OMR Answer Sheet No

Question Booklet Number

24/2341

B.C.A. (Second Semester) Examination, 2024

Booklet Code **D**

Fundamentals of Discrete Mathematics

Paper-V-A (Major)

(निम्न पूर्तियाँ परीक्षार्थी स्वयं भरें / To be filled in by the Candidate)

अनुक्रमांक (अंकों में) _____ [समय : 2 : 00 घण्टे
Roll No. (in figures) [Time : 2 : 00 Hours

अनुक्रमांक (शब्दों में) _____ [अधिकतम अंक : 75
Roll No. (in words) [Maximum Marks : 75

Enrolment No. (in figures) _____

कॉलेज का नाम _____ कक्ष निरीक्षक के हस्ताक्षर
Name of College Signature of Invigilator

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. इस प्रश्न-पुस्तिका में कुल 75 प्रश्न हैं। परीक्षार्थियों को सभी प्रश्न हल करना अनिवार्य है। दिये गये OMR उत्तर-पत्रक पर ही सभी प्रश्न हल करना है। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR उत्तर-पत्रक को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका, जिसमें कुछ भाग छपने से छूट गये हों या प्रश्न एक से अधिक बार छप गये हों या किसी भी प्रकार की कमी हो, उसे तुरन्त बदल लें।

(शेष निर्देश अन्तिम पृष्ठ पर)

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. This booklet contains 75 questions. Examinee have to attempt all questions. All questions attempt on the given OMR Answer Sheet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be immediately replaced.

(Remaining Instructions on last page)

1. In Euler's formula for planar graphs, what does VVV represent?
   (1) The number of edges
   (2) The number of faces
   (3) The number of vertices
   (4) The number of loops

2. According to Euler's formula, if a planar graph has 6 vertices, 10 edges, how many faces does it have?
   (1) 4
   (2) 6
   (3) 8
   (4) 1

3. What type of graphs does Euler's formula apply to?
   (1) All graphs
   (2) Planar graphs
   (3) Complete graphs
   (4) Bipartite graphs

4. Which of the following is a corollary of Euler's formula?
   (1) A connected planar graph with n vertices has at most 3n-6 edges.
   (2) The degree of each vertex in a planar graph is even
   (3) A connected planar graph with n edges has at most 3n-6 vertices
   (4) A planar graph cannot have more than 2n-4 faces

5. What is a Hamiltonian circuit?
   (1) A path that visits each vertex exactly once
   (2) A circuit that visits each edge exactly once
   (3) A path that visits each vertex and returns to the staring vertex
   (4) A circuit that visits each vertex and returns to the starting vertex

6. Which of the following is a necessary condition for a graph to be Hamiltonian?
   (1) The graph must be bipartite
   (2) The graph must have at least two vertices
   (3) The graph must be connected
   (4) The graph must be complete

7. Which of the following theorem provides a sufficient condition for a graph to be Hamiltonian?
   (1) Euler's theorem
   (2) Dirac's theorem
   (3) Kruskal's theorem
   (4) Floyd's theorem

P.T.O.

8. What is the difference between a Hamiltonian path and a Hamiltonian circuit?

(1) A Hamiltonian path visits every vertex exactly once and does not return to the starting vertex, while a Hamiltonian circuit does

(2) A Hamiltonian path visits every edge exactly once, while a Hamiltonian circuit visits every vertex exactly once

(3) A Hamiltonian path visits every vertex and returns to the starting vertex, while a Hamiltonian circuit visits every edge exactly once

(4) There is no difference

9. What is the Travelling Salesman Problem in relation to Hamiltonian graphs?

(1) Finding the shortest path that visits each vertex exactly once and returns to the starting vertex

(2) Finding the longest path that visits each vertex exactly once and returns to the starting vertex

(3) Finding the shortest path that visits each edge exactly once

(4) Finding the shortest circuit that visits each vertex exactly once and returns to the starting vertex

