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(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SIXTH SEMESTER EXAMINATION, JUNE 2022

THIRD YEAR [BATCH 2019-22]

Date : 17/06/2022 **PHYSICS (HONOURS)**

Time : 11 am – 1 pm **Paper : XIV [CC14]** Full Marks : 50

Answer **any five** questions: [5×10]

1. a) Convert $(987)_{10}$ to $(?)_7$ and $(234)_5$ to $(?)_{10}$.
   b) Find the value of base 'n' if $8_n \times 7_n = 38_n$.
   c) Represent $(27)_{10}$ in the two following BCD schemes: $(?)_{8\text{-}4\text{-}2\text{-}1}$ and $(?)_{2\text{-}4\text{-}2\text{-}1}$. Compare these two BCD representation schemes.
   d) What is ASCII code? If 'C' is represented in ASCII scheme by (1000011)2 then find code for 'BAD'. [2+2+(2+1)+(1.5+1.5)]

2. a) What do you mean by Controlled Inverter gate? Implement it using NOR gates.
   b) How can we implement AND logic using only OR and NOT gates?
   c) Simplify $(A+B)\left(A+\overline{B}\right)\left(\overline{A}+C\right)$ and $\left(\overline{A}B+\overline{A}C+BC+A\overline{B}C\right)$.
   d) A logic circuit has three input terminals and one output terminal. The logic circuit is such that the output becomes high when only two inputs are at high state. Design the circuit using basic gates. [(1+1)+1+(2+2)+3]

3. a) Mention the basic postulates of Boolean Switching algebra.
   b) Write Adsorption theorem and Adjacency theorem. Prove them using the basic postulates.
   c) Compare canonical representation of a switching function with non-canonical representation of the same.
   d) Express the function $F(X,Y,Z) = (XY+Z).(Y+XZ)$ in the canonical POS and SOP respectively. Also get the non-canonical SOP of the given function. [2+(1+2)+2+(2+1)]

4. a) Define prime implicants (PI) and essential prime implicants (EPI).
   b) Find out the PIs and EPIs of the function $F(A,B,C,D) = \sum m(2,3,5,7,10,11,13,14,15)$. Also obtain the minimal expression of the given function.
   c) Find out minimum SOP and POS expressions for the function given below:

$$F(W,X,Y,Z) = \prod M(0,1,4,6,8,14,15).\prod \Phi(2,3,9).$$

   d) In canonical representation of a switching function if $\boldsymbol{m_i}$ and $\boldsymbol{M_i}$ represent the i^{th} minterm and maxterm respectively then show that $\boldsymbol{m_i.M_i = 0}$ and $\boldsymbol{m_i + M_i = 1}$. [2+3+3+2]

5. a) What is the function of a MUX? Design a 4 × 1 MUX using only basic gates.

   b) IC 74153 contains two 4 × 1 MUX which are named as MUX1 and MUX2, both having dedicated 4 input lines and one output line. There are only two common select lines (S1, S0) available. Also, there are two active low Enable pins EN1 and EN2. When EN1 is LOW, then MUX1 is activated and when EN2 is LOW, then MUX2 is activated. Use the IC in such a way that the same can act as a single 8 × 1 MUX.

   c) Show that the two universal gates can be easily implemented using only 2 × 1 MUXs. [(1+2)+4+3]

6. a) Design a 2 × 4 Decoder circuit. Show that the same circuit can act as a 1 × 4 DeMUX.

   b) What is Encoder? Design a Decimal to BCD encoder circuit.

   c) Discuss the basic logic of working of a 2-bit magnitude comparator circuit. Also implement the same using basic gates. [(2+1)+(1+2)+(2+2)]

7. a) Consider that you have four full adder blocks cascaded together so that the final circuit can add two 4-bit numbers. Use that block diagram of the circuit to implement sum of two binary numbers $(1101)_2$ and $(1011)_2$.

   b) Use IC 7483/74283 (*pin numbers are not required*) to design a 1's complement Adder *cum* Subtractor circuit. Mention the principle of operation of the circuit.

   c) Compare *Latches* with *Flip-Flops*.

   d) What is Toggle type Flip-Flop? Why is it not designed with SR Flip-Flops? [2+5+1+(1+1)]

8. a) Differentiate between ROM and RAM. Design a 1-bit RAM using basic gates.

   b) A given RAM chip has 16 address lines and it has 8 lines for data in and data out operation. Calculate how many single bit memory elements are there in that chip.

   c) Consider that a 2-input XNOR gate is designed with NOR gates. If I_{CCH} (for output of the gate is HIGH) = 8 mA and I_{CCL} (for output of the gate is LOW) = 22 mA, then calculate the power drop across the IC for various input conditions.

   d) Ring Counter and Johnson Counter are not counters. Is it true? Explain.

   e) Explain the working of a 4-bit Johnson counter with suitable circuit diagram. [(1+1)+2+2+1+3]

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