

**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT,  
KABLANA (JHAJJAR)  
An Autonomous Institute (UGC)  
Approved by AICTE, New Delhi and Affiliated to MDU, Rohtak  
NAAC 'A' GRADE**

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**Scheme of Studies and Examination  
Bachelor of Computer Applications**

## 1. DEFINITION OF CREDIT

1	1 Lecture (L) per week	1 Credit
2	1 Tutorial (T) per week	1 Credit
3	1 Practical (P) per week	0.5 Credit
4	2 Practical (Lab) per week	1 Credit

## 2. RANGE OF CREDIT

A range of credits from 136 to 144 for a student to be eligible to get Under Graduate degree in Computer Application. A student will be eligible to get Under Graduate degree with Honours or Research Program, if he/she completes an additional 48 credits.

## 3. STRUCTURE OF UNDER GRADUATE PROGRAM (BCA)

Sr. No.	Category	Break up of Credits BCA	BCA (Honours)	BCA (With Research)
1	Discipline-Specific Courses(DSC)-Major Course	76*	116*	104*
2	Minor(MIC)/ Minor Vocational(MV)/MIC Vocational(VOC)/Skill Enhancement Courses (SEC)/Internship	37*	45*	45*
3	Multidisciplinary Courses	9*	9*	9*
4	Ability Enhancement Course	8*	8*	8*
5	Value Added Course	6*	6*	6*
6	Research Project/Dissertation	4*	4*	16*
<b>Total Credits</b>		<b>140*</b>	<b>188*</b>	<b>188*</b>

\* Minor variations allowed as per need of the respective disciplines.

Students exiting the program after second semester and securing 48 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/Subject. Students exiting the program after fourth semester and securing 96 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject. Students will be awarded 3-year UG Degree in relevant major Discipline/Subject upon securing 140 credits.

Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3 year UG Programs without taking exit option.

#### 4. COURSE CODE AND DEFINITIONS

<b>Sr. No.</b>	<b>Category</b>	<b>Course Code</b>
1	Discipline-Specific Courses-Major Course	DSC
2	Minor Vocational	MV
3	MIC Vocational(VOC)	MICV
4	Skill Enhancement Courses	SEC
5	Multidisciplinary Courses	MDC
6	Ability Enhancement Courses	AEC
7	Value Added Courses	VAC
8	Internship	INT
9	Research Project	RP
10	Dissertation	DISS

## Scheme of Studies and Examination

### BCA – 3rd Semester

*w.e.f. 2025-26*

Sr. No.	Category	Course Code	Course Title	Hours per Week			Week Credits	Examination Schedule (Marks)					Exam Duration In Hours
				L	T	P		Assessment	End Semester Exam	Practical	Total		
1	Discipline-Specific Courses-Major Courses	DSC-BCA-201A	Operating Systems	4	0	0	4	4	30	70	-	100	3
2	Discipline-Specific Courses-Major Courses	DSC-BCA-203A	Object Oriented Programming Using C++	3	0	0	3	3	25	50	-	75	3
		LC-BCA-205A	Object Oriented Programming Using C++ Lab	0	0	2	2	1	10	-	15	25	3
3	Discipline-Specific Courses-Major Courses	DSC-BCA-207A	Database Management System & SQL	3	0	0	3	3	25	50	-	75	3
		LC-BCA-209A	Database Management System & SQL Lab	0	0	2	2	1	10	-	15	25	3
4	Minor Vocational	MV-BCA-211A	Web Development-I	2	0	0	2	2	15	35	-	50	3
		LC-BCA-213A	Web Development-I Lab	0	0	4	4	2	15	-	35	50	3
5	Skill Enhancement Courses	SEC-215A	Data Science	1	0	0	1	1	-	25	-	25	3
		LC-SEC-217A	Data Science Lab	0	0	4	4	2	15	-	35	50	3
6	Multidisciplinary Courses	Refer Table VII	-----	3	0	0	3	3	25	50	-	75	3
7	Ability Enhancement Courses	Refer Table VIII	-----	2	0	0	2	2	15	35	-	50	3
<b>Total Credits</b>								<b>24</b>	<b>185</b>	<b>315</b>	<b>100</b>	<b>600</b>	

**Revised Scheme of Studies and Examination**  
**BCA – 4th Semester**  
*w.e.f. 2025-26*

Sr. No.	Category	Course Code	Course Title	Hours per Week			Week Credits	Examination Schedule (Marks)					Exam Duration In Hours
				L	T	P		Assessment	Semester Exam	Practical	Total		
1	Discipline-Specific Courses Major Courses	DSC-BCA-202A	Computer System Architecture	4	0	0	4	4	30	70	-	100	3
2	Discipline-Specific Courses Major Courses	DSC-BCA-204A	Data Communication & Computer Networks	4	0	0	4	4	30	70	-	100	3
3	Discipline-Specific Courses-Major Courses	DSC-BCA-206A	Java Programming	2	0	0	2	2	15	35	-	50	3
		LC-BCA-208A	Java Programming Lab	0	0	4	2	2	15	-	35	50	3
4	Discipline-Specific Courses-Major Courses	DSC-BCA-210A	Computer Graphics	3	0	0	3	3	25	50	-	75	3
		LC-BCA-212A	Computer Graphics Lab	0	0	2	2	1	10	-	15	25	3
5	Major Discipline Relevant Course (Vocational)-Minor Courses	Refer Table XI	-----	3	1	0	4	4	30	70	-	100	3
6	Ability Enhancement Courses	Refer Table IX	-----	2	0	0	2	2	15	35	-	50	3
7	Value Added Courses	Refer Table X	-----	2	0	0	2	2	15	35	-	50	3
<b>Total Credits</b>								<b>24</b>	<b>185</b>	<b>365</b>	<b>50</b>	<b>600</b>	

### Semester-III

Table No VII (Multidisciplinary Courses)

S. No.	Category	Course Code	Course Title	Offered By
1	Multidisciplinary Courses	MDC-BBA-201A	Corporate Social Responsibility	Department of Management (UG)
2		MDC-BBA-203A	Finance for Non-Finance Managers	Department of Management (UG)
3		MDC-BBA-205A	Group Dynamics and Leadership	Department of Management (UG)
4		MDC-CSA-207A	Web Technology	Department of Computer Application
5		MDC-CSA-209A	Graphic Designing	Department of Computer Application
6		MDC-CSA-211A	Multimedia Systems	Department of Computer Application

Table No. VIII (Ability Enhancement Course)

S. No.	Category	Course Code	Course Name
1	Ability Enhancement Courses	AEC-201A	English-II
2		AEC-203A	German

## Semester-IV

Table No. IX (Ability Enhancement Course)

S. No.	Category	Course Code	Course Name
1	Ability Enhancement Course	AEC-202A	Hindi-II
2		AEC-204A	Sanskrit-II

Table No. X (Value Added Courses)

S. No.	Category	Course Code	Course Title
1	Value Added Courses	VAC-202A	Wellbeing Through Yoga
2		VAC-204A	Communication Skills

Table No. XI (Major Discipline Relevant Course (Vocational)- Minor Courses)

S. No.	Category	Course Code	Course Name
1	Major Discipline Relevant Course (Vocational)- Minor	MICV-208A	Managerial Skills
2		MICV-210A	Database Management System
3		LC-MICV-212A	Database Management System Lab

**Note:**

1. The duration of all the end-term theory examinations shall be 3 hours.
2. The Criteria for awarding the internal assessment throughout the programme shall be as under:
  - a) Sessional Examination: 20 Marks (66.67%)
  - b) Assignments /Presentations /Seminars and Class Participation: 5 Marks (16.67%)
  - c) Attendance : 5 Marks (16.67%)

Less than 65%	: 0% of Attendance marks
65% - 69.99%	: 40% of Attendance marks
70% - 74.99%	: 60% of Attendance marks
75% - 80%	: 80% of Attendance marks
Above 80%	: 100% of Attendance marks
3. The Criteria for awarding the Internal assessment practical course throughout the Programs shall be as under:
  - a) Practical Assignments /Practical File :06 Marks (60% Weightage of Assessment)
  - b) Attendance (Criteria as mentioned above in 2 (c)) :04 Marks (40% Weightage of Assessment)
4. The panel of examiners for end-semester theory examinations shall be prepared and approved by the Department of Computer Science and Application of the internal/external examiners based on their expertise/ specialization/ area of interest.
5. The panel of examiners based on the examiners' expertise/specialization/area of interest for practicum/viva-voce examination shall be recommended by the Department of Computer Science and Application. In case of unavailability of external examiners due to unavoidable circumstances, the Controller of Examinations may allow the conduct of practical examinations by the internal examiners.
6. The panel of examiners for assessment of the Project Reports/Dissertation/Research Project/Summer Internship Reports shall be recommended by the Department of Computer Science and Application.
7. A student while selecting the minor discipline has to ensure that the courses of the opted minor discipline do not match with the major courses of his/her opted program.
8. The student may choose the Multidisciplinary Courses from other than the courses offered by their own/respective department.

Course Code	<b>DSC-BCA-201A</b>				
Category	Discipline- Specific Courses-Major Courses				
Course Title	<b>Operating Systems</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester III</b>
	4	0	0	<b>4</b>	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>• To understand the fundamental concepts of operating systems, including process management, memory management, and scheduling algorithms.</li> <li>• To explore I/O management, secondary storage structures, and the role of system calls in OS operations.</li> </ul>				
Assessment	30 Marks				
End Semester Examination	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall fundamental concepts, types, operations, and structures related to operating systems, processes, memory, I/O, and file systems.	Level 1: Remember
CO2	Explain the functioning of processes, scheduling, memory management, I/O systems, and file structures in operating systems.	Level 2: Understand
CO3	Apply process scheduling, memory allocation, and file access strategies to optimize system performance.	Level 3: Apply
CO4	Analyze process interactions, memory techniques, I/O mechanisms, and file system methods for system-level efficiency.	Level 4: Analyze

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 7 parts of 2 marks each from all units and remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Introduction to Operating Systems:** Objectives and Characteristics. Classification: Batch, Multiprogramming, Multi-processing, Multi-tasking, Time-sharing, Distributed, Network and Real time Operating systems. System Calls and Services.

