QP Code:MA2T03C-2 **(Pages: 3)**

Reg No : .... Name : ....

MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM

(Govt. Aided Autonomous Institution)

Third Semester B.Tech. Degree (SAY) Examination, February, 2026

Course Code: B24MA2T03C

Course Name: DISCRETE MATHEMATICS

Max. Marks: 100 Duration:3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)

Answer all questions

1. What are the number of possible arrangements of the letters in the word " DATABASES" ?
2. Calculate the number of ways to construct a secret code by assigning to each letter of the alphabet a different letter to represent it.
3. Determine the expontential generating function of the sequence $1, -1, 1, -1, 1, -1, \ldots$
4. Solve the recurrence relation $a_{n+1} = 3a_n, \;\; n \geq 0, \;\; a_0 = 5.$
5. Show that the following argument is valid $(p \wedge q) \Rightarrow (p \to q)$.
6. Find the dual of $(p \vee q) \wedge (\neg r \vee T_0)$.
7. Define equivalence relation. Give an example.
8. Draw the Hasse diagram of $(D_6, |)$. ($|$ is the divides relation)
9. Find all subgroups of $(Z_5, +)$, “+” is the addition modulo 5.
10. Prove that the identity element of a group is unique.

PART - B: 70 Marks (5 Qns x 14 Marks)

Answer any One full question from each module.

Module 1

11. a. Determine the coefficient of $a^2b^3c^2d^5$ in the expansion of, $(a + 2b - 3c + 2d + 4)^{16}$. (7 Marks)

    b. How many permutations of the 26 letters of the alphabet do not contain any of the patterns fish, rat, duck? (7 Marks)

OR

12. a. In how many ways can we distribute eight identical white balls into 4 distinct containers so that; (7 Marks)

(i) no container is left empty?

(ii) the 4th container has an odd number of balls in it ?

b. Determine the number of five-digit integers (without repeatation) made from the digits 1,2,3,4,5 which are ; (7 Marks)

(i) even.

(ii) even and greater than 30000.

Module 2

13. a. Find the sequence generated by the generating function ; (7 Marks)

(i) $f(x) = \dfrac{x^3}{1-x}$.

(ii) $g(x) = \dfrac{1}{3-x}$.

b. Find the unique solution of the recurrence relation, $2a_n - 3a_{n-1} = 0, n \geq 1, a_4 = 81$. (7 Marks)

OR

14. a. Solve the recurrence relation $a_{n+2} + 3_{n+1} + 2a_n = 3^n,\ a_0 = 0,\ a_1 = 1$. (7 Marks)

b. Determine whether each of the following relations are functions. If the relation is a function, find the range; (7 Marks)

(i) $R_1 = \{(x, y) |\ x, y \in Q,\ \ y = |x|\}$ a relation from Q to Q where Q is the set of rational numbers.

(ii) $R_2 = \{(x, y) |\ x, y \in R, y = \sqrt{x}\}$ a relation from R to R where R is the set of real numbers.

Module 3

15. a. Consider the open statement $p(x) : x^2 \geq 1$. Find the truth value of the statement $'\ \forall x\ p(x)'$ where the universe consists of , (7 Marks)

(i) set of all positive integers.

(ii) set of all non negative real numbers.

(iii) set of all real numbers.

b. Show that $q \wedge (p \vee \neg q) \wedge (\neg p \vee \neg q) \iff F_0$. (7 Marks)

OR

16. a. Determine whether $\neg(q \to r) \wedge r \wedge (p \to q)$ is a contradiction. (7 Marks)

b. Check the validity of the following statement, (7 Marks)

"If the band could not play rock music or the refreshments were not delivered on time, then the new year's party will be cancelled and Alex will be angry", " If the party were cancelled then refunds will be made", " No refunds were made". Therefore, " The band could play rock music".

Module 4

17. a. Let $A = \{1, 2, 3, 5, 30\}$, show that the lattice $(A, |)$ is not a distributive lattice. (7 Marks)

b. The relation R on $Z^+$is defined by $a\,R\,b$ if 'a divides b'. Is R a partial order relation ? (7 Marks)

OR

18. a. Let T be the set of all triangles in R^2 . Determine whether the relation R on T defined by, $t_1\,R\,t_2$ if $t_1$and t_2 have an angle of same measure, is reflexive, symmetric and transitive. (7 Marks)

b. Define R on set of all integers by $x\ R\ y$ if $x - y$ is a multiple of 5. Determine the equivalence classes and a partition of Z induced by R. (7 Marks)

Module 5

19. a. Show that $(Z, \cdot)$ is a commutative semigroup where Z is the set of all integers and $'\cdot'$ is the multiplication operator. Is it a monoid? (7 Marks)

b. Consider $(Z_n, +_n)$, the group of integers mod n under modular addition. List the generators of; (7 Marks)

(i)Z_{10} (ii)Z_9 (iii)Z_p, where p is a prime.

OR

20. a. Let $G = \{1, -1, i, -i\}$ and '$\cdot$' defines multiplication. (7 Marks)

(i) Show that $(G, \cdot)$ a group.

(ii) Is $(G, \cdot)$ a cyclic group? If so, find each generator of G.

b. If G is a group prove that, (7 Marks)

(i) $(a^{-1})^{-1} = a$

(ii) $(ab)^{-1} = b^{-1}a^{-1}$

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