10. Which of the following graphs is always Hamiltonian?

(1) A complete graph K_n with $n \geq 3$

(2) A star graphs

(3) A bipartite graph

(4) A tree

11. Which of the following is a well-known Hamiltonian graph?

(1) Petersen graph

(2) Complete graph K_5

(3) Star graph $K_{1,5}$

(4) Path graph P_n

12. What is a tree in graph theory?

(1) A connected graph with no cycles

(2) A connected graph with exactly two cycles

(3) A disconnected graph with no cycles

(4) A graph with at least two disconnected components

13. How many edges does a tree with 10 vertices have?

(1) 8

(2) 9

(3) 10

(4) 11

14. What is the minimum number of vertices in a tree with 5 edges?

(1) 3

(2) 4

(3) 5

(4) 6

15. Which of the following statements about trees is true?

(1) Every tree is a complete graph

(2) Every tree is bipartite

(3) Every tree is planar

(4) Every tree is connected and acyclic

16. What is the maximum number of edges in a tree with 8 vertices?

(1) 7

(2) 8

(3) 9

(4) 10

17. Which of the following is a characteristic of a spanning tree of a graph G?

(1) It contains all vertices of G

(2) It contains all edges of G

(3) It contains the same number of vertices as G

(4) It contains exactly n+1edges where n is the number of vertices in G

18. Which of the following graphs is always a tree?

(1) Complete graph K_n

(2) Bipartite graph

(3) Cycle graph C_n

(4) Star graph

19. What is the height of a tree?

(1) The number of edges in the longest path between two vertices

(2) The number of vertices in the longest path between two vertices

(3) The number of levels in the tree

(4) The number of leaves in the tree

20. Which of the following operations is used to construct a minimum spanning tree of a weighted graph?

(1) Depth-first search

(2) Breadth-first search

(3) Prim's algorithm

(4) Dijkstra's algorithm

21. Which data structure is typically used to implement Depth-first search?

(1) Stack

(2) Queue

(3) Priority Queue

(4) Hash Table

22. Which of the following best describes the behaviour of Depth-first search, when traversing a graph?

(1) Explores nodes level by level

(2) Explores nodes from one neighbor to the next, depth wise

(3) Explores nodes in random order

(4) Explores nodes based on their weights

23. In Depth-first search, if a vertex has multiple neighbors, in what order are they visited?

(1) In ascending order of their labels

(2) In descending order of their labels

(3) In any arbitrary order

(4) In the order they are discovered

24. Which of the following data structures is used to keep track of visited vertices in Depth-first search to avoid processing them more than once?