**Functions and Structures:** Operating System Functions- Process management, Memory management, Secondary storage management, I/O management, File management, Protection and Security. Structures Simple Structure, Monolithic structure, Layered approach

### Unit-II

**Process Management and Scheduling:** Process concept- Process State Model, Process Control Block and Threads. Process Scheduling- Scheduling Queues, Schedulers and Context Switch. Operations on Processes, Cooperating processes and Inter-Process Communication.

**Process Scheduling:** Scheduling Criteria, Scheduling Algorithms: Single Processor Scheduling: FCFS, SJF, Round Robin, Multi Feedback Queue. Multiple Processor Scheduling and Real Time scheduling. Scheduling Algorithm Evaluation.

### Unit-III

**Memory Management:** Concepts of Memory Management, Logical and Physical address space, Swapping, Memory allocation: Contiguous and Non-Contiguous. Paging: Hardware Support. Page Map Table and Protection. Segmentation: Hardware Support and Protection and Sharing.

**Virtual Memory:** Need of Virtual Memory, Demand paging, Pure Demand Paging. Handling page faults, Performance of Demand Paging. Page replacement Algorithms and Allocation of Frames: Allocation algorithms and Global vs Local Allocation. Thrashing.

### Unit-IV

**I/O Management:** Basic I/O Devices, Types of I/O Devices: Block and Character Devices. I/O Software: Device Independent I/O, User Space I/O and Kernel I/O Software. Device Controllers, Device Drivers and Interrupt Handlers. Communication Approaches to I/O Devices: Special Instruction I/O, Memory Mapped I/O and Direct Memory Access (DMA). Secondary Storage Structure: Disk Structure and Disk Scheduling Algorithms.

**File System Interface:** File Concept: Attributes, Operations and Types. File Access Methods: Sequential Access, Direct Access and Indexed Sequential. Free Space Management. Directory Structures: Single Level, Two level and Tree Structured. File Protection and Sharing.

#### Suggested Readings:

- Operating System Concepts by Abraham Silberschatz, Peter B. Galvin, and Greg Gagne
- Modern Operating Systems by Andrew S. Tanenbaum and Herbert Bos
- Operating Systems: Internals and Design Principles by William Stallings
- Operating System Principles by Peter B. Galvin and Abraham Silberschatz
- Operating Systems: A Concept-Based Approach by D.M. Dhamdhare
- Understanding Operating Systems by Ann McHoes and Ida M. Flynn

#### Useful Video Links:

Unit No.	Topics	Links
Unit-I	Introduction to Operating Systems	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
	Operating System Structures	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
Unit-II	Process Management	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
	CPU Scheduling	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
	Threads and Inter-Process Communication	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
Unit-III	Memory Management	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
	Virtual Memory	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
	Page Replacement Algorithms	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
Unit-IV	I/O Management	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
	File Systems	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
	Disk Scheduling	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>

Course Code	<b>DSC-BCA-203A</b>			
Category	Discipline- Specific Courses-Major Courses			
Course Title	<b>Object Oriented Programming Using C++</b>			
Scheme and Credits	L	T	P	<b>Credits</b>
	3	0	0	<b>3</b>
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To understand object-oriented programming concepts such as classes, inheritance, polymorphism, and encapsulation in C++.</li> <li>To develop proficiency in memory management, exception handling, file operations, and the use of templates in C++ applications.</li> </ul>			
Assessment	25 Marks			
End Semester Examination	50 Marks			
Total	75 Marks			
Duration of Exam	03 Hours			

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the basic concepts of object-oriented programming, C++ syntax, data types, classes, inheritance, polymorphism, and file handling.	Level 1: Remember
CO2	Explain the principles of OOP, class structures, memory management, function overloading, templates, and exception handling in C++.	Level 2: Understand
CO3	Apply OOP principles to develop C++ programs using classes, inheritance, polymorphism, dynamic memory, and file I/O operations.	Level 3: Apply
CO4	Analyze OOP features like inheritance, polymorphism, encapsulation, and exception handling for efficient and modular program design.	Level 4: Analyze

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 mark each from all units and remaining eight questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Introduction to OOP concepts:** Procedural vs. Object- Oriented Programming, Principles of OOP and their benefits. Object, classes, Inheritance, Abstraction, Encapsulation Polymorphism, Dynamic Binding, and Message passing.

**C++ Programming Basics:** Syntax and structure of C++ programs, Data types, variables, and constants in C++, Control structures: decision making and looping constructs

### Unit-II

**Classes and objects:** Defining and using classes and objects, Member functions and data members, Access specifiers: public, private, protected, Functions and parameter passing in C++, Arrays and strings in C++, Pointer, Constructors and destructors.

**Inheritance:** Derived class and Base class, Types of inheritance: single, multiple, multilevel, hierarchical, Access control in inheritance.

### Unit-III

**Polymorphism:** function overloading, Operator overloading, Virtual functions and dynamic polymorphism, Abstract classes and pure virtual functions, Encapsulation and data hiding, Friend functions, static function.

**Memory Management:** Dynamic Memory Allocation: new, delete, Object Creation at run time

### Unit-IV

**Exception handling:** Throwing, Catching, Re-throwing an exception, specifying exception: processing unexpected exceptions; try-catch blocks, Exception propagation, Templates: class and function templates, Standard Template Library: benefits of STL and generic programming

**Working with Files:** Stream Classes, File input and output Operations in C++, Error handling during file operations.

#### Suggested Readings:

- Object-Oriented Programming with C++ by E. Balagurusamy
- Let Us C++ by Yashavant Kanetkar
- Programming: Principles and Practice Using C++ by Bjarne Stroustrup
- C++ Primer (5th Edition) by Stanley B. Lippman, José Lajoie, and Barbara E. Moo
- Accelerated C++: Practical Programming by Example by Andrew Koenig and Barbara E. Moo
- C++ Programming: From Problem Analysis to Program Design by D.S. Malik

#### Useful Video Links:

Unit No.	Topics	Links
Unit-I	Introduction to OOPS	<a href="https://onlinecourses.nptel.ac.in/noc25_cs34/preview">https://onlinecourses.nptel.ac.in/noc25_cs34/preview</a>
	Classes and Objects	<a href="https://onlinecourses.nptel.ac.in/noc25_cs34/preview">https://onlinecourses.nptel.ac.in/noc25_cs34/preview</a>
	Introduction to C++	<a href="https://onlinecourses.nptel.ac.in/noc20_cs07/preview">https://onlinecourses.nptel.ac.in/noc20_cs07/preview</a>
Unit-II	Inheritance	<a href="https://onlinecourses.nptel.ac.in/noc25_cs34/preview">https://onlinecourses.nptel.ac.in/noc25_cs34/preview</a>
	Classes and Objects	<a href="https://onlinecourses.nptel.ac.in/noc20_cs07/preview">https://onlinecourses.nptel.ac.in/noc20_cs07/preview</a>
Unit-III	Polymorphism	<a href="https://onlinecourses.nptel.ac.in/noc25_cs34/preview">https://onlinecourses.nptel.ac.in/noc25_cs34/preview</a>
Unit-IV	Exception Handling	<a href="https://onlinecourses.nptel.ac.in/noc25_cs34/preview">https://onlinecourses.nptel.ac.in/noc25_cs34/preview</a>
	File Handling	<a href="https://onlinecourses.nptel.ac.in/noc25_cs34/preview">https://onlinecourses.nptel.ac.in/noc25_cs34/preview</a>
	Templates and Generics	<a href="https://onlinecourses.nptel.ac.in/noc25_cs34/preview">https://onlinecourses.nptel.ac.in/noc25_cs34/preview</a>

Course Code	<b>LC-BCA-205A</b>			
Category	Discipline- Specific Courses-Major Courses			
Course Title	<b>Object Oriented Programming Using C++ Lab</b>			
Scheme and Credits	L	T	P	Credits
	0	0	2	<b>1</b>
	<b>Semester III</b>			
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To develop object-oriented programming skills in C++ through concepts like classes, inheritance, polymorphism, and memory management.</li> <li>To implement data handling, control structures, operator overloading, and dynamic memory allocation in real-world applications.</li> </ul>			
Assessment	10 Marks			
End Semester Examination	15 Marks			
Total	25 Marks			
Duration of Exam	03 Hours			

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply fundamental C++ programming concepts including variables, control structures, functions, and memory management to develop functional applications.	Level 3: Apply
CO2	Analyze and implement object-oriented programming principles such as encapsulation, inheritance, and polymorphism in class-based design.	Level 4: Analyze
CO3	Evaluate program design decisions using friend functions, access specifiers, and function overloading to enhance code readability and efficiency.	Level 5 Evaluate
CO4	Create robust and reusable C++ applications by integrating constructors, destructors, operator overloading, and advanced OOP techniques.	Level 6 Create

Exp. no.	Contents
1.	Write a C++ program to demonstrate basic syntax, variables, constants, and control structures (if-else, loops).
2.	Implement a simple program that demonstrates Object-Oriented Programming (OOP) principles: encapsulation, abstraction, and polymorphism.
3.	Define a Student class with attributes (name, age, and grade) and methods to display student details. Create multiple objects and test them.
4.	Write a program that accepts user input and uses loops (for, while, do-while) and conditional statements (if-else, switch) to perform computations.
5.	Implement a BankAccount class with attributes like account number, balance, and methods for deposit and withdrawal. Use access specifiers.
6.	Create a class Employee that stores an array of employee names and their salaries. Implement functions to update and display employee details.
7.	Write a program that dynamically allocates memory for an integer array using new and deallocates it using delete.
8.	Implement a class Car with a constructor to initialize brand and model details and a destructor to clean up resources.

<b>9.</b>	Demonstrate single, multiple, and multilevel inheritance by creating a Person base class and derived classes (Employee, Student).
<b>10.</b>	Implement function overloading for calculating the area of different shapes. Overload the + operator to add two complex numbers.
<b>11.</b>	Create a base class Shape with a virtual function draw(). Derive classes like Circle and Rectangle and override the function.
<b>12.</b>	Implement a Rectangle class with private members and a friend function to calculate the area.

