VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY, BALLARI
JNANASAGARA CAMPUS, BALLARI-583 105

Department of Studies in Computer Science

Credits Structure under Choice based Credit System (CBCS) as per SEP 2024

Syllabus of I & II Semester

Bachelor of Computer Applications (BCA)

in

Artificial Intelligence & Machine Learning

With effect from the Academic Year 2026-27 Onwards

Approved in the BOS Dated 15-05-2026

Board of Studies
Department of Studies in Computer Science

Sl. No	Name	Designation
1.	Prof. Hanumesh Vaidya, Professor and Chairman Department of Studies in Computer Science, VSK University, Ballari.	Chairman
2.	Prof. Hanumanthappa, Senior Professor, Bangalore University, Bengaluru	External Member
3.	Prof. Aziz Makandar, Senior Professor, Karnataka State Akkamahadevi Women's University, Vijayapura	External Member
4.	Dr.Kumaraswamy K., Associate Professor, Kishkinda University, Ballari	External Member
5.	Dr. Pavan Kumar C., Assistant Professor, Indian Institute of Technology (IIT), Dharwad	External Member
6.	Shri. Vijaykumar Jangamashetti., Technical Cloud Consultant, Google, Pune	External Member
7.	Shri. Sainath Patil, Vice President, Barclays, Pune	External Member
8.	Dr.Vinod Kumar Murthy, Founder and CEO, Livey Learning, Bengaluru	External Member
9.	Shri. Santosh Sangamesh Patil, Assistant Professor, Department of Studies in Computer Science, V.S.K. University, Ballari	Internal Member
10.	Dr. Halker Rachappa, Associate Professor, S.G.R.C.M. Government Commerce and Management College, Ballari	Member
11.	Dr. Harish Gujjar, Associate Professor, Government First Grade College, Vijayanagara	Member
12.	Dr. Renuka S., Associate Professor, Government Degree College, Sindhanur	External Member

Eligibility Criteria for Admission:

Candidates who have passed 10+2 (PUC / Intermediate) or equivalent examination recognized by the Government of Karnataka (GoK), with Science or Commerce as the stream of study, from a recognized Board.

Prerequisite / Bridge Course for Non-Mathematics/ Statistics Students:

Candidates who have passed 10+2 (PUC / Intermediate) without Mathematics or Statistics as a subject (e.g., Commerce stream) are eligible for admission to the BCA programme, provided they attend a mandatory Bridge Course conducted by the respective college before the commencement of Semester I.

Details of the Bridge Course:

Particulars	Details
Course Title	Foundation Mathematics and Statistics for BCA
Duration	2–3 weeks (prior to commencement of Semester I)
Contact Hours	25–30 hours
Schedule	2 hours/day, 6 days a week
Conducted by	Respective College / Institution offering BCA
Credits	Zero Credit (Audit / Non-credit Course)
Assessment	No Examination and attendance-based completion
Minimum Attendance	75% attendance is mandatory to complete the Bridge Course

Foundation Mathematics and Statistics for BCA	
Contact Hours: 25–30 hours	**Zero Credit (Audit / Non-credit Course)**

Topics for the Bridge Course:

1. **Basic Arithmetic, Algebra and Number Systems.**
2. **Set Theory, Relations and Functions.**
3. **Matrices and Determinants.**
4. **Permutations, Combinations and Sequences.**
5. **Elementary Statistics — Mean, Median, Mode, Probability Basics.**
6. **Introduction to Logic and Boolean Algebra.**
7. **Basics of Trigonometry: Trigonometric Ratios, Identities and Applications.**
8. **Basics of Differentiation: Limits, Derivatives and Elementary Rules of Differentitation.**
9. **Graph Theory: Graphs, vertices, Edges, Types of Graphs, Paths and Connectivity.**

Reference Books:

1. **Tremblay, J.P. and Manohar, R., Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill Publishing Company Limited, New Delhi. (35th Reprint, 2017).**
2. **Sharma, R.D., Mathematics for Class XI and XII (Vol. 1 & 2), Dhanpat Rai Publications (P) Ltd., New Delhi. (Latest Edition).**

Note: The Bridge Course carries no marks, no grades, and no examination. It is a compulsory preparatory support programme to ensure foundational readiness for the BCA curriculum. Students who have studied Mathematics or Statistics at the 10+2 level are exempted from attending this course. The respective college shall maintain attendance records.