(1) Array

(2) Queue

(3) Starck

(4) Hash Table

25. What is the main application of Depth-first search?

(1) Finding the shortest path in a graph

(2) Finding the longest path in a graph

(3) Finding connected components in a graph

(4) Sorting vertices in a graph

26. Which of the following is NOT a traversal order possible in Depth-first search for a given graph?

(1) Pre-order

(2) Post-order

(3) Level-order

(4) In-order

27. Which of the following is a subset of every set?

(1) The set itself

(2) The empty set

(3) A singleton set

(4) A finite set

28. If A={1, 2, 3} and B={2, 3, 4}, what is A∪B?

(1) {1, 2, 3}

(2) {2, 3, 4}

(3) {1, 2, 3, 4}

(4) {2, 3}

29. What is the power set of {a, b}?

(1) {a, b}

(2) {{a}, {b}}

(3) {{}, {a}, {b}, {a, b}}

(4) {a, b, {a, b}}

30. The Cartesian product A × B of sets A and B is:

(1) The set of all ordered pairs (a, b) where a∈A and b∈B

(2) The union of sets A and B

(3) The intersection of sets A and B

(4) The difference of sets A and B

31. If A={1, 2} and B={a, b}, how many elements are there in A×B?

(1) 2

(2) 4

(3) 6

(4) 8

32. Which of the following is not a relation?

(1) {(1, 2), (2, 3)}

(2) {(a, b), (b, c)}

(3) {1, 2, 3}

(4) {(x, y)|x<y}

33. If A={1, 2, 3} and R={(1, 2), (2, 3)}, which of the following statement is true?

(1) R is reflexive

(2) R is symmetric

(3) R is transitive

(4) R is antisymmetric

34. Which of the following is an example of a symmetric relation?

(1) $\{(1, 2), (2, 1), (2, 3)\}$

(2) $\{(a, b), (b, a)\}$

(3) $\{(x, y) \mid x=y\}$

(4) $\{(1, 2), (2, 3), (3, 1)\}$

35. Which of the following properties must a relation satisfy to be an equivalence relation?

(1) Reflexive, symmetric, and transitive

(2) Reflexive, symmetric, and antisymmetric

(3) Symmetric, antisymmetric, and transitive

(4) Reflexive, antisymmetric, and transitive

36. If $A=\{1, 2, 3\}$ and $B=\{4, 5\}$, what is $A-B$?

(1) $\{4, 5\}$

(2) $\{1, 2, 3, 4, 5\}$

(3) $\{1, 2, 3\}$

(4) $\{\}$

37. If $R=\{(1, 2), (2, 3), (3, 1)\}$, which property does R satisfy?

(1) Reflexive

(2) Symmetric

(3) Transitive

(4) None of the above

38. Which set is infinite?

(1) $\{1, 2, 3, 4\}$

(2) $\{a, b, c\}$

(3) The set of all even numbers

(4) $\{x|x<10\}$

39. What is the number of elements in the power set of $\{a, b, c\}$?

(1) 3

(2) 6

(3) 8

(4) 9

40. If $A=\{1, 2\}$, $B=\{3, 4\}$ and $C=\{1, 2, 3, 4\}$ then $(A\cup B)\cap C$ is:

(1) $\{1, 2, 3, 4\}$

(2) $\{1, 2\}$

(3) $\{3, 4\}$

(4) $\{1, 2, 3\}$

41. Which of the following is a null relation on a set A?

(1) $\{(x, x)|x\in A\}$

(2) $\{\}$

(3) $\{(x, y)|x, y\in A\}$

(4) $\{(x, y)|x\neq y\}$

42. What is Boolean logic primarily used for?

(1) Image processing

(2) Text formatting

(3) Digital circuit design and computer programming

(4) Statistical analysis

43. Who is considered the foundes of Boolean logic?

(1) Alan Turing

(2) Isaac Newton

(3) George Boole

(4) Charles Babbage

44. Which of the following values can a Boolean variable have?

(1) Any integer

(2) Any real number

(3) True or False

(4) Any string

45. What is the basic operation of the AND gate in Boolean logic?

(1) Output 1 if at least one input is 1

(2) Output 1 if both inputs are 1

(3) Output 1 if at least one input is 0

(4) Output 1 if both inputs are 0

46. Which Boolean operation output True, only if exactly one of the input is True?

(1) AND

(2) OR

(3) XOR (Exclusive OR)

(4) NOT

47. What is the result of the Boolean expression 1?

(1) 1

(2) 0

(3) True

(4) False

48. What is the output of the OR operation if both input are 0?

(1) 1

(2) 0

(3) Undefined

(4) A

49. Which Boolean operation is also known as inversion?

(1) AND

(2) OR

(3) NOT

(4) XOR

50. Which of the following is true for a conditional statement A→B when both A and B are false?

(1) The statement is true

(2) The statement is false

(3) The statement is undefined

(4) The statement depends on the value of A

51. In Boolean logic, the statement A↔B is true when:

(1) Both (1) and (2) are true

(2) Both (1) and (2) are false

(3) (1) and (2) have the same truth value

(4) (1) and (2) have different truth values

52. What is the truth value of A↔B if A is true and B is false?

(1) True

(2) False

(3) Undefined

(4) True only if AAA is false

53. What is a Disjunctive Normal Form?

(1) A conjunction of literals

(2) A disjunction of clauses where each clause is a conjunction of literals

(3) A conjunction of clauses where each clause is a disjunction of literals

(4) A disjunction of variables

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55. Which of the following Boolean expressions is in Conjunctive Normal form?