Course Code	<b>DSC-BCA-207A</b>				
Category	Discipline- Specific Courses-Major Courses				
Course Title	<b>Database Management System &amp; SQL</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester III</b>
	3	0	0	<b>3</b>	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To understand the principles of database management, including database design, relational models, and query processing.</li> <li>To apply normalization techniques, transaction management, concurrency control, and recovery mechanisms for reliable and efficient database operations.</li> </ul>				
Assessment	25 Marks				
End Semester Examination	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall basic concepts of database systems, models, ER design, relational structures, normalization, and recovery techniques.	Level 1: Remember
CO2	Explain database design approaches, relational operations, query languages, normalization forms, and concurrency control methods.	Level 2: Understand
CO3	Apply ER modeling, relational algebra/calculus, normalization techniques, and transaction protocols to develop efficient databases.	Level 3: Apply
CO4	Analyze schema designs, normalization impacts, concurrency issues, and recovery mechanisms for data consistency and efficiency.	Level 4: Analyze

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 marks each from all units and remaining eight questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Database Management System:** Introduction, Database System Applications, History of Database Systems, Database System Vs. File Processing System, View of Data, Data Abstraction, Instances and Schemas. DBMS Environment, Database languages, Database Models.

**Database design and ER Model:** Physical, Conceptual and Logical Database design, Entity-Relationship model: Entities, Relationships, Representation of entities, attributes, Representation of relationship set, Generalization, Aggregation, Conceptual design with ER Mode

### Unit-II

**Relational Model:** Introduction to the Relational Model, Attributes, Domains, Tuples, Relations and their schemes, relation representation, Keys, relationship, relational operations, Integrity Constraint Over relations, Enforcing Integrity constraints, querying relational data, View: Introduction to Views, Destroying / altering Views.

**Relational Algebra and Calculus:** Relational Algebra & its operations, Relational calculus & its types, Power of Algebra and calculus.

### Unit-III

**Normalization:** Schema Refinement, Problems caused by redundancy, Decomposition & its properties; Normalization: First, Second, Third Normal forms, BCNF, Multivalued Dependencies, Join Dependencies.

**Transaction Management & Concurrency Control:** ACID properties, Transactions and Schedules, Concurrent execution of transaction, Serializability and Recoverability, Lock based Concurrency control, Lock Management, Lock Conversion, Dealing with deadlocks, Concurrency without Locking.

### Unit-IV

**Crash Recovery and Backup:** Failure classifications, storage structure, Recovery & Atomicity, Log base recovery, Recovery with concurrent transactions, Failure with loss of nonvolatile storage, Database backup & recovery from catastrophic failure, Remote Backup System.

**Storage and File Organization:** Overview of physical storage media, Storage access; File organization, Operations on Files, Serial Files, Sequential Files, Index-Sequential Files, Direct Files.

#### Suggested Readings:

- Database Management Systems by Raghuram Ramakrishnan and Johannes Gehrke
- Database Management System by R.P. Mahapatra and Govind Verma
- Database Management Systems: A Practical Approach by Rajiv Chopra
- Fundamentals of Database Systems by Ramez Elmasri and Shamkant B. Navathe
- An Introduction to Database Systems by C.J. Date
- Database System Concepts by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan

#### Useful Video Links:

Unit No.	Topics	Links
Unit-I	Database Management System	<a href="https://archive.nptel.ac.in/courses/106/105/106105175/?utm">https://archive.nptel.ac.in/courses/106/105/106105175/?utm</a>
Unit-II	Relational Model	<a href="https://archive.nptel.ac.in/courses/106/105/106105175/?utm">https://archive.nptel.ac.in/courses/106/105/106105175/?utm</a>
Unit-III	Transaction Management & Concurrency Control	<a href="https://archive.nptel.ac.in/courses/106/105/106105175/?utm">https://archive.nptel.ac.in/courses/106/105/106105175/?utm</a>
Unit-IV	Recovery & Atomicity	<a href="https://archive.nptel.ac.in/courses/106/105/106105175/?utm">https://archive.nptel.ac.in/courses/106/105/106105175/?utm</a>

Course Code	<b>LC-BCA-209A</b>				
Category	Discipline- Specific Courses-Major Courses				
Course Title	<b>Database Management System &amp; SQL Lab</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester III</b>
	0	0	2	<b>1</b>	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To design, implement, and manage relational databases using SQL, including schema creation, data manipulation, and view management.</li> <li>To apply normalization techniques, transaction handling, and backup strategies for database optimization, integrity, and recovery.</li> </ul>				
Assessment	10 Marks				
End Semester Examination	15 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply relational database concepts to create, modify, and query databases using SQL.	Level 3: Apply
CO2	Analyze database structures and queries by interpreting ER models, comparing file systems vs. DBMS, and applying relational algebra operations.	Level 4: Analyze
CO3	Evaluate database designs and normalization techniques to improve schema efficiency and eliminate anomalies.	Level 5 Evaluate
CO4	Create reliable and secure database systems by implementing transaction management, concurrency control, and backup mechanisms.	Level 6 Create

Exp. no.	Contents
1.	Install MySQL/PostgreSQL/Oracle. Create and manage a simple database with tables.
2.	Demonstrate how data is stored and retrieved in file systems vs. databases.
3.	Design an ER diagram for a university database with entities like Student, Course, Instructor, and Department.
4.	Convert an ER diagram into a relational schema and implement it using SQL.
5.	Write SQL queries to create tables with different constraints (Primary Key, Foreign Key, NOT NULL, UNIQUE).
6.	Perform basic SQL operations: SELECT, INSERT, UPDATE, DELETE with WHERE conditions.
7.	Create, modify, and delete views for a relational database.
8.	Implement relational algebra operations (Selection, Projection, Union, Intersection, Join) using SQL.
9.	Normalize a given unnormalized database schema step by step up to BCNF.
10.	Create transactions for a banking system using SQL commands like COMMIT, ROLLBACK.
11.	Demonstrate deadlock occurrence and resolution strategies in a DBMS.

<b>12.</b>	Perform a full database backup and restore using MySQL/PostgreSQL.				
Course Code	<b>MV-BCA-211A</b>				
Category	Minor Vocational				
Course Title	<b>Web Development-I</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester III</b>
	2	0	0	2	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To understand the fundamentals of Node.js, including its history, features, and use cases. Set up the development environment and write basic scripts.</li> <li>To create and manage REST APIs, perform file system operations, and utilize version control with Git for effective project management and collaboration.</li> </ul>				
Assessment	15 Marks				
End Semester Examination	35 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall fundamental concepts of JavaScript, Node.js features, core modules, and development environment setup.	Level 1: Remember
CO2	Explain Node.js architecture, modular programming, advanced JavaScript usage, and Git-based version control processes.	Level 2: Understand
CO3	Apply Node.js tools to develop servers, manage dependencies, create REST APIs, and perform file operations.	Level 3: Apply
CO4	Analyze project structures, code modularity, error handling, and integration of Node.js features in real-time solutions.	Level 4: Analyze

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 7 parts of 1 marks each from all units and remaining eight questions of 7 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Node.js Overview and JavaScript Fundamentals:** Introduction, history, key features, and applications. Comparison between JavaScript and Node.js. Differences between client-side and server-side programming. Use cases of Node.js in real-time applications and its integration with JavaScript.

**Installation and Environment Setup:** Installing Node.js and npm, understanding the Node.js runtime, writing and executing basic scripts.

**JavaScript Refresher:** JavaScript fundamentals including variables, data types, functions, control structures (if/else, loops), and arrays.

## Unit-II

**Node.js Modules and HTTP Server:** Understanding modules: core modules (fs, http, path, etc.), global modules, and non-global modules. Creating and managing a basic HTTP server.

**Advanced JavaScript Concepts in Node.js:** Using functions as parameters, callback functions, and arrow function syntax. Understanding modular programming and organizing code into separate files for scalability.

## Unit-III

**Project Structure and Dependency Management:** Introduction to package.json, initializing Node.js projects, managing dependencies, and configuring scripts.

**Version Control and Git Integration:** Basic Git commands, initializing repositories, tracking changes, gitignore usage, and project collaboration using Git.

**Development Tools:** Usage of Nodemon and other automation tools for improving the development experience.

## Unit-IV

**API Development and File System Operations:** Creating simple REST APIs using Node.js, handling GET and POST requests, parsing and sending JSON data.

**File System Module:** Reading from and writing to files, directory operations, working with file paths, and handling errors during file operations.

**Practical Application and Mini Project:** End-to-end mini project integrating concepts from all units, including module usage, server creation, file operations, and basic API routes.

### Suggested Readings:

- Node.js in Action by Mike Cantelon, Marc Harter, and T.J. Holowaychuk
- Learning Node.js Development by Andrew Mead
- Node.js for JavaScript Developers by Richard Blum
- Mastering Node.js by Sandro Pasquali
- Node.js 8 Cookbook by David Mark Clements
- The Node Beginner Book by Manuel Kiessling

**Useful Video Links:**

<b>Unit No.</b>	<b>Topics</b>	<b>Links</b>
<b>Unit-I</b>	Introduction to Client-side JavaScript	<a href="https://archive.nptel.ac.in/courses/106/106/106106156/">https://archive.nptel.ac.in/courses/106/106/106106156/</a>
	APIs and Mobile Apps Use Web-Servers	<a href="https://archive.nptel.ac.in/courses/106/106/106106156/">https://archive.nptel.ac.in/courses/106/106/106106156/</a>
<b>Unit-II</b>	Introduction to Server-side JavaScript and HTML/CSS	<a href="https://archive.nptel.ac.in/courses/106/106/106106156/">https://archive.nptel.ac.in/courses/106/106/106106156/</a>
	Introduction to Databases	<a href="https://archive.nptel.ac.in/courses/106/106/106106156/">https://archive.nptel.ac.in/courses/106/106/106106156/</a>
<b>Unit-III</b>	Setting up a Website	<a href="https://onlinecourses.nptel.ac.in/noc20_cs52/preview">https://onlinecourses.nptel.ac.in/noc20_cs52/preview</a>
	Using Third-party Web Services	<a href="https://onlinecourses.nptel.ac.in/noc20_cs52/preview">https://onlinecourses.nptel.ac.in/noc20_cs52/preview</a>
<b>Unit-IV</b>	Extended Project	<a href="https://onlinecourses.nptel.ac.in/noc20_cs52/preview">https://onlinecourses.nptel.ac.in/noc20_cs52/preview</a>

Course Code	<b>LC-BCA-213A</b>				
Category	Minor Vocational				
Course Title	<b>Web Development-I Lab</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester III</b>
	0	0	4	<b>2</b>	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To set up Node.js and npm, write and execute a "Hello, World!" script, and ensure Node.js is correctly installed.</li> <li>Create a basic HTTP server using the http module to handle GET requests and respond with a "Hello, World!" message.</li> </ul>				
Assessment	15 Marks				
End Semester Examination	35 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply foundational Node.js concepts to build and execute basic scripts, handle files, and create simple servers.	Level 3: Apply
CO2	Analyze and structure Node.js applications by organizing modules, handling asynchronous operations, and integrating external packages.	Level 4: Analyze
CO3	Evaluate development tools and practices by integrating Git version control, automation tools like nodemon, and dependency management in Node.js projects.	Level 5 Evaluate
CO4	Create full-fledged RESTful APIs and file-based backend services using Node.js and Express, implementing modular and scalable code.	Level 6 Create

Exp. no.	Contents
1.	Install Node.js and npm. Write a "Hello, World!" script and execute it to ensure that Node.js is set up correctly.
2.	Use the fs module to create a script that reads the contents of a file and displays it on the console.
3.	Create a basic HTTP server using the http module in Node.js that responds with a "Hello, World!" message on a GET request.
4.	Write a JavaScript function that takes two numbers as arguments and returns their sum. Add error handling to ensure both arguments are numbers.
5.	Implement a function that takes a callback to read a file asynchronously and display its contents once the reading is complete.
6.	Organize your Node.js application into modules. Split the HTTP server code into a separate module and import it into your main file.

