

**DIGITAL LOGIC  
(ECEN 2104)**

**Time Allotted : 2½ hrs**

**Full Marks : 60**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.*

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

**Group – A**

1. Answer any twelve:

**12 × 1 = 12**

*Choose the correct alternative for the following*

- (i) The number system which use only 0-7 symbol is known as  
(a) binary number (b) octal number  
(c) hexadecimal number (d) all of these.
- (ii) The code used for labelling cells of the K-map is  
(a) Natural BCD (b) Hexadecimal  
(c) Gray (d) Octal.
- (iii) The OR operation can be produced with  
(a) Two NOR gates (b) Three NAND gates  
(c) Four NAND gates (d) Both answers (a) and (b)
- (iv) Simplified form of Boolean expression  $(A + B' + A'B)C$  is  
(a) 1 (b) 0 (c) C (d) C'
- (v) The minimum number of 2-input NAND gates required to realize a half-adder is  
(a) 3 (b) 4 (c) 5 (d) 6.
- (vi) Which of the following is an invalid code combination in 8421 BCD code?  
(a) 1001 (b) 0101 (c) 1100 (d) 0111.
- (vii) In which of the following base systems 123 is not a valid number?  
(a) Base 10 (b) Base 8 (c) Base 2 (d) Base 16.
- (viii) Digital circuit can be made by repeated use of which gates only?  
(a) AND (b) NOT (c) NOR (d) OR.
- (ix) Select the type of logic circuit whose output depends not only on the present value of its input signals but also on the history of its inputs.  
(a) Combinational logic circuits  
(b) Sequential logic circuits  
(c) Both Combinational & Sequential logic circuits  
(d) None of these.

- (x) If  $(212)_x = (23)_{10}$ , then the value of x is  
 (a) 2 (b) 3 (c) 4 (d) 5.

*Fill in the blanks with the correct word*

- (xi) Binary equivalent of decimal number 14 is \_\_\_\_\_.  
 (xii) The invalid range for an input to TTL logic is from \_\_\_\_\_.  
 (xiii) Octal equivalent of the binary number 010111101 is \_\_\_\_\_.  
 (xiv) A logic circuit that can store one bit of information is a \_\_\_\_\_.  
 (xv) In 2's complement representation of a negative number (using 8 bits) 10010101 in decimal is written as \_\_\_\_\_.

### Group - B

2. (a) Simplify the Boolean expression  $X.Y + X(Y+Z) + Y(Y+Z)$ . [[CO1](Apply/IOCQ)]  
 (b) Convert the given function into canonical (SOP) form  $f(A, B, C, D) = A.B + B.C'.D + A'.D$ . [[CO1](Apply/IOCQ)]  
 (c) Simplify using K-map in SOP form.  $f(A, B, C, D) = \sum (1, 2, 4, 5, 9, 10) + \sum d(6, 7, 8, 13)$   
 (d=don't care). [[CO1](Apply/IOCQ)]  
**4 + 4 + 4 = 12**
3. (a) Implement two input Ex-OR gate using basic gates. [[CO1](Analyse/HOCQ)]  
 (b) Express the function  $Y = A + \overline{B}C$  in canonical SOP form. [[CO1](Apply/IOCQ)]  
 (c) Convert  $(78)_{10}$  to gray code. [[CO1](Understand/LOCQ)]  
**5 + 5 + 2 = 12**

### Group - C

4. (a) Design a 3 bit even parity generator and the corresponding 4 bit even parity checker circuit. [[CO2](Apply/IOCQ)]  
 (b) Implement a full-adder circuit using decoder and OR gates. [[CO2](Evaluate/HOCQ)]  
 (c) Explain the operation of an octal to binary encoder. [[CO2](Analyse/IOCQ)]  
**4 + 4 + 4 = 12**
5. (a) Design 8:1 multiplexer using 4:1 multiplexers. [[CO1](Analyse/HOCQ)]  
 (b) Implement the logic function  $F(A, B, C, D) = \sum_m (0, 1, 3, 4, 8, 9, 15)$  using 8:1 multiplexer.  
 Consider B, C, D as select lines. [[CO1](Analyse/HOCQ)]  
**6 + 6 = 12**

### Group - D

6. (a) What are the difference between asynchronous and synchronous counters?  
[[CO2](Analyse/HOCQ)]

- (b) What is race around condition or racing in JK flip-flop. Design Master-Slave JK flip-flop circuit to overcome this problem. [[CO2,CO3](Apply/IOCQ)]  
**2 + (3 + 7) = 12**
7. (a) Convert a S-R flip flop to D and T flip flop. [[CO3](Apply/IOCQ)]  
 (b) Design a synchronous counter using D flip flop that goes through the states 0-1-2-3-4-0. [[CO3](Evaluate/HOCQ)]  
**(3 + 3) + 6 = 12**

### Group - E

8. (a) Explain the working principle of SERIAL-IN, PARALLEL-OUT shift register with suitable logic diagram. [[CO2](Apply/IOCQ)]  
 (b) What are ROM and RAM? What are the basic differences between EPROM and EEROM? [[CO4](Remember/LOCQ)]  
 (c) What functions does a PLD programmer perform? What are the applications of PLA? [[CO4](Apply/IOCQ)]  
**4 + (2 + 2) + (2 + 2) = 12**
9. (a) Implement the function  $Y = (A+B)'$  using CMOS logic circuit. [[CO5](Analyse/HOCQ)]  
 (b) Draw a NOR Gate using RTL logic circuit. [[CO5,CO6](Remember/LOCQ)]  
 (c) Draw the circuit of TTL NAND gate. [[CO5,CO6](Remember/LOCQ)]  
**6 + 3 + 3 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	12.5	51.04	36.46

#### Course Outcome (CO):

After the completion of the course students will be able to

ECEN2104.1. Students will learn Binary Number system, and logic design using combinational gates.

ECEN2104.2. Students will design applications of Sequential Circuits.

ECEN2104.3. Students will design Finite State Machines.

ECEN2104.4. Students will learn Memory classifications.

ECEN2104.5. Students will learn basics of CMOS logic.

ECEN2104.6. Students will be prepared to learn various digital component design as used in VLSI Applications.

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.

