

END TERM EXAMINATION

FIRST SEMESTER [MCA] DEC 2025-JAN 2026

Paper Code: MCA-101

Subject: Discrete Structures

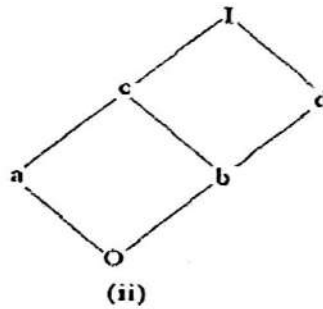
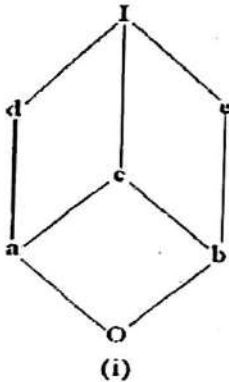
Time: 3 Hours

Maximum Marks: 60

Note: Attempt any five questions in all including Q.No.1 which is compulsory. Attempt one question from each unit.

Q1 Answer all the following questions briefly:- (2×10=20)

- a) Show that $(A-B) \cap B = \emptyset$
- b) In a class of 20 students, consisting of 12 boys and 8 girls, how many ways can a group of 4 students be selected such that at least one girl is included?
- c) Prove that for all integers $n \geq 1$, $5^n - 1$ is divisible by 4.
- d) Using the following true statements, locate the treasure hidden in the estate. If the house is next to lake, then the treasure is not in the kitchen. If the tree in front yard is a mango tree, then the treasure is in the kitchen. The house is next to lake. The tree in the front yard is a mango tree or the treasure is in the drawing room.
- e) Show that the identity element in a group is unique
- f) Using Fermat's Little Theorem, check whether $n=33$ is prime by testing it with base $a=2$.
- g) If R is the relation on the set of positive integers such that $(a, b) \in R$ if and only if $a^2 + b$ is even, prove that R is an equivalence relation.
- h) Check the following lattice is distributive or not?



- i) Define Konigsberg bridge problem and draw the graph of the problem.
- j) Given the expression $P \rightarrow (Q \wedge R)$, Evaluate its CNF and DNF form.

UNIT-I

- 22-21 In how many ways can 20 students out of a class of 30 be selected for an extracurricular activity, if: (5)
- i. Rama refuses to be selected.
 - ii. Raja insists on being selected.
 - iii. Gopal and Govind insists on being selected.
 - iv. Either Gopal or Govind or both get selected.
 - v. Just one or Gopal and Govind gets selected.

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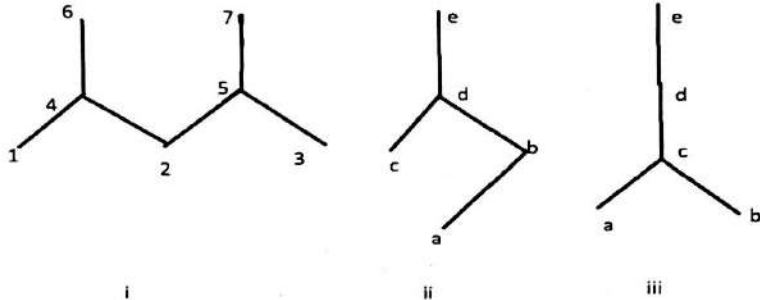
- Q2 b) Let $A = \{1, 2, 3, 4, 5\}$ and $R = \{(1, 2), (1, 3), (2, 4), (3, 5)\}$. Find the (5)
- Reflexive closure of R
 - Symmetric closure of R
 - Transitive closure of R using Warshals' algorithm.

- Q3 a) Among the first 1000 positive integers: (5)
- Determine the integers which are not divisible by 5, nor by 7, nor by 9
 - Determine the integers divisible by 5, but not by 7, not by 9
- b) Find the particular solution of the difference equation $a_r - a_{r-1} = 7r$. (5)

UNIT-II

- Q4 a) i. Test the validity of following argument. If I will select in IAS examination, then I will not be able to go to London. Since I am going to London, I will not select in IAS examination. (5)
- ii. Prove that the following is a tautology $A \vee (B \wedge C) = (A \vee B) \vee C$ (5)
- b) Determine the set D50 and relation divides to be partial order relation (5)
- Draw Hasse diagram for D50.
 - Determine upper bounds, lower bounds, GLB and LUB of 5 and 10.
 - Determine greatest and least element of D50
 - Is D50 a lattice. Justify

- Q5 a) Determine whether the posets shown below are lattices or not. Justify (5)



