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EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY
An Autonomous Institution Affiliated to Visvesvaraya Technological University (VTU) Belagavi

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24AD46B/24CI46B/24CS46B/24IC46B/24IS46B

Fourth Semester B.E. Degree Examination, May 2026
DISCRETE MATHEMATICAL STRUCTURES

TIME:3 hrs. Max.Marks:100

Note: 1. Answer **any FIVE** full questions, choosing **ONE** question from **each MODULE.**
2. M: Marks, L: Bloom's level,C: Course outcomes.
3. Assume missing data suitably.

		Module-1	M	L	C
Q.1	a	Define Tautology. Prove that $[(p\rightarrow q)\wedge(q\rightarrow r)]\rightarrow(p\rightarrow q)$.	6	L1	CO1
	b	Prove the following using the laws of logic: $[\sim p\wedge(\sim q\wedge r)]\vee[(q\wedge r)\vee(p\wedge r)]\Leftrightarrow r$.	7	L2	CO1
	c	Give(i) a direct proof (ii) an indirect proof for the following statement: "If n is an odd integer, then (n+9) is an even integer."	7	L3	CO1
		OR			
Q.2	a	Test the validity of the following argument: If Ram studies then he we will pass 12th If Ram passes 12th, then his father gifts him a bike. If Ram doesn't play video game, then he will pass 12th. Ram did not get a bike. ∴ Ram played video game.	6	L1	CO1
	b	Test the validity of the following argument: i) $\{(p\wedge q)\wedge(p\rightarrow(q\rightarrow r))\}\Rightarrow r$ ii) $\{[p\vee(q\vee r)]\wedge\sim q\}\Rightarrow(p\vee r)$	7	L2	CO1
	c	Determine the truth values of the following statements, the universe being the set of all non-zero integers. (i)$\exists x,\exists y[xy=1]$, (ii) $\exists x,\forall y[xy=1]$, (iii) $\forall x,\exists y[xy=1]$ (iv) $\exists x,\exists y[(2x+y=5)\wedge(x-3y=-8)]$ (v) $\exists x,\exists y[(3x-y=17)\wedge(2x+4y=3)]$.	7	L3	CO1
		Module–2			
Q.3	a	By mathematical induction prove that $1^2+2^2+3^2+\cdots\cdots\cdots+n^2=\frac{n(n+1)(2n+1)}{6}$.	6	L2	CO2
	b	How many words can be made with or without meaning from the letters of the word "STATISTICS"? In many of these A and C are adjacent? In how many vowels together?	7	L3	CO2
	c	Obtain the recursive definitions for the following cases $(a)\ a_n=5n$ (b) $a_n=3n+7$ (c) $a_n=n^2$ (d) $a_n=2-(-1)^n$.	7	L2	CO2
		OR			
Q.4	a	Define well ordering principal. By Mathematical Induction, Prove that $(n!)\geq 2n-1$ for all integers $n\geq 1$.	6	L2	CO2
	b	Find the coefficient of x^3y^8 in the expression of $(2x-y)^{11}$.	7	L2	CO2

	c	A women has 11 close relatives and wish to invite 5 of them for dinner. In how many ways can she invite them if (i) no restriction on her choice. (ii) 2 persons will not attend separately. (iii) 2 persons will not attend together.	7	L3	CO2
		Module–3			
Q.5	a	State pigeon hole principle. Using pigeon hole principle find the minimum number of persons chosen so that at least 5 of them will have their birthday in the same month.	6	L1	CO3
	b	Let f and g be the 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 and b.	7	L2	CO3
	c	Draw the Hasse diagram of positive divisors of 36	7	L3	CO3
		OR			
Q.6	a	Let $f: R \to R$ be defined by $f(x) = \begin{cases} 3x - 5 \text{ if } x > 0 \\ 1 - 3x \text{ if } x \leq 0 \end{cases}$ Find $f^{-1}(0), f^{-1}(1), f^{-1}(6), f^{-1}([-6,5])$	6	L1	CO3
	b	Prove that if any 5 number from 1 to 8 chosen then two of them will have their sum 9.	7	L2	CO3
	c	Let $A = \{1, 2, 3, 4, 6\}$ and R be a relation on A defined by aR_b if and only if a is multiple of b. Write down R as set of order pair. Write relation matrix and draw the digraph.	7	L3	CO3
		Module–4			
Q.7	a	Find the number of positive integer n, $1 \leq n \leq 100$ which are divisible by at least one of 2, 3 or 5	6	L2	CO4
	b	An apple, a banana, a mango and an orange are to be distributed to four boys B_1, B_2, B_3, B_4. The boy B_1 and B_2 do not wish to have apple, the boy B_3 does not want banana or mango, and B_4 refuses orange. In how many ways the distribution can be made so that no boy displaced?	7	L3	CO4
	c	Solve the recurrence relation $a_n = 3a_{n-1} - 2a_{n-2}$ for $n \geq 2$ given that $a_1 = 5$ and $a_2 = 3$.	7	L2	CO4
		OR			
Q.8	a	Define Derangements. Find the number of derangements of 1, 2, 3, 4. Also write all the derangements.	6	L2	CO4
	b	In how many ways the 26 letters of the English alphabets are permuted so that none of the pattern's CAR, DOG, PUN or BYTE occurs? (i) Exactly three pattern's occurs together (ii) At least three pattern's occurs together.	7	L3	CO4
	c	The number of virus affected files in a system is 1000 (to start with) and this increases 250% every two hours. Use a recurrence relation to determine the number of virus affected files in the system after one day.	7	L2	CO4
		Module–5			
Q.9	a	Define group. Show that fourth roots of unity is an abelian group	6	L2	CO5
	b	Define Klein 4-group. Let if A = {e, a, b, c} then show that this set is a Klein -4 group	7	L2	CO5
	c	Show that (A, ·) is an abelian group where $A = \{a \in Q \mid a \neq -1\}$ and for any a, b $\in A$ a . b = a + b + ab	7	L3	CO5

		OR			
Q.10	**a**	Prove that the cube roots of unity form a group under the multiplication.	**6**	**L2**	**CO5**
	b	State and prove Lagrange's theorem.	**7**	**L2**	**CO5**
	c	Let G = S_4 for $\alpha = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \end{pmatrix}$. Find the subgroup $H = \langle \alpha \rangle$ determine the left cosets of H in G.	**7**	**L3**	**CO5**

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