

Online Circulation of the Undergraduate Board of studies (UGBOS) held on 20th May 2026.

Chaudhary Bansi Lal University, Bhiwani, Haryana

Scheme of Examination and Syllabus for Undergraduate Programme

Course: Computer Applications (Bachelor of Computer Applications AI/ Cloud Computing) (Under Multiple Entry-Exit, Internship and CBCS- LOCF in accordance to NEP-2020) w.e.f. 2025-26 in Phased Manner

Semester	Discipline-Specific Courses (DSC)	Paper Code	Nomenclature of Paper	Credit	Minor (MIC) / Vocational (VOC)	Credit	Multidisciplinary Courses (MDC)	Ability Enhancement Courses (AEC)	Skill Enhancement Courses (SEC) / Internship/ Dissertation	Value-Added Courses (VAC)	Total Credits
III	CC	25BCAICC- N- 301	Fundamental of C Programing	3+1	25BCAICC-N-304 Discrete Mathematics	3	24UN-BBA-MDC 301 Fundamentals of Indian Capital Market@ 3 Credit	24UN-ENG-AEC301 English Grammar and Usage@2 Credit	25BCAI- N - SEC -301 Cloud Storage and Virtualization @ 3+1 CREDIT	24UN-GEO-VAC303 Culture of India @ 2 Credit	25
	CC	25BCAICC- N-302	Operating system	3							
	CC	25BCAICC-N-303	Cloud Foundations and Web Architecture Introduction to Cloud Computing	4							
IV	CC	25BCAICC- N- 401	Java Programming	3+1	25BCAICC- N- 404 AWS Cloud Security and Compliance	3		24UN-ENG-AEC401 Vocabulary Building@ 2 Credit			17
	CC	25BCAICC- N- 402	Cloud Governance and Risk Management	4							
	CC	24BCAICC-N-403	Data Structure using C	3+1							

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Sr. No.	Course/ Paper Code	Title of the Course	Mode of Learning	Course Type	Credit			Contact Hours per Week			Examination Scheme				Total Marks
					Theory	Practical / Seminar	Total	Theory	Practical / Seminar	Total	End Semester Exam	Internal Assessment	Practical (External)	Practical (Internal)	
1	25BCAICC-N-301	Fundamental of C Programming	CL/BL	CC	3	1	4	3	2	5	50	20	20	10	100
2	25BCAICC-N-302	Operating system	CL/BL	CC	3	-	3	3	..	3	50	20	..	..	70
3	25BCAICC-N-303	Cloud Foundations and Web Architecture Introduction to Cloud Computing	CL/BL	CC	4	..	4	4	--	4	70	30	..	..	100
4	25BCAICC-N-304	Discrete Mathematics	CL/BL	MIC	3	--	3	3	--	3	50	20	20	70	70
5	24UN-ENG-AEC301	English Grammar and Usage	CL/BL	AEC	2	..	2	2	..	2	35	15	..	..	50
6	25BCAICC-N-SEC301	Cloud Storage and Virtualization	CL	SEC	3	1	4	3	2	5	50	20	20	10	100

10	24UN-BBA-MDC301	Fundamentals of Indian Capital Markets	CL	MDC	3	..	3	3	..	3	50	20			70
11	24UN-GEO-VAC303	Culture of India	CL	VAC	2	..	2	2	..	2	35	15			50
	Total						25			23					610

CC - Core Course; SEC-Skill Enhancement Course; AEC: Ability Enhancement Course MDC: Multidisciplinary Course VAC: Value Added course

MIC: Minor course

For

25BCAICC- N- 301	Fundamental of C programing	3L:0T:0P	3 Credits
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Maximum Marks:70
External Examination: 50
Internal Assessment: 20
Max. Time: 3 Hrs

Course Objectives

The course is designed to provide a working knowledge and skills of programming with C Language. Students will be able to develop logics which will help them to create programs. Also by learning the basic programming constructs they can easily be able to grasp any other new computer languages in future.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten short answers type questions of one mark each covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.

Unit I

Overview of C: History of C, Importance of C, Elements of C: C character set, identifiers and keywords, Data types, Constants and Variables, Assignment statement, Symbolic constant, Structure of a C Program, printf(), scanf() Functions, Operators & Expression: Arithmetic, relational, logical, bitwise, unary, assignment, shorthand assignment operators, conditional operators and increment and decrement operators, Arithmetic expressions, evaluation of arithmetic expression, type casting and conversion, operator hierarchy & associativity.

Unit II

Decision making & branching: Decision making with IF statement, IF-ELSE statement, Nested IF statement, ELSE-IF ladder, switch statement, goto statement. Decision making & looping: For, while, and do-while loop, jumps in loops, break, continue statement, Nested loops.

Unit III

Functions: Standard Mathematical functions, Input/output: Unformatted & formatted I/O function in C, Input functions viz. getch(), getche(), getchar(), gets(), output functions viz., putch(), putchar(), puts(), string manipulation functions. User defined functions: Introduction/Definition, prototype, Local and global variables, passing parameters, recursion.

