INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA
HIMACHAL PRADESH
An Institute of National Importance under MoE
Saloh, Una – 177209
Website: www.iiitu.ac.in

AY 2023-24
School of Computing
Cycle Test – I
16, Oct.'23
09:00 AM -10:00 AM

22324

Degree	B. Tech.	**Branch**	Information Technology
Semester	III Semester		
Subject Code & Name	ITC301 Discrete Structures		
Time: 60 Minutes	**Answer All Questions**		**Maximum: 20 Marks**

Sl. No.	Question	Marks
1.a	Find a compound proposition involving the propositional variables p, q, r, and s that is true when exactly three of these propositional variables are true and is false otherwise.	(1)
1.b	Show that if S is a proposition, where S is the conditional statement "If S is true, then unicorns live," then "Unicorns live" is true. Show that it follows that S cannot be a proposition.	(2)
1.c	Suppose that there are three people Aaron, Bohan, and Crystal. Determine what Aaron, Bohan, and Crystal are if Aaron says "All of us are knaves" and Bohan says "Exactly one of us is a knave."?	(2)
2.a	Let P (x, y) be a propositional function. Prove or disprove that $\exists x\, \forall y\, P(x, y) \rightarrow \forall y\, \exists x\, P(x, y)$ is a tautology.	(1)
2.b	Prove or disprove that there are infinitely many prime numbers.	(2)
2.c	Prove or disprove that these compound propositions are tautologies. a) $(\neg q \wedge (p \rightarrow q)) \rightarrow \neg p$ b) $((p \vee q) \wedge \neg p) \rightarrow q$	(2)
3.a	Prove or disprove that the compound proposition $(p \vee q) \wedge (\neg p \vee q) \wedge (p \vee \neg q) \wedge (\neg p \vee \neg q)$ is satisfiable.	(1)
3.b	Prove or disprove that $(a \vee b) \wedge (\neg a \vee \neg c)$ is satisfiable.	(2)
3.c	Find the truth table of the compound proposition $(p \vee q) \rightarrow (p \wedge \neg r)$.	(2)
4.a	Given the universal set U = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, construct a representation of sets given below with bit strings where the i^{th} bit in the string is 1 if i is in the set and 0 otherwise. a) {3, 4, 5} b) {1, 3, 6, 10}	(1)
4.b	Prove that $P(A) \subseteq P(B)$ if and only if $A \subseteq B$.	(2)
4.c	Let S be the set that contains a set x if the set x does not belong to itself, S = {x | x not in x}. Show the assumption that S is not a member of S leads to a contradiction.	(2)

*****GOOD LUCK*****

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20, Nov.'23
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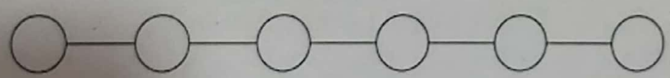
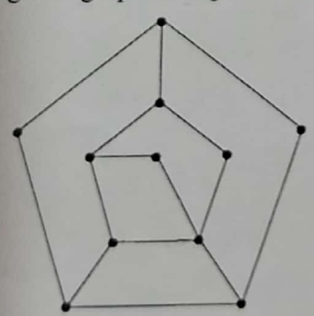
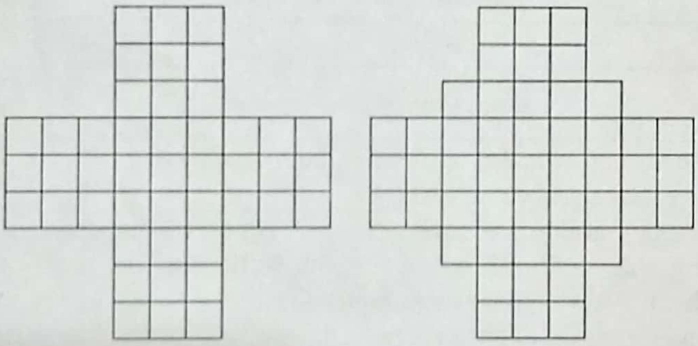
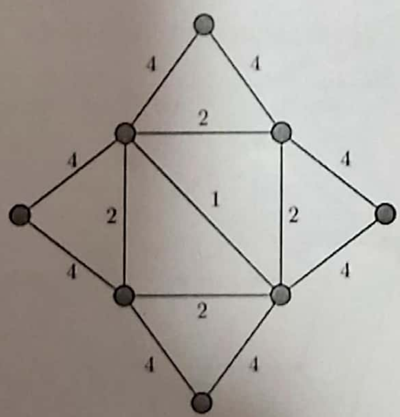
Degree	B. Tech.	**Branch**	Information Technology
Semester	III Semester		
Subject Code & Name	ITC301 Discrete Structures		
Time: 60 Minutes	**Answer All Questions**		**Maximum: 20 Marks**

Sl. No.	Question	Marks
1.a	Let G=(V, E) be an undirected graph with k components and $\|V\| = n$, $\|E\| = m$. Prove that m is greater than or equal to n - k.	(1)
1.b	A minimum cut in a graph is a smallest set of edges which, upon removal, disconnects the graph, so that there are vertices in the resulting graph with no path between them. We are given two graphs. $G_1 = (V_1, E_1)$ is a connected, 3-regular graph and $G_2 = (V_2, E_2)$ is a connected, 4-regular graph. The vertex sets V_1 and V_2 are disjoint. It is also given that the size of any minimum cut in G_1 is the same as the size of any minimum cut in G_2. Calculate the size of the minimum cut.	(2)
1.c	Let G = (V, E) be an undirected simple graph. How many maximal matchings does the following graph have?  Figure 1. A path graph with six vertices.	(2)
2.a	Prove or disprove that the given graph in Figure 2 has a hamiltonian circuit.  Figure 2. A graph on eleven vertices.	(1)

2.b	Let G be a graph on n vertices in which there is a subset M of m edges which is a matching. Consider a random process where each vertex in the graph is independently selected with probability $0 < p < 1$ and let B be the set of vertices so obtained. What is the probability that there exists at least one edge from the matching M with both end points in the set B?	(2)
2.c	Let G be a connected bipartite simple graph (i.e., no parallel edges) with distinct edge weights. Prove or disprove that no MST in G contains the heaviest edge.	(2)
3.a	Let G be a graph with k vertices of odd degree. What is the minimum number of edges that can be added to the graph so that the resultant graph has an eulerian circuit?	(1)
3.b	There will be a party at IIIT Una involving 2n students. Each pair of students are either friends or enemies. It has managed to invite an excellent set of guests, each of whom has more friends than enemies (among the other guests). Design a seating at a round table so that everyone has two friends as their neighbours.	(2)
3.c	For each of the two boards in Figure 3, either find a path that passes through every square of the board exactly once or prove that no such path exists. A path may proceed through any sequence of horizontally or vertically adjacent squares and is not required to return to its starting square.  Figure 3. Given graphs are made up of squares.	(2)
4.a	→ h+1 Calculate the minimum and maximum numbers of elements in a heap of height h?	(1)
4.b	Let G be a complete graph on n vertices. Let e be any edge from G, delete it from the graph G. Calculate the number of spanning trees in the resultant graph.	(2)
4.c	Calculate the number of distinct weight minimum spanning tree in the graph given in Figure 4.  Figure 4. A graph with eight vertices	(2)

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