2-2-E

Mahindra University Hyderabad

École Centrale School of Engineering
End-semester Examination

Program: B. Tech. **Branch: CM** **Year: II** **Semester: II**
Subject: Computer Organization (MA2211)

Date: 03/06/2025 **Start Time: 10:00 AM**
Time Duration: 3 Hours **Max. Marks: 100**

Instructions:

1) Answer all the questions.

2) All questions are self-explanatory; no clarification will be provided during the exam.

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1. (20 points) Consider the following Boolean function:

$$F(A, B, C, D) = \sum(0, 2, 5, 7, 10, 13).$$

   (a) Express F(A, B, C, D) in a truth table.

   (b) Find the complement $\overline{F}(A, B, C, D)$.

   (c) Show that $F + \overline{F} = 1$.

   (d) Express F and $\overline{F}$ in Sum of Products (SOP) form.

   (e) Minimize F and $\overline{F}$ using a Karnaugh Map (K-map).

   (f) Draw the logic circuit diagram for F and $\overline{F}$ using basic gates (AND, OR, NOT).

2. (20 points) Consider the Boolean function of four variables, given by

$$F(A, B, C, D) = \sum(1, 4, 5, 7, 9, 12, 13).$$

   Answer the following:

   (a) Implement the function F using a 4×1 multiplexer with A and B as the select lines and express the data inputs in terms of C and D.

   (b) Implement the function F using a 4×1 multiplexer with C and D as the select lines and express the data inputs in terms of A and B.

   (c) Implement the function F using an 8×1 multiplexer with A, B, and C as the select lines and express the data inputs in terms of D.

   (d) Implement the function F using an 8×1 multiplexer with B, C, and D as the select lines and express the data inputs in terms of A.

3. (20 points) Design a combinational circuit that converts a 4-bit Binary Coded Decimal (BCD) input into a corresponding 7-segment display output. The circuit should take a 4-bit input A, B, C, D representing decimal digits 0 through 9. The output should control a 7-segment display using outputs a, b, c, d, e, f, g to correctly display the digit.

   (a) Complete the truth table showing the relationship between the 4-bit BCD inputs and the corresponding 7-segment outputs for digits 0 through 9.

   (b) For each output segment a, b, c, d, e, f, g, derive the Boolean expression using the truth table.

   (c) Minimize the expression for a, b, c, d, e, f, g using a Karnaugh Map (K-map) and don't care conditions.

   (d) Draw a logic diagram for the segments d, e, f using basic gates.

P.T.O.

4. (20 points) Convert the following numbers from the given base to the other three bases listed in the table:

Decimal	Binary	Octal	Hexadecimal
154.625	–	–	–
–	1101011.011	–	–
–	–	475.4	–
–	–	–	2F9.B

Fill in the table by converting each number into the remaining three number systems and justify your answers.

5. (20 points) (a) Find the base r such that the following equation holds:

$$((24)_r + (13)_r) \times (11)_r = (561)_r$$

Interpret all numbers as base-r representations and perform the computations in decimal.

(b) Represent the decimal numbers 794 and 735 in Binary Coded Decimal (BCD), and then find their sum.

(c) Write the 4-bit Gray code representation for all decimal numbers from 0 to 15.

(d) Let $A = 54$ and $B = 63$. Represent both numbers in 8-bit binary, then use 2's complement method to compute $A - B$ and $B - A$. Show all steps and express the final answer in decimal.

(e) Perform the multiplication $(462)_8 \times (55)_8$.

(f) Perform the addition $(5EF)_{16} + (EF6)_{16}$.

End of exam