PE-157

(511) M.A./M.Sc. (First Semester) EXAMINATION, DEC.-2021

Advanced Discrete Mathematics (I)

Time : Three hours] **Paper-IV** **[Maximum Marks : 80**

Note : *Answer from both the Sections as directed. The figures in the right-hand margin indicate marks.*

[Section-A]

1. Answer the following multiple choice type questions : **1×10=10**

(a) The truth value of statements $p \wedge q \Rightarrow q$ is :

(i) true (ii) false (iii) true and false (iv) None of these

(b) Contrapositive of statement 'If $4x - 2 = 10$ then $x = 3$' :

(i) If $x = 3$ then $4x - 2 = 10$ (ii) If $4x - 2 \neq 10$ then $x \neq 3$

(iii) If $x \neq 3$ then $4x - 2 \neq 10$ (iv) None of the above

(c) Which one of the following is De-Morgan's Laws :

(i) $p \wedge q \equiv \sim p \vee \sim q$ (ii) $\sim(p \vee q) \equiv \sim q \wedge \sim p$

(iii) $\sim(p \wedge q) \equiv \sim p \vee \sim q$ (iv) $\sim(p \wedge q) \equiv \sim p \wedge \sim q$

(d) In a lattice $(L \leq)$ the value of $a \vee (a \wedge b)$ is :

(i) a (ii) b (iii) $a \vee b$ (iv) $a \wedge b$

(e) The value of function $xy + xy' + x'y + x'y'$ is :

(i) 0 (ii) 1 (iii) x (iv) y

(f) If $(L \leq)$ is a lattice with least element 0 and greatest element 1 then for any $a \in L$ the value of $a \vee 1$ is :

(i) a (ii) 1 (iii) 0 (iv) $a \wedge 1$

(g) An element a in a semigroup $(\leq *)$ is called an idempotent if :

(i) $a = e$ (ii) $a^n = e$ (iii) $a^2 = a$ (iv) $a^n = na$

(h) For any commutative monoid $(M *)$ the set of idempotent element of M form a :

(i) Submonoid (ii) Subsemigroup

(iii) Submonoid and subsemigroup (iv) None of the above.

(i) The number of minimal Boolean function in 3 variable is :

(i) 2 (ii) 4 (iii) 8 (iv) 16

(j) The value of complete disjunctive normal form of n variable is :

(i) 0 (ii) 1 (iii) n (iv) None of the above

2. Answer the following short answer type questions : **2×5=10**

(a) Define partial order relation.

(b) Define complemented complete lattice.

(P.T.O.)

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(c) Design the circuit for the swiching function :

$$x + y(z + st) + uv$$

(d) Using $\wedge$ and $\sim$ for A and N respectively rewrite the statements :–

AApNrAqNp

(e) Define Existential Quantifiers with example.

[Section-B]

Answer the following questions. **12×5=60**

3. (a) Prove by using truth table that formula :–

$(p \Rightarrow q) \vee (r \Rightarrow p)$ is tautology.

(b) Show that $[(p \wedge q) \Rightarrow p] \Rightarrow (q \wedge \sim q)$ is contra-diction.

OR

(a) Show that the argument $p, p \rightarrow q, q \rightarrow r' - r$ is valid.

(b) Check the validity of following argument.

p

$\sim q \vee r$

$\sim p \Rightarrow q$

r

4. (a) Show that dual of lattice is also lattice.

(b) Prove that in a distributive lattice, if an element has a complement then this complement is unique.

OR

(a) Show that every finite lattice is bounded.

(b) In a lattice $(L \leq)$ prove that :–

$$a \wedge (a \vee b) = 9$$

$$a \vee (a \wedge b) = 9$$

5. (a) In a Boolean Algebra show that :

$$a \cdot b + [(a + b') \cdot b]' = 1$$

(b) If $a, b \in (B, +, ., ')$ then show that :

(i) $(a + b)' = a' . b'$

(ii) $(a . b)' = a' + b'$

OR

(a) Replace the swiching function :

$$f(x, y, z) = xyz + x \cdot y' \cdot z + x' \cdot y' \cdot z$$

by a simpler swiching circuit.

(b) Draw the logic circuit for the Boolean Expre-ssion :

$$f(x, y, z) = x \cdot y + z \cdot y'$$

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6. (a) Define Semigroup and Monoid with example.

(b) Explain direct Product of two semigroup.

OR

(a) State and prove Basic Theorem of semigroup.

(b) If $<S, *>$, $<T, \Delta>$ and $< V, \nabla >$ be semigroup $f : S \to T$ and $g : T \to V$ be a semigroup homomorphism then show that $gof : S \to V$ be a semigroup homomorphism from $<S, *>$ to $< V, \nabla >$.

7. (a) Explain NAND gate and OR-gate.

(b) Draw logic circuit for the Boolean function :

$$f = ab'c + abc' + ab'c$$

OR

(a) Express the following function into disjunctive normal form :

(i) $f(x, y, z) = xy' + x \cdot z + x \cdot y$

(ii) $f(x, y, z) = (xy' + x \cdot z)' + x'$

(b) Explain Karnough Map method for Boolean function in two variable.

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