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**DMI-ST. EUGENE UNIVERSITY**  
**DEGREE EXAMINATION – DECEMBER – 2022**

**SEM: IV**

**351 MA 41 DISCRETE MATHEMATICS**

Time: 3 Hours

Max. Marks: 100

**Answer any Five questions (5 x 20 = 100 Marks)**

1. a) Prove that  $(P \wedge P \rightarrow Q) \rightarrow Q$  is a Tautology. **(5 Marks)**  
 b) Construct the truth table for  $(P \wedge Q) \Leftrightarrow (\sim P \vee \sim Q)$ . **(5 Marks)**  
 c) Construct the truth table for  $((P \wedge \sim Q) \rightarrow R) \rightarrow (P \rightarrow (Q \vee R))$  and verify that it is a tautology. **(5 Marks)**  
 d) Prove that  $(P \rightarrow Q) \Leftrightarrow \sim P \vee Q$ . **(5 Marks)**
2. a) In how many ways can 8 papers in an examination to be arranged so that the two Mathematics papers are not consecutive. **(10 Marks)**  
 b) In 9 colors are used to paint 100 houses, show that 12 houses will be of the same color. **(5 Marks)**  
 c) How many three-digit numbers are divisible by 7. **(5 Marks)**
3. a) Describe any five different types of Graphs. **(10 Marks)**  
 b) Draw a complete bipartite of  $K_{2,3}$   $K_{3,3}$ . **(5 Marks)**  
 c) State and prove Handshaking Theorem. **(5 Marks)**
4. a) Show that elementary properties of a Group for cancelation Law. **(10 Marks)**  
 b) Show that  $M_2$ , the set of all  $2 \times 2$  non- singular matrices over  $\bar{R}$  is group under usual matrix multiplication. Is it Abelian? **(10 Marks)**
5. a) Which elements of the poset  $\{2,4,5,10,12,20,25\}$ , are maximal and which are minimal? **(10 Marks)**  
 b) Draw the Hasse diagram for (i)  $P1 = \{1, 2, 3, 4, 12\}$  and  $\leq$  is a relation such that  $x \leq y$  if  $x$  divides  $y$   
 (ii) Let  $S = \{a, b, c\}$  and  $\tilde{A} = P(S) = \{\phi, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}$  Consider the partial order of set inclusion ( $\subseteq$ ). **(10 Marks)**
6. a) Show that the conclusion  $C: \sim P$  follows from the premises  $H_1: \sim P \vee Q$ ,  $H_2: \sim(Q \wedge \sim R)$  and  $H_3: \sim R$ . **(10 Marks)**

- b) Show that  $S \vee R$  is tautologically implied by  $(P \vee Q) \wedge (P \rightarrow R) \wedge (Q \rightarrow S)$ . **(5 Marks)**
- c) Show that  $P \rightarrow Q \equiv (P \rightarrow Q) \wedge (Q \rightarrow P) \equiv (P \wedge Q) \vee (\sim P \wedge \sim Q)$ . **(5 Marks)**
7. a) Show that  $K_7$  has Hamiltonian graph. How many edge disjoint Hamiltonian cycles are there in  $K_7$ ? List all the edge-disjoint Hamiltonian cycles. Is it Eulerian graph? **(10 Marks)**
- b) Draw a graph that is both Eulerian and Hamiltonian. **(10 Marks)**