(2½ Hours) **[Total Marks: 75]**

N. B.: (1) **All** questions are **compulsory**.
(2) Make **suitable assumptions** wherever necessary and **state the assumptions** made.
(3) Answers to the **same question** must be **written together**.
(4) Numbers to the **right** indicate **marks**.
(5) Draw **neat labeled diagrams** wherever **necessary**.
(6) Use of **Non-programmable** calculators is **allowed**.

1. Attempt *any three* of the following: **15**

a. Convert:
- i) $(100011)_2 = (\ ?\ )_{10}$ 2
- ii) $(2F)_{16} = (\ ?\ )_{10}$ 2
- iii) $(011000)_2 = (\ ?\ )_8$ 1

b. Convert :
- i) $(62)_{10} = (\ ?\ )_{excess3}$ 2
- ii) $(577)_{10} = (\ ?\ )_{bcd}$ 2
- iii) $(100110000111)_{bcd} = (\ ?\ )_{10}$ 1

c. Explain with an example to steps to find a two's complement of a number and write the rules of two's complement subtraction in binary number system. 5

d. Solve :
- i) $(1000100)_2 + (10010101)_2 = (\ ?\ )_2$ 2
- ii) $(10101010)_2 - (10100010)_2 = (\ ?\ )_2$ (use direct method) 3

e. Solve:
- i) $(122)_{10} = (\ )_2 = (\ ?\ )_8$ 3
- ii) $(110101001)_2 = (\ ?\ )_{16}$ 2

f. Solve:
- i) $(AFD1)_{16} + (1292)_{16} = (\ ?\ )_{16}$ 2
- ii) $(AFD1)_{16} - (129A)_{16} = (\ ?\ )_{16}$ 3

2. Attempt *any three* of the following: **15**

a. Describe the NAND and the OR gate with the symbol , the logical statement , the Boolean expression and its logical circuit diagram

b. State and proof the commutative and associative law in Boolean algebra.

c. Prove the following
- i) $A + \bar{A}B = \bar{A} + B$
- ii) $(\bar{A} + B)\,\bar{A}\,\bar{\bar{B}}\,\bar{C} = \bar{A}\bar{\bar{B}}\bar{C}$

d. Simplify the expression and draw circuit diagram
$Y = (X + Y)(\bar{X} + Y + Z)$

e. Solve the SOP expression using Kmaps $F(A,B,C,D) = \Sigma\, m(1,3,4,5,7,9,11,13,15)$

f. Solve the POS expression using Kmaps
$F(A,B,C,D) = \pi\, M(4,6,8,9,10,12,13,14) + d(0,2,5)$

3. Attempt *any three* of the following: **15**

a. Design a 4 -bit full adder using 3 Full adders.

b. With the help of K-Maps build a 2- bit half adder and describe it working.

c. Explain with an example code conversion from binary to gray.

d. Design a combinational circuit for the following description. The circuit had 4 inputs and 2 output. One of the outputs is true if the major inputs are true, the other output is true if there is a tie between the 4 input.
e. Describe the working of a comparator.
f. Describe the working a BCD subtractor.

4. Attempt *any three* of the following: 15

a. Draw the logical circuit diagram and describe the working of a 4:2 decoder.
b. Draw the logical circuit diagram and describe the working 4:1 multiplexer using 2:1 multiplexers.
c. Difference between multiplexer and demultiplexer,
d. Describe with a truth table the working of D-flip flop.
e. Describe with a truth table the working of T- flip flop.
f. Describe the working of the JK Flip Flop.

5. Attempt *any three* of the following: 15

a. Short note on synchronous counters .
b. Describe working of 4 bit binary counter
c. Explain the terms bushing and perset of a counter
d. Write a short note on Bidirectional shift registers .
e. Describe the working of the Johnson counter.
f. What are parallel and shift registers ? Explain