<b>7.</b>	Initialize a Node.js project using <code>npm init</code> , install a package (e.g., <code>express</code> ), and create a basic server using that package.
<b>8.</b>	Initialize a Git repository in your project. Commit the initial changes and push to a remote repository (e.g., GitHub). Add <code>node_modules</code> to <code>.gitignore</code> .
<b>9.</b>	Install and set up <code>nodemon</code> to automatically restart your server whenever there are changes to your code.
<b>10.</b>	Use <code>express</code> to create a simple REST API with routes for handling GET and POST requests. Ensure that the server can handle basic JSON data.
<b>11.</b>	Create a script that uses the <code>fs</code> module to write data to a file, read the content of the file, and display it on the console.
<b>12.</b>	Build a simple API in Node.js that reads data from a file when a GET request is made and writes new data to the file when a POST request is sent.

Course Code	<b>SEC-215A</b>			
Category	Skill Enhancement Courses			
Course Title	<b>Data Science</b>			
Scheme and Credits	L	T	P	<b>Credits</b>
	1	0	0	<b>1</b>
	<b>Semester III</b>			
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To apply Excel-based data manipulation, transformation, and visualization techniques for effective data analysis and decision-making.</li> <li>To utilize predictive analysis, descriptive statistics, and advanced Excel functions for building data models, generating insights, and creating interactive dashboards.</li> </ul>			
Assessment				
End Semester Examination	25 Marks			
Total	25 Marks			
Duration of Exam	03 Hours			

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall key concepts of data science, Excel fundamentals, data types, functions, and basic statistical measures.	Level 1: Remember
CO2	Explain techniques for data cleaning, transformation, validation, visualization, and analysis using Excel tools.	Level 2: Understand
CO3	Apply Excel functions, PivotTables, charts, and predictive tools for data manipulation, forecasting, and optimization.	Level 3: Apply
CO4	Analyze datasets using statistical methods, advanced Excel functions, and dashboards to derive and present insights.	Level 4: Analyze

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 1 marks each from all units and remaining eight questions of 5 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Introduction to Data Science:** Overview of Data Science and its significance in various industries, Key concepts: Data collection, data analysis, data visualization, Data Science workflow: Data Cleaning, Data Analysis, Data Visualization, Data Modeling.

**Excel Fundamentals for Data Science:** Introduction to Excel Interface and Key Features Basic Excel Functions: SUM, AVERAGE, COUNT, COUNTA, MAX, MIN, Data Formatting: Conditional formatting, cell formatting, number formatting, Working with Excel Sheets and Workbooks

**Data Types and Data Structure in Excel:** Types of Data: Numeric, Text, Date, Boolean, organizing data: Rows, Columns, and Tables, Importing Data into Excel (CSV, text files, and databases)

## Unit-II

**Data Cleaning Techniques:** Handling missing values: Techniques for filling or removing missing data, Duplicate Data: Identifying and removing duplicates, Data Validation: Using data validation rules to maintain data integrity.

**Data Transformation in Excel:** Using Text Functions: CONCATENATE, LEFT, and RIGHT, MID, TRIM, Date and Time Functions: YEAR, MONTH, DAY, TEXT, and Data Sorting and Filtering: Basic Sorting, Advanced Filters, Custom Filters.

**Data Manipulation Techniques:** Using Excel Pivot Tables for summarizing data, aggregating data with SUMIF, COUNTIF, AVERAGEIF functions, working with Excel Power Query for data transformation.

## Unit-III

**Descriptive Statistics:** Calculating measures of central tendency: Mean, Median, Mode, and Measures of Dispersion: Range, Variance, Standard Deviation, Creating Frequency Distributions and Histograms.

**Excel Charts and Graphs:** Introduction to Excel charts: Bar, Line, Pie, Scatter, and Area charts, and Customizing charts: Axis formatting, adding titles, changing colors, Creating Pivot Charts.

**Data Analysis Tools in Excel:** Using the Data Analysis Toolpak for Regression Analysis, ANOVA, and Descriptive Statistics, Introduction to Excel Solver for optimization problems, Scenario Analysis using Excel What-If tools: Goal Seek, Data Tables.

## Unit-IV

**Introduction to Predictive Analysis:** Introduction to basic predictive analytics: Linear regression, Using Excel's Regression tool to perform simple linear regression, forecasting with Excel: Using TREND, FORECAST, and LINEST functions.

**Advanced Excel Functions for Data Science:** Array Formulas and Dynamic Arrays, Using INDEX-MATCH functions for advanced lookups, Conditional aggregation: SUMIFS, AVERAGEIFS, and COUNTIFS.

**Reporting and Presentation:** Creating Dashboards with Excel: Combining charts, tables, and PivotTables, Automating reports with Excel macros and VBA, Best practices for presenting data and insights: Formatting, layout, and storytelling with data.

### Suggested Readings:

- Data Analysis with Excel by Manisha Nigam
- Data Analysis and Business Modelling Using Microsoft Excel by Hansa Lysander Manohar
- Statistical Data Analysis Using MS-Excel by Dr. B.G. Kore
- Modern Data Analytics in Excel by George Mount
- Microsoft Excel Data Analysis for Dummies by Stephen L. Nelson
- Business Statistics Using Excel: A Complete Course in Data Analytics by R. Panneerselvam

**Useful Video Links:**

<b>Unit No.</b>	<b>Topics</b>	<b>Links</b>
<b>Unit-I</b>	Introduction to Data and Excel Environment	<a href="https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_01.html">https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_01.html</a>
	Data Types and Handling Data in Excel	<a href="https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_02.html">https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_02.html</a>
<b>Unit-II</b>	Data Cleaning and Manipulation	<a href="https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_03.html">https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_03.html</a>
	Advanced Data Transformation	<a href="https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_04.html">https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_04.html</a>
<b>Unit-III</b>	Descriptive Statistics and PivofTables	<a href="https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_05.html">https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_05.html</a>
	Charts and Visualization Tools in Excel	<a href="https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_06.html">https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_06.html</a>
<b>Unit-IV</b>	Regression, Forecasting, and Solver	<a href="https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_07.html">https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_07.html</a>
	Dashboards and Reporting with Excel	<a href="https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_08.html">https://nptel.ac.in/noc/courses/noc22/SEM1/106106235/Week_08.html</a>

Course Code	<b>LC-SEC-217A</b>				
Category	Skill Enhancement Courses				
Course Title	<b>Data Science Lab</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester III</b>
	0	0	4	2	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To develop proficiency in Node.js, focusing on core modules, JavaScript fundamentals, and building real-time applications using server-side programming.</li> <li>To create and manage REST APIs, perform file system operations, and utilize version control with Git for effective project management and collaboration.</li> </ul>				
Assessment	15 Marks				
End Semester Examination	35 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply Excel functions and tools to organize, analyze, and visualize data for real-world business scenarios.	Level 3: Apply
CO2	Analyze and manipulate complex data sets by identifying patterns, performing calculations, and cleaning data to ensure accuracy.	Level 4: Analyze
CO3	Evaluate and optimize data organization and visualization strategies to improve decision-making and reporting accuracy.	Level 5 Evaluate
CO4	Create advanced Excel solutions to automate tasks, generate forecasts, and develop interactive dashboards for data-driven decision-making.	Level 6 Create

Exp. no.	Contents
1.	Import the "Employee_Data.csv" file into Excel, convert it into a table, and apply conditional formatting to highlight salaries above \$50,000 in green and below \$20,000 in red.
2.	Identify and remove duplicate records based on "Employee ID" and apply data validation to the "Email" column for valid formats.
3.	Calculate Mean, Median, Mode, Range, Variance, and Standard Deviation for the "Monthly Sales" data and create a Histogram to visualize the distribution.
4.	Create Bar, Line, and Pie charts for the "Quarterly Revenue" dataset and customize them with titles, axis labels, and data points.
5.	Concatenate "First Name" and "Last Name" into a "Full Name" column and extract the first three characters of the last name into a separate column.
6.	Create a Pivot Table from "Sales_Data.xlsx" to display total sales by region and product category, and filter the top 5 regions.

7.	Perform linear regression on the "House Price Data" using Excel's Analysis Toolpak and plot the regression line on a scatter chart.
8.	Identify missing values in the "Order Date" and "Order Amount" columns, and fill the dates with the average date and amounts with the median value.
9.	Sort the "Product Inventory" sheet by category and quantity in descending order, and filter only "Electronics" with quantities below 50.
10.	Create an interactive dashboard using Excel with charts, PivotTables, and slicers to filter data by region and product type.
11.	Record a macro to automate sorting data by "Revenue," applying conditional formatting, and generating a summary report.
12.	Perform a 6-month sales forecast using the "Monthly_Sales_Data.xlsx" with Excel's FORECAST and TREND functions, and visualize the results in a line chart.