- b) Draw K map and simplify the following Boolean expression (5)
- $$ABC'D + A'BCD + A'B'C' + A'B'D' + AC' + AB'C + B'$$

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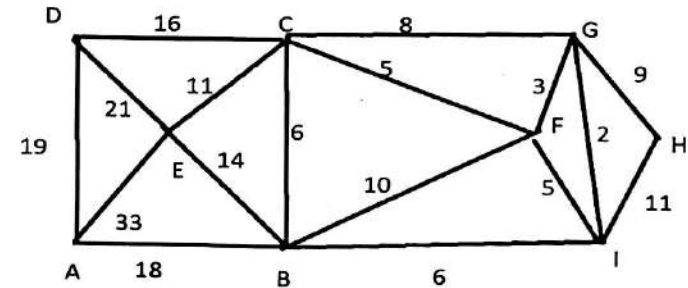
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UNIT-III

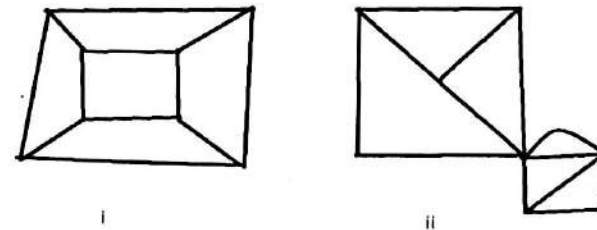
- Q6 a) Consider the algebraic system $(Q, *)$, where Q is set of rational numbers and * is defined by $a*b = a + b - ab$, For all $a, b \in Q$ (5)
- b) Determine $\gcd(a, b)$. Find s and t such that $\gcd(a, b) = s.a + t.b$, where $a=56$ and $b = 98$ (5)
- Q7 a) Let G be a finite group and H be a subgroup of G. For $a \in G$, define $aH = \{ah | h \in H\}$ (5)
- Show that $|aH| = |H|$
 - Show that every pair of elements, $a, b \in G$ either $aH=bH$ or aH and bH are disjoint
 - Use the above to argue that the order of H must divide the order of G
- b) Consider two distinct prime numbers $p= 37$ and $q=41$. Apply the RSA algorithm to find the public key and private key. (5)

UNIT-IV

- Q8 a) A connected graph has 12 edges and 6 vertices, each of which has degree 2 or 5. How many vertices are of each degree. (5)
- b) Use Dijkstra's algorithm to find the shortest path between A and H in the given graph. (5)



- Q9 a) Determine for the graphs given in figures below the edge connectivity and vertex connectivity (5)

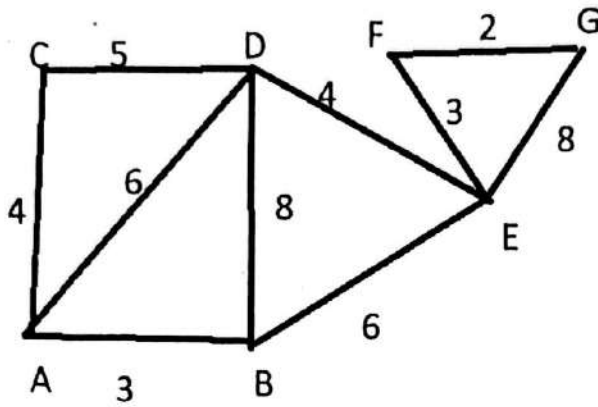


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- b) Using Kruskal's algorithm Find the minimal spanning tree for the following graph (5)



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END TERM EXAMINATION

FIRST SEMESTER [MCA] DEC 2025-JAN 2026

Paper Code: MCA-105

Subject: Operating Systems with Linux

Time: 3 Hours

Maximum Marks: 60

Note: Attempt all questions as directed. Internal choice is indicated.

(4×5=20)

- Q1. Attempt any four of the following questions:
- Describe operating system and its components.
 - Explain kernel and its types. How kernel is different from operating system?
 - Discuss producer-consumer problem with its solution through semaphore.
 - Differentiate between busy waiting and blocked waiting. Elaborate process synchronization through counting semaphore.
 - What external fragmentation in memory? Explain various approaches used to address the issue of external fragmentation.
 - Explain virtual memory and its importance in an operating system. How virtual memory can be implemented in an operating system?
 - Explain file system and various operations performed on a file.
 - Differentiate between single-level and two-level directory. Discuss the approaches used for directory implementation.
- Q2. (a) Explain the following types of operating systems: (a) batch operating system, (b) multi-programmed operating system, (c) time-shared operating system, (d) real-time operating system, and (e) distributed operating system. (5)
- (b) Describe inter-process communication and different mechanisms to implement inter-process communication. (5)

