B.E. COMPUTER SCIENCE AND ENGINEERING
SECOND YEAR
FIRST SEMESTER EXAM 2023

Subject: **Digital Logic and Circuits**

Time : Three hours **Full Marks: 100**

CO-1 (10 marks)	1. Answer the following questions (any four): [4x2.5=10] a. Convert $(225.25)_{10}$ to binary, octal and hexadecimal. b. Perform binary addition of the number $(250.5)_{10}$ with $(403.5)_8$ c. Perform subtraction with the following binary numbers using 1's complement: (i) 11010 – 10100 (ii) 100 – 110000 d. Represent the decimal number 564 (i) in BCD, (ii) in excess-3 code, (iii) in 2,4,2,1 code. e. Find the hamming distances between each pair of the following codes: 11011011, 11111111, 00011110, 00110011. What is the minimum hamming distance? f. Determine the even parity bits generated for the messages consisting of binary equivalents of 349 and 464.
CO-2 (30 marks)	Answer any 3 questions: 2. (a) Simplify the expression Y = AB + (AC)' + AB'C (AB+C) (b) Express the function Y = A+B'C in (i) canonical SOP and (ii) canonical POS form. 4+3+3=10 3. (a) Plot the logical expression ABCD + AB'C'D' + AB'C + AB on a 4 variable K-map, obtain the simplified expression from the map. (b) Implement the simplified expression using only AND and NOT gates. 5+5=10 4. Find the minimal sum of products for the Boolean expression, $F= \sum (1,2,3,7,8,9,10,11,14,15)$, using the Quine- McCluskey method. 10 5. (a) Reduce the following Boolean expression to four literals: BC + AC' + AB + BCD (b) Implement the expression using 2-input NAND gates. (c) Convert the following to the other canonical form $F(A,B,C) = \Pi (1,3,7)$ 4+3+3=10
CO-3 (40 marks)	Answer any two questions from this group. 6. (a) A combinational circuit has four inputs and one output. The output is equal to 1, when (i) all the inputs are equal to one, (ii) none of the inputs are equal to one, or (iii) an odd number of inputs are equal to one. *Obtain the truth table* *Find the simplified output function in sum of products.* *Draw the logic diagram using AND, OR and NOT gates.* (b) Write the Boolean expressions for a binary full adder. Draw a full adder circuit using AND, OR and NOT gates. (5+5+4)+(2+4)=20 7. (a) Explain the functioning of a multiplexer and a demultiplexer. (b) Show the implementation of a 4x1 multiplexer. Construct a 8x1 multiplexer using 2 number of 4x1 multiplexer and any additional logic gates (if required). (c) Using a decoder and external gates, design the combinational circuit defined by the following Boolean functions: (i) F1 = x'y'z' + xz (ii) F2 = xy'z' + x'y (d) What is the purpose of a look ahead carry generator? Explain how the carries are generated in a look ahead carry generator. 3+6+6+5=20 8. (a) Show the logic diagram of an SR latch using NOR gates. With a timing diagram, show the changes in the output signals for the following changes in inputs: Initially, S=1 and R=0; then S=0 and R=0; S=0 and R=1; R=1 and S=1; and finally R-0 and S=0. (b) Implement the following Boolean function using a 8x1 multiplexer:

	$F(A,B,C,D) = \sum (0,1,3,4,8,9,15)$ (c) What is a ripple counter? Draw the timing diagram of a 4-bit +ve edge triggered ripple counter. (d) With a timing diagram explain the functioning of a 4-bit Serial-in to Parallel-out Shift Register. 6+5+5+4=20 9. (a) Show the implementation of J-K flip-flop using NAND gates. (b) What is a race-around condition in J-K flip-flop? How can it be avoided? (c) What is the difference between a synchronous and an asynchronous counter? Design a synchronous counter that counts the following sequence 0 → 5 → 3 → 2 → 1 → 0. (d) What is the difference between a Moore machine and a Mealy machine? Draw a Mealy machine for a sequence detector for 00 or 11. 4+3+10+3=20
CO-4 & 5 (20 marks)	Answer the following questions: 10. Draw the functional diagram of monostable multivibrator using IC 555 timer and explain their operation. 5+5=10 OR 10. (a) Draw and explain the operation of a R-2R Ladder digital to analog converter. (b) Draw and explain the operation of 4 bit successive approximation analog to digital converter. 5+5=10 11. (a) Implement and explain Y= (A+B)' using CMOS. (b) Implement and explain Y= (AB)' using TTL. 5+5=10 OR 11. (a) With a neat diagram explain how high impedance can be achieved using TTL. (b) Define the following terms in relation with logic families: i) Fan-in ii) Fan-out. 7+3=10