Unit IV

Arrays, strings and pointers: Definition, types, initialization, processing an array, passing arrays to functions, Array of Strings. String constant and variables, Declaration and initialization of string, Input/output of string data, Introduction to pointers. Storage classes in C: auto, extern, register and static storage class, their scope, storage, & lifetime. Algorithm development, Flowcharting and Development of efficient program in C

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Course Outcome (CO) :

- 1 Remember & Understand the Computer Fundamentals
- 2 Remember & Understand the Program methods using C
- 3 Understand general problem solving using C
- 4 Understand & Apply control flow, function of PS, Arrays & Pointers using C
- 5 Analyse the Structure and Input & Output using C
- 6 Application & Analysis using guided competitive programming laboratory work

Suggested Readings:

1. Jeri R. Hanly & Elliot P. Koffman, Problem Solving and Program Design in C, Addison Wesley.
2. Yashwant Kanetkar, Let us C, BPB.
3. Rajaraman, V., Computer Programming in C, PHI. 4. Yashwant Kanetkar, Working with C, BPB.



25BCAICC- N-302	Operating system	3L:0T:0P	3 Credits
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Maximum Marks:70
 External Examination: 50
 Internal Assessment: 20
 Max. Time: 3 Hrs

Course Objectives

- To understand the basic concepts, functions and types of operating systems.
- To understand Processes and Process scheduling
- To understand the concept of Deadlocks
- To analyze various memory management schemes.
- To understand I/O management and File systems.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten short answer type questions of one mark each covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.

Unit I

Introduction: Introduction to Operating System Concepts, Various Operating System functions, Types of Operating Systems: Batch Operating System, Multi programming, Time-Sharing System, Real time, Multi processing, System architecture, System Calls,

Unit II

Process Management: Process Concept, Process Model, Hierarchies and Implementation, Process States and Transitions, Operations on a process, Level of Scheduler, CPU Scheduling, Scheduling Criteria, Scheduling Algorithms- First come First Serve (FCFS), Shortest- Job- First (SJF), Priority Scheduling, Round Robin (RR), Priority Scheduling
 Deadlock: Methods for handling deadlock- Deadlock prevention, Avoidance

Unit III

Memory Management: Logical & Physical Address Space, Swapping, Contiguous Memory allocation, paging and segmentation techniques; Virtual Memory Management- Demand Paging , Page replacement, Page Replacement Algorithm

Unit IV

Device Management: Disk structure, Disk scheduling: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK.

File management: File system Structure, Allocation methods: Contiguous allocation, Linked allocation, Indexed allocation, Free space management: Bit vector, Linked list, Grouping, Counting.

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Course Outcomes

- Analyze various scheduling algorithms.
- Understand deadlock, prevention and avoidance algorithms.
- Compare and contrast various memory management schemes.
- Understand the functionality of file systems

Suggested Readings:

1. Operating System Concepts by Silberschatz et al 5th Edition 1998, Addison-Wesley.
2. Modern Operating System by A. Tanenbaum, 1992, Prentice Hall
3. Operating System By Peterson, 1985, AW.
4. Operating System By Milankoyik, 1990, THM
5. Operating System Incorporating with Unix & Windows by Colin Ritchie, 1974, THM.

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25BCAICC-N-303	Cloud Foundations and Web Architecture Introduction to Cloud Computing	4L:0T:0P	4 Credits
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Maximum Marks:100
External Examination: 70
Internal Assessment: 30
Max. Time: 3 Hrs

Course Objectives

- This course is designed to demystify cloud computing by treating it as a modern utility. The curriculum transitions students from basic "Cloud Tourists" to "Pro Builders" capable of architecting scalable web environments. Students will develop core competencies in virtual compute (EC2), global networking (VPC), and serverless automation (Lambda). By the end of the course, students will be prepared to design integrated systems—such as student portals—while maintaining strict cost control and security standards.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven short answer type questions of 2 mark each covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.

Unit I

Introduction to Utility Computing: The "Someone Else's Computer" rule; global infrastructure hierarchy (Regions vs. Availability Zones). **Cloud Economics:** The 6 benefits of cloud (Speed, Global Reach, Pay-as-you-go). **Identity and Access Management (IAM):** Root User vs. IAM User; the principle of "Least Privilege"; understanding JSON-based Permission Policies and Administrator Access. **Getting Started:** AWS Free Tier management and console navigation across global regions.

Unit II

Elastic Compute Cloud (EC2): Understanding "Instances" as virtual hardware; Instance types (t2.micro/t3.micro) and Operating Systems (AMI). **Access and Lifecycle:** Key Pair security (.pem files) vs. passwords; remote connectivity (SSH/RDP); Instance states (Stop vs. Terminate) and billing implications. **Simple Storage Service (S3):** Object storage concepts; Buckets and Objects. **Static Web Hosting:** Configuring S3 for hosting; managing Public Access Blocks and Bucket Policies for web delivery.

Unit III

Virtual Private Cloud (VPC): Architecture of a private "Cloud Island"; IP Addressing basics. **Subnetting:** Dividing infrastructure into Public (Internet-facing) and Private (Internal) tiers. **Connectivity and Routing:** Internet Gateways (IGW) as bridges; Route Tables; NAT Gateways for secure private-tier updates. **Perimeter Security:** Security Groups as "Bouncers" (Stateful firewalls); port management (Port 80 for HTTP, Port 22 for SSH).

