B.Sc. 3rd Semester (Honours) Examination, 2022 (CBCS)
Subject : Physics
Course : CC-VII

Time: 2 Hours **Full Marks: 40**

The figures in the margin indicate full marks.

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

Symbols have their usual meaning.

1. Answer *any five* of the following questions: 2×5=10

   (a) Draw a positive logic OR gate with diodes and resistor. Write down the corresponding truth table.

   (b) Convert the binary number 101011·101001 into hexadecimal and decimal numbers.

   (c) Prove the Boolean identity: $AB + BC + C\bar{A} = AB + C\bar{A}$

   (d) Distinguish between active and passive circuit elements with examples.

   (e) A RAM contains 2^{30} number of words and 16 bits per word. What is the memory capacity of RAM in GB?

   (f) Construct D-FF from J-K FF. Write down its truth table.

   (g) The calibrated time base of a CRO is set at 0·1 ms/cm. The horizontal display switch is kept at normal position. A sinusoidal signal applied to the vertical deflection plates gives 2·5 cycles over a sweep width of 5 cm. Calculate the frequency of the sinusoidal signal.

   (h) A base diffused resistor stripe in a monolithic IC is of 0·0254 mm wide and 0·254 mm long. If the value of the sheet resistance of the base diffusion is 200 Ω/square, what is the value of the resistor stripe?

2. Answer *any two* of the following questions: 5×2=10

   (a) Sketch the logic circuit for a clocked S-R flip-flop. Give the truth table and explain it. 1+4=5

   (b) Define (i) fan out and (ii) fan in, of a digital IC. Draw a logic circuit using NAND gates to implement the Boolean expression $y = AB + \overline{BC}$. Write two advantages of a digital system over an analog system. 2+1+2=5

   (c) List four advantages of semiconductor RAMs over core memories. What advantage does a core memory have over a RAM? What is meant by cycle time of a RAM? 4+½+½=5

   (d) Explain the following instructions for a 8085 microprocessor:
   - (i) MOVr, M
   - (ii) LDA 16-bit
   - (iii) ADI 75H
   - (iv) ANA B

   What is the function of the accumulator of ALU? 4+1=5

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3. Answer *any two* of the following questions: $10 \times 2 = 20$

   (a) Explain the operation of an encoder with a block diagram. Consider that a binary code is to be generated by an encoder with every stroke of an alphanumeric keyboard having 84 characters. Find the number of bits required for generating an output code for every character on a keyboard. Explain the design procedure for constructing an encoder to transform a decimal number into a binary code. Show the necessary truth table and indicate how this encoder can be implemented with normal gates or diodes. $2+1+3+2+2=10$

   (b) Define a register. Construct a 4-bit shift register using JK flip-flops. Explain how this shift register can be used as a serial-to-parallel data converter. What is universal shift register? $1+3+5+1=10$

   (c) Draw the truth table for a 3-input full adder and give the meanings of input and output symbols. Write down Boolean expressions for the outputs. Show NAND-NAND realization of the outputs. Explain with simple sketch how a four-bit adder can be used as a four-bit subtractor with the help of X-OR gates. $3+2+3+2=10$

   (d) Simplify the following SOP form of equation using Karnaugh Map:

   $$f(A, B, C, D) = \sum m(0, 1, 3, 7, 8, 9, 11, 15)$$

   Implement the following expression using an 8 : 1 MUX: $6+4=10$

   $$f(A, B, C, D) = \sum m(2, 4, 6, 7, 9, 10, 11, 12, 15)$$

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