OR

- Q3. (a) Explain various services offered by an operating system. (5)
- (b) Describe system call and its types. Implement the following systems calls (with syntax in 'C' programming): (a) access, (b) creat, and (c) chmod. (5)
- Q4. (a) Differentiate between long-term scheduler and short-term scheduler. Identify the need of medium-term scheduler. (5)
- (b) Explain the Bakery algorithm for process synchronization. List the advantages and limitations of the Bakery algorithm. (5)

OR

- Q5. (a) Differentiate between zombie and orphan processes in Linux. Write a 'C' program to fork a new process which executes another 'C' program (which simply displays the calendar of current month). (5)

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- (b) Explain multilevel queue scheduling. A uniprocessor computer system has three processes, which alternate 20ms CPU bursts with 80ms I/O bursts. All the processes were created at nearly the same time. The I/O of all the processes can proceed in parallel. Determine the CPU utilization (over a long period of time) using FCFS and Round Robin (time quantum 10ms) for this system. (5)
- Q6. (a) Describe different types of addressing binding approaches. Illustrate the process of dynamic linking. (5)
- (b) Illustrate the working of translation look-aside buffer (TLB) in demand paging. List the advantages of TLB. (5)

OR

- Q7. (a) List the characteristics of deadlock. Discuss the approaches used for detection of deadlock with single and multiple instances of resources. (5)
- (b) What is page table? Consider a system with 35 bits LA, 32 bits PA, 4KB page size, and each table entry contains 2 protection bits, 1 valid/invalid bit, and 1 modified bit along with frame number, determine the size of page table. (5)
- Q8. (a) Explain disk management. Discuss various levels of RAID to addresses the performance and reliability issues. (5)
- (b) Compare CLV and CAV. Consider the page reference string 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2 with 4-page frames. Find number of page faults using least-recently-used algorithm. (5)

OR

- Q9. (a) Illustrate contiguous disk space allocation approach with its advantages and disadvantages. (5)
- (b) Compare Look and C-Look disk-scheduling algorithms. A disk queue requests for I/O to blocks on cylinders 98, 183, 37, 122, 14, 124, 65, 67. Determine the total head movement (in cylinders) if the disk head is initially at cylinder 53 and the disk arm is moving toward 199. (5)

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FIRST SEMESTER [MCA] DECEMBER 2025

Paper Code: MCA-107

Subject: Database Management Systems

Time: 3 Hours

Maximum Marks: 60

Note: Attempt all questions as directed. Internal Choice is indicated.
Attempt any one question from each Unit.

- Q1 Answer **any four** of the following questions:- (4x5=20)
- (a) Explain how logical and physical data independence improve database design flexibility.
 - (b) Write a detailed note on the domain and key constraint.
 - (c) Evaluate the differences between Relational Algebra and SQL.
 - (d) Discuss with an example DML, DDL, DCL, TCL
 - (e) Explain functional dependency, and how is it used in database normalization?
 - (f) Discuss the basic structure of a PL/SQL block and briefly explain its main sections.
 - (g) Discuss checkpoints in log-based recovery, and why it is important in transaction recovery.
 - (h) Explain deadlock in transaction processing. How can a DBMS detect and handle deadlocks?

UNIT-I

- Q2 (a) Analyze how the concept of data independence is implemented in the three-level DBMS architecture. (5)
- (b) Evaluate the impact of schema design decisions (for example, choice of primary keys, normalization level, and constraints) on the performance and maintainability of a database system. Provide real-world reasoning. (5)
- Q3 (a) Design an ER diagram for a hospital management system to store information about doctors, patients, and appointments. Include entities, relationships, cardinalities, and necessary attributes. (5)
- (b) Explain the extended ER model with the help of generalization, specialization and Aggregation. (5)

UNIT-II

- Q4 (a) Explain the usage of reduced function, and how this function helps in empowering the users to perform aggregation and other tasks. (5)
- (b) Evaluate the effectiveness of aggregate functions versus subqueries when generating summarized results (e.g., total sales per region). Under what circumstances would you prefer one approach over the other, and why? (5)
- Q5 (a) How do NoSQL databases redefine data management, and in what ways do their functions enhance scalability and performance in any developed applications? (5)
- (b) Assess the significance of JOIN operations in comparison with SET operations (UNION, INTERSECT, MINUS) for combining data from multiple tables. Discuss their relative advantages and limitations using suitable examples. (5)