VSKUB STATE EDUCTION POLICY(SEP): Proposed/Tentative Curricular and Credits Structure under Choice Based Credit System (CBCS) Scheme for the Three Years B.C.A. with Specialization in AI & ML Undergraduate Programme with effect from the Academic Year 2026-27

Semester	Major 1 (A)	Major 2 (B)	Major 3 (C)	Elective / Optional	Language	Compulsory / Skill Courses	Total Credits
1	Problem Solving Techniques (L:T:P = 4:0:2=6)	Computer Architecture (L:T:P = 4:0:2=6)	Discrete Mathematical Structures (L:T:P = 4:0:0=4)	-	L1 (3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	Constitutional Values (2) (L:T:P = 3:0:0)	24
2	Data Structures (L:T:P = 4:0:2=6)	Object Oriented Programming using Java (L:T:P = 4:0:2=6)	Operating System (L:T:P = 4:0:0=4)	-	L1(3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	Environmental Studies (2) (L:T:P = 3:0:0)	24
3	Database Management System (L:T:P = 4:0:2=6)	Python Programming (L:T:P = 4:0:2=6)	Principles of AI (L:T:P = 4:0:0=4) *Specialization*	-	L1 (3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	SEC-1 (2)Web Technologies (L:T:P = 1:0:2)	24
4	Design and Analysis of Algorithm (L:T:P = 4:0:2=6)	Computer Networks (L:T:P = 4:0:2=6)	Principles of Data Privacy and Security (L:T:P = 4:0:0=4) *Specialization*	-	L1 (3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	SEC-2 (2) Elementary Research Methodology (L:T:P = 1:0:2)	24
5	Introduction to Machine Learning (L:T:P = 4:0:2=6)	Big Data Analytics (L:T:P = 4:0:2=6)	Natural Language Processing (L:T:P = 4:0:2=6)	Cyber Security/ IoT / Social Network Analysis (L:T:P = 4:0:0=4)	-	SEC-3 (2) Advanced data Analysis tool (L:T:P = 2:0:0)	24
6	Deep Learning Fundamentals (L:T:P = 4:0:2=6)	Predictive Analytics (L:T:P = 4:0:2=6)	Software Engineering (L:T:P = 4:0:0=4)	Bioinformatics/ Robotics and Automation/ Soft Computing (L:T:P = 4:0:0=4)	-	Internship/ Research Project (4)	24
Total	36	36	36	04	24	14	144
						Total 144 Credits	

Note:

1. The curriculum for all Courses except L1, L2, Constitutional Values, Environmental values and Elementary Research Methodology will be framed by the respective Board of Studies.

2. The Curriculum for Languages L1 & L2 will be framed by respective Board of Studies (BoS) (Example: Kannada/ English/ Hindi/ Sanskrit/ Telugu etc.).

3. The curriculum for Constitutional values will be framed by Board of Studies (BoS) in Political Science.

4. The curriculum for Environmental Science will be framed by special/common Board of Studies (BoS) set up by the University.

5. The curriculum for Elementary Research Methodology will be set by special/ common Board of Studies (BoS - Faculty of Science & Applied Science) set up by the University.

VSKUB STATE EDUCTION POLICY(SEP): Proposed Curricular and Credits Structure under Choice Based Credit System (CBCS) Scheme for the Three Years B.C.A with Specialization in AI & ML Undergraduate Programme with effect from the Academic Year 2026-27

I Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
26BCA1L1	Language 1	20	80	100	4	0	0	3	03
26BCA1L2	Language 2	20	80	100	4	0	0	3	03
26BCA11	Problem Solving Techniques	20	80	100	4	0	0	4	03
26BCA12	Computer Architecture	20	80	100	4	0	0	4	03
26BCA13	Discrete Mathematical Structures	20	80	100	4	0	0	4	03
26BCA11P	Problem Solving Techniques Lab	10	40	50	0	0	4	2	03
26BCA12P	Computer Architecture Lab	10	40	50	0	0	4	2	03
26BCA1CV	Constitutional Values	10	40	50	3	0	0	2	1.5*
TOTAL		130	520	650	23	0	8	24	-

