean, Median, Mode, Variance, Standard Deviation using Datasets
4	Implement Linear Regression on a dataset like housing price.
5	Build a k-Nearest Neighbors (KNN) classifier for handwritten digit recognition (e.g., using the MNIST dataset).
6	Write a program to demonstrate the working of the decision tree algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
7	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
8	Write a python program to implement K-Means clustering Algorithm. Vary the number of k values as follows and compare the results: i. 1 ii. 3 iii. 5
9	Write a program to demonstrate the working of the Hierarchical Clustering
10	Implement Dimensionality reduction using Principle component Analysis method on a dataset iris.

Text Books

1. Tom M. Mitchell, Machine Learning, McGraw Hill, First Edition.
2. Ethern Alpaydin, Introduction to Machine Learning, MIT Press, 3rd Edition.
3. Aditya Dwivedi, Machine Learning Textbook, Kindle Edition, Dec 2019.

Reference Books

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BACHELORS OF COMPUTER APPLICATIONS

1. Chris Bishop, Pattern Recognition and Machine Learning, Springer.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2nd Edition

Online Learning Material

1. https://www.tutorialspoint.com/machine_learning/machine_learning_tutorial.pdf
2. <https://nptel.ac.in/courses/106106213/> Accessed on 17 February, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	A Basic course in Machine Learning	Sumitra Padmanabhan	uGDX School of Technology, ATLAS SkillTech University, Mumbai	https://onlinecourses.swayam2.ac.in/inb24_mg126/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA116
Course Title: Computer Network

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 3	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply the fundamental concepts of data communication, transmission modes, and network topologies.
2	Compare different network reference models, multiplexing techniques and transmission impairments.
3	Analyze data link layer protocols and mechanisms for error and flow control.
4	Evaluate network layer protocols, routing algorithms and congestion control mechanism used in network layer operations.
5	Examine the functionalities of the transport and session layers in distributed network applications.
6	Identify data translation and compression techniques to ensure secure and compatible communication.

Contents

Part-A

Unit-I

12(L) hrs

Data communications concepts: Digital and analog transmissions: Modem, parallel and serial transmission, synchronous and asynchronous communication. Modes of communication: Simplex, half duplex, full duplex. Types of Networks, Network Topologies.

Transmission Media: Telephone lines, leased lines, switch line, coaxial cables, optical fiber, Wireless Transmission (radio, microwave, infrared).

Communication Switching Techniques: Circuit Switching, Message Switching, Packet Switching.

Unit-II

12(L) hrs

Network Reference Models: OSI Reference Model, TCP/IP Reference Model, Comparison of OSI and TCP/IP Reference Models.

Transmission impairments: Attenuation, Distortion, Noise. Multiplexing: Frequency division, Time division, Wavelength division.

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Data Link Layer Design Issues: Services provided to the Network Layer, Framing, Error Control (error detection and correction code), Flow Control, Data Link Layer in the Internet (SLIP, PPP)

Part-B

Unit-III

13(L) hrs

MAC sub layer: CSMA/CD/CA, IEEE standards (IEEE802.3 Ethernet, Gigabit Ethernet, IEEE 802.4 Token Bus, IEEE 802.5 Token Ring)

Network Layer: Design Issues, Routing Algorithms: Optimality Principle, Shortest Path Routing, Congestion Control Policies, Leaky bucket and token bucket algorithm, Concept of Internetworking.

Unit-IV

8(L) hrs

Transport Layer: Design issues, Elements of transport protocols: Addressing, Connection establishment and release, Flow control and buffering, Introduction to TCP/UDP protocols.

Session, Presentation and Application Layers: Session Layer: Design issues. Presentation Layer: Design issues, Data compression techniques. Application Layer: Distributed application (client/server, peer to peer, cloud etc.), WWW, DNS, E-mail, FTP, HTTP & HTTPS.

Laboratory Work

Open-source Cisco Packet Tracer will be used to perform and simulate all computer Networks Practicals.

Experiment No.	Experiment Title
1	Familiarization with networking components and devices: LAN Adapters, Hubs, Switches, Routers etc
2	Familiarization with transmission media and tools: Coaxial cable ,UTP cable, Crimping tool, Connectors etc
3	Preparing straight and cross cables
4	Study of various LAN topologies and their creation using network devices, cables and computers
5	Configuration of TCP/IP Protocols in Windows and Linux
6	Develop a program to compute the Hamming Distance between any two code Words
7	Implement CRC for error detection and correction
8	Implementation of resource sharing (file,printer etc.)
9	LAN Configuration Using Ethernet in Packet Tracer
10	Implement Dijkstra's Algorithm (Shortest Path)
11	Familiarization with network simulation tools.
12	Installation of FTP server and client
13	To configure proxy server

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14	Use browser to analyze HTTP, HTTPS and FTP requests/responses
15	Use Telnet or software tools to simulate email sending and receiving

Text Books

1. S. Tanenbaum and D. J. Wetherall, *Computer Networks*, 5th ed. New Delhi, India: Pearson, 2010
2. B. A. Forouzan, *Data Communications and Networking*, 4th ed. New York, NY, USA: McGraw-Hill, 2007.
3. S. K. Basandra, *Computers Today*, 1st ed. New Delhi, India: Galgotia Publications, 2001.