Course Code	<b>DSC-BCA-202A</b>				
Category	Discipline-Specific Courses Major Courses				
Course Title	<b>Computer System Architecture</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester IV</b>
	4	0	0	<b>4</b>	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To understand the fundamental structure and functioning of digital computers, including data representation, register transfer, and CPU organization.</li> <li>To explore instruction formats, memory and I/O organization, addressing modes, and interrupt handling mechanisms in computer systems.</li> </ul>				
Assessment	30 Marks				
End Semester Examination	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall concepts of computer architecture, including data representation, register operations, instruction types, and memory hierarchy.	Level 1: Remember
CO2	Explain the structure and functioning of CPU, instruction execution, addressing modes, and interrupt mechanisms.	Level 2: Understand
CO3	Apply knowledge of register transfer, instruction cycles, and addressing modes to analyze computer system behavior.	Level 3: Apply
CO4	Analyze CPU and memory operations, I/O organization, and performance aspects like cache coherence and DMA for efficient data handling.	Level 4: Analyze

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 7 parts of 2 marks each from all units and remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Basic Computer Concepts:** Computer Types: Analog and Digital, Digital Computer Organization and Architecture: Functional Units, Basic Organizational Concepts, Von-Neumann Architecture, Bus Structure. Data representation: Number Systems, Fixed and Floating point representation.

**Register Transfer and Micro-operations:** Basic concepts and types of Registers, Register Transfer Language, Data Transfer between Registers, Bus and Memory Transfer, Micro-operations: Arithmetic, Logic and Shift Micro-operations.

### Unit-II

**Basic Computer Design:** Instruction codes, Common Bus System Architecture, Computer Instructions: Instruction Set and Instruction Cycle. Types of Instructions: Register Reference, Memory Reference and Input-Output Reference.

**Interrupts:** Classifications of Interrupts: Maskable and Non maskable, Hardware and Software. Interrupt Service Routine, Context Switching, Interrupt Identification: Daisy Chaining, Polling and Vectored Interrupt. Interrupt Cycle.

### Unit-III

**Central Processing Unit:** Introduction, General Register Organization, Stack Organization: Register and /memory Stack, Reverse Polish Notation. Instruction Formats: Three Address, Two Address, One Address and Zero Address.

**Data Transfer and Manipulation:** Addressing Modes: Implied, Immediate, Register Direct and Indirect Mode and Direct Address Mode. Data Transfer and Data Manipulation Instructions, Program Control, Reduced Instruction Set Computer (RISC) and Complex Instruction Set Computer (CISC).

### Unit-IV

**Memory Organization:** Memory Hierarchy, Main Memory Technologies, Auxiliary Memory, Associative Memory: Hardware requisites, Working Principle and Operations. Cache Memory: Characteristics, Types of Mapping, Writing into Cache, Cache Coherence.

**Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer: Programmed I/O and Interrupt Initiated I/O. Concepts related to Priority Interrupt: Daisy Chaining Priority and Parallel Priority Interrupt. Direct Memory Access (DMA): DMA Controller and DMA Transfer.

#### Suggested Readings:

- M. Morris Mano: Computer System Architecture (3rd Edition), Prentice Hall of India.
- Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, McGraw Hill.
- William Stallings: Computer Organization and Architecture: Designing for Performance, 10th Edition, Pearson Education.
- John L. Hennessy and David A. Patterson: Computer Architecture: A Quantitative Approach, Morgan Kaufmann.
- P. Pal Chaudhuri: Computer Organization and Design, Prentice Hall of India.
- Govindarajalu B.: Computer Architecture and Organization: Design Principles and Applications, Tata McGraw Hill.

**Useful Video Links:**

<b>Unit No.</b>	<b>Topics</b>	<b>Links</b>
<b>Unit-I</b>	Introduction and Evolution of Computers	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture1.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture1.html</a>
	Data Representation	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture2.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture2.html</a>
	Bus and Memory Transfers	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture4.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture4.html</a>
<b>Unit-II</b>	Instruction Set and Cycle	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture5.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture5.html</a>
	Common Bus System and Instruction Types	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture6.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture6.html</a>
	Interrupt Handling Techniques	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture7.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture7.html</a>
<b>Unit-III</b>	General Register and Stack Organization	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture8.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture8.html</a>
	Addressing Modes	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture9.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture9.html</a>
	Instruction Formats and RISC vs CISC	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture10.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture10.html</a>
<b>Unit-IV</b>	Memory Hierarchy and Cache	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture11.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture11.html</a>
	Associative Memory	<a href="https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture12.html">https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs13/lecture12.html</a>

Course Code	<b>DSC-BCA-204A</b>				
Category	Discipline-Specific Courses –Major Courses				
Course Title	<b>Data Communication and Computer Network</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester IV</b>
	4	0	0	<b>4</b>	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To understand the fundamental principles of data communication, network models, transmission media, and protocols across various network layers.</li> <li>To explore network architectures, protocols, and mechanisms in the data link, network, transport, and application layers for effective communication.</li> </ul>				
Assessment	30 Marks				
End Semester Examination	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall key concepts of data transmission, network models, transmission media, and basic network protocols.	Level 1: Remember
CO2	Explain the functions and protocols of data link, network, transport, and application layers in a computer network.	Level 2: Understand
CO3	Apply network protocols and algorithms to establish connections, route packets, manage congestion, and support communication services.	Level 3: Apply
CO4	Analyze network architectures, communication techniques, and protocol mechanisms for performance and efficiency in network operations.	Level 4: Analyze

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 7 parts of 2 marks each from all units and remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Introduction:** Data Transmission concepts, transmission impairments, switching, modulation, multiplexing.

**Network Hardware:** LAN, MAN, WAN, Wireless networks, Internet-works.

**Network Software:** Layer, Protocols, interfaces and services.

**Reference Models:** OSI, TCP/IP and their comparison

**Transmission Media:** Magnetic, twisted pair, coaxial cable, fibre optics, wireless transmission (radio, microwave, infrared).

### Unit-II

**Data Link Layer:** Framing, Error control, sliding window protocols (one bit, Go back n, selective repeat). DLL Protocols–HDLC, PPP.

**Medium Access Sub layer:** Channel Allocation, MAC protocols – ALOHA, CSMA protocols, Collision free protocols, Limited Contention Protocols, Wireless LAN protocols, IEEE 802.3, 802.4, 802.5 standards and their comparison.

### Unit-III

**Network Layer:** Design issues, Routing algorithms (shortest path, flooding, flow based, distance vector, hierarchical, broadcast, multicast, for mobile hosts), Congestion control algorithms (Leaky bucket, Token bucket, Choke Packet, Load shedding), Internetworking, IP Protocol, ARP, RARP.

### Unit-IV

**Transport Layer:** Addressing, establishing and releasing connection, flow control, buffering, Internet Transport Protocol (TCP and UDP).

Application Layer: Domain name system, E-mail, File transfer protocol, HTTP, HTTPS, TELNET.

#### Suggested Readings:

- Tanenbaum, Andrew S.: Computer Networks (4th Edition), PHI.
- Gill Nasib Singh: Handbook of Computer Fundamentals, Khanna Book Publishing Company(Pvt.) Ltd, New Delhi.
- Forouzan, B. A.: Data Communications and Networking, Fourth Edition, Tata McGraw Hill.
- Douglas E. Comer: Internet Working with TCP/IP (Vol.1, 4th Edition), CPE.
- Stallings, William: Data and Computer Communications (8th Edition), PHI.
- Nance, Bary: Introduction to Networking, PHI, 4th Edition.
- Doerr Alan &Levasseur Kenneth: Applied Discrete Structures for Computer Science, Galgotia Pub. Pvt. Ltd.
- Any other book covering the contents of the subject.

#### Useful Video Links:

Unit No.	Topics	Links
Unit-I	Introduction to Computer Networks	<a href="https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec01.html">https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec01.html</a>
	OSI and TCP/IP Models	<a href="https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec04.html">https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec04.html</a>
Unit-II	Framing & Error Detection	<a href="https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec07.html">https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec07.html</a>
Unit-III	Congestion Control	<a href="https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec13.html">https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec13.html</a>
Unit-IV	Transport Layer (TCP & UDP)	<a href="https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec15.html">https://nptel.ac.in/noc/courses/noc20/SEM1/noc20cs29/lec15.html</a>

Course Code	<b>DSC-BCA-206A</b>				
Category	Discipline-Specific Courses –Major Courses				
Course Title	<b>JAVA Programming</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester IV</b>
	2	0	0	2	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To understand the core concepts of Java programming, including object-oriented principles, language syntax, exception handling, and multithreading.</li> <li>To explore Java packages, I/O streams, and advanced features like interfaces, strings, vectors, and file handling for robust application development.</li> </ul>				
Assessment	15 Marks				
End Semester Examination	35 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

Cos	Skills Demonstrated	RBT Level
CO1	Recall the fundamental concepts of Java, including language syntax, data types, control structures, and object-oriented elements.	Level 1: Remember
CO2	Explain object-oriented principles, Java classes, exception handling, and Java standard library usage.	Level 2: Understand
CO3	Apply Java programming constructs to develop multithreaded applications, handle files and streams, and manage user-defined exceptions.	Level 3: Apply
CO4	Analyze Java code for object-oriented structure, exception flow, and thread behavior to ensure efficient application performance.	Level 4: Analyze

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 7 parts of 1 marks each from all units and remaining eight questions of 7 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

#### Unit-I

**Introduction to Java:** Java Features, Java Virtual Machine (JVM), Byte code, Java API, Java Development Kit (JDK), Garbage Collection. Language Basics: Keywords, Constants, Variables and Data Types, Operators and Expressions, Decision Making, Branching and Looping.

**Introducing Classes, Objects and Methods:** Defining a Class, Methods Declaration, Creating Objects and accessing Class members, Constructors, Methods Overloading, Wrapper Classes, Inheritance, Methods Overriding, Final Class, variables and methods, Abstract Class and Methods, Interfaces.

#### Unit-II

**Arrays, Strings and Vectors:** Creating and using Arrays, String operations, String Buffer, String builder, and String Tokenizer class, Vector class.

**Packages and Exceptions:** Java API packages, Creating and using packages, static import, Exceptions handling, Types of Exceptions, multiple catch statements, 'throw' and 'throws', using 'finally' statement, Creating your own exceptions.

