DIGITAL LOGIC DESIGN
(MCAP 1101)

Time Allotted: 3 hrs **Full Marks: 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and Any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1= 10**

(i) An OR gate has 6 inputs. The number of input words in it's truth table are
(a) 6 (b) 32 (c) 64 (d)128.

(ii) The simplification of the Boolean expression $(A'BC')' + (AB'C)'$ is
(a) 0 (b) 1 (c) A (d) BC.

(iii) Find out the unknown base x when $(123)_8 = (313)_x$.
(a) 6 (b) 5 (c) 7 (d) 4.

(iv) What is the Grey code for the binary number $(01001)_2$?
(a) 01101 (b) 010101
(c) 101010 (d) none of these.

(v) The number of control lines for a 8 - to - 1 multiplexer is
(a) 2 (b) 3 (c) 4 (d) 5.

(vi) One disadvantage of R-S flip-flop is,
(a) it has only single output (b) it has no enable input
(c) it has RACE condition (d) it has no clock input.

(vii) The Octal equivalent of $(386)_{10}$ is
(a) 606 (b) 602 (c) 620 (d) 622.

(viii) Maximum no of inputs connected to gate is called
(a) fan (b) fan in
(c) fan out (d) out come.

(ix) 2's complement representation of 1101 0110 is _____.
(a) 0001 1001 (b) 00101010
(c) 1010 1001 (d) none.

(x) A Boolean expression Σ(1,3,6,7) is equivalent to
(a) Π(0,2,4,5) (b) Π(0,1,4,5)
(c) Π(0,2,4,6) (d) Π(1,2,3,5).

Group - B

2. (a) Perform the arithmetic operations (+42) + (-13) and (-42) - (-13) in binary signed 2's complement representation .

(b) Add the following numbers using BCD number system (37) + (15).
Convert the following hexadecimal-number $(13AC45.B3D)_{16}$ into it's octal equivalent.

(3 + 3) + (3 + 3) = 12

3. (a) Convert the Grey-code 1110111010101 into it's equivalent Binary Code.

(b) Perform the following subtraction of two unsigned numbers using 1's complement:
11001 - 10110

(c) Draw the block diagram of BCD adder and explain how it works.

(d) Convert the octal number 7401 to its Binary equivalent.

3 + 3 + 3 + 3 = 12

Group – C

4. (a) What are universal gates? Construct a logic circuit using NAND gates only for the expression $X = A.(B + C)$

(b) Convert the following Boolean-function into product of sum(POS) form:
F(w, x, y, z)= Σ(2, 3, 10, 11, 12, 13, 14, 15).

(2 + 4) + 6 = 12

5. (a) Simplify the following Boolean-function using K-map method and draw the circuit diagram using minimum number of NAND gates.
F(w, x, y, z)=Σ(0, 1, 2, 4, 5, 6, 8, 9, 12, 13, 14).

(b) Reduce the following Boolean expression into five literals:
ABC + A'B'C + A'BC + ABC' + A'B'C' .
(where X' implies the complement of X)

(5 + 3) + 4 = 12

Group - D

6. (a) Implement the following function using 4-to-1 multiplexer.

$$F(A, B, C) = \sum (2, 3, 5, 6)$$

(b) Implement a full-adder circuit with a Decoder and two OR gates.

6 + 6 = 12

7. (a) How many 128 × 8 memory chips are needed to provide a memory capacity of 4096 × 16? Also indicate the size of address bus and data bus for 4096 × 16 bits memory.

(b) Draw the logic diagram of a full subtractor using half subtractors and explain its working with the help of a truth table.

(c) What are the two approaches to reduce the delay in the adders?

(1 + 1 + 1) + 6 + 3 = 12

Group – E

8. (a) What is the difference between a latch and a flip-flop?

(b) Construct a shift register from S-R flip-flops. Explain its working.

(c) Distinguish between synchronous sequential circuit and asynchronous sequential circuit.

2 + (2 + 2) + 3 = 12

9. (a) What is a shift register? Can a shift register be used as a counter? If yes, explain how?

(b) What is race around condition in flip-flop?

(c) Justify with diagram that ,T flip-flop is a single input version of JK flip.

(2 + 4) + 3 + 3 = 12