Subject Code: KCA104

PAPER ID-411868

Roll No:

MCA
(SEM I) THEORY EXAMINATION 2021-22
DISCRETE MATHEMATICS

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. All the symbols have their usual meaning.

SECTION A

1. Attempt *all* questions in brief.

Qno.	Question	Marks	CO
a.	What is the cardinality of the set? Find the cardinality of the set $\{1, \{2, \phi, \{\phi\}\}, \{\phi\}\}$.	2	1
b.	Let the two following functions be defined on set of real numbers be as: $f(x) = 2x+3$ and $g(x) = x^2+1$. Find the (fog)(x).	2	1
c.	Define the well-ordered set? Give an example of well-ordered set.	2	2
d.	Draw the Hasse diagram of the lattice of $(D_6, \|)$.	2	2
e.	Define Tautology and Contradiction.	2	3
f.	Discuss the truth table of $p \leftrightarrow q$.	2	3
g.	What is the generator of a cyclic group?	2	4
h.	Find the order of each element in the group $(\{1, -1\}, .)$.	2	4
i.	Find the number of handshakes in party of 12 people, where each two of them shake hands with each other.	2	5
j.	Discuss the pigeonhole principle?	2	5

SECTION B

2. Attempt any *three* of the following:

Qno.	Question	Marks	CO
a.	Prove that the relation $(x, y) \in R$, if $x \geq y$ defined on the set of positive integers is a partial order relation.	10	1
b.	If $B = \{1, 3, 5, 15\}$, then show that $(B,+,.,')$ is a Boolean Algebra, where $a + b = \text{lcm}(a, b)$, $a . b = \gcd(a, b)$ and $a' = \frac{15}{a}$.	10	2
c.	**(i)** Prove that conditional proposition and its contrapositive are equivalent, i.e. $(p \to q) \equiv \sim q \to \sim p$. **(ii)** Prove the equivalence: $(p \to q) \to q \equiv p \vee q$	10	3
d.	Show that set $\mathbb{Z}_6 = \{0,1,2,3,4,5\}$ forms a group with respect to addition modulo 6.	10	4
e.	**(i)** State all PEANO's axioms. **(ii)** In how many ways, can 7 boys and 5 girls be seated in a row, so that no two girls may sit together?	10	5

SECTION C

3. Attempt any *one* part of the following:

Qno.	Question	Marks	CO
a.	In a survey of 60 people, it was found that 25 eat ***Apple***, 26 eat ***Orange*** and 26 eat ***Banana*** fruit. Also 9 eat both ***Apple*** and ***Banana***, 11 eat both ***Orange*** and ***Apple***, and 8 eat both ***Orange*** and ***Banana***. *8* eat no fruit at all. Then determine i. the number of people who eat all three fruit. ii. the number of people who eat exactly two fruit.	10	1

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	iii. the number of people who eat exactly one fruit		
b.	State and Prove De Morgan's laws for set theory.	10	1

4. Attempt any *one* part of the following:

Qno.	Question	Marks	CO
a.	**(i)**Write the definition of the maximal, minimal, greatest and least element of a Poset. **(ii)**If S = {10, 11, 12}. Determine the power set of S. Draw the Hasse diagram of Poset $(P(S), \subseteq)$. **(iii)**Find the maximal, minimal, greatest and least element of the Poset in **Part (ii)**.	10	2
b.	i) Determine the DNF of Boolean expression $f(x,y,z) = x + y'.z$ ii) Simplify the following Boolean expression using K-Map method: $A'B'C' + A'B'C + A'BC + A'BC' + AB'C + ABC$.	10	2

5. Attempt any *one* part of the following:

Qno.	Question	Marks	CO
a.	(i) Given the value of $p \to q$ is false, determine the value of $(\sim p \vee \sim q) \to q$. (ii) Prove the equivalence: $(p \to q) \to q \equiv p \vee q$.	10	3
b.	State and Prove De Morgan's laws for propositions using truth table.	10	3

6. Attempt any *one* part of the following:

Qno.	Question	Marks	CO
a.	Show that set of all integers $\mathbb{Z}$ forms a group with respect to binary operation * defined as a * b = a + b + 1, where $a,b \in \mathbb{Z}$.	10	4
b.	**(i)**Define Ring and Field. Give an example of a Ring and a Field. **(ii)**Prove that every cyclic group is abelian.	10	4

7. Attempt any *one* part of the following:

Qno.	Question	Marks	CO
a.	State Mathematical Induction. Using the Mathematical Induction, show that $1^2 + 2^2 + 3^2 + ... + n^2 = \frac{n(n+1)(2n+1)}{6}, n \geq 1$.	10	5
b.	Use generating functions to solve the recurrence relation, $a_n - 9a_{n-1} + 20a_{n-2} = 0$ where $a_o = -3$ and $a_1 = -10$.	10	5