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

26– Year of Curriculum Implementation / Revision
BCA-Bachelor of Computer Applications
L – Language
CV – Constitutional Values
1 – Semester Number
P - Practical

VSKUB STATE EDUCTION POLICY(SEP):Proposed Curricular and Credits Structure under Choice Based Credit System (CBCS) Scheme for the Three Years B.C.A with Specialization in AI & ML Undergraduate Programme with effect from the Academic Year 2026-27

II Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
26BCA2L1	Language 1	20	80	100	4	0	0	3	03
26BCA2L1	Language 2	20	80	100	4	0	0	3	03
26BCA21	Data Structures	20	80	100	4	0	0	4	03
26BCA22	Object Oriented Programming Using Java	20	80	100	4	0	0	4	03
26BCA23	Operating System	20	80	100	4	0	0	4	03
26BCA21P	Data Structures Lab	10	40	50	0	0	4	2	03
26BCA22P	Object Oriented Programming Using Java Lab	10	40	50	0	0	4	2	03
26BCA2ES	Environmental Studies	10	40	50	3	0	0	2	1.5*
TOTAL		130	520	650	23	0	8	24	-

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

26 – Year of Curriculum Implementation / Revision
BCA-Bachelor of Computer Applications
L – Language
ES – Environmental Studies
2 – Semester Number
P - Practical

Semester – I

Course Title: Problem Solving Techniques	Course Code: 26BCA11
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	Duration of SEE: 03 Hours
Internal Assessment Marks: 20	Semester End Exam Marks: 80

Course Outcomes:

CO1: Understand basic terminology of computers, problem solving, programming Languages and their evolution

CO2: Create specification from problem requirements by asking questions to disambiguate the requirement statement

CO3: Design the solution from specification of a problem and write pseudo code of the algorithm using basic building blocks or structured programming constructs (Sequence, Selection and Repetition statement)

CO4: Translate an algorithm into a C computer program

CO5: Testing and analyzing programs using debugging tools

Unit		Hours
1	Problems and Problem Instances, Generalization and Special Cases, Types of Computational Problems, Classification of Problems, Analysis of Problems, Solution Approaches, Algorithm Development, Analysis of Algorithm, Efficiency, Correctness, Role of Data Structures in Problem Solving, Problem-Solving Steps (Understand the Problem, Plan, Execute, And Review), Breaking the Problem into Sub-problems, Input/Output Specification, Input Validation, Pre and Post Conditions.	12
2	**C Language:** Introduction To Programming Languages, Different Generations of Programming Languages. Typed Vs Typeless Programming Languages, History of C Language, An Empty C Program. C Language Counterparts for Input(scanf()), Output(printf()) Statements, Assignment, Arithmetic, Relational and Logical Operators, Increment/Decrement Operators. Decision-making Statements, Looping Statements, break and continue Statements. Data Types. Translating Pseudocode/Algorithm to C Program. Incremental Compilation and Testing of The C Program. Simple Problems Involving Input, Output, Assignment Statement, Functions. Debugging and Good Coding Practices.	11
3	**Structured Programming Concepts:** Sequence (Input/Output/Assignment), Selection (If, If-Else) And Repetition (For, While, Do-While) Statements, Control Structure Stacking and Nesting. Different Kinds of Repetitions: Entry Controlled, Exit Controlled, Counter Controlled, Definite, Indefinite and Sentinel-Controlled Repetitions. Pseudocode and Flowcharts. Definition And Characteristics of Algorithms, Standard Algorithm Format. Problems Involving Iteration and Nesting: Displaying Different Patterns and Shapes Using Symbols and Numbers.	11
4	**Problems on Numbers:** Extracting Digits of a Number (Left to Right and Right to Left), Palindrome, Prime Number, Prime Factors, Amicable Number, Perfect Number, Armstrong Number, Factorial, Converting Number from One	11

