18242

BRAINWARE UNIVERSITY

Term End Examination 2025-2026
Programme – MCA-2024/MCA-2025
Course Name – Mathematical Foundation for Computer Science
Course Code - MCA10102/MCA10401
(Semester I)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A
(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Calculate the number of three digit numbers that can be formed from the digits 1,3,5,7 (repetitions of numbers is not allowed)

a) 24 b) 12
c) 4 d) 14

(ii) Determine the number of ways 7 different beads can be arranged to form a necklace

a) 250 b) 300
c) 360 d) 350

(iii) Write the correct one: If the origin and terminus of a path coincide then it is a

a) Path b) Open walk
c) Circuit d) None of these

(iv) Select the correct option:

a) A null graph has no nodes b) A null graph has no edges
c) A null graph has no odd vertex d) None of these

(v) **Select the number of permutations of all the letters a, a, a, b, c, c is**

a) $6!$ b) $\frac{6!}{2!}$
c) $\frac{6!}{3!}$ d) $\frac{6!}{3!\,2!}$

(vi) Identify the sequence represented by the function $\frac{1}{1-5x}$

a) $\{3^n\}$ b) $\{5^n\}$
c) $\{5^n + 1\}$ d) $\{4^n\}$

(vii) Select the correct option: Solution of the recurrence relation $a_n = 2\,a_{n-1} + 1$ with $a_0 = 0$ is

a) $1 - 2^n$
b) $2^n - 2$
c) $2^{n-1} - 1$
d) $2^n - 1$

(viii) If $\Sigma = \{a, b, c\}$ be an alphabet, select one string from the followings

a) a^2babba
b) $a^2 + b - a$
c) $a \to ba$
d) None of these

(ix) For any two strings u and v, identify the value of $|uv|$

a) $|u||v|$
b) $\max\{|u|, |v|\}$
c) $\min\{|u|, |v|\}$
d) $|u| + |v|$

(x) Choose the following operations that is closed in regular languages

a) Union
b) Intersection
c) Complement
d) All of these

(xi) Choose the correct answer : In a Mealy machine, output depends on the current state and ____

a) Previous input
b) Next state
c) Current input
d) Previous state

(xii) If $p \leftrightarrow q \equiv (p \to q) \wedge r$ then r is, select to the correct option

a) $p \to q$
b) $\neg p$
c) $q \to p$
d) $\neg q$

(xiii) Identify the negation of the statement 'No one wants to buy my house'

a) All want to buy my house
b) Someone wants to buy my house
c) Everyone wants to buy my house
d) None of these

(xiv) Choose the correct option: If the incidence matrix of a graph G has five identical columns, then G has

a) Five loops
b) Five isolated vertices
c) Five parallel edges
d) Five vertices in series

(xv) Select the correct option : A recursive definition of a function consists of

a) Only iterative steps
b) Multiple base cases
c) A single equation
d) A base case and a recursive step

Group-B

(Short Answer Type Questions) 3 x 5=15

2. Explain the difference between permutation and combination with an example. (3)

3. Describe Cantor's diagonal argument and hence prove that any interval [a, b] is uncountable. (3)

4. Construct a graph with the following adjacency matrix (3)

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

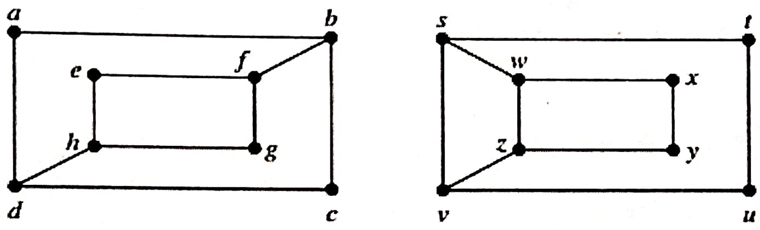
with respect to the ordering of vertices *a, b, c, d.*

5. Calculate the number of 5-digit telephone numbers that can be constructed using the digits 0 to 9, if each number starts with 67 and no digit appears more than once. (3)

6. Justify the first theorem of graph theory. (3)

OR

Justify that the following graphs G and H are isomorphic. (3)



G *H*

Group-C

(Long Answer Type Questions) 5 x 6=30

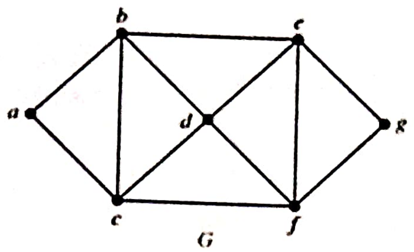
7. Examine that every infinite set has a countable infinite subset. (5)

8. Estimate the state diagram for the finite-state automaton M = (S, I, f, s0, F), where S = {s0, s1, s2, s3}, I = {0, 1}, F = {s0, s3}, and the transition function f is given in the following Table. (5)

	f	
	Input	
State	**0**	**1**
s_0	s_0	s_1
s_1	s_0	s_2
s_2	s_0	s_0
s_3	s_2	s_1

9. Illustrate the number of positive integers less than or equal to 500 that are divisible by 7, 10, or 15. (5)

10. **Estimate the chromatic numbers of the graph G shown below:** (5)



11. **Evaluate the graph whose adjacency matrix is** (5)

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

12. Evaluate the value of n if ${}^{2n}C_3 : {}^{n}C_3 = 11:1$. (5)

OR

A committee of 7 has to be formed from 9 boys and 4 girls. Calculate the numbers of ways this can be done so that the committee consists of: (a) atleast 3 girls (b) atmost 3 girls. (5)

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