Reference Books

- U. Black, *Data Communication and Distributed Networks*, 3rd ed. New Delhi, India: PHI Learning, 2000.
- W. Stallings, *Data and Computer Communications*, 9th ed. New Delhi, India: PHI Learning, 2010.
- J. F. Kurose and K. W. Ross, *Computer Networking: A Top-Down Approach*, 6th ed. Boston, MA, USA: Pearson Education, 2013.

Online Learning Materials

1. <https://www.geeksforgeeks.org/computer-network-tutorials/> Accessed on 02 April, 2025
2. <https://www.spiceworks.com/tech/networking/articles/what-is-a-computer-network/> Accessed on 08 April, 2025

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BACHELORS OF COMPUTER APPLICATIONS

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Computer Networks	Prof. Dr. Narayan Patidar	Educational Multimedia Research Centre, Devi Ahilya Vishwavidyalaya, Indore	https://onlinecourses.swayam2.ac.in/cec22_cs05/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA117
Course Title: Operating System

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 4	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P)= 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand role, responsibilities, features, and design of operating system.
2	Analyze memory management schemes and process scheduling algorithms.
3	Apply process synchronization techniques to formulate solution for critical section problems.
4	Illustrate the concept of disk scheduling.
5	Evaluate process deadlock handling techniques.

Contents

Part-A

Unit –I **12(L) hrs**

Introduction: Operating system and functions, Classification of Operating systems: Batch, Time sharing, Real Time System, Single user, Multiprocessor Systems, Multiuser Systems, Operating System Structure(Role of Kernel and Shell), System Components, Operating System Services.

Unit-II **12(L) hrs**

Process & Thread Management: Program vs. Process; Process States, PCB, State transition diagram, Scheduling Queues, Types of schedulers, Concept of Thread, Benefits, Types of threads, Process synchronization: race condition, The Critical-Section Problem, Peterson's Solution, Mutual Exclusion, Classical Synchronization Problems, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors, Interprocess Communication.

Part-B

Unit-III **13(L) hrs**

CPU Scheduling: Need of CPU scheduling, Pre-emptive vs. Non-pre-emptive scheduling, Different scheduling criteria's, scheduling algorithms (FCFS, SJF, Round-Robin, Priority Scheduling, Multilevel Queue). Deadlock: System model, Deadlock characterization, Methods for Handling Deadlocks, Prevention, Avoidance and detection, Recovery from deadlock.

Unit-IV **8(L) hrs**

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Memory Management: Introduction, Logical address space, Physical address space, MMU, Swapping, Contiguous Memory Allocation, Paging and segmentation; Virtual memory: basic concepts of demand paging, page replacement algorithms, Thrashing.

Mass-Storage Structure: Overview, Disk Structure, Disk Scheduling, Disk Management

File Management: Basic concepts, file operations, access methods, directory structures and management, File system protection and security.

Scenario based assignments will be provided to help students apply theoretical concepts to real-time situations.

Laboratory Work:

Experiment No.	Experiment Title
1	Installation of Windows Operating System
2	Installation of Linux Operating System.
3	To perform various DOS and Linux Commands.
4	To practice file and directory handling commands.
5	Design and implement process creation using fork().
6	To apply and compare CPU scheduling using the FCFS algorithm
7	To implement and analyze the SJF scheduling algorithm.
8	To implement and evaluate the Round Robin scheduling algorithm
9	To analyze and interpret the Priority scheduling algorithm for process management.
10	Write a program to implement the deadlock detection
11	To design and demonstrate a solution for the Producer–Consumer problem
12	Evaluate and implement the FIFO page replacement algorithm.
13	Analyze and utilize the Vi editor and its commands.
14	To create shell scripts using conditional statements
15	To create shell scripts using while, and for control statements

Text Books

1. Abraham Silberschatz, Greg Gagne, and Peter B. Galvin, "Operating System Concepts," Tenth Edition, Wiley, 2018.
2. Principals of Operating System by Naresh Chauhan, Published by OXFORD University Press, India.

Reference Books

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BACHELORS OF COMPUTER APPLICATIONS

1. Andrew S. Tanenbaum and Herbert Bos, "Modern Operating Systems," Fourth Edition, Pearson, 2014
2. William Stallings, "Operating Systems: Internals and Design Principles," Seventh Edition, Prentice Hall, 2011.
3. Dhanjay Dhamdhare, "Operating Systems," First Edition, McGraw-Hill, 2008

Online Learning Materials

1. <https://www.geeksforgeeks.org/operating-systems/> Accessed on 31 January, 2025
2. <https://www.cse.iitb.ac.in/~mythili/os/> Accessed on 15 July, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Introduction to Operating System	Prof. Chester Rebeiro	IIT Madras	https://onlinecourses.nptel.ac.in/noc25_cs94/preview

BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA118
Course Title: Data Structures-II

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 4	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply fundamental concepts of trees and their types.
2	Implement various operations on trees and graphs.
3	Compare various graph representations and traversal algorithms.
4	Evaluate different sorting algorithms based on their time complexity.
5	Understand hashing techniques and resolve collisions using appropriate methods.