	Base to Another. Statistics (Maximum, Minimum, Sum and Average) on a Sequence of Numbers which are Read using SentinelControlled Repetition using only a few Variables.	
5	**Modular Programming and Problems on Arrays:** Modular Programming Top-Down and Bottom-Up Approaches to Problem Solving. Recursion. Problems on Arrays: Reading and Writing of Array Elements, Maximum, Minimum, Sum, Average, Median and Mode. Sequential And Binary Search. Any one Sorting Algorithm. Matrix Operations. One Dimensional and Two-Dimensional Arrays.	11

References:

1. Venkatesh, Nagaraju Y, Practical C Programming for Problem Solving, Khanna Book Publishing Company, 2024.
2. Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Company, 2024.
3. Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India, 2015.
4. R G Dromey, How to Solve it by Computer, Pearson.
5. Brian W. Kernighan and Dennis Ritchie, The C Programming Language, 2nd edition, Pearson, 2015.
6. Jeri Hanly and Elliot Koffman, Problem Solving and Program Design in C, 8th edition, Pearson, 2015.

Course Title: Computer Architecture	Course Code: 26BCA12
Total Contact Hours: 56	No. of Credits: 04
L:T:P=4:0:2	Duration of SEE: 03 Hours
Internal Assessment Marks: 20	Semester End Exam Marks: 80

Course Outcomes (COs):

CO1: To Understand the basics of Digital Electronics and Binary Number System
CO2: To Learn the implementation of Combinational Circuit.
CO3: To Learn the implementation of Sequential Circuit.
CO4: To Understand the Organization of basic computers.
CO5: To Understand the concept of Parallel Processing.
CO6: To Understand the concept of memory organization.

Unit	Description	Hours
1	**Digital Principles:** Definition for Digital signals, Digital logic, Digital computers, Von Neumann Architecture, Boolean Laws and Theorems, K-Map: Truth Tables to K-Map, 2, 3 and 4 variable K Map, K-Map Simplifications, Don't Care Conditions, SOP and POS.	10
2	**Number Systems:** Decimal, Binary, Octal, Hexadecimal, Number System Conversions, Binary Arithmetic, Addition and subtraction of BCD, Octal Arithmetic, Hexadecimal Arithmetic, Binary Codes, Decimal Codes, Error detecting and correcting codes, ASCII, EBCDIC, Excess3 Code, The Gray Code	11
3	**Combinational Circuits**: Half Adder and Full Adder, Subtractor, Decoders, Encoder, Multiplexer, Demultiplexer Sequential Circuits: Flip-Flops- SR Flip-Flop, D Flip-Flop, J-K Flip-Flop, T Flip-Flop. Register: 4 bit register with parallel load, Shift Registers- Bidirectional shift register with parallel load Binary Counters-4 bit synchronous and Asynchronous binary counter.	12
4	**Basic Computer Organization and Design**: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, InputOutput Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator logic. Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC), RISC Vs CISC.	12
5	**Pipeline and Vector Processing:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing: Vector Operations, Vector Processors, Memory Interleaving, Vector Pipeline Processor. Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access, Input-Output Processor (IOP). Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.	11

References:

1. Donald P Leach, Albert Paul Malvino, Goutam Saha- "Digital Principles & Applications" , Tata McGraw Hill Education Private Limited, 2011.
2. M. Morris Mano, "Computer System Architecture", Pearson/Phi, 3rd Edition. Reference.
3. William Stallings- "Computer Organization and Architecture", Pearson/PHI, Sixth Edition.
4. Andrew S. Tanenbaum- "Structured Computer Organization", PHI /Pearson 4th Edition.
5. M.V.Subramanyam, "Switching Theory and Logic Design", Laxmi Publications (P) Ltd.
6. Ikvinderpal Singh, Computer Organization Architecture, 2nd Edition, Khanna Book Publishing, 2024.

Course Title : Discrete Mathematical Structures	Course Code: 26BCA13
Total Contact Hours: 56	No. of Credits: 4
L:T:P= 4:0:0	Duration of SEE: 03 Hours
Internal Assessment Marks: 20	Semester End Exam Marks: 80

Course Outcomes (COs):

Upon completion of the course the student should be able to

CO1: Provide a basic understanding of fundamental mathematical concepts such as sets, functions, matrix algebra, and discrete mathematics.

