CBCS SCHEME

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18CS36

Third Semester B.E./ B.Tech. Degree Examination, Dec.2025/Jan.2026
Discrete Mathematical Structures

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Prove that for any propositions p, q, r the compound proposition.
$[(p \vee q) \wedge \{ (p \rightarrow r) \wedge (q \rightarrow r) \}] \rightarrow r$ is a tautology. **(06 Marks)**

b. Prove that if n is an odd integer, then n + 9 is an even integer by
i) contradiction method, ii) an indirect proof **(07 Marks)**

c. Find whether the following argument is valid No Engineering students of 1st or 2nd semester studies logic.
Anil is an Engineering student who studies Logic.
$\therefore$ Anil is not in 2nd semester. **(07 Marks)**

OR

2 a. Prove the following using laws of Logic :
$p \rightarrow (q \rightarrow r) \Leftrightarrow (p \wedge q) \rightarrow r$ **(06 Marks)**

b. Test the validity of the following arguments:
If Ganika studies, then she will pass in DMS
If Ganika doesn't play throw ball, then she will pass in DMS
Ganika failed in DMS
$\therefore$ Ganika played throw ball **(07 Marks)**

c. Give a direct proof of the statement " For all integers k and ℓ , if k and ℓ are both even then k + ℓ is even kℓ is even". **(07 Marks)**

Module-2

3 a. Prove by mathematical induction that for each $n \in z^+$
$1^2 + 2^2 + 3^2 + \ldots\ldots\ldots + n^2 = \frac{1}{6} n(n+1)(2n+1)$ **(06 Marks)**

b. How many positive integers n can we form using the digits 3, 4, 4, 5, 5, 6, 7 if we want n to exceed 5000000? **(07 Marks)**

c. In how many ways can one distribute eight identical balls into four distinct containers so that
i) no container is left empty?
ii) the fourth container gets an odd number of balls. **(07 Marks)**

OR

4 a. Determine the coefficient of $a^2 b^3 c^2 d^5$ in the expansion of $(a + 2b - 3c + 2d + 5)^{16}$ **(06 Marks)**

b. By mathematical induction, prove that for every positive integer n, the number $A_n = 5^n + 2.3^{n-1} + 1$ is a multiple of 8. **(07 Marks)**

c. A certain question paper contains two parts A and B each containing 4 questions. How many different ways a student can answer 5 questions by selecting atleast 2 questions from each part? **(07 Marks)**

Module-3

5 a. Let A = { 1, 2, 3, 4, 5, 6, 7 } and B = { w, x, y , z } Find the number of onto functions from A to B. **(06 Marks)**

b. ABC is an equilateral tringle whose sides are of length 1 cm each. If we select 5 points inside the triangle, prove that at least two of these points are such that the distance between them is less than ½ cm. **(07 Marks)**

c. Draw the Hasse diagram representing the positive divisors of 36. **(07 Marks)**

OR

6 a. Prove that if $f : A \rightarrow B$ and $g : B \rightarrow C$ are invertible functions then $gof : A \rightarrow C$ is an invertible function and $(gof)^{-1} = f^{-1}og^{-1}$. **(06 Marks)**

b. Let A = { 1, 2, 3, 4, 6} and R be a relation on A defined by aRb if and only if a is multiple of b. Represent the relation R as a matrix and draw its digraph. **(07 Marks)**

c. Let f and g be functions from R to R defined by $f(x) = ax + b$ and $g(x) = 1 - x + x^2$. If $gof(x) = 9x^2 - 9x + 3$, determine a, b. **(07 Marks)**

Module-4

7 a. There are eight letters to eight different people to be placed in eight different addressed envelops. Find the number of ways of doing this so that at least one letter gets to the right person. **(06 Marks)**

b. In how many ways can the 26 letters of English alphabet be permuted so that none of the patterns CAR, DOG, PUN or BYTE occurs? **(07 Marks)**

c. Find the rook polynomial for the 3 × 3 board by using the expansion formula. **(07 Marks)**

OR

8 a. Out of 30 students in a hostel, 15 study History, 8 study Economics and 6 study Geography. It is known that 3 students study all these subjects. Show that 7 or more students study none of these subjects. **(06 Marks)**

b. Solve the recurrence relation $a_n - 6a_{n-1} + 9a_{n-2} = 0$ for $n \geq 2$
Given that $a_0 = 5$, $a_1 = 12$ **(07 Marks)**

c. Four persons P_1, P_2, P_3, P_4 who arrive late for a dinner party. Find that only one chair at each of five tables T_1, T_2, T_3, T_4 and T_5 is vacant. P_1 will not sit at T_1 or T_2, P_2 will not sit at T_2, P_3 will not sit at T_3 or T_4 and P_4 will not sit at T_4 or T_5. Find the number of ways they can occupy the vacant chairs. **(07 Marks)**

Module-5

9 a. Define the following with an example for each :
(i) Complete graph
(ii) Regular graph
(iii) Complete bipartite graph (06 Marks)

b. Prove that a tree with 'n' vertices has n – 1 edges. (07 Marks)

c. Obtain an optimal prefix code for the letters of the word ENGINEERING. Indicate the code. (07 Marks)

OR

10 a. Define isomorphism of two graphs. Verify the following graphs are isomorphic or not.

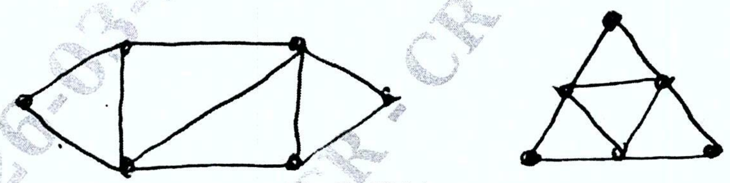

Fig. Q. 10 (a) (06 Marks)

b. If a tree T has four vertices of degree 2, one vertex of degree 3, two vertices of degree 4 and one vertex of degree 5, find the number of leaves in T. (07 Marks)

c. Define optimal tree and construct an optimal tree for a given set of weights { 4, 15, 25, 5, 8, 16 }. Hence, find the weight of the optimal tree. (07 Marks)

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