Indian Institute of Information Technology and Management, Gwalior

**Discrete Mathematical Structures(MA-201)**

Mid-Term Examination (Session 2024)

Maximum Time: 2 Hours | Max marks: 30

**Attempt all the questions**

1. (a) Prove or disprove whether the relation R, defined in the set A of all polygons as $R = \{(P_1, P_2) : P_1 \text{ and } P_2 \text{ have same number of sides}\}$ is an equivalence relation on A. **(2.5)**

   (b) Let $S = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$. Prove or disprove whether the relation R on $A = S \times S$ defined by $(a, b)R(c, d)$ if and only if $10a + b \leq 10c + d$, is a partial order relation. **(2.5)**

   (c) Without constructing truth table, prove the following
   1. $\neg p \to (q \to r) \equiv q \to (p \vee r)$
   2. $((p \vee q) \wedge \neg(\neg p \wedge (\neg q \vee \neg r))) \vee (\neg p \wedge \neg q) \vee (\neg p \wedge \neg r)$ is a tatulogy **(5)**

2. (a) Using law of inference, prove that, $p \vee q, q \to r, p \to s, \neg s \Rightarrow r \wedge (p \vee q)$. **(5)**

   (b) Using Inference theory of predicate logic show that "Everyone who knows JAVA will get a high paying job" and "someone in this class knows JAVA" will logically conclude "someone in this class will get high paying job". **(5)**

3. (a) Prove that $\sqrt{2}$ is irrational. **(4)**

   (b) Consider the poset, $P = \{1, 2, 5, 6, 10, 60, 420\}$, where relation $aRb$ is $a|b$ stands for a divides b.
   1. Draw the Hasse diagram for the poset P.
   2. Find the maximal and minimal elements of P.
   3. Determine whether the poset, P is a Lattice, with proper justification. **(6)**

*******Best wishes*********