CO2: This course enables the students to use mathematical models and techniques to analyze and understand problems in computer science.

CO3: This course demonstrates how the mathematical principles give succinct abstraction of computer science problems and help them to efficiently analyze

Unit		Hours
1	**Set Theory**: Fundamentals of Set theory, Set Operations, Laws of Set Theory, Counting and Venn Diagrams, Cartesian Product, Relations, Types of Relations, Functions, Types of Functions, Function Composition, Inverse Functions. Mathematical Induction..	12
2	**Logic and Counting:** Fundamentals of Logic, Propositional Logic, Logical Connectives and Truth Tables, Logic Equivalence, Tautology and Contradiction. Basics of counting, Counting Principles, Pigeonhole Principle, Permutation, Combinations.	11
3	**Matrices:** Basics of Matrix, Types of Matrices, Operations on Matrices, Inverse of a matrix, Solution for system of linear equations, Determinant, Properties of Determinant, Cramer's Rule, Introduction to Eigen Values and Eigen Vectors.	11
4	**Graph Theory:** Graphs: Introduction, Representing Graphs, Operations on graphs, Directed Graphs Graph Isomorphism, Paths, Cycles, Euler Graph, Hamilton Graph, Planar Graphs.	11
5	Trees: Introduction of tree, Properties of Trees, types of Tree, Binary Trees, Full Binary Trees, Complete Binary Trees, Spanning Trees, Subtrees, Degree of a Vertex in a Tree, Applications of Trees, Leaf Nodes and Internal Nodes, Tree Traversal Techniques, Minimum Spanning Trees, Tree Representation using Graphs, Prim's and Kruskul's Algorithms.	11

Reference:

1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education.
2. Richard Bronson, Schaum's Outline of Matrix Operations, McGraw-Hill publications, 2nd Edition,
3. Gregory Hartman, Fundamentals of Matrix Algebra, Third Edition
4. Gary Haggard, John Schlipf, Sue Whitesides, Discrete Mathematics for Computer Science, Thomson Books.

Course Title: Problem Solving Techniques Lab	Course Code: 26BCA11P
Contact Hours: 04 Hours/week	No. of Credits: 02
L:T:P= 0:0:2	Duration of SEE: 03 Hours
Internal Assessment Marks: 10	Semester End Exam Marks: 40

Sl. No.	Experiment / Program
1.	Converting degrees Celsius to Fahrenheit and vice versa.
2.	Display three input numbers in sorted (non-decreasing) order.
3.	Given a positive integer value n (>= 0) display number, square and cube of numbers from 1 to n in a tabular format?
4.	Display the Hollow square Pattern of n rows (n > 0), for the below examples n = 5. ###### # # # # # # ######
5.	Display the Triangle Pattern with numbers of n rows (n > 0), for the below examples n = 5. 1 121 12321 1234321 123454321
6.	Check if a given positive integer number is a palindrome or not.
7.	Compute character grade from the marks (0 ≤ marks ≤ 100) of a subject. Solve this using both else-if ladder and switch case. Grading Scheme: 80-100: A,60 - 79: B, 50 - 59: C, 40-49: D, 0-39: E.
8.	Check if a given positive integer number is a prime number or not.
9.	Compute maximum, minimum, sum and average of a sequence of numbers which are read using sentinel controlled repetition using only few variables.
10.	Design a modular algorithm/program which reads an array of n integer elements and outputs median.
11.	Implement your own string length and string reversal functions.
12.	Design a modularized algorithm/program to check if a given positive integer number is a circular prime or not.
13.	Design a modularized algorithm/program to compute a maximum of 8 numbers.
14.	Design a modular algorithm/program which reads an array of n integer elements and outputs mean (average), range (max-min) and mode (most frequent elements).
15.	Compute body mass index, BMI = weightinKGs / (HeightinMeters * HeightinMeters), Both weight and height values are positive real numbers. Yourprogram should display BMI value followed by whether the person is Underweight,Normal, Overweight or Obese using the below ranges: BMI Values Underweight: less than 18.5 Normal: >=18.5 and <25 Overweight: >=25 and < 30 Obese: >= 30

