

U.G. 4th Semester Examination - 2024

MATHEMATICS

[HONOURS]

Skill Enhancement Course (SEC)

Course Code : MATH-H-SEC-T-2(A&B)

Full Marks : 40

Time : 2 Hours

The figures in the right-hand margin indicate marks.

The symbols and notations have their usual meanings.

Answer all the questions from selected Option.

OPTION-A

MATH-H-SEC-T-2A

(Logic & Boolean Algebra)

1. Answer any five questions:

2×5=10

- a) Examine whether the sentence $x^2+6 = 10$ is a statement or not.
- b) Find the negation of the statement $p:3+6 = 8$.
- c) If the truth value of p is F and the truth values of q and r are both T, compute the truth value of $(p \wedge q) \vee \sim r$.

[Turn Over]

- d) Define the universal quantifier with an example.
- e) What is the difference between the converse and contrapositive of a proposition?
- f) Define a lattice with an example.
- g) If $\{L, \leq\}$ is a lattice and $a \in L$, prove that $a \vee a = a$ and $a \wedge a = a$.
- h) If $(B, +, ', 0, 1)$ is a Boolean algebra, prove that $(a+b)' = a'.b' \forall a, b \in B$.

2. Answer any two questions: 5×2=10

- a) What is a tautology? Determine whether the compound proposition $\sim(q \rightarrow r) \wedge r \wedge (p \rightarrow q)$ is a tautology or a contradiction. 1+4
- b) Without using truth table, prove that $p \rightarrow (q \rightarrow p) \equiv \sim p \rightarrow (p \rightarrow q)$. 5
- c) Simplify the Boolean expression $(x.y + z').(y' + z.x') + x'.y'.z'$ and then draw a switching circuit for it. 5
- d) Minimize the function $f(a, b, c, d) = \sum(0, 2, 6, 7, 8, 9, 13, 15)$ using Karnaugh map method. 5

3. Answer any two questions: 10×2=20

- a) i) Express the statement "If a number is divisible by 3 and by 5, then it is divisible by 15" as a compound proposition and construct its truth table.
- ii) Prove the following equivalence by proving the equivalence of the dual:

$$(p \rightarrow r) \wedge (q \rightarrow r) \equiv (p \vee q) \rightarrow r. \quad 5+5$$

- b) If $(L, \leq)$ is a lattice, then for any $a, b, c \in L$, prove that

- i) $a \wedge (b \vee c) \geq (a \wedge b) \vee (a \wedge c)$
- ii) $a \vee (b \wedge c) \leq (a \vee b) \wedge (a \vee c)$. 5+5

- c) i) In any Boolean algebra, show that $ab' + a'b = 0$ if and only if $a = b$.
- ii) Convert the Boolean expression $(yz + xz')(xy' + z')$ in Conjunctive normal form involving three variables x, y and z . 5+5

- d) i) Define a minterm with an example.
- ii) Minimise the Boolean expression $f(a, b, c, d) = \sum(0, 1, 2, 3, 4, 6, 7, 8, 9, 11, 15)$ using Quine McCluskey method. 2+8

d) Write short notes:

5+5

i) Hamiltonian graph

ii) Travelling Salesman Problem.
