

(6 pages)

Reg. No. : .....

Code No. : 20675 E      Sub. Code : EECA 11

B.C.A. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2023.

First Semester

Computer Application

Elective — DISCRETE MATHEMATICS

(For those who joined in July 2023 onwards)

Time : Three hours

Maximum : 75 marks

PART A — ( $10 \times 1 = 10$  marks)

Answer ALL questions.

Choose the correct answer :

1. A binary relation on a set  $A$  is a subset of
  - (a) Set  $A$
  - (b) Set  $A \times \text{Set } A$
  - (c) Set  $B - \text{Set } B$
  - (d) Set  $A \cup \text{Set } A$
2. A relation represented by "A set of ordered pairs where each element is related to itself" is represented in
  - (a) Symmetric relation
  - (b) Reflexive relation
  - (c) Transitive relation
  - (d) Antisymmetric relation

3. The composition of two functions is
  - (a) Commutative
  - (b) Associative
  - (c) Distributive
  - (d) None of the above
4. When multiplying two functions,  $f(x)$  and  $g(x)$ , the result is
  - (a)  $f(x) * g(x)$
  - (b)  $f(x) + g(x)$
  - (c)  $f(x) - g(x)$
  - (d)  $f(x)/g(x)$
5. Which of the following is a binary logical operator?
  - (a)  $\neg$  (Negation)
  - (b)  $\wedge$  (Conjunction)
  - (c)  $\vee$  (Disjunction)
  - (d)  $\rightarrow$  (Implication)
6. Two propositions are said to be logically equivalent if
  - (a) They are identical in terms of syntax
  - (b) They have the same truth values for all possible combinations of truth values of their atomic propositions
  - (c) They have the same atomic propositions
  - (d) They are both tautologies

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7. The transpose of a matrix is obtained by
- Changing all elements to ones
  - Changing all elements to zeros
  - Interchanging its row and columns
  - Negating all elements
8. What is the determinant of a  $2 \times 2$  matrix with elements  $a, b, c$  and  $d$ ?
- $ad - bc$
  - $ac - bd$
  - $a + b + c + d$
  - $(a + b)(c + d)$
9. A collection of vertices and edges is known as a
- Circuit
  - Tree
  - Graph
  - Cycle
10. Which representation of a graph is suitable for dense graphs with many edges?
- List representation
  - Adjacency matrix representation
  - Incidence matrix representation
  - Edge list representation

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PART B — ( $5 \times 5 = 25$  marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) If  $A = \{a, b, c\}$  and  $M_R = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$ , find the relation  $R$  defined on  $A$ .

Or

- (b) Find the Composition of the Relations.  
 $R_1 = \{(1, 2), (1, 6), (2, 4), (3, 4), (3, 6), (3, 8)\}$  and  
 $R_2 = \{(2, x), (4, y), (4, z), (6, z), (8, x)\}$

12. (a) Examine the function  $f(x) = x^2$  from the set of integers to the set of integers for one to one.

Or

- (b) Let  $A = \{1, 2, 3, 4\}$ ,  $B = \{a, b, c\}$  and  $f = \{(1, a), (2, a), (3, b)\}$ . Check whether  $f$  is a function or not?

13. (a) Find the negation of the following statements :

- Kolkata is in India
- $4 + 4 = 9$ .

Or

- (b) Construct truth tables for the propositions.  
 $\sim (p \vee q) \vee (\sim p \wedge \sim q)$

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[P.T.O.]





14. (a) Show that  $\begin{pmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{pmatrix}$  is orthogonal.

Determine the value of  $|A|$ .

Or

- (b) Show that the matrix  $A = \begin{pmatrix} 2 & 3 \\ 1 & 2 \end{pmatrix}$  satisfies the equation  $A^2 - 4A + I = 0$ .

15. (a) Prove that, In a graph, total number of odd-degree vertices is even.

Or

- (b) Show that the degree of a vertex of a simple graph  $G$  on  $n$  vertices cannot exceed  $n-1$ .

PART C — ( $5 \times 8 = 40$  marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Let  $A = \{1, 2, 3\}$ ,  $B = \{a, b\}$  and  $R = \{(1, a), (2, b), (3, a)\}$ . Determine  $M_R$  in tabular form and in matrix forms.

Or

- (b) Explain the classification of relations with example.

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17. (a) Let  $f: R \rightarrow R$  be defined by  $f(x) = x+1$  and  $g: R \rightarrow R$  be defined as  $g(x) = 2x^2 + 3$ . Find  $f \circ g$  and  $g \circ f$ . Is  $f \circ g = g \circ f$ ?

Or

- (b) Let  $f: R \rightarrow R$  be defined by  $f(x) = 3x - 4$ . Find a formula for  $f^{-1}$ . Solution :

18. (a) Show that  $p \rightarrow (q \rightarrow r) \Leftrightarrow p \rightarrow (\sim q \vee r) \Leftrightarrow (\sim p \wedge q) \vee r$ .

Or

- (b) Write a brief note on disjunctive and conjunctive normal forms.

19. (a) Prove that  $A^3 - 4A^2 - 3A + 11I = 0$  where  $A$  is

given by  $A = \begin{pmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{pmatrix}$  And  $I$  is the unit matrix of order 3.

Or

- (b) Show that  $A = \begin{pmatrix} -5 & -8 & 0 \\ 3 & 5 & 0 \\ 1 & 2 & -1 \end{pmatrix}$  is involutory.

20. (a) Explain the operations on graphs.

Or

- (b) Show that maximum number of edges in a simple undirected graph with ' $n$ ' vertices is  $n(n-1)/2$ .

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