Unit IV

Relational Database Service (RDS): Launching managed MySQL instances; connecting compute layers to data layers. **High Availability:** Introduction to Load Balancers for traffic distribution across multiple servers. **Serverless Computing:** Event-driven architecture with AWS Lambda; executing Python code via S3 triggers. **Cloud Financial Management (FinOps):** Using the AWS Pricing Calculator for startup cost estimation. **Capstone Integration:** Designing a multi-tier "Student Result Portal" using S3, Lambda, and RDS.

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Course Learning Outcomes:

On successful completion of this course, a student will be able to:

- Identify the core global infrastructure components of AWS and manage IAM security identities.
- Launch, configure, and securely connect to virtual Linux/Windows servers (EC2).
- Deploy static websites and manage unlimited object storage using Amazon S3.
- Design a custom VPC with public and private subnets, gateways, and security group rules.
- Implement managed relational databases and connect them to application frontends.
- Create serverless workflows using Python and AWS Lambda to automate cloud tasks.
- Analyze cloud costs and prepare for the AWS Certified Cloud Practitioner foundational exam.

Suggested Readings:

1. **AWS Whitepapers:** *Overview of Amazon Web Services and Cloud Concepts Guide.*
2. **Technical Documentation:** *Amazon EC2 and Amazon S3 User Guides.*
3. **Exam Prep:** *Official AWS Certified Cloud Practitioner (CLF-C02) Study Guide.*

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24BCAICC-N-304	Discrete Mathematics	3L:0T:0P	3 Credits
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Maximum Marks:70
External Examination: 50
Internal Assessment: 20
Max. Time: 3 Hrs

Course Objectives

- To provide students with a solid foundation in set theory, logic, inference, counting, relations, graph theory, algebraic structures, and computability theory, equipping them with the skills to solve complex mathematical problems and apply these concepts in computer science.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten short answers type questions of one mark each covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.

Unit I

Sets & Logic: Sets - Visualizing sets; understanding membership, operations on sets (union, intersection, difference, complement). Algebra of sets and its laws, Mathematical Induction, Relations, Types of Relation- reflexive, symmetric, antisymmetric, Equivalence Relations
Logic - Introduction to propositional logic, truth tables, Logical Operations, Conditional Statements

Unit II

Vectors & Matrix: Vectors - Operations, Column Vectors, Matrices - Matrix Addition, Matrix Multiplication, Transpose, Square Matrices and Algebra on Square Matrices, Inverse of Square Matrix
Functions & Algorithms: Functions as Relations, One-to-One, Onto and Invertible Functions, Mathematical, Exponential and Logarithmic Functions, Recursively Defined Functions (Examples like- Factorial, Fibonacci), Algorithm and Functions - Polynomial Evaluation (Direct Method, Synthetic Division), Complexity of Algorithm - Best Case, Worst Case, Average Case

Unit III

Counting Techniques: Counting Principles - Sum Rule and Product Rule. Mathematical Functions - Factorial Function, Binomial Coefficients. Binomial Theorem - Binomial Coefficients and Pascal's Triangle. Permutations & Combinations - Understanding arrangements (permutations) and selections (combinations), using formulas for common scenarios. Tree Diagram

Unit IV

Graph - Graphs and Multigraphs, Degree of Vertex, Subgraphs, Isomorphic Graphs, Homeomorphic Graphs, Path, Connected Graph, Labeled Graph, Weighted Graph, Directed Graph, Undirected Graph, Complete Graphs, Regular Graphs, Bipartite Graphs, Planar Graph, Maps & Regions - Euler's Formula, Representing Graphs in Memory - Adjacency Matrix, Linked Representation of a Graph
Tree - Tree Graphs, Spanning Trees, Minimum Spanning Trees, Binary Trees, Representing Binary Trees in Memory - Linked & Sequential, Traversing Binary Tree, Binary Search Tree

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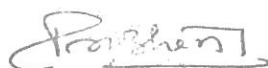
Course Outcomes:

A student will be able to:

- Understand sets, sequences, matrices, and logical operations..
- Use statements, connectives, and normal forms in logic.
- Apply inference theories in statement and predicate calculus.
- Solve problems using permutations, combinations, and recurrence relations; manipulate relations and digraphs
- Understand graph theory concepts, Boolean algebras, and basic computability; explore semi-groups and groups.

Suggested Readings:

- E. Goodaire , "Discrete Mathematics with Graph theory", PHI,. ISBN--10: 0131679953 2) J. K. Sharma, "Discrete Mathematics", McMillan, ISBN-9780230322301
- J.P. Tremblay and R. Manohar, "Discrete Mathematical Structure with Applications to Computer Science", TMH, ISBN- 0-07-463113-6
- Bernard Kolman, Robert C. Busby and Sharon Ross, "Discrete Mathematical Structure", PHI, ISBN- 978-81-203-3689-6
- C. L. Liu, "Elements of Discrete Mathematics", TMH



25BCAICC- N SEC301	Cloud Storage and Virtualization	3L:0T:1P	4 Credits
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Maximum Marks:70
External Examination: 50
Internal Assessment: 20
Max. Time: 3 Hrs

Course Objectives

This course is designed to take students from the basics of local hardware abstraction to global cloud storage solutions. The curriculum begins with the "Magic of Virtualization," teaching students how to run multiple "Guest" operating systems on a single "Host" machine using hypervisors. The second phase transitions these skills to the cloud, exploring Amazon Web Services (AWS) as a global data center. Students will achieve competence in managing object storage (S3), block storage (EBS), and shared file systems (EFS) while implementing professional security and cost-optimization strategies

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten short answers type questions of one mark each covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.

