

2025

PHYSICS — HONOURS

Paper : CC-13

(Digital Systems and Applications)

Full Marks : 50

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*Answer **question no. 1** and **any four** questions from the rest.

1. Answer **any five** questions : 2×5
- Convert 40.125 decimal into its octal equivalent.
 - Using 2's complement method, find $X - Y$ where $X = 100101$ and $Y = 11100$.
 - What is the basic difference between SR flip-flop and JK flip-flop?
 - Draw the circuit diagram of AND gate using TTL logic and write down its truth table.
 - Implement a two input X-OR gate using NAND gates only.
 - Show algebraically that $A + BC = (A + B)(A + C)$.
 - Write two advantages of Integrated Circuits.
2. (a) Design and NOT gate using a transistor ($\beta_{\text{sat}} = 50$) considering $V_{CE\text{sat}} = 0.2 \text{ V}$, $I_c = 5 \text{ mA}$ and source voltage 5 volt.
- (b) Write down the Boolean expressions for SUM and CARRY of a full-adder from its truth table.
- (c) Give the truth table of a half-subtractor. Implement it with basic gates. 2+(2+2)+(2+2)
3. (a) What is equality detector? Explain with truth table.
- (b) Simplify the function $F(A, B, C) = \sum m(0, 2, 4, 5, 6)$ using Karnaugh map.
- (c) Find the standard POS form of the Boolean expression $\bar{A}(\bar{B} + C)$ from its truth table. Write down the SOP form. 2+4+(3+1)
4. (a) What is the basic difference in operation between MS-JK and JK flip-flop? Explain with block diagram.
- (b) Explain why JK flip-flop is called an one bit register.
- (c) State and explain the difference between positive and negative edge triggering. (2+2)+2+(2+2)

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5. (a) How many control (or select) inputs are required for a 32:1 MUX? Draw a 4:1 MUX using basic gates and explain its operation. How it can be used for making a 8:1 MUX (Give circuit diagram only)?

(b) Implement the following Boolean expression using 8 : 1 multiplexers :

$$f(A, B, C) = \sum m(2, 4, 6, 7). \quad [1+(2+2)+2]+3$$

6. (a) What is Shift Register? Draw a 4-bit serial-in-serial-out shift register using D flip-flops.

(b) For 4 bit data transmission, what is the time required if we use SISO and SIPO shift register? Given the duration of each the pulse is 2 ms.

(c) Draw the circuit diagram and explain how to convert MOD-16 counter to a decade counter.

$$(1+3)+2+(2+2)$$

7. (a) What is A/D conversion? Find the output from a 5 bit ladder that has a digital input of 11101.

[Take state 0 = 0V, State 1 = +10V]

(b) Write two differencesp between RAM and ROM.

(c) Implement the following Boolean function using Programmable Logic Array (PAL) :

$$F = A + \bar{C}B. \quad (2+3)+2+3$$