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( NEP—2020 )

( 5th Semester )

**ELECTRONICS (MAJOR3/MINOR)**

**( Digital Electronics )**

*Full Marks : 75*

*Time : 3 hours*

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

*Use of Scientific Calculator allow*

**( SECTION : A—OBJECTIVE )**

*( Marks : 10 )*

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×10=10

1. The radix of a binary number is

- (a) 2 ( )
- (b) 10 ( )
- (c) 0, 1 ( )
- (d) 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ( )

2. The output of a 2-input OR-gate is zero only when its

- (a) both inputs are 0 ( )
- (b) each input is 1 ( )
- (c) both inputs are 1 ( )
- (d) each input is 0 ( )

3. Boolean algebra is a system of mathematics based on
- (a) symbols ( )                      (b) logic ( )
- (c) truth ( )                              (d) numbers ( )
4. When we demorganize  $\overline{A \cdot B}$ , we get
- (a)  $\overline{A} \overline{B}$  ( )                      (b)  $\overline{AB}$  ( )
- (c)  $\overline{\overline{A} \overline{B}}$  ( )                      (d)  $\overline{AB}$  ( )
5. What happens to the output of a *J-K* flip-flop when the race-around condition occurs?
- (a) It remains the same ( )
- (b) It sets to 1 ( )
- (c) It resets to 0 ( )
- (d) It toggles multiple times unpredictably ( )
6. What is the basic function of an *R-S* flip-flop?
- (a) To store a single bit of data ( )
- (b) To perform arithmetic operations ( )
- (c) To generate clock signals ( )
- (d) To convert parallel data to serial data ( )
7. What is the function of the clock input in a flip-flop?
- (a) To set the output to 1 ( )
- (b) To reset the output to 0 ( )
- (c) To trigger the output change ( )
- (d) To hold the previous output ( )

8. What is the primary function of a shift register?
- (a) To store binary data ( )
  - (b) To perform arithmetic operations ( )
  - (c) To shift data from one position to another ( )
  - (d) To generate clock signals ( )
9. What is the purpose of the clock input in a synchronous up/down counter?
- (a) To control the counting direction ( )
  - (b) To synchronize the flip-flops ( )
  - (c) To reset the counter ( )
  - (d) To preset the counter ( )
10. What is the primary function of a ring counter?
- (a) To count random pulses ( )
  - (b) To generate a cyclic sequence ( )
  - (c) To store binary data ( )
  - (d) To perform arithmetic operations ( )

**( SECTION : B—SHORT ANSWERS )**

( Marks : 15 )

Answer *five* questions, taking at least *one* from each Unit : 3×5=15

UNIT—I

1. How do you determine 1's and 2's complements of a binary number?
2. Explain functioning of half adder with truth table and necessary diagrams.

UNIT—II

3. Using Boolean Algebra, explain the steps to convert non-standard product term to a standard SOP.
4. What is a Karnaugh map? With necessary diagram, explain a two-variable Karnaugh map.

UNIT—III

5. Explain the output of a T flip-flop when  $T = 1$  and the clock pulse is applied.
6. Discuss how a *J-K* flip-flop overcomes the limitations of an *S-R* flip-flop.

UNIT—IV

7. What is a ring counter?
8. What are the limitations of asynchronous counters?

( SECTION : C—DESCRIPTIVE )

( Marks : 50 )

Answer *five* questions, taking at least *one* from each Unit :

10×5=50

UNIT—I

1. (a) Convert  $11001_2$  into its equivalent decimal number. 3  
(b) Using 2's complement, subtract  $1010_2$  from  $1101_2$ . 4  
(c) Perform the binary division  $11011 \div 100$ . 3
2. (a) Explain the operation and functioning of a parallel binary adder for 2-bit binary numbers with suitable diagrams. 6  
(b) Describe the operation of AND gate with necessary diagrams and truth table. 4

UNIT—II

3. (a) Why is NAND gate called universal gate? Show how NAND gate can represent NOT gate. 2+2=4
- (b) What are half adder and full adder of Logic gates? Explain the functioning of half adder with appropriate diagrams and truth table. 1+1+4=6
4. (a) Simplify the following Boolean expression using the Karnaugh mapping technique : 7
- $$X \quad \bar{A}B \quad \bar{A}\bar{B}C \quad ABC \quad \bar{A}\bar{B}\bar{C}$$
- (b) Demorganize the expression  $\overline{(A \quad B)(C \quad D)}$ . 3

UNIT—III

5. (a) With logic diagram, describe the operation of a J-K flip-flop, including its truth table. 5
- (b) Explain the operation of a Master-Slave J-K flip-flop using NAND gates. 5
6. (a) With logic diagram, describe the operation of a D-flip-flop including its truth table. 5
- (b) Explain the operation of a clocked R-S flip-flop using NAND gates. 5

UNIT—IV

7. (a) With logic diagram, explain the operation of a 4-bit ring counter. 5
- (b) With logic diagram, explain the operation of a 3-bit ripple counter. 5
8. With logic diagram, explain the operation of a 3-bit bidirectional counter, including its truth table and timing diagram. 10

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