STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI - 600 086
(For candidates admitted from the academic year 2019-20 & thereafter)

B. Sc. DEGREE EXAMINATION, APRIL 2024
BRANCH I – MATHEMATICS
FOURTH SEMESTER

COURSE	**:**	**MAJOR CORE**
PAPER	**:**	**DISCRETE MATHEMATICS**
SUBJECT CODE	**:**	**19MT/MC/DM43**
TIME	**:**	**3 HOURS**

MAX. MARKS : 100

SECTION – A

ANSWER ANY TEN QUESTIONS: **(10×2=20)**

1. Construct the truth table for $\neg(p \wedge q)$
2. What is universal quantifier?
3. Write down the law of contraposition.
4. Define sublattice.
5. When is a lattice said to be complete?
6. Define Boolean algebra.
7. When is a Boolean expression called sum-of-product expression.
8. Draw the OR gate and construct its truth table.
9. What is a finite state machine?
10. Define non-deterministic finite state automaton.
11. Define language over a set of finite symbols.
12. Define phrase-structure grammar.

SECTION – B

ANSWER ANY FIVE QUESTIONS: **(5×8=40)**

13. Obtain the disjunctive normal of $(\sim p \to r) \wedge (p \leftrightarrow q)$ using truth table.
14. If n is a positive integer, D_n the set of all divisors of n and D denotes the relation of division in such a way that for any $a, b \in D_n, aDb$ if and only if a divides b, Draw the Hasse diagram for D_8, D_{20} and D_{30}
15. State and establish modular inequality in lattice.

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16. State and prove associative law in Boolean algebra using the principle of duality

17. Draw the logic circuit for $ab' + ba'$.

18. Find the transition diagram of the finite state automaton $M = (I, S, A, s_0, f)$ where $I = \{0,1\}, S = \{s_0, s_1, s_2\}, A = \{s_2\}, s_0$ is the initial state and the transition function is Given by

$$f(s_0, 0) = s_1,\ f(s_0, 1) = s_0,$$
$$f(s_1, 0) = s_2,\ f(s_1, 1) = s_0,$$
$$f(s_2, 0) = s_2,\ f(s_2, 1) = s_0.$$

19. Find the language $L(G)$ generated by the grammar G with variables $\sigma, A, B; T = \{a, b\}$ **a**nd productions $P = \{\sigma \to aB, B \to b, B \to bA, A \to aB\}$

SECTION – C

ANSWER ANY TWO QUESTIONS: (2×20=40)

20. (a) Show that the propositions $\neg(p \wedge q)$ and $\neg p \vee \neg q$ are logically equivalent.
    (b) Without constructing truth table, Obtain the conjunctive and disjunctive normal forms of $(p \vee q) \leftrightarrow (p \wedge q)$

(5+15)

21. (a) State and establish distributive inequalities in lattice.
    (b) Construct the truth table for the Boolean function $f : B_3 \to B$ determined by the Boolean polynomial $p(x_1, x_2, x_3) = (x_1 \wedge x_2) \vee \big(x_1 \vee (x_2' \wedge x_3)\big)$.

(10+10)

22. (a) If L is a set accepted by a non-deterministic automaton, then prove that there exists a deterministic finite automaton that accepts L.
    (b) If $G(T, N, P, \sigma)$ is a regular where $T = \{a, b\}, N = \{\sigma, A\}, \sigma$ is a starting symbol and $P = \{\sigma \to b\sigma, \sigma \to aA, A \to bA, A \to b\}$. Does there exist finite state automaton corresponding to G?

(10+10)