2026

PHYSICS

(Major)

Paper : PHY4200304MJ

(Digital Electronics)

Full Marks : 45

Time : 2 hours

The figures in the margin indicate full marks for the questions.

1. **Answer the following as directed :** **1×5=5**

(a) What is a logic gate?

(b) $\overline{(A+B)}$ =_____; $\overline{AB}$ =_____. (Fill in the blanks)

(c) The output of a gate is LOW when at least one of its inputs is HIGH. This is true for

(i) AND (ii) NAND (iii) NOR (iv) OR

(Choose the correct answer)

(d) Define a flip-flop.

(e) A two-variable K-Map can have _____ possible combinations of the input variables A and B. (Fill in the blank)

2. **Answer any *five* questions :** **2×5=10**

(a) Differentiate between active and passive components.

(b) What are the different levels of integration?

(c) Convert $(73)_{10}$ to binary.

(d) Write a brief note on X-OR *or* X-NOR gate.

(e) Which gates are known as the universal gates? Show with an example.

(f) Write two applications of digital circuits.

(g) What are the basic operations in Boolean algebra?

(h) What is a Karnaugh map or K-map?

(i) Plot the expression $f = (A + B)(\overline{A} + B)(\overline{A} + \overline{B})$ on the K-map.

(j) Write in short on full-subtractor.

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3. **Answer any *four* questions :** **5×4=20**

(a) State the truth tables of OR and AND gates. Describe the realization of gate using diodes with proper circuit diagram.

(b) Show that $A \oplus B = A\bar{B} + \bar{A}B$ and construct the corresponding logic diagrams.

(c) Reduce the expression : 2½×2=5

(i) $f = A[B + \bar{C}(\overline{AB + A\bar{C}})]$

(ii) $f = A + B[AC + (B + \bar{C})D]$

(d) State and prove the first law of De Morgan's theorem with the help of truth table and schematic representation.

(e) Show the possible minterm grouping in a two-variable K-map in the SOP form.

(f) Explain SR flip-flop with truth table.

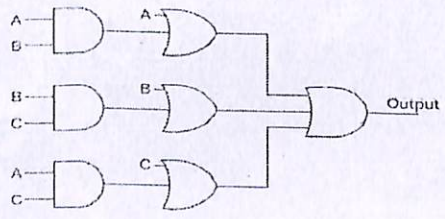
(g) Describe monostable multivibrator using IC 555.

(h) What are shift registers? Explain serial-in-serial-out (SISO) shift registers with diagram.

4. **Answer any *one* question :** 10

(a) (i) Show with an example, how a Boolean expression can be converted to a logic circuit.

(ii) Write the Boolean expression for the logic diagram given below and simplify it as much as possible and draw the logic diagram that implements the simplified expression. 5+5



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(b) Explain shift registers in detail. Describe all four modes with diagrams and applications.

(c) Prove—

(i) associative law 1 : $(A + B) + C = A + (B + C)$ and law 2 : $(A.B)C = A(B.C)$

(ii) commutative law : $A + B + C = B + C + A$

with the help of logic gates and truth tables.

(d) What is a half-adder? Draw the truth table and block diagram of a half-adder. Realize the half-adder using one X-OR gate and one AND gate. Also realize a half-adder using only (i) NAND gates and only (ii) NOR gates. 1+1+1+1+3+3=10

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