Contents

Part-A

Unit –I

16(L) hrs

Tree Definitions and Concepts: Root, Node, Leaf Node, Level, Degree, Height. **Tree Representations:** Using Linked List and Array. **Types of Trees:** Binary Tree, Binary Search Tree (BST), Height-Balanced Tree (AVL Tree), B-Tree, B+ Tree. **Tree Operations:** Creation, Insertion, Deletion, and Traversals (Pre-order, In-order, Post-order), and Searching in various types of trees.

Unit-II

12(L) hrs

Graph Definitions and Structure: Vertices, Edges **Graph Representations:** Adjacency Matrix, Adjacency List **Types of Graphs:** Weighted and Unweighted, Directed and Undirected **Graph Operations:** Creation, Insertion, Deletion, Traversals (Depth-First Search, Breadth-First Search), and Searching **Shortest Path Algorithm:** Dijkstra's Algorithm

Part-B

Unit-III

8(L) hrs

Sorting Concepts: Order, Stability, and Efficiency. **Sorting Algorithms:** Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Radix Sort

Unit-IV

9(L) hrs

Hashing Basics: Concept of Hashing, Hash Functions, Hash Tables, And Applications of hashing in computer science: Symbol tables, Caching mechanism, Password storage, **Re-Hashing:** Rehashing techniques, when and why rehashing is required, Rehashing strategies.

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Collision Resolution Techniques: Open Addressing: Linear Probing, Quadratic Probing, Double Hashing Closed Addressing: Chaining

Laboratory Work:

Experiment No.	Experiment Title
1	Write a program to create a Balanced Binary Search Tree (BST) using an array (given) elements where array elements are sorted in ascending order.
2	Traverse the binary tree using pre-order, post-order and in- order traversal.
3	Create an AVL Tree and implement its various operations: searching, insertion, deletion on AVL Trees
4	Demonstrate the use of B Tree.
5	Implement graph traversal using Depth First Search.
6	Using Breadth First Search, traverse the graph.
7	Create a graph and find the shortest path using Dijkstra Algorithm.
8	Write a program to sort a list of elements using the selection sort algorithm
9	Enter a list of elements by the user and sort the elements using bubble sort algorithm.
10	Using the insertion sort algorithm, sort a list of elements entered by the user.
11	Implement the merge sort algorithm to sort a list of elements.
12	Design a program to sort a list of elements using the quick sort algorithm.
13	Create a heap sort algorithm to sort a list of elements.
14	Write a program to sort a list of elements using the radix sort algorithm.
15	Implement Hash Table using Open Addressing (Linear Probing)

Text Books

1. S. Lipschutz, Data Structures, special ed., adapted by R. Rajan, New Delhi, India: Tata McGraw Hill Education (India) Pvt. Ltd., 2008.
2. E. Horowitz, S. Sahni, and S. Anderson-Freed, Fundamentals of Data Structures in C, 2nd ed., New Jersey, USA: Silicon Press, 2008.
3. N. Karumanchi, *Data Structures and Algorithms Made Easy*, 2nd ed., Hyderabad, India: Career Monk Publications, 2011.

Reference Books

1. Y. Kanetkar, *Data Structures through C*, 5th ed., New Delhi, India: BPB Publications, 2023.
2. V. H. Patil, *Data Structures Using C++*, Illustrated ed., New Delhi, India: Oxford University Press, 2012.

Online Learning Materials

1. <https://www.geeksforgeeks.org/introduction-to-tree-data-structure/> Accessed on 4 March, 2025.

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2. https://www.tutorialspoint.com/data_structures_algorithms/sorting_algorithms.htm/ Accessed on 16 June, 2025.
3. <https://www.simplilearn.com/tutorials/data-structure-tutorial/graphs-in-data-structure/>
Accessed on 25 February, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Data Structures	Dr. S.Sasikala	University of Madras	https://onlinecourses.swayam2.ac.in/cec19_cs04/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA119

Course Title: Database Management Systems-I

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 4	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply fundamental concepts of DBMS to distinguish between different data models for appropriate application.
2	Analyze database schemas, interpret ER diagrams, and perform operations using relational algebra and calculus to model databases effectively.
3	Evaluate database designs by applying normalization rules up to DKNF to minimize redundancy and ensure integrity.
4	Design SQL queries and database objects (tables, views) to manipulate and retrieve data effectively.
5	Construct a complete relational database application incorporating ER modeling, normalization, and SQL querying.

Contents

Part-A

Unit –I **10(L) hrs**

Introduction to Fundamentals of DBMS: Database Management Systems (DBMS) Database System Applications, Drawbacks of File Processing System, Advantages of DBMS, Components of DBMS, Data Model in DBMS and its types; Hierarchical, Network and Relational Model, Comparison of Network, Hierarchical and Relational Model.

