

2022 – 2024 Batch Question Paper (External)

END TERM EXAMINATION

FIRST SEMESTER [MCA] FEBRUARY 2023

Paper Code: MCA-101

Subject: Discrete Structures

Time: 3 Hours

Maximum Marks: 75

Note: Attempt five questions in all including Q. No.1 which is compulsory. Select one question from each unit.

- Q1 Answer the following questions:- (2.5x10=25)
- (a) Prove that an irreflexive relation with a suitable example.
 - (b) Prove that every positive integer can be written as sum of integral powers of 2.
 - (c) Test the validity of the following statement:-
If the cup is white then it is my cup.
The cup is not white.
Therefore, the cup is not mine.
 - (d) Prove that the mathematical structure (\mathbb{Z}, \leq) is a Poset, where \mathbb{Z} is set of integers.
 - (e) What is a Boolean Expression?
 - (f) Write five negative integers that are congruent to 3 (modulo 7).
 - (g) Define the term Left Coset and right Coset in a group.
 - (h) Write the main components of an Encryption System.
 - (i) Define a regular graph. Is it possible for a 3-regular graph to contain 5 nodes?
 - (j) State Four Colour theorem.

UNIT-I

- Q2 (a) Convert the following expression in CNF. (6)
 $(p \vee \neg q \leftrightarrow q \rightarrow p) \wedge (p \rightarrow r)$
- (b) In an examination, if you have to answer 6 questions for 50 marks, then there is at least one question of minimum 9 marks. Prove this statement. (6.5)
- Q3 (a) Nine persons volunteer for a four-person committee. Every possible committee of four persons that can be formed from these 9 names is written on a slip of paper, one slip for each possible committee, and the slips are put in 15 hats. Show that one of the hat contains at least 9 slips of paper. (6.5)
- (b) Let $f: A \rightarrow B$ be a function and $|A| = |B| = n$. Prove that the following two statements are equivalent. (6)
- (i) f is one to one,
 - (ii) f is onto.

UNIT-II

- Q4 (a) Prove that $(A, <)$ is a lattice where $A = \{1, 2, 3, 5, 6, 10, 15, 30\}$ and $<$ is the relation of divisibility defined on A such that $x < y$ if x divides y . (6.5)
- (b) Explain the term Tautologies, Contradiction and Contingency with a suitable example for each. (6)
- Q5 (a) Explain the concept of isomorphic lattice with a suitable example. (6)
- (b) Consider the multiplication of bacteria in a controlled environment. Let a_r denote the number of bacteria there are on r^{th} day. If $a_r = 2a_{r-1}$ be the rate of growth of r^{th} day and that the rate of growth doubles every day, determine a_r given that $a_0 = 1$. (6.5)

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UNIT-III

- Q6 (a) Solve the equation $19x + 17y = 5$ for integers x and y . (6)
(b) Define permutation group and show that product of two even permutations in a group is again an even permutation. (6.5)
- Q7 (a) State Chinese Remainder Theorem. Explain its application with an example. (6.5)
(b) What is Euler phi function? Compute $\phi(19)$. (6)

UNIT-IV

- Q8 (a) What is chromatic number and chromatic polynomial? Determine the chromatic number and chromatic polynomial for a complete bipartite $K_{10,10}$. (6)
(b) Distinguish between Hamiltonian and Euler Graph. Give an example of a graph that is Hamiltonian but not an Euler Graph. (6.5)
- Q9 (a) With a suitable graph, explain the meaning of cut vertex, cut edge and articulation point. (6)
(b) Define isomorphism of graphs with a suitable example. What is degree spectrum? Can we use degree spectrum to determine isomorphism of two graphs? (6.5)