Course Title: Computer Architecture Lab	Course Code: 26BCA12P
Contact Hours: 04 Hours/week	No. of Credits: 02
L:T:P= 0:0:2	Duration of SEE: 03 Hours
Internal Assessment Marks: 10	Semester End Exam Marks: 40

Sl. No.	Experiment / Program
1.	Design and verify the truth tables of basic logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) using digital simulation software.
2.	Verify De Morgan's Theorems using logic gate simulation and compare the outputs using truth tables.
3.	Implement and simplify Boolean expressions using SOP and POS forms with K-Map minimization for 2, 3, and 4 variables.
4.	Design and simulate a Binary to Gray code and Gray to Binary converter circuit.
5.	Develop a simulator for number system conversions between Decimal, Binary, Octal, and Hexadecimal systems.
6.	Design and test Half Adder and Full Adder circuits using logic gate simulation software.
7.	Design and verify Half Subtractor and Full Subtractor circuits using digital logic simulation tools.
8.	Implement and test Encoder and Decoder circuits using basic logic gates.
9.	Design and simulate a 4:1 Multiplexer and 1:4 Demultiplexer using logic gates.
10.	Design and verify SR, JK, D, and T Flip-Flops using digital circuit simulation software.
11.	Implement and simulate a 4-bit shift register with parallel load and bidirectional shifting operation.
12.	Design and simulate 4-bit synchronous and asynchronous binary counters and analyze their outputs.
13.	Simulate binary arithmetic operations including binary addition, subtraction, and BCD arithmetic.
14.	Design and simulate an Arithmetic Logic Unit (ALU) capable of performing arithmetic and logical operations.
15.	Simulate the instruction cycle of a basic computer system including fetch, decode, and execute operations using computer architecture simulation tools.

Semester II

Course Title: Data Structures	Course Code: 26BCA21
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	Duration of SEE: 03 Hours
Internal Assessment Marks: 20	Semester End Exam Marks: 80

Course Outcomes (COs):

Upon completion of the course the student should be able to

CO1: Understand fundamental data structures, their classification, and the complexity analysis of algorithms.

CO2: Implement stack, queue, and linked list operations using static and dynamic memory allocation.

CO3: Apply tree and graph data structures for problem-solving, including traversal and searching algorithms.

CO4: Develop efficient algorithms for sorting, searching, and hashing to optimize data management.

Unit	Description	Hours
1	**Introduction to Data Structures:** Algorithms and Flowcharts, Basics Analysis on Algorithm, Complexity of Algorithm, Introduction and Definition of Data Structure, Classification of Data, Arrays, Various types of Data Structure, Static and Dynamic Memory Allocation, Function, Recursion.	10
2	**Stacks and Queue:-** Introduction to Stack, Definition, Stack Implementation, Operations of Stack, Applications of Stack and Multiple Stacks. Implementation of Multiple Stack Queues, Introduction to Queue, Definition, Queue Implementation, Operations of Queue, Circular Queue, De-queue and Priority Queue.	10
3	**Linked Lists:** Introduction, Representation and Operations of Linked Lists, Singly Linked List, Doubly Linked List, Circular Linked List, And Circular Doubly Linked List.	12
4	**Trees:**Introduction to Tree, Tree Terminology Binary Tree, Binary Search Tree, Strictly Binary Tree, Complete Binary Tree, Tree Traversal, Threaded Binary Tree, AVL Tree, B Tree, B+ Tree.	12
5	**Graphs, Searching, Sorting:** Introduction, Representation to Graphs, Graph Traversals Shortest Path Algorithms. **Searching and Sorting:** Searching, Types of Searching, Sorting, Types of sorting like quick sort, bubble sort, merge sort, selection sort.	12

References:

1. Balagurusamy, "Data Structures Using C", Publisher, McGraw-Hill Education (India), 2013. ISBN, 1259029549, 9781259029547.
2. Seymour Lipschutz, "Data Structures with C", Schaum'sout Lines, Tata McGraw-Hill, 2011.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2013.
4. Forouzan, "A Structured Programming Approach using C", 2nd Edition, Cengage Learning India, 2008.