### Unit-III

**Multithreaded Programming:** Single threaded and multi-threaded program, Creating threads using Thread class, Life cycle of a Thread, Stopping and blocking a Thread, getting and setting the Thread Priority, Synchronization, implementing the Runnable interface.

**Managing Input/Output Streams:** Concept to fstreams, Byte and Character streams, Reading and Writing from Console and Files. Input output exceptions.

### Unit-IV

**Applet Programming:** How Applets differs from Java Application, Applet Life Cycle, APPLET Tag, Running an Applet, Passing Parameters to Applet.

**Event Handling:** Mechanism, The Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter and inner classes.

**GUI Programming:** Working with Frame Window, Graphics and Text, AWT Controls and classes. Layout Managers, working with Menus.

### Suggested Readings:

- Balagurusamy, E.: Programming with Java: A Primer, McGraw Hill Education.
- Schildt, Herbert: Java: The Complete Reference (11th Edition), McGraw Hill.
- Deitel&Deitel: Java: How to Program, Pearson Education.
- Bruce Eckel: Thinking in Java, Prentice Hall.
- Cay S. Horstmann, Gary Cornell: Core Java Volume I—Fundamentals, Prentice Hall.

### Useful Video Links:

Unit No.	Topics	Links
Unit-I	Introduction to Java & OOP Concepts	<a href="https://archive.nptel.ac.in/courses/106/105/106105191/">https://archive.nptel.ac.in/courses/106/105/106105191/</a>
Unit-II	Java Programming Steps	<a href="https://archive.nptel.ac.in/courses/106/105/106105191/">https://archive.nptel.ac.in/courses/106/105/106105191/</a>
Unit-III	Encapsulation	<a href="https://archive.nptel.ac.in/courses/106/105/106105191/">https://archive.nptel.ac.in/courses/106/105/106105191/</a>
Unit-IV	Multithreaded Programming	<a href="https://archive.nptel.ac.in/courses/106/105/106105191/">https://archive.nptel.ac.in/courses/106/105/106105191/</a>

Course Code	<b>LC-BCA-208A</b>				
Category	Discipline-Specific Courses –Major Courses				
Course Title	<b>Java Programming-Lab</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester IV</b>
	0	0	4	2	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To equip students with the knowledge and practical skills required to apply object-oriented programming principles using Java, including inheritance, polymorphism, abstraction, and exception handling.</li> <li>To enable students to design and develop robust Java applications by leveraging multithreading, file I/O, user-defined packages, and standard library features.</li> </ul>				
Assessment	15 Marks				
End Semester Examination	35 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply object-oriented programming concepts such as classes, objects, method overloading, method overriding, inheritance, and abstraction in Java.	Level 3: Apply
CO2	Analyze Java programs that implement exception handling, packages, and vector operations to understand program behavior and flow.	Level 4: Analyze
CO3	Evaluate multithreading, synchronization, and file I/O operations in Java to determine efficient and secure program execution.	Level 5 Evaluate
CO4	Design and develop robust and reusable Java applications by integrating object-oriented principles, custom exceptions, packages, and file handling techniques.	Level 6 Create

Exp. no.	Contents
1.	Write a Java program to define a class `Student` with data members for name and age. Include member functions to input and display the details of a student.
2.	Create a Java program to demonstrate method overloading by creating multiple methods with the same name but different parameters in a class
3.	Create a Java program to demonstrate method overriding by creating a base class `Animal` and a derived class `Dog` that overrides a method from the base class.
4.	Implement a Java program to define an abstract class `Shape` with an abstract method `draw()`. Create derived classes `Circle` and `Square` that implement the `draw()` method.

<b>5.</b>	Implement a Java program to demonstrate the use of the `Vector` class by performing operations like adding, removing, and displaying elements of a vector.
<b>6.</b>	Write a Java program to create a user-defined package and use it in another class.
<b>7.</b>	Create a Java program to handle multiple exceptions using try-catch blocks.
<b>8.</b>	Implement a Java program to demonstrate the use of the `finally` statement in exception handling.
<b>9.</b>	Write a Java program to create and throw a custom exception.
<b>10.</b>	Create a Java program to implement a multithreaded application by extending the `Thread` class.
<b>11.</b>	Implement a Java program to demonstrate thread synchronization.
<b>12.</b>	Create a Java program to read and write data to a file using `File Input Stream` and File Output Stream`.

Course Code	<b>DSC-BCA-210A</b>				
Category	Discipline-Specific Courses –Major Courses				
Course Title	<b>Computer Graphics</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester IV</b>
	3	0	0	<b>3</b>	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To understand the core concepts, mathematical foundations, and algorithms used in 2D and 3D computer graphics.</li> <li>To explore various techniques including transformations, clipping, shading, and rendering to create and manipulate graphical content.</li> </ul>				
Assessment	25 Marks				
End Semester Examination	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall basic concepts, coordinate systems, and fundamental graphics algorithms used in 2D and 3D computer graphics.	Level 1: Remember
CO2	Explain drawing techniques, color models, transformations, and clipping methods in both 2D and 3D environments.	Level 2: Understand
CO3	Apply transformation algorithms, clipping techniques, and projection models to implement graphical rendering and image processing tasks.	Level 3: Apply
CO4	Analyze rendering techniques, lighting models, and hidden surface algorithms to enhance visual realism in computer-generated imagery.	Level 4: Analyze

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 marks each from all units and remaining eight questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Introduction to Computer Graphics:** Overview of computer graphics and its applications, Historical development, Application areas e.g. entertainment, scientific visualization, user interfaces, Basics of raster and vector graphics, differences between raster and vector graphics, Representation and storage formats, Graphics pipeline and rendering process, stages of the graphics pipeline (modelling, transformation, rendering), concepts of rendering primitives, vertices, and fragments.

**Graphics primitives:** Coordinate systems, types of primitives (points, lines, polygons), Cartesian and homogeneous coordinate systems, transformation matrices and their applications

### Unit-II

**2D Graphics Programming:** Pixel operations and drawing algorithms, color models (RGB, CMYK, HSL), pixel operations (blending, interpolation), Line drawing algorithms (Digital differential analyzer algorithm, Bresenham's line drawing algorithm), Circle drawing algorithms (Midpoint circle algorithm, Bresenham's circle drawing algorithm).

**2D Transformations:** translation, rotation, scaling in 2D space, mirror reflection basic and advance problems involving composite operations.

**Windowing techniques:** basic terminologies-window, viewport, clipping window, region codes.

### Unit-III

**Clipping techniques:** Mathematics of point clipping, line clipping (midpoint subdivision method, Cohen-Sutherland line clipping algorithm), polygon clipping (Sutherland-Hodgman polygon clipping algorithm)

**3D Graphics Programming:** 3D transformations, Translation, Rotation, Scaling in 3D space, Homogeneous coordinates and transformations.

**Projection techniques:** Orthographic projection, Perspective projection and vanishing points

### Unit-IV

**Lighting and shading models:** Phong reflection model, Gouraud and Phong shading techniques

**Hidden surface removal algorithms:** Z-buffer algorithm, Scan line algorithm for hidden surface removal

**Texture mapping and image rendering:** Texture coordinates and mapping techniques, Texture filtering and mipmapping.

#### Suggested Readings:

- J. F. Hughes, A. van Dam, M. McGuire, D. F. Sklar, and J. D. Foley: Computer Graphics: Principles and Practice, Addison-Wesley.
- D. Shreiner, G. Sellers, J. M. Kessenich, and B. M. Licea-Kane: OpenGL Programming Guide: The Official Guide to Learning OpenGL, Addison-Wesley.
- D. Hearn and M. P. Baker: Computer Graphics with OpenGL, Pearson.
- E. Angel and D. Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, Addison-Wesley.
- F. Klawonn: Introduction to Computer Graphics: Using Java 2D and 3D, Springer.

#### Useful Video Links:

Unit No.	Topics	Links
Unit-I	Introduction to Computer Graphics	<a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec1.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec1.html</a>
	Raster Graphics	<a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec2.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec2.html</a>
Unit-II	2D Transformations	<a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec6.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec6.html</a>
	Composite Transformations	<a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec7.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec7.html</a>
Unit-III	Clipping	<a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec8.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec8.html</a>
	Polygon Clipping	<a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec9.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec9.html</a>
Unit-IV	Illumination Models	<a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec17.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec17.html</a>
	Shading Techniques	<a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec18.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec18.html</a>

Course Code	<b>LC-BCA-212A</b>			
Category	Discipline-Specific Courses –Major Courses			
Course Title	<b>Computer Graphics Lab</b>			
Scheme and Credits	L	T	P	<b>Credits</b>
	0	0	2	<b>1</b>
	<b>Semester IV</b>			
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To develop a foundational understanding of 2D graphics concepts and algorithms such as line and circle drawing, transformations, and clipping techniques.</li> <li>To enable students to apply and implement computer graphics algorithms for visualizing geometric transformations, object rendering, and graphical manipulations using programming.</li> </ul>			
Assessment	10 Marks			
End Semester Examination	15 Marks			
Total	25 Marks			
Duration of Exam	03 Hours			

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply basic computer graphics algorithms such as DDA, Bresenham's line and circle drawing to construct and render 2D primitives.	Level 3: Apply
CO2	Implement 2D geometric transformations such as translation, rotation, scaling, reflection, and shearing on graphical objects.	Level 4: Analyze
CO3	Analyze and compare different line and polygon clipping algorithms, and implement solutions to clip graphics primitives within a defined window.	Level 5 Evaluate
CO4	Evaluate the effect of various transformations and coloring techniques in rendering graphical scenes.	Level 6 Create

Exp. no.	Contents
1.	Implement a program to define and use basic graphics primitives such as points, lines, and polygons.
2.	Implement a program to draw a line using the Digital Differential Analyzer (DDA) algorithm.
3.	Create a program to draw a line using Bresenham's line drawing algorithm.
4.	Write a program to draw a circle using the Midpoint Circle algorithm.
5.	Implement a program to draw a circle using Bresenham's circle drawing algorithm.
6.	Create a program to perform 2D transformations: translation, rotation, and scaling on a given set of points.
7.	Write a program to perform mirror reflection of a 2D shape across the x-axis and y-axis.