Unit –II **16(L) hrs**

Three level Architecture of DBMS, Data independence RDBMS: Concept, Components, Keys and Constraints in DBMS.

Entity Relationship Model: Entity-Relationship Model Constraints, ER Diagrams: Components of an ER Diagram, Relational Database; Relational Algebra: Select Operation, Project Operation, Union Operation, Set Intersection, Set Difference, Cartesian product, Rename Operation. Relational Calculus: Tuple Relational Calculus and Domain Relational Calculus.

Part-B

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Unit –III

8(L) hrs

Introduction to Normalization: First, Second, Third Normal Forms, Dependency Preservation, Boyce-Codd Normal Form, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Domain-key normal form (DKNF).

Unit –IV

11(L) hrs

SQL Fundamentals: Data types in SQL, DDL, DML: Insert Command, Update statement, Delete statement, Sub query, Query DCL commands: Difference between grant and revoke, Aggregate Functions: Numeric functions, Character functions, Character-Manipulative Functions, Order by and group by clause in SQL, SQL Constraints Types of SQL Joins. View in database.

Laboratory Work

Experiment No.	Experiment Title
1	Create an ER Diagram for Students, Teachers and Courses taught
2	Create an ER Diagram for Employee Management System
3	Installation and Configuration of SQL Server
4	Create a relation 'Student' and demonstrate the use of CREATE, ALTER, RENAME and DROP statement in the database table
5	Add records and make manipulations in relation 'Student' using INSERT INTO, DELETE and UPDATE statement in the database table
6	Fetch records from relation 'Student' using select statement.
7	Use of GRANT and REVOKE statement in the relation 'Student' to give user permissions.
8	Use of Primary Key and Unique Key Constraints in relation 'Student'.
9	Demonstrate the use of Aggregate Functions using 'Student_marks' relation.
10	Implement built-in string functions such as LENGTH, UPPER, LOWER, SUBSTRING, CONCAT, TRIM in relation 'Student'
11	Use Order by to organize student data according to their Grades in relation 'Student_marks'
12	Write SQL code to demonstrate the use of GROUP BY statement and Having Clause
13	Create the following schema for a Library Database using Primary Key and Foreign Key constraint : BOOK (<i>Book_id</i>, <i>Title</i>, <i>Publisher_Name</i>, <i>Pub_Year</i>) . BOOK_AUTHORS (<i>Book_id</i>, <i>Author_Name</i>) . BOOK_COPIES(<i>Book_id</i>, <i>Branch_id</i>, <i>No-of_Copies</i>) . LIBRARY_BRANCH (<i>Branch_id</i>, <i>Branch_Name</i>, <i>Address</i>) . Write SQL queries using joins to retrieve details of all books in the library i.e book_id, title, authors, number of copies in each branch.
14	Implement different types of Joins using the following schema for Order Database: SALESMAN(<i>Salesman_id</i>,<i>Name</i>,<i>City</i>,<i>Commission</i>) CUSTOMER(<i>Customer_id</i>,<i>Cust_Name</i>,<i>City</i>,<i>Grade</i>,<i>Salesman_id</i>) ORDERS (<i>Ord_No</i>, <i>Purchase_Amt</i>, <i>Ord_Date</i>, <i>Customer_id</i>, <i>Salesman_id</i>)
15	Create a view that finds the salesman who has the customer with the highest number of orders in a day .(Refer schema of Q11)

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Text Books

1. B. C. Desai, *An Introduction to Database System*, Revised ed., New Delhi, India: Galgotia Publications Pvt. Ltd., 2012.
2. A. Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts*, 6th ed., New Delhi, India: Tata McGraw Hill, 2013.

Reference Books

1. I. Bayross, *SQL, PL/SQL: The Programming Language of Oracle*, 4th Revised ed., New Delhi, India: BPB Publications, 2009.
2. C. J. Date, A. Kannan, and S. Swamynathan, *An Introduction to Database Systems*, 8th ed., Chennai, India: Pearson Education, 2006.
3. R. Ramakrishnan, *Database Management Systems*, 3rd ed., New York, USA: McGraw-Hill, 2014.

Online Learning Materials

1. <https://www.geeksforgeeks.org/dbms-architecture-2-level-3-level/> Accessed on 08 May, 2025
2. <https://www.studytonight.com/dbms/database-normalization.php> Accessed on 01 Aug, 2024
3. https://www.w3schools.com/mysql/mysql_rdbms.asp Accessed on 10 June, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Database Management System	Prof. Partha Pratim Das	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc22_cs91/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: BCA120

Course Title: Cryptography & Network Security

Programme: BCA	L: 3 T: 0 P: 0	Credits: 3
Semester: 4	Theory/Practical: Theory	Teaching Hours: 45(L) = 45 hrs
Total Max. Marks: 100	Continuous Internal Assessment (CIA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply the fundamental concepts of security techniques to identify various cyber-attacks and protection mechanisms.
2	Analyze various symmetric and asymmetric cryptographic algorithms in terms of their design, strengths, and vulnerabilities.
3	Evaluate the structure and role of Public Key Infrastructure (PKI) to ensure secure communication.
4	Implement basic user authentication mechanisms and network security tools for secure communication over networks.
5	Design various internet security protocols.

