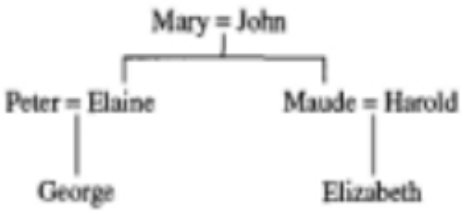
**STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086**
**(For candidates admitted during the academic year 2023 – 2024 & thereafter)**

**M. Sc. DEGREE EXAMINATION, NOVEMBER 2024**
**INFORMATION TECHNOLOGY**
**FIRST SEMESTER**

**COURSE : MAJOR CORE**
**PAPER : DISCRETE MATHEMATICS FOR COMPUTER SCIENCE**
**SUBJECT CODE: 23CS/PC/DM14**
**TIME : 3 HOURS MAX. MARKS: 100**

| Q. No. | SECTION A<br>Answer all the questions: (10 X 2 =20) | CO | KL |
|---|---|---|---|
| 1 | Define a lattice. | CO1 | K1 |
| 2 | What is a tautology? | CO1 | K1 |
| 3 | What is a reflexive relation? | CO1 | K1 |
| 4 | What is an asymptotic notation in complexity analysis? | CO1 | K1 |
| 5 | Define a planar graph. | CO1 | K1 |
| 6 | State the principle of inclusion and exclusion. | CO1 | K2 |
| 7 | Differentiate between restricted and nested quantification. | CO1 | K2 |
| 8 | What are the criteria for an algorithm? | CO1 | K2 |
| 9 | What is graph isomorphism? | CO1 | K2 |
| 10 | What is the Four color theorem? | CO1 | K2 |
| **Q. No.** | **SECTION B**<br>**Answer all the questions: (4 X 5 = 20)** | **CO** | **KL** |
| 6 | (a) Apply the principle of mathematical induction to prove the sum of the first n natural numbers is n(n+1)/2.<br>**(OR)**<br>(b) Construct the conjunctive normal form of the following statement: $(p \wedge q) \vee (\neg p \wedge \neg q)$. | CO2 | K3 |
| **7** | a) For the family tree given below find the following<br>(i) IsParentOf() (ii) IsParentOf()$^{-1}$<br>(iii) IsOfSamegeneration()<br>  <br><br>**(OR)**<br>b) Using suitable quantification, disjunction and conjunction express the following statements:<br>(i). "All cats are mammals and all dogs are mammals."<br>(ii). "There is a person who speaks either English or French." | CO2 | K3 |
| 8 | (a) In a library with 500 books, 20 books are about mathematics, 25 are about science, and 30 are about history. Prove that there must be at least one book that covers both mathematics and science.<br>**(OR)**<br>(b) For each of the following relations, state whether they are reflexive, symmetric or transitive. | CO2 | K3 |

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|---|---|---|---|
| | i) X is the set of people in the world, and xRy if and only if x and y have a parent in common.<br>ii) X is the set of real numbers, xRy is true when $x^2 = y^2$<br>iii) X = {a, b, c, d} and R = {(a, a),(a, b),(a, c),(d, b),(b, b),(c, d)}. | | |
| 9 | (a) You need to draw 5 cards to guarantee that you have at least two cards of the same suit. There are 4 suits (hearts, diamonds, clubs, and spades), and drawing 5 cards ensures that at least two of them must belong to the same suit.<br>**(OR)**<br>(b) Analyze the complexity of the quicksort algorithm. | CO3 | K4 |
| **Q. No.** | **SECTION C**<br>**Answer all the questions: (6 X 10 = 60)** | **CO** | **KL** |
| 10 | a). i.How many numbers between 1 and 1000 are divisible by 3,7 or 9?<br>ii. Construct combinatorial circuit for: $(P \rightarrow Q) \Lambda (P \leftrightarrow \neg R)$<br>**(OR)**<br>b) Identify CNF and DNF of : $a \Lambda (b \leftrightarrow c)$ | CO2 | K3 |
| 11 | a) Give the algorithm for computing square roots and analyze with an example.<br>**(OR)**<br>b) Examine using truth table to determine whether any of these formulas is a tautology, fallacy, satisfiability or valid:<br>i. $(P \Lambda (P \rightarrow Q) \Lambda (Q \rightarrow R)) \rightarrow R$<br>ii. $((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \leftrightarrow r)$<br>iii. $(p \rightarrow q) \leftrightarrow (\neg p \vee q)$ | CO3 | K4 |
| 12 | a) Compare and contrast Big O, Omega (Ω), and Theta (Θ) notations. Provide examples of each notation.<br>**(OR)**<br>b) Analyse the general rules for estimation of complexity of algorithm. | CO3 | K4 |
| 13 | a) For any natural number n and for any real number x, prove that<br>$(1-x)(1+x+x^2+\ldots..+x^n) = 1-x^{n+1}$<br>**(OR)**<br>b) Defend if the following statements are logically correct<br>**i.** Socrates says:<br>"If I'm guilty, I must be punished;<br>I'm guilty. Thus I must be punished."<br>**ii.** "If Paola is happy and paints a picture then Renzo isn't happy" | CO4 | K5 |
| 14 | a) Prove: A real number is rational if and only if it has a repeating decimal expansion.<br>**(OR)**<br>b) Discuss about problems with divisors and schedules. | CO4 | K5 |
| 15 | a) Design a planar graph and explain its applications in real-world problems.<br>**(OR)**<br>b) Create an algorithm that computes powers using recursion, and prove its correctness using mathematical induction. | CO5 | K6 |

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