Course Title: Object Oriented Programming using Java	Course Code: 26BCA22
Total Contact Hours: 56	**No. of Credits: 04**
L:T:P= 4:0:2	**Duration of SEE: 03 Hours**
Internal Assessment Marks: 20	**Semester End Exam Marks: 80**

Course Outcomes (COs):

Upon completion of the course the student should able to
CO1: To introduce the object oriented programming system concepts
CO2: To introduce syntax and semantics of Java programming language
CO3: To develop modular programs using Java
CO4: To setup JDK environment to create, debug and run Java programs

Unit	Description	Hours
1	**Fundamentals of Object Oriented Programming**: Basic Concepts of Object Oriented Programming (OOP), Benefits and Applications of OOP. Java Evolution:Java Features, Difference between Java, C and C++, Javaand Internet, Java Environment. **Overview of Java Language**: Introduction to Simple Java Program, Use ofComments and Math function, Application of two classes,Java Program Structure,Java Tokens and statements, Implementing Java program and JVM, Command Line Arguments.	12
2	**Constants, Variables and Data Types**: Constants, Variables, Data Types, Declaration of Variables, Giving values to Variables, Symbolic Constants, Typecasting. **Operators & Expressions**: Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment & Decrement operators, conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence & Associativity	11
3	**Decision Making, Branching & Looping**: Decision Making with ControlStatements, Looping statements, Jump in loops, Labelled loops. **Classes, Objects and Methods**: Defining Class, Methods Declaration,Constructors, Methods Overloading, Overriding Methods, Inheritance	11
4	**Arrays, Strings and Vectors**: 1D arrays, Creating an Array, 2D arrays, Strings,Vectors, Wrapper Classes, Enumerated Types **Inheritance**: Defining, extending classes, and Implementing Interfaces. Multipleinheritance and polymorphism.	11
5	**Packages**: Basics of packages, System packages, Creating and accessingpackages, Creating user defined packages, Adding class to a package. **Exception Handling**: Using the main keywords of exception handling: try, catch,throw, throws and finally; Nested try, Multiple catch statements, Creating user defined exceptions	11

References:

1. Balaguruswamy E. (2023). Programming with JAVA: A Primer. 7th edition. India: McGraw Hill Education

2. Schildt, H. (2022). Java: The Complete Reference. 12th edition. McGraw-Hill Education.
3. AruneshGoyal, The Essentials of JAVA, Khanna Book Publishing Company Private Limited, 2012.
4. Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson, 2008.
5. S. Malhotra and S. Choudhary, Programming in Java, 2nd Edition, Oxford University Press, 2014.

Web Resources:

1. https://www.w3schools.com/java
2. http://www.java2s.com/.
3. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

Course Title: Operating System	Course Code: 26BCA23
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	Duration of SEE: 03 Hours
Internal Assessment Marks: 20	Semester End Exam Marks: 80

Course Outcomes (COs):

Upon completion of the course the student should be able to

CO1: Understand the basic working process of an operating system.

CO2: Understand the importance of process and scheduling.

CO3: Understand the issues in synchronization and memory management. …

Unit	Description	Hours
1	Introduction: Computer System Organization, Architecture, Structure, Operations, Process Management, Memory Management, Storage Management. Operating System Structures: Services, System Calls, Types, Operating System Structure, System Boot.	11
2	Process Management: Process Concept- Process Scheduling- Operations on Processes: process creation and termination - zombie and orphan process- Cooperating Processes- Inter-process Communication- Process related commands	10
3	Process Synchronization: The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Examples. Process Scheduling: Criteria, Scheduling Algorithms, Multi-Processor Scheduling, Real-time CPU Scheduling.	12
4	Deadlocks: System model, Characterization, Methods for handling deadlocks, Deadlock Prevention, Avoidance, Detection and Recovery from deadlock. Memory Management Strategies: Background, Swapping, Contiguous Memory Allocation, Segmentation	12
5	Paging, Structure of the Page Table. Virtual Memory Management: Demand Paging; Copy-on-Write, Page Replacement; Allocation of Frames, File System: File Concept, Access Methods, Directory and Disk Structure, Protection.	11

References:

1. Silberschatz- P.B. Galvin and G. Gagne- Operating System Concepts, 9th Edition- New Delhi: Wiley India- 2011
2. Stalling William- Operating Systems: Internals and Design Principles, 7th Edition -Prentice Hall-2011.