<b>8.</b>	Create a program to draw basic two-dimensional objects like rectangles, triangles, and polygons using inbuilt functions
<b>9.</b>	Write a program to implement the Cohen-Sutherland line clipping algorithm to clip a line within a rectangular clipping window.
<b>10.</b>	Write a program to apply a shearing transformation to a 2D object (like a square or triangle) and display the original and transformed objects
<b>11.</b>	Write a program to apply various coloring techniques to 2D pictures..
<b>12.</b>	Write a program to implement line clipping using the Cohen-Sutherland line clipping algorithm

Course Code	MICV-208A				
Category	Discipline Specific course-Minor Course				
Course Title	<b>Managerial Skills</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester-IV</b>
	3	1	0	<b>4</b>	
Course Objectives	<p>The objectives of this course are</p> <ul style="list-style-type: none"> <li>To understand and apply key managerial skills, with a focus on coordination, interpersonal roles, and effective management techniques.</li> <li>To learn problem-solving strategies, foster creativity, and understand the importance of empowerment and delegation in management.</li> <li>To understand team-building, group behavior, and leadership skills, using techniques like brainstorming and sensitivity training.</li> <li>To improve communication skills, conduct meetings and interviews, and develop self-confidence and motivational skills for managerial effectiveness.</li> </ul>				
Assessment	30 Marks				
End Semester Examination	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	<b>Define</b> key concepts of managerial skills, problem-solving, team dynamics, and communication.	Level-1: Remember
CO2	<b>Explain</b> the significance of managerial skills in fostering effective management.	Level-2: Understand
CO3	<b>Apply</b> managerial skills in the context of delegation and empowerment, group Dynamics and communication styles in organizational problem solving.	Level-3: Apply
CO4	<b>Analyze</b> managerial skills in the context of delegation and empowerment, group Dynamics and communication styles in organizational decision making.	Level-4: Analyze

**Note:** Examiner will set nine questions in total. Question one will have 7 short questions of 2 marks (each) from all units. Remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first question being compulsory and selecting one from each Unit.

### Unit-I

**Introduction to managerial skills:** Meaning and concept of managerial skills, Need and its importance, Techniques of skill development for effective management, Application of management skills, Coordination and Interpersonal roles.

## Unit-II

**Problem-solving:-** Problem-solving, creativity, innovation, steps of analytical problem solving, limitations of analytical problem solving, impediments of creativity, multiple approaches to creativity.

**Empowering and delegating:-** Meaning of empowerment, dimensions of empowerment, how to develop empowerment, inhibitors of empowerment, delegating works.

## Unit-III

**Teams and Groups:** Team Building, developing teams and teamwork, advantages of a team, leading a team, team membership, Group Dynamics, Group Behavior, Cohesion, Importance of Brain Storming, Sensitivity Training, Nominal Group techniques, Leadership and competence development.

## Unit-IV

**Communication:** Process of communication, Need and Importance of communication skills, Types of communication, conduct of meetings, Interviews, reporting of projects, reporting of case analysis, Building self-confidence, Role of motivation skills in developing managers

### Suggested Readings:

- Essentials of Management by Herald Koontz, Weihrich and Cannice, Tata-Mc Graw Hill Publishing House.
- Management by A. E. James Stoner, Freeman, Gilberth, Pearson Publishing House.
- Management by Robbins, Coulter, Fernandez Pearson Publishing House.
- Principles of Management by L. Richard Daft., Cengage Learning India.
- Managerial Skills by V.S.P. Rao Excel Books, New Delhi.
- Developing Management skills by David A Whetten, Cameron, PHI.
- Managerial Skills by Ramnik Kapoor Path Makers, Bangalore
- Skills development for Business and Management Students by Kevin Gallagher, Oxford.
- Business Communication Strategies by Monipally, Mutthukutty Tata Mc GrawHill.
- Organisational Behaviour by P. Robbins Stephen, Pearson.

### Useful Video Links:

Unit No	Topics	Links
Unit-I	Introduction to managerial skills	<a href="https://www.youtube.com/watch?v=iYzpESZbuQQ">https://www.youtube.com/watch?v=iYzpESZbuQQ</a>
Unit-II	Problem-solving	<a href="https://www.youtube.com/watch?v=hiqoCvPs_Jc">https://www.youtube.com/watch?v=hiqoCvPs_Jc</a>
Unit-III	Teams and Groups	<a href="https://www.youtube.com/watch?app=desktop&amp;si=zavzAEqML949-6rt&amp;v=uG-FLOi4OOU&amp;feature=youtu.be">https://www.youtube.com/watch?app=desktop&amp;si=zavzAEqML949-6rt&amp;v=uG-FLOi4OOU&amp;feature=youtu.be</a>
Unit-IV	Communication	<a href="http://kcl.digimat.in/nptel/courses/video/109104031/L01.html">http://kcl.digimat.in/nptel/courses/video/109104031/L01.html</a>

Course code	VAC-202A				
Category	Value Added Courses				
Course Title	<b>Wellbeing Through Yoga</b>				
Scheme and Credits	L	T	P	Credits	Semester-IV
	2	0	0	2	
Course Objectives	<p>The objectives of this course are:</p> <ul style="list-style-type: none"> <li>To understand the basic concepts, philosophy, and importance of Yoga for holistic health.</li> <li>To explore the role of Asanas in improving physical wellbeing and overall fitness.</li> <li>To understand the benefits of Pranayama and Bandhas for physical health and energy regulation.</li> <li>To learn meditation and Mudras for enhancing mental wellbeing and mindfulness</li> </ul>				
Assessment	15 Marks				
End Semester Examination	35 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	<b>Define</b> the fundamental concepts, history, and philosophy of Yoga, including Ashtanga and Hatha Yoga.	Level-1Remember
CO2	<b>Explain</b> the role of Asanas, Pranayama, Bandhas, and Mudras in promoting physical and mental wellbeing.	Level-2Understand
CO3	<b>Apply</b> Yogic practices such as Asanas, breathing techniques, and meditation for improving physical health, mental balance, and overall wellness.	Level-3Apply
CO4	<b>Apply</b> the interconnection between mind, body, and spirit to manage stress, mindfulness, and holistic health.	Level-3 Apply

**Note:** Examiner will set nine questions in total. Question one will have 7 short questions of 1 marks (each) from all units. Remaining eight questions of 7 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first question being compulsory and selecting one from each Unit.

### Unit-I

**Introduction to Yoga:-**History and Philosophy of Yoga, Ashtanga Yoga & Hatha Yoga, Importance of Yoga.

### Unit-II

**Physical Wellbeing through Asanas:-** Basics of human physiology & anatomy, Benefits of Asanas in Physical Health, Practice of some important Asanas (Vrikshasana, Utkatasana, Padahasthasana, Trikonasana, Veerasana,, BaddhaPadamasana, UttithaPadamasana, PawanmuktasanaMandukasana,

Uttanmandukasana, Pashimottanasana, Matsyasana, Naukasana, Uttanpadasana, Sarvangasana, Halasana, Bhujangasana, Shalabhasana, Dhanurasana, Makarasana, Shavasana).

### Unit-III

**Physical Wellbeing through Pranayama and Bandhas:** - Introduction to Pranayama and its Benefits, Basic Breathing Exercises (Puraka, Rechaka and Kumbhaka, Anulom Vilom, Bhastrika Bhramari, Kapalbhathi), Introduction to Bandhas and their practical procedure.

### Unit-IV

**Mental Wellbeing through Meditation and Mudras:-** Connection between Mind, Body, and Spirit, Benefits of Meditation on Mental Health, Benefit of Mudras for Meditation, Introduction to Mudras and their practical procedure, Guided Meditation Sessions (Mindfulness, Loving-kindness).

#### Suggested Readings:

- The Heart of Yoga: Developing a Personal Practice by T.K.V. Desikachar.
- Light on Yoga by B.K.S. Iyengar.
- Yoga in daily life by Kiss Josie Orient paper, New Delhi.
- History of yoga by S P Singh, PHISPC Centre for studies of civilization.
- Ashtanga Yoga by Swami Devavrata, Arsha Yoga Sansthan, Mirzapur, Faridabad.
- Ashtanga Yoga by Dr. Jagwanti Deswal.
- Yogavidya: Ek Adhyayan by Dr. Surendra Kumar.

#### Useful Video Links:

Unit No.	Topics	Links
Unit-I	Ashtanga Yoga	<a href="http://www.digimat.in/nptel/courses/video/110101165/L60.html">http://www.digimat.in/nptel/courses/video/110101165/L60.html</a>
Unit-II	Benefits of Asanas in Physical Health	<a href="https://youtu.be/rmTB7uaFOfs?si=3Dq3IME4q0MNFFog">https://youtu.be/rmTB7uaFOfs?si=3Dq3IME4q0MNFFog</a>
Unit-III	Pranayama Practices and Conscious Breathing	<a href="http://www.digimat.in/nptel/courses/video/110101165/L76.html">http://www.digimat.in/nptel/courses/video/110101165/L76.html</a>
Unit-IV	Meditation and Mindfulness	<a href="http://digimat.in/nptel/courses/video/109105199/L27.html">http://digimat.in/nptel/courses/video/109105199/L27.html</a>

Course Code	<b>VAC-204A</b>			
Category	Value Added Courses			
Course Title	<b>Communication Skills</b>			
Scheme and Credits	L	T	P	<b>Credits</b>
	2	0	0	<b>2</b>
Course Objectives	<p>The objectives of this course are:</p> <ul style="list-style-type: none"> <li>• To understand the basics of listening, speaking, reading, writing, and non-verbal communication.</li> <li>• To explore effective communication techniques and language skills.</li> <li>• To understand basic computer skills, digital platforms, social media, and digital marketing.</li> <li>• To learn ethical, safe, and responsible use of digital technologies and online communication.</li> </ul>			
Assessment	15 Marks			
End Semester Examination	35 Marks			
Total	50 Marks			
Duration of Exam	03 Hours			

**Course Outcomes:** After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	<b>Define</b> the fundamental concepts of listening, speaking, reading, writing, non-verbal communication, and digital literacy.	Level-1 Remember
CO2	<b>Explain</b> effective communication skills, basic computer applications, social media usage, digital marketing concepts, and cybersecurity principles.	Level-2 Understand
CO3	<b>Apply</b> language skills, non-verbal communication techniques, digital tools, and online platforms for effective academic and professional communication.	Level-3 Apply
CO4	<b>Apply</b> written, spoken, and digital information to ensure ethical communication, informed decision-making, and secure digital practices.	Level-3 Apply

**Note:** Examiner will set nine questions in total. Question one will have 7 short questions of 1 marks (each) from all units. Remaining eight questions of 7 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first question being compulsory and selecting one from each Unit.

