



R22 Regulation *Subject code: E251PC1*
TKR COLLEGE OF ENGINEERING AND TECHNOLOGY
(Autonomous, Accredited by NAAC with 'A+' Grade)

M.Tech I Semester Regular/Supplementary Examinations, March 2024

MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE
(CSE & Ph.D Course Work)

Maximum Marks: 60

Date:04.03.2024 Duration: 3 hours

- Note:
1. This question paper contains two parts A and B.
 2. Part A is compulsory which carries 10 marks. Answer all questions in Part A.
 3. Part B consists of 5 Units. Answer any one full question from each unit.
 4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks

(10X1M=10 Marks)

- 1.a) Represent the proposition "If you are late then you miss the final examination" into symbolic form and also its negation.
- b) List any three implications in statement calculus.
- c) Define a geometric sequence.
- d) Let $f(x) = x^2 - 3x + 2$, find $f(x+3)$.
- e) State the principle of mathematical induction.
- f) What do you mean by program correctness?
- g) Define a recurrence relation.
- h) Give the example for Inclusion-Exclusion.
- i) If G is a k regular graph with 18 edges and the order of the graph is 9. Find the value of k .
- j) How many edges are present in a complete graph with n vertices? Explain.

Part-B

Answer All the following questions.

(5X10M=50Marks)

- 2 a. Prove the following equivalence without constructing the truth table. [5M]
$$((P \wedge Q \wedge A) \rightarrow C) \wedge (A \rightarrow (P \vee Q \vee C)) \Leftrightarrow (A \wedge (P \leftrightarrow Q)) \rightarrow C.$$

b. Without constructing a truth table, show that $A \wedge E$ is not a valid consequence of [5M]
$$A \leftrightarrow B \quad B \leftrightarrow (C \wedge D) \quad C \leftrightarrow (A \vee E) \quad A \vee E$$

OR

- 3 a. Test the validity of the following argument. [5M]
If I study, I will not fail in the examination.
If I do not watch TV in the evenings, I will study.
I failed in the examination.
Therefore, I must watch TV in the evenings.

b. For the following formulas, let the universe be \mathbb{R} . Translate each of the following sentences into a formula (using quantifiers): [5M]

- i) There is a smallest number.
- ii) Every positive number has a square root. (Do not use the square root symbol; use only multiplication.)

4 a. Let $A = \{1,2,3,4,6,8,12,24\}$, show that the relation "divides" is partial ordering on A and draw Hasse diagram. [5M]

b. Prove that the set of real numbers has a greater cardinality than the set of natural numbers. [5M]

OR

5 a. Let $A = \{1,2,3,4\}$, $B = \{a,b,c,d\}$ and $C = \{x,y,z\}$. Consider the function $f: A \rightarrow B$ and $g: B \rightarrow C$ defined by $f = \{(1,a),(2,c),(3,b),(4,a)\}$ and $g = \{(a,x),(b,x),(c,y),(d,y)\}$. Find the composition function (gof). [5M]

b. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be given by $f(x) = x^3 - 2$. Find f^{-1} . [5M]

6 a. Prove that $3^n > n^3$ for all $n \geq 10$ using induction. [5M]

b. Describe a method for proving the correctness of a program using loop invariants. [5M]

OR

7 Analyze the time complexity of the recursive algorithm for computing Fibonacci numbers. [10M]

8 Use Bayes' theorem to calculate the probability of a medical test being accurate given the prior probability of a person having a disease and the sensitivity and specificity of the test. [10M]

OR

9 a. Solve the recurrence relation $a_n - 7a_{n-1} + 10a_{n-2} = 4^n$, $a_0=0$, $a_1=1$. [5M]

b. Apply the inclusion-exclusion principle to find the number of permutations of the word "MISSISSIPPI." [5M]

10 a. Prove that a graph G with at least one edge is 2-chromatic if and only if G has no cycle of odd length. [5M]

b. Suppose that G is a non directed graph with 12 edges. Suppose that G has 6 vertices of degree 3 and the rest have degree less than 3. Determine the minimum number of vertices G can have. [5M]

OR

11 a. How do you test the planarity of a graph? Explain. [5M]

b. Write Kruskal's Algorithm and explain it with an example. [5M]