Course Title: Data Structure Lab	Course Code: 26BCA21P
Contact Hours: 04 Hours/week	No. of Credits: 02
L:T:P= 0:0:2	Duration of SEE: 03 Hours
Internal Assessment Marks: 10	Semester End Exam Marks: 40

List of Experiments / Programs (For a Lab Course)

Sl. No.	Experiment / Program
1.	Write a program to perform operations on arrays.
2.	Write a recursive program to find factorial and Fibonacci series.
3.	Write a program to implement stack operations using arrays.
4.	Write a program to implement multiple stacks in a single array.
5.	Write a program to implement queue operations using arrays.
6.	Write a program to implement circular queue operations.
7.	Write a program to implement priority queue and dequeue operations.
8.	Write a program to implement singly linked list operations.
9.	Write a program to implement doubly linked list and circular linked list operations.
10.	Write a program to perform binary tree traversal operations.
11.	Write a program to implement Binary Search Tree (BST) operations.
12.	Write a program to implement AVL tree insertion and balancing.
13.	Write a program to represent graphs and perform BFS and DFS traversals.
14.	Write a program to implement searching algorithms.
15.	Write a program to implement sorting algorithms.

Course Title: Object Oriented Programming using Java Lab	Course Code: 26BCA22P
Contact Hours: 04 Hours/week	No. of Credits: 02
L:T:P= 0:0:2	Duration of SEE: 03 Hours
Internal Assessment Marks: 10	Semester End Exam Marks: 40

List of Experiments / Programs (For a Lab Course)

Sl. No.	Experiment / Program
1	Java program to display "Hello World" and display the size of all the data types.
2	Java program to implement the usage of static, local and global variables.
3	Java program to implement string operations string length, string concatenate, substring
4	Java program to implement default and parameterized constructors.
5	Java program to implement Single Inheritance
6	Java program to implement Multiple Inheritance using Interface
7	Java program to demonstrate a division by zero exception
8	Java program to add two integers and two float numbers. When no arguments are supplied give a default value to calculate the sum. Use method overloading.
9	Java program that demonstrates run-time polymorphism
10	Java program to catch negative array size Exception. This exception is caused when the array is initialized to negative values.
11	Java program to handle null pointer exception and use the "finally" method to display a message to the user.
12	Java program to import user-defined packages
13	Java program to check whether a number is palindrome or not
14	Java program to find the factorial of a list of numbers reading input as command line argument.
15	Java program to display all prime numbers between two limits.

BCA Degree Examination,
SEP–QP-Pattern

Time: 3 Hours **Max. Marks: 80**

Section–A

Note: Answer all sub questions
Each question carries TWO marks. **(10 x2 =20)**

1.

a)
b)
c)
d)
e)
f)
g)
h)
i)
j)

Section–B

Note: Answer any Four questions
Each question carries FIVE marks. **(4 x5 =20)**

2.
3.
4.
5.
6.
7.

Section–C

Note: Answer any Four questions
Each question carries TEN marks. **(4x10=40)**

8.
9.
10.
11.
12.
13.

Note: 1. For Section –A, Two questions from each Unit.
2. For Section–B, One question from each Unit, andQ-7 must be from Unit 2 to5.
3. For Section– C, One question from each Unit, and Q-13 must be from Unit 2 to5.

BCA Degree Examination, SEP–Scheme for Practical Examination

1. Writing Two Programs :14 Marks (for each 7 marks)
2. Execution of Two programs :16 Marks (for each 8 marks)
3. Practical record : 05 Marks
4. Viva-Voce : 05 Marks
5. Total :40 Marks

QUESTION PAPER PATTERNS FOR ALL SKILL PAPERS IS 40 MULTIPLE CHOICE QUESTIONS.