

Sample Question Paper
By Department of Mathematics
Dumkal College
for
U.G. 1st Semester [NEP-2020]
MATHEMATICS [Skill Enhancement Course (SEC)]
Course Code: MATH-SEC-T-01 (Logic & Boolean Algebra)

Section I

1. Answer any five questions: ($1 \times 5 = 5$)
 - a) What is a proposition? Give an example of a declarative statement.
 - b) Write the truth table for $p \wedge (p \rightarrow q)$.
 - c) Define the existential quantifier with an example.
 - d) What is the difference between a tautology and a contradiction?
 - e) Express the negation of the statement 'All birds can fly' using quantifiers.
 - f) Define a complemented lattice with an example.
 - g) If $\{L, \leq\}$ is a lattice, prove that $a \vee (a \wedge b) = a$.
 - h) In a Boolean algebra $(B, +, \cdot, ', 0, 1)$, prove that $(a')' = a$.

Section II

2. Answer any two questions: ($5 \times 2 = 10$)
 - a) What is a contradiction? Determine whether the compound proposition $((p \wedge q) \rightarrow r) \vee (p \wedge \sim r)$ is a contradiction.
 - b) Without using a truth table, prove that $(p \vee q) \wedge (\sim p \vee r) \equiv (q \vee r)$.
 - c) Simplify the Boolean expression $(x + y')(x' + z) + y$ and draw the corresponding switching circuit.
 - d) Simplify the Boolean function $f(a, b, c) = \Sigma(1, 3, 5, 7)$ using the Karnaugh map method.

Section III

3. Answer any two questions: ($10 \times 2 = 20$)

- a) i) Construct a truth table for the statement: 'If it rains, then the ground is wet.'
- ii) Prove that $(p \rightarrow q) \wedge (\sim q \rightarrow \sim p)$ is a tautology.
- b) i) Prove that $\{P(S), \cap, \cup\}$ is a lattice, where $P(S)$ is the power set of S .
- ii) Define a modular lattice and prove that every distributive lattice is modular.
- c) i) Show that in a Boolean algebra, $(a + b)' = a' \cdot b'$.
- ii) Convert the Boolean expression $(x + y')(y + z)$ into Conjunctive Normal Form (CNF).
- d) i) Define a maxterm with an example.
- ii) Minimize the Boolean expression $f(a, b, c, d) = \Sigma(2, 4, 6, 8, 10, 12, 14, 15)$ using the Quine-McCluskey method.
