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**MCA**  
**(SEM I) THEORY EXAMINATION 2024-25**  
**DISCRETE MATHEMATICS**

TIME: 3 HRS

M.MARKS: 70

**Note:** Attempt all Sections. In case of any missing data; choose suitably.**SECTION A****1. Attempt all questions in brief.****2 x 07 = 14**

Q no.	Question	CO	Level
a.	What is multiplicity of an element in a multiset? Find the multiplicities of each element in the multiset $\{a, a, a, \{a, a, a\}\}$ .	1	K2
b.	Consider the two functions $f$ and $g$ defined on set of real numbers as $f(x) = 2x + 1$ and $g(x) = \frac{x}{3}$ . Find $f^{-1} \circ g^{-1}$ .	1	K2
c.	Let $P(S)$ be the power set of $S = \{a, b, c\}$ . Determine the greatest lower bound and the least upper bound of the set $\{\{a\}, \{c\}\}$ in the poset $(P(S), \subseteq)$ .	2	K3
d.	State the Modus Ponens rule of inference.	3	K3
e.	How many generators are there of the cyclic group $G$ of order 6.	4	K3
f.	Define Normal subgroup.	4	K2
g.	Obtain the generating function of the numeric function $a_r = 2^r + 3^r, r \geq 0$ .	5	K3

**SECTION B****2. Attempt any three of the following:****07 x 3 = 21**

Q no.	Question	CO	Level
a.	Prove that the relation $R$ in $N \times N$ such that $(a, b)R(c, d)$ iff $a + d = c + b$ for $a, b, c, d \in N$ is an equivalence relation. Also find equivalence class of $(4, 6)$ .	1	K2
b.	Prove that $(D_{24},  )$ is lattice.	2	K2
c.	Show that $\{[(p \vee q) \Rightarrow r] \wedge (\sim p)\} \Rightarrow (q \Rightarrow r)$ is a tautology without truth table.	3	K3
d.	State and prove Lagrange's theorem of group.	4	K2
e.	Prove by mathematical induction: $n^4 - 4n^2$ is divisible by 3 for all $n \geq 2$ .	5	K3

**SECTION C****3. Attempt any one part of the following:****07 x 1 = 07**

Q no.	Question	CO	Level
a.	For any set $A$ and $B$ (i) Prove that if $A \subseteq B$ then $P(A) \subseteq P(B)$ . (ii) Is it true $P(A \cup B) = P(A) \cup P(B)$ ? Justify your answer.	1	K3
b.	Let a function is defined as $f: R - \{5\} \rightarrow R - \{1\}$ , $f(x) = \frac{x-1}{x-5}$ , where $R$ is the set of real numbers. Show that $f$ is bijective function and also compute inverse of $f$ .	1	K2



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**4. Attempt any one part of the following:****07 x 1 = 07**

Q no.	Question	CO	Level
a.	Show that if $(A, \leq)$ and $(B, \leq)$ are posets, then $(A \times B, \leq)$ is a poset, with partial order $\leq$ defined by $(a, b) \leq (a', b')$ if $a \leq a'$ and $b \leq b'$ , where $a, a' \in A$ and $b, b' \in B$ .	2	K2
b.	(i) For any Boolean algebra B prove that $(a + b).(b + c).(c + a) = a.b + b.c + c.a$ (ii) Use Karnaugh map representation to find minimal sum of products expression of $F(A, B, C, D) = \sum(1,9,11,13,15)$	2	K3

**5. Attempt any one part of the following:****07 x 1 = 07**

Q no.	Question	CO	Level
a.	Express the following statements using quantifiers: (i) There is a student who spends more than 5 hours every weekday in class. (ii) No well behaved person is quarrelsome. (iii) Everyone meets someone. (iv) All graduates are educated.	3	K3
b.	Check the validity of the following arguments: "If there was a ball game, then travelling was difficult. If they arrived on time, then travelling was not difficult. They arrived on time. Therefore there was no ball game."	3	K3

**6. Attempt any one part of the following:****07 x 1 = 07**

Q no.	Question	CO	Level
a.	What do you mean by cosets of a subgroup? Consider the group Z of integers under addition and subgroup $H = \{ \dots, -10, -5, 0, 5, 10, \dots \}$ considering multiple of 5. Find the cosets of H in Z.	4	K3
b.	If R is ring such that $a^2 = a \forall a \in R$ , prove that (i) $a + a = 0, \forall a \in R$ (ii) $a + b = 0 \Rightarrow a = b$	4	K3

**7. Attempt any one part of the following:****07 x 1 = 07**

Q no.	Question	CO	Level
a.	Solve the recurrence relation $a_r - 4a_{r-1} + 4a_{r-2} = 0$ given that $a_0 = 1, a_1 = 6$ .	5	K3
b.	In how many ways can a committee of 3 ladies and 4 gentlemen be appointed from a group consisting of 8 ladies and 7 gentlemen? What will be the number of ways, if Sanjana of this committee refuses to serve in a committee in which Akhilesh is a member.	5	K3