BRAINWARE UNIVERSITY

Term End Examination 2023-2024
Programme – MCA-2022/MCA-2023
Course Name – Mathematical Foundation for Computer Science
Course Code - MCA104
(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) If $P = \{1,2,3\}$ and $Q = \{2,3\}$, then determine $P \times Q$ is

a) $\{(1,2), (1,3), (2,2), (2,3), (3,2), (3,3)\}$ b) $\{(1,2), (1,3), (3,2), (3,3)\}$

c) $\{(1,2), (1,3), (2,2), (2,3)\}$ d) $\{(1,2), (2,2), (2,3), (3,2), (3,3)\}$

(ii) For the inequality $7n > n^3$, where $n = 3$, write the correct option

a) $652 > 189$ b) $42 < 132$

c) $343 > 27$ d) $42 \leq 431$

(iii) Choose the correct one: If $^nC_2 = 36$ then the value of n is

a) 6   b) 9

c) 8   d) 7

(iv) Select the number of permutations of a set of k elements

a) $k!$ b) $(k-1)!$

c) $(k+1)!$ d) none of these.

(v) If $u = a^2b$, $v = ba$, and $w = ab$ are three strings then determine the string for ba^2ba^2b

a) uvw b) vuw

c) uuv d) vwu

(vi) Select the value of $\dfrac{^nP_r}{^{n-2}P_{r-2}}$

a) n b) $n(n-1)$

c) $n-1$ d) none of these

(vii) Determine the number of non-negative integral solutions to the equation

$x_1 + x_2 + x_3 = 10, x_1, x_2, x_3 \geq 0$

a) 75   b) 62

c) 220   d) 72

(viii) If $f(x) = x^3 - \frac{1}{x^3}$ then the calculate value of $f(x) + f\left(\frac{1}{x}\right)$

  a) $2x^3$ b) $\frac{2}{x^3}$

  c) 0   d) 1

(ix) Choose from the following sets that are null sets.

  a) $\{0\}$ b) $\emptyset$

  c) $\{ \}$ d) Both $\{ \}$ and $\emptyset$

(x) Choose the correct answer: If R be a relation on a set A. R is equivalence if

  a) R is reflexive and symmetric   b) R is reflexive, symmetric and anti-symmetric

  c) R is reflexive, symmetric and transitive   d) R is reflexive, anti-symmetric, and transitive

(xi) If $f(x) = x^2 + 3x + 1$ and $g(x) = 2x - 3$ then calculate $(f \circ g)(x)$

  a) $4x^2 - 6x$ b) $x^2 - 6x$

  c) $4x - 6$ d) $4x^2 - 6x + 1$

(xii) A man has 5 friends. Calculate the number of ways he can invite one or more of them to a party

  a) 64   b) 31

  c) 32   d) 63

(xiii) Select the generating function for the sequence <1,2,3, 4,...>

  a) $(1 + 2x)^{-1}$ b) $(1 - 2x)^{-1}$

  c) $(1 - x)^{-2}$ d) $(1 + x)^{-2}$

(xiv) Let R be a non-empty relation on a collection of sets defined by $_A R_B$ if and only if $A \cap B = \emptyset$, then, choose the correct option

  a) R is reflexive and transitive   b) R is symmetric and not transitive

  c) R is an equivalence relation   d) R is not reflexive and not symmetric

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

  a) $a^2 babba$ b) $a^2 + b - a$

  c) $a \rightarrow ba$ d) none of these

Group-B
(Short Answer Type Questions)   3 x 5=15

2. Let $A = \{0, 11\}$ and $B = \{1, 10, 110\}$. Illustrate $A \times B$ and $B \times A$.   (3)

3. Identify the value of $^{15}C_8 + {}^{15}C_9 - {}^{15}C_6 - {}^{15}C_7$.   (3)

4. Find the inverse of the function $f(x) = \frac{2x-3}{7}$.   (3)

5. Examine whether the function $f: R \rightarrow R$ given by $f(x) = 5x$ is injective, surjective or both.   (3)

6. Calculate the number of numbers lying between 100 and 1000 can be formed with the digits 0, 1, 2, 3, 4, 5, if the repetition of the digits is not allowed.   (3)

Solve the value of n such that

(3)

$$^nP_5 = 42 \ ^nP_3, \ n > 4$$

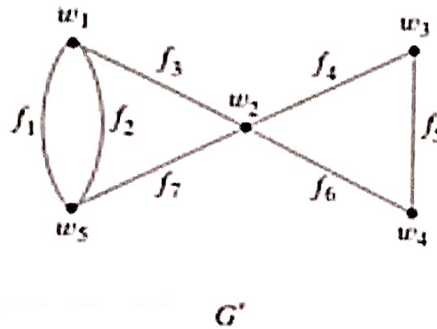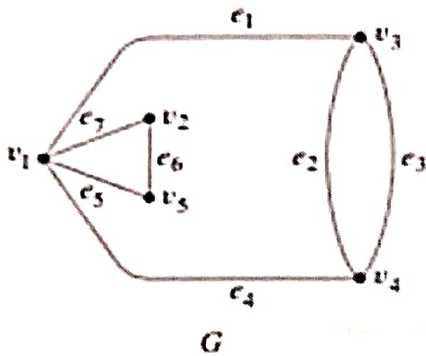**Group-C**
(Long Answer Type Questions)
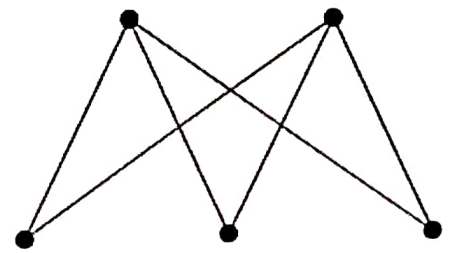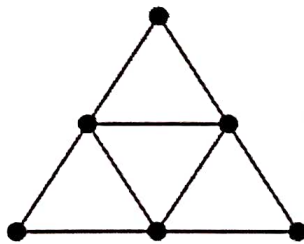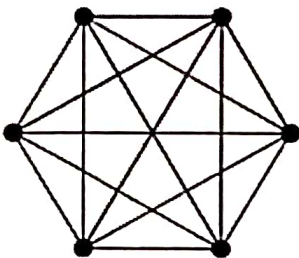
5 x 6=30

7. Show that the following two graphs are isomorphic.

(5)

8. Determine that the relation R = {(a,b): $a-b$ is an even number, $a, b \in Z$} is an equivalence relation.

(5)

9.

(5)

Write the chromatic number of the graphs below:

10. Establish that $p \lor (q \land r)$ and $(p \lor q) \land (p \lor r)$ are Logically Equivalent.

(5)

11. Construct the state diagram for the finite-state automaton $M = (S, I, f, s_0, F)$, where $S = \{s_0, s_1, s_2, s_3\}$, $I = \{0, 1\}$, $F = \{s_0, s_3\}$, and the transition function f is given in the following Table. (5)

State	f Input	
	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

12. Establish that the relation $R = \{(a,b): a \text{ divides } b, a, b \in Z\}$ is a partially ordered relation. (5)

OR

Solve the recurrence relation $a_n = 3a_{n-1} + 2n$. (5)

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