Contents

Part-A

Unit-I

12(L) hrs

Introduction to the concepts of Security: Introduction, The Need for Security, Security approaches, Principles of Security, Types of Attacks. Cryptographic Techniques: Introduction, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of attacks.

Unit-II

12(L) hrs

Computer Based Cryptographic Algorithms: Introduction, Algorithm Types and modes, An Overview of Symmetric Key Cryptography, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), RC5, Blowfish, Advanced Encryption Standard (AES), Differential and Linear Cryptanalysis. Computer Based Asymmetric Key Cryptographic Algorithms: Introduction, Brief history of Asymmetric Key Cryptography, An Overview of Asymmetric Key Cryptography, the RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm.

Part-B

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Unit-III

13(L) hrs

Public Key Infrastructure: Introduction, Digital Certificates, Private Key Management, Public Key Cryptography Standards (PKCS) XML, PKI and Security. Internet Security Protocols: Basic Concepts, Secure Socket Layer (SSL)/ TLS, Secure HyperText Transfer Protocols (SHTTP), Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), SSL versus SET, Electronic money, Email Security, Wireless Application Protocol (WAP), Security in GSM.

Unit-IV

8(L) hrs

User Authentication Mechanisms: Introduction, Authentication Basics, Passwords, Authentication Tokens, Certificate-based Authentication, Biometric Authentication, Kerberos. Network Security: Brief Introduction to TCP/IP, Firewalls, IP Security, Virtual Private Networks (VPN).

Scenario based assignments will be provided to help students apply theoretical concepts to real-time situations.

Text Books

1. W. Stallings, Cryptography and Network Security, PHI, (7th Edition), 2007.
2. B. A. Forouzan, Cryptography and Network Security, (1st Edition), McGraw Hill, 2007

Reference Books

1. Bruce Schneier, Applied cryptography: protocols, algorithms, and source code in C, John Wiley & Sons, (20th Edition), 2015
2. A. Kahate, Cryptography and Network Security, PHI, (3rd Edition), 2017
3. W. Stallings, Network Security Essentials: Applications and Standards, (6th Edition), Pearson, 2018.

Online Learning Materials

1. <https://www.geeksforgeeks.org/computer-networks/cryptography-and-network-security-principles/> Accessed on 02 May, 2025
2. https://kp.kiit.ac.in/pdf_files/05/Study-materials_CSE_6th_Cryptography-Network-Security_S.-Dalai.pdf Accessed on 20 May 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Cryptography and Network Security	Prof. Sourav Mukhopadhyay	IIT Kharagpur	https://onlinecourses.swayam2.ac.in/cec22_cs05/preview

GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA
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BACHELORS OF COMPUTER APPLICATIONS

Course Code: UGNE102

Course Title: Indian Knowledge System

Programme: BCA	L: 2 T: 0 P: 0	Credits: 2
Semester: 4	Theory/Practical: Theory	Teaching Hours: 30(L) = 30 hrs
Total Max. Marks: 100	Continuous Internal Assessment (CIA) Marks: 40	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type:		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Provide students with a fundamental understanding of the rich heritage of Indian knowledge systems.
2	Explore the contributions of IKS to various fields, including Management, science and technology.
3	Foster an appreciation for the cultural and societal values embedded in IKS.
4	Encourage critical thinking and interdisciplinary perspectives.
5	Various approaches for Protection, preservation, conservation and Management of Indian Knowledge System.

Contents

Part-A

Unit-I

8(L) hrs

Definition and scope of Indian Knowledge System: Importance of Indian Knowledge System in the modern world, Historical context and evolution of Indian Knowledge System, Indian Knowledge System based approaches on Knowledge Paradigms, Indian Knowledge System in ancient India and in modern India.

Unit-II

7(L) hrs

Indian Knowledge System and Indian Scholars: Ancient Indian advancements in mathematics, and management. Philosophy and Literature (Maharishi Vyas, Manu, Kanad), and Astronomy (Aryabhatta, Mahaviracharya, Bodhayan,), Medicine and Yoga (Charak, Susruta).

Part-B

Unit-III

7(L) hrs

Indian Knowledge System and Indian Literature: Sahitya (Vedas, Upavedas) Puran and Upnishad, Shastra, Indian philosophy and its impact on society, Linguistics and literature, Indian art, music, and dance, Ethical and moral values in Indian Knowledge System. Indian perspectives on nature and the astronomy.