UNIT-III

- Q6 (a) Develop a PL/SQL stored procedure that accepts a department ID and increases the salary of all employees in that department by 10%. Include necessary exception handling. (5)
- (b) For given relation $R = \{A, B, C, D, E\}$, FDs = $\{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$. Find Primary Key and Normalize till 3NF. (5)

- Q7? (a) Consider the relation $R(A, B, C, D, E)$ with the following Functional Dependencies (FDs): (5)
- $A \rightarrow BC$
 $CD \rightarrow E$
 $B \rightarrow D$

The relation R is decomposed into the following sub-relations:

- $R_1(A, B, C)$
 $R_2(B, D)$
 $R_3(C, D, E)$

Evaluate whether this decomposition is lossless or lossy. Justify your answer.

- (b) Consider the relation $R(A, B, C, D)$ with the following Functional Dependencies (FDs): (5)
- $A \rightarrow B$
 $B \rightarrow C$
 $C \rightarrow D$

The relation R is decomposed into the following sub-relations:

- $R_1(A, B)$
 $R_2(B, C)$
 $R_3(C, D)$

Evaluate whether this decomposition is dependency preserving or not.

UNIT-IV

- Q8 (a) What are object-oriented database management systems and distributed DBMS? Explain their key features and also give an overview of basic database security concepts. (5)
- (b) Discuss concurrency control techniques in DBMS. Explain locking protocols and timestamp ordering methods used to manage concurrent transactions. (5)
- Q9 (a) Evaluate different concurrency control techniques (locking, timestamp ordering, and optimistic concurrency). Which is more efficient in a high-contention environment and why? (5)
- (b) Describe log-based recovery mechanisms. How do checkpoints help in efficient recovery from transaction failures? (5)

END TERM EXAMINATION

FIRST SEMESTER [MCA] DECEMBER 2025

Paper Code: MCA-109

Subject: Object Oriented Programming and JAVA

Maximum Marks: 60

Time: 3 Hours

Note: Attempt all questions as directed. Internal choice is indicated.

- Q1 Attempt **any five** of the following questions: (4x5=20)
- a) What are Exceptions? Explain different type of exceptions in JAVA.
 - b) Explain TreeSet and TreeMap in JAVA with example.
 - c) Explain the concept of platform dependent and platform independent languages. Also, what is a platform?
 - d) What is the difference between Socket and ServerSocket? Explain in detail.
 - e) Write a logic to input a number from user and use this number to create a stack of coins. Remove the coins from stack three times (remove 2 coins, then 1 coin and then 3 coins). Then add the coins in stack two time (add 4 coins and then add 2 coins). Print the total coins left in the stack.
 - f) Differentiate between Process based multitasking and a thread-based multitasking. Also elaborate thread life cycle with example.
 - g) Explain nested class, inner class and method local inner class.
 - h) Differentiate between TCP and UDP connections? Also explain how is socket connection created in JAVA.
- Q2 a) What is Polymorphism? Differentiate between compile time and run-time polymorphism. Explain with appropriate examples. (10)
- OR**
- Q3 a) Explain the usage of final and abstract class. (5)
b) Write program to create a one-dimensional array that accepts numeric values. Find the smallest number and largest number in the array. (5)
- Q4 Differentiate between multitasking, multiprocessing and multithreading? Also explain what is a main thread? Can a main thread be started? Give example to support the answer. (10)
- OR**
- Q5 a) What is an interface? Write a program to explain the concept of multiple inheritance by using an interface. (5)
b) Explain how collection framework plays an important role in JAVA. Also, explain the hierarchy of collection framework. (5)
- Q6 Explain how to use adapter classes to implement event handling in JAVA with an Example. Also, design a simple paint program using event handling. Use mouse events to capture user input and draw shapes on the canvas. (10)
- OR**
- Q7 a) Explain the concept of anonymous class in JAVA with an appropriate real-world example. (5)
b) Discuss the features and advantages of Swing compared to AWT in JAVA GUI Development. Provide examples of components and functionalities unique to Swing. (5)

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Q8 What is JDBC? Explain JDBC Architecture. Also elaborate that why JDBC used when ODBC was already there? Write the connectivity steps and list the package and classes used for connectivity from JAVA to backend server. (10)

OR

- Q9 a) What is RMI? Explain RMI Architecture. Also explain what is stub and skeleton in RMI. (5)
- b) Write a program a to create a file that holds 10 sentences. Read the file and print the sentences on the screen line by line. (5)

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