



Fourth Semester B.E./B.Tech. Degree Examination, June / July 2026 Discrete Mathematical Structures

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1				M	L	C
Q.1	a.	Define a Tautology. Verify that $[p \rightarrow (q \rightarrow r)] \rightarrow [(p \rightarrow q) \rightarrow (p \rightarrow r)]$ is a tautology by constructing the truth table.		06	L2	CO1
	b.	Check whether the following is a valid argument. If I study, then I will not fail in the examination If I don't watch TV in the evening, I will study I failed in the examination $\therefore$ I must watch TV in the evening.		07	L3	CO1
	c.	Show that for all odd integers. i) The sum of two odd integers is even. ii) The product of two odd integer is odd.		07	L2	CO1
OR						
Q.2	a.	Prove the following Logical equivalences by using the laws of logic. $[\sim p \wedge (\sim q \wedge r)] \vee [(q \wedge r) \vee (p \wedge r)] \Leftrightarrow r$		06	L2	CO1
	b.	Establish the validity of the following argument : $\forall x, [p(x) \vee q(x)]$ $\exists x, \sim p(x)$ $\forall x, [\sim q(x) \vee r(x)]$ $\forall x, [s(x) \rightarrow \sim r(x)]$ ----- $\therefore \exists x, \sim s(x)$		07	L3	CO1
	c.	Give : i) A direct proof ii) A proof by contradiction for the following statement. “If n is an odd integer, then (n+9) is an even integer”.		07	L2	CO1
Module – 2						
Q.3	a.	Prove the following statement by mathematical induction $1.3 + 2.4 + 3.5 + \dots + n(n+2) = \frac{n(n+1)(2n+7)}{6}$		06	L2	CO2
	b.	Find the number of permutations of the letters of the word ENGINEERING such that i) all the E's are together ii) G and R are next to each other iii) all the vowels are adjacent		07	L3	CO2
	c.	Find the Co-efficient of $a^3b^2cd^2$ in the expansions of $(2a - b + 3c - 2d)^8$		07	L2	CO2

OR

Q.4	a.	Prove the following results by mathematical induction $2^n > n$, whenever n is a positive integer than equal to 1.	06	L2	CO2
	b.	If $F_0, F_1, F_2, \dots$ are Fibonacci numbers prove that $F_n = \frac{1}{\sqrt{5}} \left[\left(\frac{1+\sqrt{5}}{2} \right)^n - \left(\frac{1-\sqrt{5}}{2} \right)^n \right]$	07	L3	CO2
	c.	In how many ways can 10 identical dimes be distributed among 5 children if i) there are no restrictions ii) each child gets atleast 1 dimes iii) The oldest child gets atleast 2 dimes.	07	L2	CO2

Module – 3

Q.5	a.	State pigeon – hole principle. Find the least number of pages contained in a book. 6 books each of maths, DMS, CO and UNIX and 4 books of ADE and DS. Totally contain 10416 pages.	06	L3	CO3
	b.	Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined by $f(x) = \begin{cases} 3x - 5, & \text{if } x > 0 \\ 1 - 3x, & \text{if } x \leq 0 \end{cases}$ find $f(1), f^{-1}(-1), f^{-1}([-5, 5])$	07	L3	CO3
	c.	If A is set of positive real number and f, g are functions on A defined by $f(x) = (2x + 5)^3$ and $g(x) = \frac{\sqrt[3]{x} - 5}{2}$. S.T functions f and g are invertible.	07	L2	CO3

OR

Q.6	a.	Let $A = \{1, 2, 3, 6, 9, 12, 18\}$. Define a relation 'R' on 'A' as xRy if x divides y . Draw the Hasse diagram of poset (A, R) .	06	L3	CO3
	b.	Let $A = \{1, 2, 3, 4, 6\}$ & R be a relation of A defined by aRb if and only if 'a' is a multiple of 'b'. Represent 'R' as a set of ordered pairs. Draw the digraph and matrix representation of 'R'.	07	L3	CO3
	c.	If $f: A \rightarrow B, g: B \rightarrow C, h: C \rightarrow D$ are three functions then prove that $h \circ (g \circ f) = (h \circ g) \circ f$.	07	L2	CO3

Module – 4

Q.7	a.	There are 8 letters to 8 different people to be placed in 8 different addressed envelopes. Find the number of ways of doing this so that atleast one letter gets to the right person.	06	L3	CO4
	b.	Determine in how many ways can the letters in the word ARRANGEMENT be arranged so that: i) none of the pairs ii) atleast one pair	07	L3	CO4
	c.	Solve the recurrence relation $F_{n+2} = F_{n+1} + F_n$ where $n \geq 0$ and $F_0 = 0, F_1 = 1$.	07	L3	CO4

OR

Q.8	a.	Obtain the unique solution of the recurrence relation $a_n = a_{n-1} + n, \quad n \geq 2, \quad a_1 = 4.$	06	L2	CO4
	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	L3	CO4
	c.	Find the rook polynomial for the 3×3 board by using the expansion formula.	07	L3	CO4

Module – 5

Q.9	a.	Show that fourth roots of unity is an abelian group.	06	L2	CO5
	b.	Let $G = S_4$, for $\alpha = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \end{pmatrix}$ find the Subgroup $H = \langle a \rangle$. Determine the left co-sets of H in G.	07	L3	CO5
	c.	State and prove Lagrange's Theorem.	07	L2	CO5

OR

Q.10	a.	Define a Group. Show that any group G is abelian iff $(ab)^2 = a^2b^2$ and $a, b \in G$.	06	L2	CO5
	b.	In the group S_5 Let $\alpha = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 1 & 4 & 5 \end{pmatrix}$ and $\beta = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 1 & 5 & 3 & 4 \end{pmatrix}$ Determine the $\alpha\beta, \beta\alpha, \alpha^{-1}, \beta^{-1}, \beta^{-1}\alpha^{-1}$.	07	L3	CO5
	c.	If H, K are subgroups of a group G, prove that $H \cap K$ is also a subgroup of G. Is $H \cup K$ a subgroup of G?	07	L2	CO5