Unit I:

Hardware Abstraction: Understanding physical components (RAM/CPU) and the evolution of virtualization ("apartments in a house" analogy). **Hypervisor Technology:** Type-1 (Bare Metal/ESXi) vs. Type-2 (Hosted/VirtualBox) managers. **Virtual Machine (VM) Architecture:** Guest vs. Host relationship; Digital ISO disks and virtual hard disk formats (.vdi). **Resource Management:** Allocating CPU cores and memory; dynamic allocation vs. fixed disks. **Operational Skills:** Utilizing Snapshots as "Time Machines" for system recovery and using Clones for rapid deployment.

Unit II:

Virtual Connectivity: Understanding NAT (Network Address Translation) for internet access and Bridged networking for unique IP assignments. **Optimization:** Installing Guest Additions for full-screen and performance enhancements. **Inter-OS Communication:** Setting up Shared Folders for file transfers between Host and Guest. **Lifecycle Operations:** Comparing Shut Down, Save State, and Power Off modes. **Portability:** Exporting and Importing VMs using the Open Virtualization Format (.OVA). **Evolution:** Transitioning from full OS virtualization to high-density containers (Docker).

Unit III:

Cloud Fundamentals: Global infrastructure, Regions (Mumbai/ap-south-1), and Availability Zones. **Object Storage (S3):** Concepts of Buckets and Objects; unique naming conventions and Object URLs. **Security and Access:** Default private settings; unblocking Public Access and implementing JSON-based Bucket Policies. **Web and Lifecycle:** Static Website Hosting via S3; Storage Classes (Standard vs. Glacier); and automating data

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transitions with Lifecycle Rules. **Identity Management:** Using IAM to issue "ID Cards" and Read-Only permissions to users.

Unit IV:

Block Storage (EBS): Virtual USB sticks for EC2; Volume creation, attachment, and modification. **Storage Operations:** Initializing disks via formatting (mkfs) and Mounting to Linux directories (/mydata). **Scalability:** Growing EBS volumes on-the-fly and capturing state via Snapshots. **Shared File Systems (EFS):** Implementing concurrent storage access for multiple Linux instances. **Cloud Administration:** Interacting with storage via the AWS CLI; implementing default encryption; and monitoring storage health with CloudWatch alarms. **Physical Data Transfer:** Understanding AWS Snowball for massive data migration.

Course Learning Outcomes:

On successful completion of this course, a student will be able to:

- Install and configure Type-2 hypervisors to run multiple Linux Guest operating systems simultaneously.
- Implement "Undo" strategies using VM Snapshots to recover from system failures during software testing.
- Architect static websites and durable data lakes using Amazon S3 with fine-grained access policies.
- Deploy and scale virtual block storage (EBS) for database and application workloads.
- Configure shared file systems (EFS) to enable collaborative data access across distributed cloud servers.
- Automate cloud storage tasks using the Command Line Interface (CLI) and implement lifecycle rules to reduce costs.

Suggested Readings:

1. **Virtualization Guide:** *Oracle VM VirtualBox User Manual.*
2. **AWS Whitepapers:** *Overview of Amazon Web Services and AWS Storage Services Overview.*
3. **Lab Manual:** *Hands-on Guide to Linux Installation and Storage Management*



C programming Lab (Based on 25BCAICC- N- 301)	0L:0T:2P	1 Credits
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Maximum Marks:30
 External Examination: 20
 Internal Assessment: 10

1. Write a program to print sum and average of two given numbers.
2. Write a program to swap two numbers without using a third variable.
3. Write a program check whether the given number is even or odd.
4. Write a program to print the largest number among three numbers given by the user.
5. Write a program to print table of any number using for loop.
6. Write a program to print Fibonacci Series (0, 1, 1, 2, 3, 5, 8, 13, 21...)
7. Write a program to print table of any number using do while loop
8. Write a program to print factorial of a given number using recursive function.
9. Write a program to print Fibonacci series using recursion.
10. Write a program to scan and print 5 values using array
11. Write a program to print the largest value in an array.
12. Write a program to print length of a given string without using string functions.
13. Write a program to check a string is palindrome or not.
14. Write a program to print sum of two matrices.
15. Write a program to perform matrix multiplication.

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Cloud Storage and Virtualization LAB (Based on 25BCAICC- N SEC301)	0L:0T:2P	1 Credits
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Maximum Marks:30
External Examination: 20
Internal Assessment: 10

Lab 1: Local Virtualization Setup with Type-2 Hypervisor

- **Objective:** To install and configure Oracle VM VirtualBox for hardware abstraction.
- **Key Points:**
 - **Installation:** Setting up the hypervisor on a Windows/macOS Host.
 - **Resource Mapping:** Understanding how the hypervisor allocates a portion of the Host's RAM and CPU to the virtual environment.
 - **Submission Tip:** Include a screenshot of the "System Settings" showing allocated RAM and Processor cores.

