KC-7422

Integrated M.C.A. (Sem.-I) Examination - December-2024

IMCA-102T

Discrete Mathematics

Time allowed : **Three Hours**

Maximum Marks : **70**
Min. Marks : **28**

*Note : This question paper contains **two** sections as under :*

Section-A ***Max. Marks-20***

This section will have 10 questions, having 02 questions from each unit with no internal choice. Answer in about 20 words. All questions will have equal marks. (10×02=20)

Section-B ***Max. Marks-50***

This section will have 10 questions, having 02 questions from each unit, one question to be attempted from each unit. Word limit approximately 400-500 words. Questions may have sub divisions. All questions will have equal marks. (10×05=50)

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SECTION - A

1 (i) Define order of a set.

(ii) In an advertising survey conducted on 200 people, it was found that 140 drink tea. 80 drink coffee, and 40 drink both. Find how many drink at least one beverage and how many drink neither?

(iii) Let R be a relation defined on a set $A = \{1,2,3,4\}$ has the matrix representation as :

$$M_R = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Draw the diagraph of R.

(iv) If $A = \{1,2,3,4\}$ then consider the following relation in A.

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

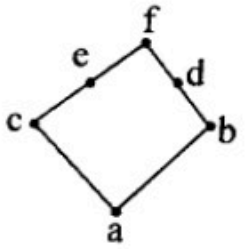
Determine : $R^2 = R \cdot R$.

(v) Determine the range of the function $f : A \to R$ is defined as $f(x) = x^2 + 1$, where $A = \{-1,0,2,4\}$

(vi) Find gof and fog, when $f : R \to R$ and $g : R \to R$ defined as $f(x) = 2x + 1$ and $g(x) = x^2 - 2$.

(vii) Draw the Hasse diagram of the POSet (S, R), where $S = \{1,2,3\}$ and $R = \{(1,1), (2,2), (3,3), (1,2), (2,3), (1,3)\}$

(viii) Explain the following figure is Lattice :



(ix) Show that the proposition $p \vee \sim (p \wedge q)$ is a tautology.

(x) Define (a) Predicates and (b) Quantifiers.

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SECTION - B

UNIT - I

2 (a) Suppose that 100 out of 120 students of computer science in a college offer at least one of the language Hindi, English and German. Also, suppose 65 study Hindi, 45 study English, 42 study German, 20 study Hindi and English, 25 study English and German and 15 study Hindi and German. Find the number of students who study all the three languages.

(b) For any sets A, B and C prove that :

$$A \cap (B \cup C) = (A \cap B) \cup (A \cap C).$$

OR

3 (a) Prove that : $A - (A - B) = A \cap B$.

(b) In a group of 52 persons, 16 drink tea but not coffee and 33 drink tea. Find

(i) How many drink tea and coffee both

(ii) How many drink coffee, but not tea.

UNIT - II

4 Prove that the relation R in the set N of natural numbers defined by 'x-y is divisible by n is an equivalence relation.

OR

5 (a) Prove that in the set $S = \{1,2,3\}$ the relation $R = \{(1,1), (2,2,), (3,3), (1,2), (2,1), (2,3), (3,2), (3,1), (1,3)\}$ is an equivalence relation.

(b) Prove that a relation R in a set is symmetric if and only if $R = R^{-1}$.

UNIT - III

6 If $f : R \to R$; $f(x) = 2x + 7$, find the inverse of f.

OR

7 Prove that if f and g are two bijections such that gof is defined, then gof is also a bijection.

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UNIT - IV

8 Answer the following questions concerning the Poset $(\{2,4,6,9,12,18,27,36,48,60,72\},1)$.

(i) Find the maximal and minimal elements.

(ii) Find the greatest and least element, if exists.

(iii) Find least upper bound of $\{2,9\}$, if it exists.

(iv) Find greatest lower bound of $\{60, 72\}$, if it exists.

OR

9 In N the set of natural numbers, prove that the relation R is defined as $aRb \Leftrightarrow a = b^n$, $\forall a,b,n \in N$, is a partial order relation.

UNIT - V

10 (a) Show that $p \wedge q$ is a contingency, where

p : John is a bachelor

q : Smith is married

Also, show that $p \vee \sim q$ is a tautology and $p \wedge \sim q$ is a contradiction.

(b) Show that the compound propositions $p \vee (q \wedge r)$ and $(p \vee q) \wedge (p \vee r)$ are logically equivalent.

OR

11 (a) Prove $(p \rightarrow q) \rightarrow (\sim q \rightarrow \sim p)$ is a tautology without constructing truth table.

(b) Translate each of these statements into logical expressions using predicates, quantifiers and logical connectives :

(i) No one is perfect.

(ii) Not every one is perfect.

(iii) All your friends are perfect.

(iv) One of your friend is perfect.

(v) Every one is your friend and perfect.

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