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**3 (Sem-3/CBCS) PHY HC 3**

**2023**

**PHYSICS**

(Honours Core)

Paper : PHY-HC-3036

**(Digital Systems and Applications)**

Full Marks : 60

Time : Three hours

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

1. Answer the following questions :  $1 \times 7 = 7$

(a) What is the function of the trigger circuit in a CRO ?

(A) To control the vertical deflection.

(B) To adjust the horizontal position of the trace.

(C) To stabilize the waveform display.

(D) To change the time/division setting.

*Contd.*

(b) Which of the following statement is not true ?

(A) Analog ICs are more suitable for applications that involve precise control of voltage and current.

(B) A flip-flop is a component of digital IC commonly used for data storage and sequential logic operations.

(C) Digital ICs are typically more resistant to noise and interference compared to analog ICs.

(D) Operational amplifiers (op-amps) are commonly found in digital ICs for performing arithmetic and logic operations.

(c) What is the BCD representation of the decimal number 7 ?

(d) In a 3-variable Boolean expression, how many Minterms, and Maxterms can be obtained ?

(e) What are the *two* outputs produced by a half adder ?

(f) How many operational modes does the IC555 timer have ?

(g) What is the size of the data bus in the 8085 microprocessors ?

2. Give answer to the following questions :

2×4=8

(a) What do you mean by deflection sensitivity of a CRO ?

(b) Mention *two* differences between active and passive components of an IC.

(c) Draw the external circuit diagram of an IC555 used as an astable multivibrator.

(d) Draw the logic diagram of a 4-bit parallel-in-serial-out shift register.

3. Answer **any three** questions from the following :

5×3=15

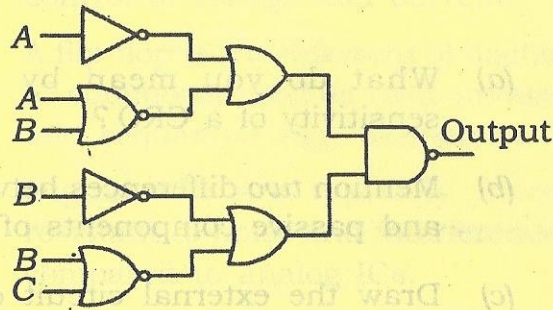
(a) Mention the names of the logic gates known as Universal gate. Describe how AND gate and OR gate can be realised using *any one* of the Universal gates.

1+2+2=5

(b) Describe the working of NAND gate using Transistor logic.



- (c) Draw the simplest possible logic diagram to provide the output of the following logic diagram :



- (d) What do you mean by 'minterm' in a Boolean expression? Expand the following Boolean expression into minterms :  $1+4=5$

$$A + B\bar{C} + AB\bar{D} + ABCD$$

- (e) Draw the circuit diagram of a 1 to 4 demultiplexer and give its truth table. Mention *two* applications of demultiplexer.  $3+2=5$

4. Answer **any three** questions from the following :  $10 \times 3 = 30$

- (a) (i) Perform the addition and subtraction of the following 8-bit numbers expressed in 2's complement representation. Verify your answer using decimal addition and subtraction.  $4$

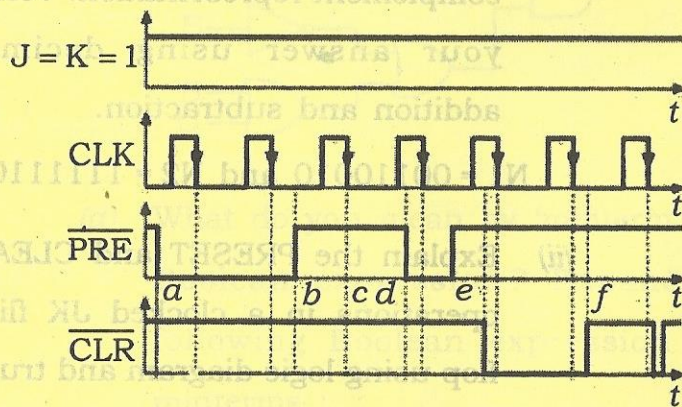
$$N1 = 00110010 \text{ and } N2 = 11111101$$

- (ii) Explain the PRESET and CLEAR operations in a clocked JK flip-flop using logic diagram and truth table.  $6$

- (b) (i) Describe the basic components of a 4-bit binary adder circuit. How does it handle the addition of two binary numbers, including carry propagation?  $4$



- (ii) The waveforms shown in the following figure are applied to a NGT clocked JK flip-flop having active low Preset and Clear inputs. Draw the output waveform explaining its behaviour at the indicated time steps (a, b, c, d, e, f). Consider the flip-flop is initially at RESET condition. 6



- (c) (i) Mention *two* basic differences between synchronous and asynchronous counters. Draw the logic diagram of a decade counter. 2+3=5
- (ii) What do you mean by the modulus of a counter? Design a three-bit asynchronous up counter using negative edge triggered flip-flops. 1+4=5

- (d) (i) Discuss various levels of memory used in computer system and their characteristics. 5
- (ii) Give *two* examples of output device of a computer system. What do you mean by the term 'bus' in computer? Discuss about the two types of buses used in CPU of a computer. 1+1+3=5
- (e) (i) What do you mean by flag registers? Describe briefly the function of various flag registers. 1+5=6

Or

- With neat diagram explain the working of various buses in a microprocessor based system. 6
- (ii) Differentiate between the 2-byte instructions and 3-byte instruction code in case of 8085 microprocessor. Write an Assembly Language Program to transfer data from register B to C. 2+2=4

**Or**

**Write an 8085 Assembly Language Program to add two 8-bit hexadecimal numbers stored in memory using direct addressing mode. 4**

**(f) (i) Write two differences between Analog and Digital circuits. 2**

**(ii) Using truth tables, prove the following : 6**

**1.  $\overline{A \cdot B} = \overline{A} + \overline{B}$**

**2.  $\overline{A + B} = \overline{A} \cdot \overline{B}$**

**(iii) Mention the truth table of XNOR gate. 2**