### Unit-I

**Listening:-**Techniques of Effective Listening, Listening and Comprehension, Probing Questions, Barriers to Listening

**Speaking:-**Pronunciation, Enunciation, Vocabulary, Fluency, Common Errors.

### Unit-II

**Reading:** - Techniques of Effective Reading, Gathering Ideas and Information from a Given Text, Evaluating these Ideas and Information, Interpreting the Text.

**Writing:** - The Writing Process, Effective Writing Strategies, Different Modes of Writing.

### Unit-III

**Basic Computer Skills:** - Introduction to Microsoft (MS) Office Suite, Open Educational Resources, Basic Virtual Platforms, Trending Technologies, Machine Learning, Artificial Intelligence (AI), Internet of Things (IoT).

**Social Media:** - Introduction to Social Media Websites, Advantages of Social Media, Ethics and Etiquettes of Social Media, How to Use Google Search Better? Effective Ways of Using Social Media.

**Digital Marketing:** - Introduction to Digital Marketing, Traditional Marketing versus Digital Marketing, Digital Marketing Tools, Social Media for Digital Marketing, Digital Marketing Analytics.

**Digital Ethics and Cyber Security:** - Digital Literacy Skills, Digital Etiquette, Digital Life Skills; Cyber Security: Understanding and introducing the environment of security, Types of attacks and attackers, the art of protecting secrets.

### Unit-IV

**Non-Verbal Communication:-** Meaning of nonverbal communication, Advantages of using nonverbal communication, Introduction to modes of nonverbal communication, Open and Closed body language, Eye contact and Facial expression, Hand gestures, Do's and Don'ts in NVC, Learning from experts, Activities-based learning.

#### Suggested Readings:

- Ahmed, R. (2015. June 18). Five essential listening skills for English learners. British Council. [https://www.britishcouncil.org/voices-magazine/five-essential-listening skills-Englishlearners](https://www.britishcouncil.org/voices-magazine/five-essential-listening-skills-Englishlearners).
- Skills You Need. (n.d.). Barriers to Effective Listening. Skills You Need. <https://www.skillsyouneed.com/ips/ineffective-listening.html>.
- Weiler, A. (2017. October 7). How to Improve English Pronunciation. Strategies in language learning. <https://www.strategiesinlanguagelearning.com/how-to-improve-englishpronunciation/>.
- Kirkham, L. (2022. February 16). How to Enunciate. Wiki how. <https://www.wikihow.com/Enunciate>.
- English for everyone. (n.d.). Homonyms, Homographs, and Homophones. English for everyone. <https://englishforeveryone.org/PDFs/Homonyms,%20Homographs,%20Homophones.pdf>.
- British Council. (n.d.). Learn English Teens. British Council. <https://learnenglishteens.britishcouncil.org/exams/speaking-exams/fluency>.
- Snyder, M. S. (2016. August 16). Oops, Did I Say That? 15 Common English Mistakes You Never Noticed Before. Fluentu. <https://www.fluentu.com/blog/english/common-mistakes-inEnglish>.
- Hogue, Ann. 1995. First Steps in Academic Writing. Pearson Longman.
- Taylor, Shirley. 2006. Communication for Business. Pearson Education.

#### Useful Video Links:

Unit No.	Topics	Links
Unit-I	Listening Skills	<a href="http://digimat.in/nptel/courses/video/109104031/L10.html">http://digimat.in/nptel/courses/video/109104031/L10.html</a>
Unit-II	Principles of Effective Writing	<a href="https://youtu.be/4bKe2mvKUIA?si=FV3_z7l1jw9nck2S">https://youtu.be/4bKe2mvKUIA?si=FV3_z7l1jw9nck2S</a>
Unit-III	Digital Marketing	<a href="https://youtu.be/Gl6mJFvIKgI?si=nD_hE4A4V30V_UA0">https://youtu.be/Gl6mJFvIKgI?si=nD_hE4A4V30V_UA0</a>
Unit-IV	Non-Verbal Communication	<a href="http://digimat.in/nptel/courses/video/109104031/L05.html">http://digimat.in/nptel/courses/video/109104031/L05.html</a>

Course code	<b>AEC-202A</b>				
Category	Ability Enhancement Course				
Course title	<b>Hindi-II</b>				
Scheme and Credits	L	T	P	Credits	<b>Semester-IV</b>
	2	0	0	2	
Course Objectives	<p>The objectives of this course are</p> <ol style="list-style-type: none"> <li>1. पत्र-लेखन और पत्रकारिता कौशल विकसित करना तथा प्रभावी भाषा अभिव्यक्ति सिखाना।</li> <li>2. प्रूफ-रीडिंग कौशल, भाषा-शुद्धि क्षमता और त्रुटि पहचान दक्षता विकसित करना।</li> <li>3. साक्षात्कार तकनीक, भाषा-प्रस्तुतीकरण और प्रभावी संचार कौशल में दक्ष बनाना।</li> <li>4. जीवन-कौशल, व्यक्तित्व विकास, आत्मविश्वास और निर्णय-क्षमता को सुदृढ़ करना।</li> </ol>				
Assessment	15 Marks				
End Semester Exam	35 Marks				
Total Marks	50				
Duration of Exam	03 Hours				

**Course Outcomes:** After studying this course, the students will be able to

CO	Skills Demonstrated	RBT Level
CO1	पत्र-लेखन, प्रूफरीडिंग, साक्षात्कार तथा जीवन-कौशल की मूल अवधारणाएँ पहचानना।	Level 1: Remember
CO2	पत्र-लेखन, प्रूफरीडिंग, प्रस्तुतीकरण और जीवन-कौशल का महत्व समझकर व्याख्या करना।	Level 2: Understand
CO3	पत्र-लेखन, प्रूफरीडिंग, संप्रेषण और जीवन-कौशल को व्यावहारिक परिस्थितियों में लागू करना।	Level 3: Apply
CO4	पत्र, प्रूफ, प्रस्तुतीकरण और जीवन-कौशल तत्वों का विश्लेषण कर प्रभाव बढ़ाना।	Level 4: Analyze

Note: Examiner will set Nine questions in total. Question one will have 07 short questions of 1 mark (each) from all units. Remaining eight questions of 7 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first question being compulsory and selecting one from each Unit.

Unit No.	Content
<b>Unit-I</b>	<b>पत्रकारिता</b> का अर्थ, उद्भव और विकास, वर्तमान समय में पत्रकारिता का महत्व, हिंदी पत्रकारिता में रोजगार की संभावनाएँ, समाचार लेखन, रिपोर्टिंग, प्रेस विज्ञप्ति, समाचार लेखक की भाषा, समाचार लेखक का वैचारिक उत्कर्ष, हिंदी भाषा संवर्धन में पत्रकारिता का योगदान
<b>Unit-II</b>	<b>प्रूफ संशोधन</b> की परिभाषा, प्रूफ शोधक के आवश्यक गुण, प्रूफ के प्रकार, प्रूफ संशोधन के महत्वपूर्ण चिह्न, प्रूफ रीडर के लिए आवश्यक सावधानियाँ, प्रूफ संशोधन में रोजगार, प्रूफ संशोधन का हिंदी भाषा संवर्धन में महत्व
<b>Unit-III</b>	<b>साक्षात्कार</b> का अर्थ, परिभाषा एवं स्वरूप: कैरियर में साक्षात्कार कौशल का महत्व, समालाप्य की भाषा, संप्रेषण: अर्थ, परिभाषा एवं प्रक्रिया: भाषा – संप्रेषण के चरण: श्रवण, अभिव्यक्ति, वाचन, लेखन: संप्रेषण को प्रभावी बनाने के नियम
<b>Unit-IV</b>	<b>जीवन कौशल</b> का अर्थ एवं स्वरूप: जीवन कौशल की विशेषताएँ, जीवन कौशल की आवश्यकता एवं महत्व, जीवन कौशल के आधार: स्वावलंबन, सहयोगपूर्ण भावना, समस्या समाधान की योग्यता, ज्ञानार्जन की प्रवृत्ति, कुशाग्रता, चातुर्य, मधुर भाषी, संवेदनशील, स्वदृजागरूक, अन्वेषणात्मक दृष्टिकोण, उदात्त सुदृढ़ – मनोबल, निश्चयात्मकवृत्ति:

### प्रेरणास्पद पुस्तकें

1. डॉ० हरिश्चन्द्र वर्मा, भाषा और भाषाविज्ञान, लक्ष्मी पब्लिशिंग हाऊस, रोहतक 3.
2. सम्पा० कालिका प्रसाद, राजवल्लभ सहाय, मुकुन्दीलाल श्रीवास्तव, बृहत् हिन्दी कोश: ज्ञानमण्डल लिमिटेड, वाराणसी
3. मुख्य सम्पादक, डॉ० लक्ष्मीनारायण शर्मा, परिशोध, मानव – मूल्य विशेषांक, 1993
4. डॉ० धर्मपाल मैनी, भारतीय जीवनमूल्य, भारतीय संस्कृति संस्थान, गुडगाँव
5. बृहत् प्रशासन शब्दावली, हिन्दी-अंग्रेजी, वैज्ञानिक तथा तकनीकी शब्दावली आयोग, नई दिल्ली-110

### Useful Video links:

Unit No	Topics	Links
Unit-I	पत्रकारिता	<a href="https://www.youtube.com/watch?v=WL_hsThX7c8">https://www.youtube.com/watch?v=WL_hsThX7c8</a>
Unit-II	प्रूफ संशोधन	<a href="https://www.youtube.com/watch?v=VLXq3EXOHQI">https://www.youtube.com/watch?v=VLXq3EXOHQI</a>
Unit-III	साक्षात्कार	<a href="https://www.youtube.com/watch?v=0QfVFZnAJks">https://www.youtube.com/watch?v=0QfVFZnAJks</a>
Unit-IV	जीवन कौशल	<a href="https://www.youtube.com/watch?v=Fwm-HjQ6060">https://www.youtube.com/watch?v=Fwm-HjQ6060</a>