Lab 2: Guest OS Deployment and Linux Installation

- **Objective:** To create a Linux-based Virtual Machine (VM) using a digital ISO.
- **Key Points:**
 - **VM Creation:** Defining the Guest OS type (e.g., Ubuntu/CentOS).
 - **Virtual Storage:** Creating a .vdi (VirtualBox Disk Image) with dynamic allocation to save physical disk space.
 - **Installation:** Executing the Linux installation wizard within the VM.

Lab 3: Advanced VM Operations: Snapshots and Clones

- **Objective:** To implement recovery and rapid deployment strategies.
- **Key Points:**
 - **Snapshots:** Capturing the VM state before a major configuration change.
 - **Restoration:** Reverting to a stable snapshot after a simulated system failure.
 - **Cloning:** Using "Full Clones" to create an independent copy of a pre-configured VM.

Lab 4: Cloud Infrastructure: Launching Amazon EC2 Instances

- **Objective:** To transition from local virtualization to global cloud compute.

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- **Key Points:**
 - **AMI Selection:** Choosing a machine image (e.g., Amazon Linux 2023).
 - **Security Groups:** Configuring inbound rules for SSH (Port 22) and HTTP (Port 80) access.
 - **Key Pairs:** Generating and using a .pem key for secure remote login.

Lab 5: Managing AWS IAM for Secure Resource Access

- **Objective:** To implement Identity and Access Management (IAM) policies.
- **Key Points:**
 - **User Creation:** Creating a programmatic user with unique access keys.
 - **Policy Attachment:** Attaching the AmazonS3ReadOnlyAccess managed policy to a group.
 - **JSON Editor:** Writing a custom policy to restrict access to a specific S3 bucket.

Lab 6: Object Storage with Amazon S3

- **Objective:** To create and manage scalable object-based storage.
- **Key Points:**
 - **Bucket Creation:** Ensuring a globally unique bucket name within a specific Region.
 - **Object Lifecycle:** Uploading files and identifying their unique Object URLs.
 - **Versioning:** Enabling bucket versioning to protect against accidental deletions.

Lab 7: Static Website Hosting via Amazon S3

- **Objective:** To deploy a cost-effective web solution using cloud storage.
- **Key Points:**
 - **Web Configuration:** Enabling "Static Website Hosting" in the bucket properties.
 - **Bucket Policy:** Using JSON to grant public s3:GetObject permission for the website content.
 - **Verification:** Accessing the site via the S3-provided endpoint URL.

Lab 8: Persistent Block Storage with Amazon EBS

- **Objective:** To manage virtual hard drives for cloud servers.
- **Key Points:**
 - **Volume Operations:** Creating a 10GB EBS volume and attaching it to a running EC2 instance.
 - **Linux Disk Management:** Partitioning, formatting with mkfs, and mounting the volume to a directory.

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- **Snapshots:** Taking a point-in-time snapshot of an EBS volume for backup.

Lab 9: Shared File Systems with Amazon EFS

- **Objective:** To enable concurrent file access for multiple Linux instances.
- **Key Points:**
 - **EFS Creation:** Setting up a regional file system with mount targets in multiple Availability Zones.
 - **Security Configuration:** Setting a security group to allow inbound traffic on Port 2049 (NFS).
 - **Mounting:** Using the nfs-utils package to mount the file system to two different EC2 instances simultaneously.

Lab 10: Cloud Automation and Cost Optimization

- **Objective:** To automate tasks using the AWS CLI and Lifecycle Rules.
- **Key Points:**
 - **AWS CLI:** Running commands like `aws s3 cp` to automate file backups from a local machine to the cloud.
 - **Lifecycle Policies:** Automating the transition of data from S3 Standard to S3 Glacier for long-term archiving.
 - **CloudWatch Alarms:** Setting up an alarm to monitor storage health or CPU utilization.

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Scheme of Examination for BCA (AI / Cloud Computing)

Sr. No.	Course/ Paper Code	Title of the Course	Mode of Learning	Course Type	Credit			Contact Hours per Week			Examination Scheme				Total Marks
					Theory	Practical / Seminar	Total	Theory	Practical / Seminar	Total	End Semester Exam	Internal Assessment	Practical (External)	Practical (Internal)	
1	25BCAICC-N-401	JAVA Programming	CL/B L	CC	3	1	4	3	2	5	50	20	20	10	100
2	25BCAICC-N-402	Cloud Governance and Risk Management	CL/B L	CC	4	.	4	4	--	4	70	30	..		100
3	25BCAICC-N-403	Data Structure using C	CL/B L	CC	3	1	4	3	2	5	50	20	20	10	100
4	25BCAICC-N-404	AWS Cloud Security and Compliance	CL/B L	MIC	3	..	3	3		3	50	20	..		70
5	24UN-ENG-AEC401	Vocabulary Building	CL/B L	AEC	2	..	2	2	..	2	35	15	.		50
	Total						17			20					420

CC - Core Course;

MIC: Minor course

AEC: Ability Enhancement Course



25BCAICC- N- 401	Java Programming	3L:0T:0P	3 Credits
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Maximum Marks:70
 External Examination: 50
 Internal Assessment: 20
 Max. Time: 3 Hrs

Course Objectives

- To introduce the object-oriented programming concepts.
- To understand object-oriented programming concepts, and apply them in solving problems.
- To introduce the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes
- To introduce the implementation of packages and interfaces
- To introduce the concepts of exception handling and multithreading.
- To introduce the design of Graphical User Interface using applets.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten short answers type questions of one mark each covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.

