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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 :

$2 \times 4 = 8$

(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 :

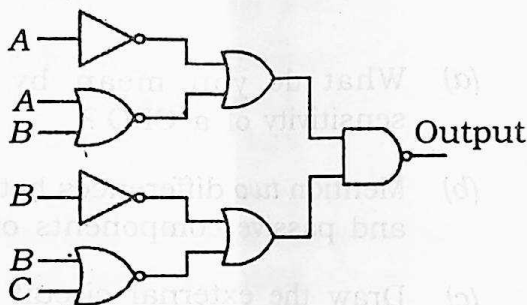
$5 \times 3 = 15$

(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 :

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

$$1+4=5$$

- (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 : 10×3=30

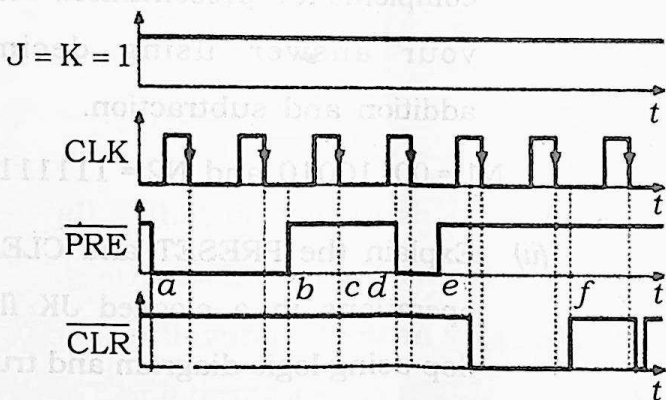
(a) (i) Perform the addition and subtraction of the following 8-bit numbers expressed in 2's complement representation. Verify your answer using decimal addition and subtraction. 4

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

(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