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Unit-IV

8(L) hrs

Indian Traditional/Tribal/Ethnic Communities, their Livelihood and Local Wisdom: Geophysical aspects, Resources and Vulnerability; Resource availability, utilization pattern and limitations; Socio-Cultural linkages with Traditional Knowledge System, Approaches for Protection, preservation, conservation and Management of Indian Knowledge System

Text Books

1. Om prakash Mishra, “Essence of Indian Traditions”, 2nd Edition, Khanna Publishers, 2021.
2. Mahadevan, B. Vinayak Rajat Bhat, and PAVANA RN NAGENDRA, "Introduction to Indian knowledge system: concepts and applications", Ist Edition, PHI Learning Pvt. Ltd., Delhi, 2022.

Reference Books

1. Frifj of Capra, “Tao of The Physics”, 3rd Edition, HarperCollins Publishers, 2007.
2. Om prakash Mishra, “Essence of Indian Traditions”, 2nd Edition, Khanna Publishers, 2021.

Online Learning Materials

1. <https://www.education.gov.in/nep/indian-knowledge-systems> Accessed on 15 April, 2025
2. https://onlinecourses.swayam2.ac.in/imb23_mg53/preview Accessed on 15 April, 2025
3. https://onlinecourses.swayam2.ac.in/imb24_mg21/preview Accessed on 15 April, 2025
4. https://onlinecourses.swayam2.ac.in/imb24_mg20/preview Accessed on 15 April, 2025

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: EBCA101
Course Title: Neural Network

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 4	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Elective		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand the fundamentals of neurons, activation functions and neural architectures.
2	Explain perceptron, Adaline, MLP, associative memory, and their working principles.
3	Apply perceptron, LMS, delta learning rule, and backpropagation to simple problems.
4	Analyze performance of neural network models using error functions and training behavior.
5	Construct small neural network models like MLP for XOR, pattern recognition, and memory networks.
6	Evaluate advantages, limitations, and practical uses of classical neural networks.

Contents

Part-A

Unit –I **10(L) hrs**

Fundamentals of Neural Networks: Introduction to Artificial Intelligence → Machine Learning → Neural Networks, Biological Neuron vs Artificial Neuron, Basic Concepts: Neuron model, Bias and threshold, Activation functions (Step, Linear, Sigmoid, Tanh, ReLU), Neural Network Architectures: Single-Layer Feedforward Network, Multi-Layer Feedforward Network, Feedback Networks, Learning Environments: Supervised learning, Unsupervised learning, Reinforcement learning

Unit-II **12(L) hrs**

Learning Processes & Single-Layer Networks: Learning Laws: Perceptron Learning, Delta Learning Rule, Perceptron: Architecture of single-layer perceptron, Linearly separable functions, Perceptron algorithm (training, convergence), Limitations of perceptron, Adaline: Adaline architecture, Cost function (MSE), Gradient descent update, Difference between Perceptron and Adaline.

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Part-B

Unit-III

12(L) hrs

Multi-Layer Neural Networks: Multilayer Perceptron (MLP): Architecture of MLP, Need for hidden layers, Universal approximation concept (no deep learning detail), Backpropagation Algorithm: Forward pass, Error calculation, Weight update mechanism, Learning rate and convergence, Activation Functions in MLP: Sigmoid, Tanh, ReLU, Problems in Training: Local minima, Overfitting, Underfitting.

Unit-IV

11(L) hrs

Associative Memory Networks & Applications: Associative Memory Networks: Auto-associative memory (simple), Hetero-associative memory, Hopfield Networks: Hopfield model, Energy function, Pattern storage & recall, Kohonen Networks (Basic): Self-Organizing Maps (SOM) – concept & applications.

Applications of Neural Networks: Pattern recognition, XOR classification using MLP, Character recognition.

Laboratory Work

Experiment No.	Experiment Title
1	Implement the McCulloch-Pitts (MCP) Neuron for basic logical operations (AND, OR, NOT).
2	Implement activation functions such as Step, Linear, Sigmoid, Tanh, and ReLU and compare their outputs.
3	Demonstrate the effect of bias and threshold on a single artificial neuron.
4	Simulate a Single-Layer Feedforward Network for simple classification tasks.
5	Implement the Perceptron Learning Rule for a linearly separable dataset.
6	Analyze the convergence of Perceptron training on different datasets.
7	Implement the Adaline network using Gradient Descent and compute MSE.
8	Compare Perceptron and Adaline based on learning rate, convergence, and error reduction
9	Build and train a Multi-Layer Perceptron (MLP) using Backpropagation.
10	Calculate forward pass, error, and weight updates manually for a small MLP (3–4 neurons).
11	Identify and analyze problems in training (overfitting, underfitting, local minima)
12	Evaluate the effect of different activation functions (Sigmoid, Tanh, ReLU) in an MLP.
13	Design and implement a Hopfield Network for storing and recalling binary patterns.
14	Implement a Kohonen Self-Organizing Map (SOM) for clustering two-dimensional data.
15	Develop a neural network model for XOR classification using an MLP and evaluate performance.

Text Books

1. Simon Haykin, “Neural Networks and Learning Machines”, 3rd edition, Pearson Education, 2009.

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2. Martin T. Hagan, Mark H. Beale, “Neural Network Design”, 2nd Edition, 2014.