Unit I

Introduction to Java: Evolution of Java, Object Oriented Programming Structure, Overview and characteristics of Java, Java program Compilation and Execution Process, Organization of the Java Virtual Machine, Client side Programming, Platform Independency & Portability, Security, Relation b/w JVM, JRE and JDK, Introduction to JAR format, Naming Conventions, Data types & Type casting, operators.

Unit II

OOPS Implementation: Classes, Objects, attributes, methods, data encapsulation, reference variables, Constructors, Anonymous block, Method Overloading, Static Data members. Argument Passing Mechanism: Passing primitive arguments, passing objects, Wrapper Classes; This keyword: Referencing instance members, Intra class constructor chaining, Method chaining; Inheritance & code reusability: Extending classes for code reusability, Usage of super keyword, Method Overriding.

Unit III

Packages: Defining Package, CLASSPATH, Package naming, Accessibility of Packages, using Package Members. Interfaces: Implementing Interfaces, Interface and Abstract Classes, Extends and Implements together. Exceptions Handling: Exception, Handling of Exception, Using try-catch, Catching Multiple Exceptions, Using finally clause, Types of Exceptions, Throwing Exceptions, Writing Exception Subclasses.

Unit IV

Multithreading: Introduction, The Main Thread, Java Thread Model, Thread Priorities, Synchronization in Java, Inter thread Communication. I/O in Java: I/O Basics, Streams and Stream Classes, The Predefined Streams, Reading from, and Writing to, Console, Reading and Writing File.

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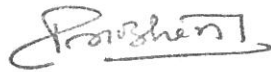
Strings and Characters: Fundamentals of Characters and Strings, The String Class, String Operations, String Buffer Class and Methods.

Course Outcomes

- Able to solve real world problems using OOP techniques.
- Able to understand the use of abstract classes.
- Able to solve problems using java collection framework and I/o classes.
- Able to develop multithreaded applications with synchronization.
- Able to develop applets for web applications.
- Able to design GUI based applications consisting of multiple classes.

Suggested Readings:

1. Balagurusamy, E., "Programming with JAVA, Tata McGraw Hill.
2. The Complete Reference JAVA, TMH Publication.
3. Beginning JAVA, Ivor Horton, WROX Public.
4. JAVA 2 UNLEASHED, Tech Media Publications.
5. Patrick Naughton and HerbertzSchildt, "Java-2 The Complete Reference", TMH.



25BCAICC- N-402	Cloud Governance and Risk Management	4L:0T:0P	4 Credits
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Maximum Marks:100
External Examination: 70
Internal Assessment: 30 Max
Max. Time: 3 Hrs

Course Objectives

- This course is designed to transition students from basic cloud usage to professional oversight, focusing on the "Rulebook" of the cloud. The curriculum emphasizes controlling access to prevent data loss, managing financial risk through automated budgeting, and identifying system vulnerabilities before they are exploited. Students will achieve competence in using "Cloud CCTV" tools like CloudTrail and Security Hub to ensure continuous compliance with global industry standards and disaster recovery protocols.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven short answers type questions of 2 mark each covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.

Unit I

Foundations of Governance: Defining the organizational "rulebook" for cloud operations; differentiating between Management ("Doing things right") and Governance ("Ensuring the right things are done"). **Financial Oversight:** Identifying the "Cost Problem"; implementing AWS Budgets and email alerts for fiscal control. **Organizational Architecture:** Managing multi-account environments via AWS Organizations; implementing Service Control Policies (SCPs) as "Parental Locks" to restrict unauthorized actions. **Inventory and Standards:** Utilizing Resource Tagging for departmental accountability and establishing strict Naming Standards to prevent "Shadow IT."

Unit II

Identity Governance: Deep dive into IAM Roles; the strategic move away from "Root" account usage. **Access Scoping:** Implementing Permission Boundaries to set a "security fence" around users, preventing access to sensitive data. **Regulatory Compliance:** Understanding global laws such as HIPAA (Healthcare) and PCI-DSS (Financial); utilizing AWS Artifact to retrieve official compliance reports. **Continuous Auditing:** Introduction to AWS Config for real-time resource inventory and configuration tracking.

Unit III

Risk Assessment Theory: Calculating risk through Probability vs. Impact; identifying Threat Actors (hackers, insiders, spies). **The Shared Responsibility Model:** AWS's responsibility for "Security of the Cloud" vs. the customer's responsibility for "Security in the Cloud." **Risk Treatment:** Strategies for Mitigation (MFA), Transfer (Cyber Insurance), and Acceptance. **Business Continuity:** Developing Business Continuity Plans (BCP) and Disaster Recovery (DR) strategies. **Recovery Metrics:** Understanding RTO (Recovery Time Objective) and RPO (Recovery Point Objective) for data restoration.

