WINTER-2018

UNIT 1

Q.1 a) Without constructing Truth table, show that

$(\neg P \wedge (\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$ **(7)**

b) Obtain principal conjunctive normal form of

$(\neg P \rightarrow R) \wedge (Q \leftrightarrow P)$ **(7)**

Q.2 a) For the formula $(P \wedge Q) \vee (\neg R \wedge \neg P)$ draw circuit diagram using AND, OR and NOT gates only. **(7)**

b) Obtain the principle conjunctive normal form of $P \rightarrow (P \wedge (Q \rightarrow P))$. **(7)**

UNIT 2

Q.3 a) Show that

$(\exists x)M(x)$ follows logically from the premises:

$(x)(H(x) \rightarrow M(x))$ and $(\exists x)H(x)$ **(7)**

b) Symbolize the following statement:

i. Rover is a dog, **ii.** All dogs are animal,

iii. Some dogs are black. **(6)**

Q.4 a) Show without constructing truth tables that the following statements cannot be true simultaneously.

$R \vee M$, $R \vee S$, $\sim M$, $\sim S$. **(7)**

b) Show that $R \vee S$ follows logically from the premises

$(C \vee D, C \vee D) \rightarrow \sim H$, $\sim H \rightarrow (A \wedge \sim B)$

and $(A \wedge \sim B) \rightarrow (R \vee S)$ **(6)**

UNIT 3

Q.5 a) Let $X = \{1, 2 \ldots., 7\}$ and $R = \{\langle x, y\rangle \mid x - y$ is divisible by 3) show that R is an equivalence relation. Draw the graph of R. **(6)**

b) Given the relation matrices M_R and M_S find $\overline{M_R}$, $\overline{M_S}$, $\overline{M_{RoS}}$ and Show that $M_{\overline{RoS}} = M_{\bar{S}o\bar{R}}$. **(7)**

$$M_R = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \quad M_S = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{bmatrix}$$

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Q.6 a) Show that $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ using Venn diagram and formal proof. **(7)**

b) Explain the following operations on set **(6)**

i) Union, **ii.** Intersection,

iii. Relative Complement, **iv.** Absolute Complement.

UNIT 4

Q.7 a) Write down the composition table for (Z_7, +7) and (Z_7, *7). **(7)**

b) What is coset? Find the left coset of {[0], [4]} in group $\langle Z_7, +7 \rangle$. **(7)**

Q.8 a) Let $Q_P = \langle \{E, T, F\}, \{a, +, *, (,), E, \phi \rangle$ where ϕ is the set of production as $E \to E + T$, $E \to T$, $T \to T * F$, $T \to F$, $F \to (E)$, $F \to a$. Generate derivation for a * a + a. **(7)**

b) Show that $\langle Z_7, +7, *7 \rangle$ is a commutative ring with identity. **(7)**

UNIT 5

Q.9 a) Draw the diagram of the lattices $\langle S_n, D \rangle$ for n = 4, 6, 8, 12, 15, 45, 60, 75 and 210. **(6)**

b) For the following function **(7)**

a. $f = x + y + z$, **b.** $f = \bar{x}\bar{y}z + \bar{x}y\bar{z} + xy\bar{z}$.

Given

i. Circuit diagram representation.

ii. Truth table representation.

iii. k-map representation.

Q.10 a) Obtain sum of product and product of sum canonical form of the following expression.

i. $x_1 x_2 + x_3$, **ii.** $[(x_1 + x_2)(x_3 x_4)]$. **(6)**

b) In any Boolean algebra show

i. $a = 0 \Leftrightarrow ab' + a'b = b$, **ii.** $a = b \Leftrightarrow ab' + a'b = 0$. **(7)**

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UNIT 6

Q.11 a) Explain with example. **(6)**

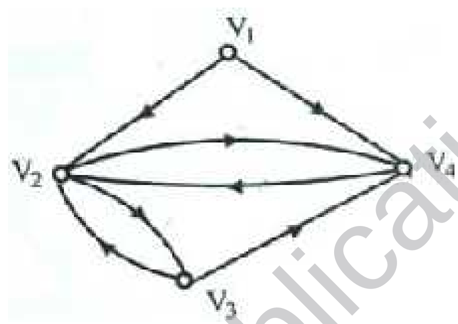
i. Graph, **ii.** Indegree, **iii.** Outdegree,

iv. Tree, **v.**Path, **vi.** Cycle,

vii. Complete binary tree.

b) Obtain adjacency matrix A of the digraph shown below. Find the elementary paths of length 1 and 2 from V_1 to V_4. Show that there is also a simple path of length 4 from V_1 to V_4.

(7)



Q.12 a) Give the directed tree representation of the formula

$(P \vee (\neg P \wedge Q)) \wedge ((\neg P \wedge Q) \wedge \neg R)$ **(6)**

b) Explain with example

i. Adjacency matrix, **ii.** Path matrix. **(7)**

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