

MCS-212
MASTER OF COMPUTER APPLICATIONS (MCAOL)
DISCRETE MATHEMATICS

Time : Three Hours

Maximum Marks : 100

Note : i) This question paper comprises of 3 Sections: Sections A, B and C.

ii) Section A: Comprises of Short Answer Questions. Attempt any 5 out of 7 questions.

iii) Section B: Comprises of Medium Answer Questions. Attempt any 5 out of 7 questions.

iv) Section C: Comprises of Long Answer Questions. Attempt any 2 out of 3 questions.

Section-I (Short Answer Type Questions) ($5 \times 4 = 20$)

Attempt any five questions.

1. Make truth table for the following:

i) $p \rightarrow (q \wedge \sim r)$

ii) $(p \oplus q) \wedge r \rightarrow p \wedge r$

2. Use proof by contradiction to verify $\sqrt{5}$ is irrational.

3. What is a regular expression? Determine regular expression to describe each of the following languages:

i) $\{x, y, z\}$

ii) $\{\wedge, x, xy, xyxy, \dots\}$

4. What is a hypercube graph? Draw hypercube graph, Q_3 .

5. A dice is rolled once. Compute the probability the following events:

i) Getting at least a value 2

ii) Getting atmost a value 2

iii) Getting an odd number

iv) Getting at least 7

6. Suppose there are 5 married couples and they (10 people) are made to sit around a round table, so that neither 2 men nor 2 women sit together. Find the number of such circular arrangements.

7. Write the following two statements in the symbolic form:

i) Some students cannot appear in exam

ii) Every one cannot sing

Section-II (Medium Answer Type Questions) ($5 \times 10 = 50$)

Attempt any five questions.

8. Use the principle of Mathematical induction to prove

$$1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n}{6}(n+1)(2n+1), \forall n \in \mathbb{N}.$$

9. Write De Morgan's laws. Verify De Morgan's law as tautology using truth tables. Use De Morgan's law to deduce AND logic from NOR logic.

10. What are context free languages? How do context free languages differ from context sensitive languages? Given L_1 and L_2 as context free languages, prove that $L_1 \cup L_2$ is also a context free language.

11. a) Explain Pigeon hole principle with suitable example.

b) Compare recursive and iterative relation. Use the recurrence relation $b_n = n b_{n-1}$ (with $n \geq 2$ and $b_1 = 1$), to show $b_n = n!, n \geq 1$.

12. How does functions differ from relations? Describe the following:

i) Reflexive Relation

ii) Symmetric Relation

iii) Transitive Relation

iv) Equivalence Relation

13. a) Draw logic circuit for the Boolean expression given below :

$$(x_1' \vee (x_2 \wedge x_3')) \wedge (x_2 \vee x_4')$$

b) Find Domain, Co-Domain and Range for a function A to B, where $A = \{1, 2, 3, 4\}$ and $B = \{1, 4, 9, 16, 25\}$.

14. a) What is divide and conquer approach? Explain how this approach can be used to perform merge sort of a list of $n = 2^k, k > 0$ elements.

b) Write and explain handshaking theorem, with suitable example.

Section-III (Long Answer Type Questions) ($2 \times 15 = 30$)

Attempt any two questions.

15. What are Hamiltonian graphs? How do Hamiltonian graphs differ from Eulerian graphs? Write and explain Dirac's criterion and Ore's criterion for Hamiltonian graphs.

16. How does Permutation differ from Combination? Perform the following:

i) Determine the number of distinct 8 letter words, not necessarily meaningful, that can be made from the letters of the word 'DISTINCT'.

ii) How many distinct ways are there to seat 8 persons at a round table?

iii) In how many ways can a prize winner choose 3 books from a list of 10 best sellers, provided:

a) Repeats are allowed?

b) Repeats are not allowed?

17. Write short notes on the following (in context of graphs):

i) Walk

ii) Path

iii) Circuit

iv) Cycle

v) Isomorphism