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Unit IV

Detective Controls: Implementing CloudTrail to record every API call and console click ("The Cloud Spy"). **Continuous Monitoring:** Utilizing Security Hub for centralized "Red Flag" dashboards and Amazon GuardDuty for intelligent threat detection. **Automated Remediation:** Introduction to AWS Config Auto-Remediation and EventBridge rules for instant alert triggers. **Incident Response:** Developing "Fire Drill" protocols; creating Incident Response Plans for hack recovery. **Soft Skills:** Training for "Audit Interviews" and professional communication between governance teams and developers.

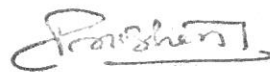
Course Learning Outcomes

On successful completion of this course, a student will be able to:

- Design a multi-account governance structure using AWS Organizations and Service Control Policies.
- Implement automated budget controls to prevent cloud overspending and financial risk.
- Evaluate and mitigate cloud vulnerabilities using tools like AWS Inspector and Amazon Macie.
- Apply encryption and identity boundaries to protect sensitive data from unauthorized exposure.
- Analyze CloudTrail logs and Security Hub scores to perform professional security audits.
- Formulate a Disaster Recovery plan that meets specific RTO and RPO business requirements.

Suggested Readings:

1. **Governance Framework:** *AWS Well-Architected Framework: Security Pillar.*
2. **Risk Management:** *NIST Special Publication 800-37 (Risk Management Framework).*
3. **Compliance Guide:** *AWS User Guide for Artifact and Audit Manager*



25BCAICC-N-403	Data Structure using C	3L:0T:0P	3 Credits
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Maximum Marks:70
 External Examination: 50
 Internal Assessment: 20
 Max. Time: 3 Hrs

Course Objectives

1. To impart the basic concepts of data structures and algorithms
- 2 To understand concepts about searching and sorting techniques
- 3 To understand basic concepts about stacks, queues, lists, trees and graphs
- 4 To understanding about writing algorithms and systematic approach in solving problems with the help of fundamental data structures.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten short answers type questions of one mark each covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.

Unit I

Introduction: Elementary data organization, Data Structure definition, Data type vs. data structure, Categories of data structures, Data structure operations, Applications of data structures, Algorithms complexity and time-space tradeoff, Big-O notation. Strings: Introduction, Storing strings, String operations, Pattern matching algorithms.

Unit II

Arrays: Introduction, Linear arrays, Representation of linear array in memory, address calculations, Traversal, Insertions, Deletion in an array, Multidimensional arrays, Parallel arrays, Sparse arrays. Linked List: Introduction, Array vs. linked list, Representation of linked lists in memory, Traversal, Insertion, Deletion, Searching in a linked list, Header linked list, Circular linked list, Two-way linked list, Threaded lists, Garbage collection, Applications of linked lists.

Unit III

Stack: Introduction, Array and linked representation of stacks, Operations on stacks, Applications of stacks: Polish notation, Recursion in C, Writing Recursive programs – Binomial coefficient, Fibonacci, GCD, towers of Hanoi. Queues: Introduction, Array and linked representation of queues, Operations on queues, Deques, Priority Queues, Applications of queues.

Unit IV

Tree: Definition, Binary tree, complete binary tree, Binary search tree, Tree terminology: root, Node, Degree of a node, ancestors of a node, Array representation of tree, Creation of Binary tree, Traversal of Binary tree: Preorder, In order and post order. Traversal algorithms using stacks. Graph: Introduction, Graph theory terminology, Sequential and linked representation of graphs, Sorting: insertion sort, bubble sort, radix sort, quick sort.

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Course Outcomes

1. Ability to analyze algorithms and algorithm correctness.
2. Ability to summarize searching and sorting techniques
3. Ability to describe stack, queue and linked list operation.
4. Ability to have knowledge of trees and graphs concepts.

REFERENCE BOOKS:

1. Trembley, J.P. And Sorenson P.G., "An Introduction to Data Structures With Applications", McgrawHill International Student Edition, New York.
2. Mark Allen Weiss Data Structures and Algorithm Analysis In C, Addison- Wesley, (An Imprint Of Pearson Education), Mexico City. Prentice- Hall Of India Pvt. Ltd., New Delhi.
3. Yedidyan Langsam, Moshe J. Augenstein, and Aaron M. Tenenbaum, "Data Structures Using C", Prentice- Hall of India Pvt. Ltd., New Delhi.

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25BCAICC- N-404	AWS Cloud Security and Compliance	3L:0T:0P	3 Credits
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Maximum Marks:70
External Examination: 50
Internal Assessment: 20 Max
Max. Time: 3 Hrs

Course Objectives

- This course provides a comprehensive deep dive into the "Invisible Fence" and "Vault" mechanisms of AWS. The curriculum transitions students from foundational identity management and network perimeter defense to advanced data protection and federal compliance auditing. Students will develop the technical competence to architect secure cloud environments, implement automated threat detection, and generate industry-standard compliance reports to meet global legal requirements.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.

