National Institute of Technology Hamirpur (H.P.)
Computer Science & Engineering

Branch/Semester: BTech & DD (2nd Year)   **Semester**: 3rd
Subject code: CS-213   **Duration**: 180 Minutes
Subject Name: Discrete Structures   **Max Marks**: 50
Date: 28 /11/2023   **Time**: 09:30 AM - 12:30 PM

Note: **All questions are compulsory.**

1. a). What is logical equivalence? Are the following two propositions logically equivalent? Prove.

   $$[(p \wedge q) \vee (p \wedge r)] \rightarrow s \text{ and } [\sim p \vee (\sim q \wedge \sim r)] \vee s$$

   b). Is $(p \rightarrow q) \rightarrow (\sim q \rightarrow \sim p)$ a Tautology? Prove.   **(4 Marks)**

2. Rewrite the following using quantifiers:
   a) "Every student in the class studied calculus."

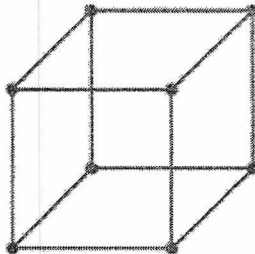   b) "Some real numbers are rational."   **(2 Marks)**

3. a). Get the contrapositives of the statement "If it is raining then I get wet.".

   b). Find a counterexample, if possible, to these universally quantified statements, whose universe of discourse for all variables consist of all integers.
   i). $\forall x \forall y (x^2 = y^2 \rightarrow x = y)$
   ii). $\forall x \forall y (xy \geq x)$ **(5 Marks)**

4. What is the chromatic number of the below given graph.   **(2 Marks)**
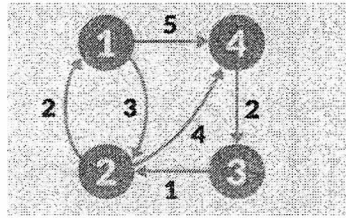

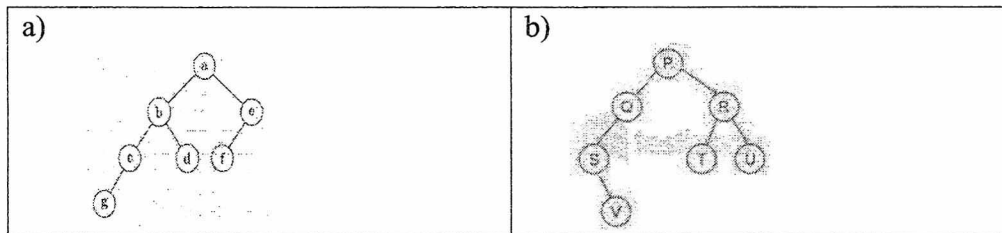5. Discuss the Difference between Poset and Toset. Draw the Hasse Diagram for
   a). Divisor of 24.
   b). Divisior of 45.   **(6 Marks)**

6. Compute all pairs shortest path using Warshall algorithm for the graph given below. Follow all the steps of the algorithm. **(5 Marks)**

7. What will be the preorder, inorder, and postorder traversal of the below given tree structure. **(6 Marks)**

a)	b)

8. Determine whether the below given graphs contains Hamiltonian path and Hamiltonian circuit or not. Also specify the Hamiltonian path and circuit found in the graphs. **(6 Marks)**
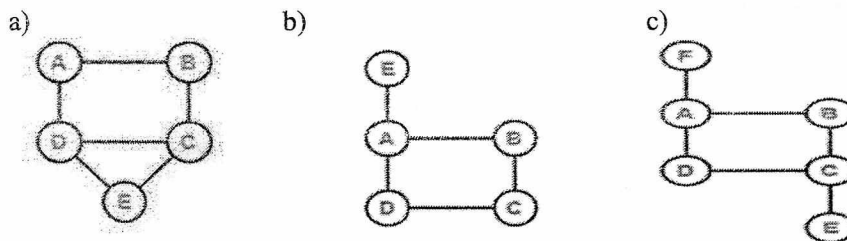
9. Construct the maxheap for the following elements in sequence.

   10, 20, 30, 40, 50, 60, 70

   What will be the total number of swap operation required to arrange the above elements in max heap order. **(5 Marks)**

10. A text is made up of the characters a, b, c, d, e with probability of occurrence 0.11, 0.40, 0.16, 0.09, and 0.24 respectively. What will be the representation of each character using Huffman coding and average length of the message. **(5 Marks)**

11. Given that the $(Z, +)$ is a group. Prove that $(H1, +)$ and $(H2, +)$ is a subgroup or not where $H1 = \{2k+1, k \in Z\}$ and $H2 = \{2k, k \in Z\}$. Write all the conditions of subgroup with examples. **(4 Marks)**