(1) (A.B)+(C.D

(2) (A+B).(C+D)

(3) A+(B.C)

(4) A.(B+C)

56. Which of the following Boolean expressions is NOT in Disjunctive Normal Form?

(1) (A.B+C.D)

(2) A+(B.C)

(3) (A.B)+(C.D)

(4) (A+B).(C+D)

57. Which of the following Boolean expression represents the NOR relation?

(1) A+B

(2) $\overline{A+B}$

(3) A.B

(4) $\overline{A}+\overline{B}$

58. In Boolean logic, what does the expression A→b represent?

(1) A AND B

(2) A OR B

(3) If A then B

(4) A XOR B

59. Which Boolean relation is false only when both operands are true?

(1) AND

(2) OR

(3) XOR

(4) NOR

P.T.O.

60. What is a mapping in the context of relations?
(1) A process of counting elements
(2) A way to pair each element of one set with exactly one element of another set
(3) A method to sort data
(4) A function to find the maximum value in a set

61. What type of mapping is defined as a relation where every elements of the domain is related to exactly one element of the codomain?
(1) One-to-one mapping
(2) Many-to-one mapping
(3) One-to-many mapping
(4) Many-to-many mapping

62. Which of the following is NOT a characteristics of a function (mapping) in relations?
(1) Every element in the domain is mapped to an element in the codomain
(2) Each element in the domain is related to exactly one element in the codomain
(3) An element inf the codomain can be related to multiple elements in the domain
(4) Every element in the codomain must be mapped to by an element in the domain

63. In the context of relations, what is the range of a function?
(1) The set of all possible inputs
(2) The set of all possible outputs
(3) The set of all elements in the domain
(4) The set of all elements in the codomain

64. Which of the following describes a surjective (onto) function?
(1) Each element of the domain is mapped to a unique element of the codomain
(2) Each element of the codomain is mapped by at least one element of the domain
(3) Each element of the domain is mapped to a multiple element of the codomian
(4) Each element of the domain is mapped to no element of the codomian

65. What is an injective (one-to-one) function?

(1) Each element of the domain is mapped to a unique element of the codomian

(2) Each element of the codomain is mapped by multiple element of the domain

(3) Each element of the domain is mapped to a multiple element of the codomian

(4) Each element of the codomain is mapped by no element of the domain

66. What is a bijective function?

(1) A function that is neither injective nor surjective

(2) A function that is both injective and surjective

(3) A function that maps each element of the domain to multiple elements of the codomain

(4) A function that maps each element of the codomain to multiple elements of the domain

67. In the context of relations, what does the term "domain" refer to?

(1) The set of all possible outputs

(2) The set of all possible inputs

(3) The set of all elements in the codomain

(4) The set of all pairs in the relation

68. What is the cardinality of a set?

(1) The number of elements in the set

(2) The sum of the element in the set

(3) The product of the elements in the set

(4) The difference between the largest and smallest elements in the set

69. What is the cardinality of the set {a, b, c, d}?

(1) 3

(2) 4

(3) 5

(4) 2

70. What is the cardinality of the power set P(S) of a set S with n elements?

(1) n

(2) 2n

(3) 2^n

(4) n^2

71. If two sets A and B have the same cardinality, what can be said about them?

(1) They have the same elements

(2) They have the same number of elements

(3) They are subsets of each other

(4) They are disjoint sets

72. What is a graph in the context of Boolean logic?

(1) A set of ordered pairs

(2) A visual representation of Boolean expressions

(3) A sequence of logical operations

(4) A set of vertices and edges connecting them

73. Which of the following correctly describes a directed graph?

(1) A graph with edges that have no direction

(2) A graph with edges that have a direction

(3) A graph with no edges

(4) A graph with a loop at each vertex

74. In Boolean logic, what is a common use of graphs?

(1) To solve algebraic equations

(2) To represent logical operations and dependencies

(3) To count the number of elements in a set

(4) To represent the Cartesian product of sets

75. In a Boolean logic circuit, which graph component corresponds to the output of a logical operation?

(1) Vertex

(2) Edge

(3) Path

(4) Loop