Unit I

Identity Governance: Understanding the "Master Key" risk of Root accounts; implementing MFA and the Principle of Least Privilege. **Access Control:** Managing IAM Users, Groups, and Roles as temporary "ID Cards" for applications. **Network Perimeter Defense:** Security Groups (Stateful) vs. Network ACLs (Stateless). **Private Architectures:** Designing Public and Private Subnets; utilizing NAT Gateways for secure updates and VPC Peering for inter-cloud tunnels. **Threat Mitigation:** Fundamentals of DDoS protection (AWS Shield) and Web Application Firewalls (WAF) to block SQL injections. **Secrets Management:** Utilizing AWS Secrets Manager to eliminate plain-text passwords in code.

Unit II

Encryption Foundations: Differentiating between Encryption "At Rest" (disk) and "In Transit" (HTTPS/SSL). **Key Management (KMS):** Creating Master Keys, implementing Automatic Key Rotation, and understanding Symmetric vs. Asymmetric cryptography. **Automated Sensitive Data Discovery:** Utilizing Amazon Macie (AI-driven) to hunt for PII and credit card data. **Storage & Database Security:** Implementing RDS storage encryption and granular S3 Bucket Policies to enforce data sovereignty (e.g., India-only access). **Certificate Management:** Issuing SSL/TLS certificates via ACM to secure web traffic.

Prashant

Unit III

Regulatory Frameworks: Deep dive into PCI-DSS (Financial), HIPAA (Healthcare), and GDPR/DPDP Act (Privacy). **Official Auditing:** Utilizing AWS Artifact to retrieve SOC 2 and ISO safety certificates. **Data Sovereignty:** Understanding regional restrictions and why specific data must remain in local regions like Mumbai (ap-south-1). **Compliance as Code:** Introduction to AWS Config for recording configuration timelines and "Robot Auditors" (Config Rules). **Forensic Evidence:** The role of an auditor and the necessity of "Audit Logs" via CloudTrail.

Unit IV

Security Observability: Utilizing Security Hub for centralized "Security Grades" and GuardDuty for behavioral monitoring. **Vulnerability Management:** Identifying security holes through automated scanning and software patching. **Incident Response:** Developing "Fire Drill" protocols; three-step isolation, investigation, and recovery plans. **Cloud Forensics:** Acting as a "Cloud Detective" by using Snapshots as evidence after a hack. **Business Impact:** Analyzing the financial cost of downtime and performing mock audits to identify infrastructure flaws.

Course Learning Outcomes

On successful completion of this course, a student will be able to:

- Design a "Locked Down" cloud environment using IAM roles, MFA, and the Principle of Least Privilege.
- Architect multi-tier VPCs that isolate sensitive databases in private subnets with no direct internet access.
- Implement end-to-end encryption for data at rest and in transit using AWS KMS and ACM.
- Utilize AI-powered tools (Macie) and behavioral monitoring (GuardDuty) to detect unauthorized data exposure.
- Retrieve official compliance reports (Artifact) to prove system safety to government regulators.
- Formulate an Incident Response Plan and perform forensic analysis on hacked servers using snapshots.

Suggested Readings:

1. **AWS Security Best Practices: Official Whitepaper on Cloud Security Design.**
2. **Key Management: KMS Developer Guide and Cryptographic Details.**
3. **Compliance: AWS User Guide for Artifact and Security Hub.**

Prashant

Java Programming Lab (Based on 25BCAICC- N-401	0L:0T:2P	1 Credits
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Maximum Marks:30
External Examination: 20
Internal Assessment: 10

1. WAP to find the average and sum of the N numbers Using Command line argument.
2. WAP to Demonstrate Type Casting.
3. WAP to find the number of arguments provide at runtime.
4. WAP to Test the Prime number.
5. Write a java program for Method overloading and Constructor overloading
6. WAP to find the factorial of a given number using Recursion.
7. WAP to design a class s using abstract Methods and Classes.
8. Write a java program to represent Abstract class with example.
9. WAP to handle the Exception using try and multiple catch block.
- 10.WAP that Implement the Nested try Statements.
- 11.Write a java program to create user defined package.
- 12.WAP that show the partial implementation of Interface.
- 13.WAP to Handle the user defined Exception using throw keyword.
- 14.WAP to create a thread that Implement the Runnable interface.
- 15.WAP to Implement Interthread communication.
- 16.Write a java program for creating multiple catch blocks
- 17.Write a java program to represent Array List class.
- 18.Write a java program that checks whether a given string is palindrome or not
- 19.Write a java program to multiply two given matrices.

Prasanth

Data structure using C LAB (Based on 25BCAICC-N-403)	0L:0T:2P	1 Credits
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Maximum Marks:30
 External Examination: 20
 Internal Assessment: 10

Write a programme:

1. To search an element in the array using Linear Search.
2. To search an element in the 2-dimensional array using Linear Search.
3. To merge two sorted array into one sorted array.
4. To perform the swapping of two numbers using call by value and call by reference.
5. To search an element in the array using Iterative Binary Search.
6. To search an element in the array using Recursive Binary Search.
7. To implement Bubble Sort.
8. To implement Selection Sort.
9. To implement Insertion Sort.
10. To implement Quick Sort.
11. To implement Stack using array.
12. To implement Queue using array.
13. To implement Linked List.

Prashant