Reference Books

1. Sivanandam, S Sumathi, S N Deepa; “Introduction to Neural Networks”, 2nd edition, TATA McGraw HILL, 2005.

Online Learning Materials

1. <https://www.geeksforgeeks.org/machine-learning/neural-networks-a-beginners-guide/>
Accessed on 13, November, 2025
2. <https://www.coursera.org/learn/neural-networks-deep-learning> Accessed on 13, November, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Machine and Deep Learning	Prof. M. K. Bhuyan	IIT Guwahati	https://onlinecourses.nptel.ac.in/noc23_ee87/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: EBCA102
Course Title: Web Technologies

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 4	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Internal Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Elective		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Demonstrate web technologies, web servers, and website design principles using HTML5 and CSS3.
2	Develop interactive and dynamic web pages using JavaScript, including DOM manipulation, event handling, and object-oriented concepts.
3	Design and validate XML documents using DTD and XSD, and transform XML data using XSLT.
4	Implement AJAX techniques to build responsive and asynchronous web applications for real-time data exchange.
5	Utilize JSON for structured data exchange and integration in modern AJAX-based web applications.

Contents

Part-A

Unit –I **11(L) hrs**
Introduction: Web Applications, TCP/IP Application Services. Web Servers: Basic Operation, SGML, HTML5, CSS3, Proxy servers, Web applications. Website design principles.

Unit-II **11(L) hrs**
Client-side Scripting JavaScript: Variables, Scope , Expression and operators, Statements, Arrays, Objects (Math, String, Date), Functions, Constructors, DOM, Document objects, DOM tree structure(nodes, elements, attributes, text), Selecting DOM Elements, Manipulating DOM, DOM traversal, Event and Event handling.

Part-B

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Unit-III

13(L) hrs

Introduction to XML and its Application: Syntax Rules for creating XML document; XML Elements; XML Attributes; XML Tree; XML Namespace; XML schema languages: Document Type Definition (DTD), XML Schema Definition (XSD); XSD Simple Types, XSD Attributes; XSD Complex Types; XML Style Sheets (XSLT), XML parsing.

Basics of AJAX: What is AJAX, How AJAX works, GET and POST requests, Handling Server response, Understanding XHR, Creating AJAX call using XHR.

Unit-IV

10(L) hrs

JSON– Syntax, Schema, Data types, Objects, Reading and writing JSON on client and server. Using JSON in AJAX applications, JSON vs XML, Asynchronous vs. Synchronous Requests, Modern AJAX Techniques (Fetch API, ASYNC/ AWAIT, Axios, AJAX with JSON).

Laboratory Work

Experiment No.	Experiment Title
1	Create a simple webpage using HTML5 tags like headings, paragraphs, images, hyperlinks, and lists.
2	Design a multi-page website and link pages using internal and external hyperlinks. Include a navigation bar.
3	Apply inline, internal, and external CSS3 styles to enhance webpage design. Use borders, padding, margins, and fonts.
4	Implement responsive layouts using CSS media queries. Ensure the page adapts to mobile and desktop screens
5	Write JavaScript code to demonstrate variables, data types, operators, and expressions. Display results in browser console or HTML page.
6	Implement JavaScript programs using loops, conditional statements, and user-defined functions.
7	Create and manipulate arrays and objects. Perform operations like sorting, filtering, and displaying data dynamically.
8	Use JavaScript to change HTML content and styles dynamically. Handle user events like button clicks and form validation.
9	Create XML documents with elements and attributes. Display hierarchical data structure and validate syntax.
10	Write an XML file which will display the Book information. It includes the following: 1) Title of the book 2) Author Name 3) ISBN number 4) Publisher name 5) Edition 6) Price Write a Document Type Definition (DTD) to validate the above XML file
11	Display the XML file created in previous program as: The contents should be displayed in a table. The header of the table should be in color GREY. And the Author names column should be displayed in one color and should be capitalized and in bold. Use your own

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	colors for remaining columns. Use XML schemas XSL and CSS for the above purpose
12	Use XSLT to transform an XML document into a formatted HTML page.
13	Implement an AJAX request to fetch data from the server without reloading the page using XMLHttpRequest or Fetch API.
14	Create JSON data, read and parse it in JavaScript, and display it dynamically on a webpage.
15	Build a web application that sends/receives JSON data asynchronously using AJAX.

Text Books

1. Kogent Learning Solutions Inc., “*Web Technologies: HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML and AJAX – Black Book*”, New Delhi, India: Dreamtech Press, 2011.
2. Achyut S. Godbole and Atul Kahate, “*Web Technologies: TCP/IP to Internet Application*”, 3rd ed., New Delhi, India: McGraw Hill Education, 2017.

Reference Books

1. Boye Akinyode, “*Web Technologies and Applications*”, 2nd ed., New Delhi, India: PHI Learning, 2021.
2. Jon Duckett, “*JavaScript and jQuery: Interactive Front-End Web Development*”, Hoboken, USA: John Wiley & Sons, 2014.

Online Learning Materials

1. <https://www.w3schools.com/js/default.asp> Accessed on 26 October, 2025
2. <https://www.geeksforgeeks.org/javascript/asynchronous-javascript/> Accessed 26 October, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Web Technologies	Dr. S. Sasirekha	National Institute of Technical Teachers' Training and Research, Chennai	https://onlinecourses.swayam2.ac.in/ntr25_ed123/preview

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BACHELORS OF COMPUTER APPLICATIONS

Course Code: EBCA103

Course Title: DevOps

Programme: BCA	L: 3 T: 0 P: 2	Credits: 4
Semester: 4	Theory/Practical: Theory	Teaching Hours: 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	Continuous Assessment (CIA) Marks: 90	End Semester Examination (ESE) Marks: 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 50%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Elective		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply DevOps principles, lifecycle stages, and Agile practices to explain modern software development workflows.
2	Analyze version control operations using Git and automate workflows using GitHub/GitLab for collaborative development.
3	Implement Continuous Integration pipelines using Jenkins and build automation tools.
4	Develop automated infrastructure setups using Ansible and containerized applications using Docker and Kubernetes.
5	Design Continuous Deployment pipelines and basic DevSecOps security measures.

Contents

Part-A

Unit –I

12(L) hrs

Introduction to DevOps: Evolution and importance of DevOps in modern software development, core principles and key benefits, DevOps lifecycle stages, Continuous Integration (CI), Continuous Delivery (CD), Continuous Deployment (CD), feedback loops and monitoring fundamentals, DevOps and Agile relationship and differences, overview of Scrum and Kanban, DevOps toolchain overview including version control, automation, testing, deployment, and monitoring, case studies of DevOps adoption such as Netflix and Amazon

Unit-II

12(L) hrs

Version Control, Build Automation & Continuous Integration: Overview of Version Control Systems, Git basics including init, status, add, commit, and log, branching, merging, and conflict resolution, remote repositories such as GitHub and GitLab, simplified Git workflows (Git Flow – basic), importance of build automation, build tools such as Maven, Gradle, and npm (basic concepts), concepts

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of Continuous Integration (CI), Jenkins installation, Jenkins job creation, basic Jenkins pipeline configuration, integrating Jenkins with Git, automating build and test processes

Part-B

Unit-III

11(L) hrs

Configuration Management & Containerization: Basics of Configuration Management, introduction to Ansible, Ansible playbooks, automating server setup using Ansible, introduction to Docker and containerization, Docker architecture, Dockerfiles, Docker images, Docker containers, building and running Docker containers.

Unit-IV

10(L) hrs

Continuous Deployment, Monitoring, and DevSecOps: Continuous Delivery vs Continuous Deployment, designing a simple CD pipeline, monitoring in DevOps, Prometheus basics for metrics collection, Grafana basics for dashboard visualization, introduction to DevSecOps, basic security practices in CI/CD pipelines, concepts of static code analysis, concepts of secrets management.

Laboratory Work

Experiment No.	Experiment Title
1	Demonstrate the installation and setup of DevOps tools (Git, Jenkins, Docker).
2	Perform basic Git operations such as init, add, commit, log.
3	Analyze Git branching, merging, and conflict resolution techniques.
4	Configure and manage remote repositories using GitHub/GitLab.
5	Build and package a Simple Project Using Maven/Gradle/npm
6	Install Jenkins and Configure a Basic Freestyle Job for Automated builds
7	Integrate Jenkins with Git to automate build triggers on code commits.
8	Develop a basic Jenkins pipeline using a Jenkinsfile.
9	Automate server configuration using an Ansible playbook.
10	Write Dockerfiles and build Docker images for application deployment.
11	Run and manage Docker containers using generated images.
12	Deploy a simple web application using Docker containers.
13	Design a continuous deployment (CD) pipeline integrating Git, Jenkins, and Docker.
14	Monitoring application metrics using Prometheus and interpret the results.
15	Create and Visualize system metrics using Grafana dashboards.

Text Books

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BACHELORS OF COMPUTER APPLICATIONS

1. Krief, Mikael, “Learning DevOps: A Comprehensive Guide to Accelerating DevOps Culture Adoption with Terraform, Azure DevOps, Kubernetes, and Jenkins”, 2nd Edition, Packt Publishing, 2022.
2. Agarwal, Gaurav, “Modern DevOps Practices: Implement, Secure, and Manage Applications on the Public Cloud with Cutting-Edge Tools”, 2nd Edition, Packt Publishing, 2024.

Reference Books

1. Freeman, Emily, DevOps For Dummies, 1st Edition, John Wiley & Sons, 2019
2. Deepak Gaikwad, Viral Thakkar, DevOps Tools from Practitioner’s Viewpoint, Wiley, 1st Edition, 2019

Online Learning Materials

1. <https://www.geeksforgeeks.org/devops/devops-tutorial/> Accessed on 14 November, 2025
2. <https://www.tutorialspoint.com/devops/index.htm> Accessed on 14 November , 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	DevOps	Lydia Halie	University of California, Berkeley	https://www.coursera.org/specializations/devops-mastery