MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING
(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

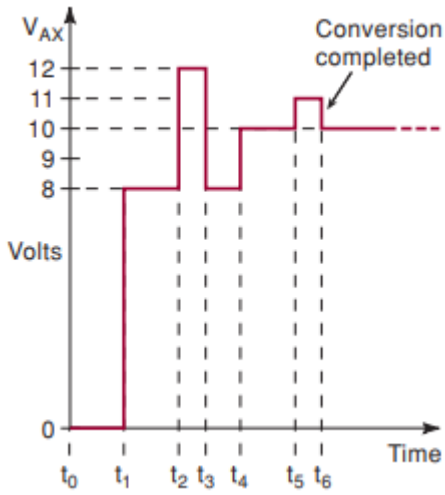
Model Question Paper
Third Semester BE Degree Examination
Digital System Design

Time: 3 Hours **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

		Module -1	M	L	C
Q1	a.	Minimize the following Boolean expressions in Sum of Products (SOP) form using a Karnaugh Map (K-Map) and draw the corresponding logic diagrams for both minimized functions: (i) $f(P, Q, R, S) = \Sigma m(0,1,4,8,9,10)+d(2,11)$ (ii) $f(a,b,c,d)=\Sigma m(1,2,3,5,6,7,11,12,13,14,15)$	08	L3	CO1
	b.	What are prime implicants and essential prime implicants? Simplify the Boolean function $f(a,b,c,d)=\Sigma m(0,1,2,5,6,7,8,9,10,13,14,15)$ using a K-Map, and identify the prime implicants and essential prime implicants.	06	L3	CO1
	c.	Simplify the following Boolean expression using K-Map$f(a,b,c,d)=\Sigma m(0,1,2,5,6,15)+ d(10,11,12)$ and implement the simplified expression using only NAND Gates	06	L3	CO1
		OR			
Q2	a.	Minimize the following Boolean expressions in Product of Sums (POS) form using a Karnaugh Map (K-Map) and draw the corresponding logic diagrams for both minimized functions: (i)$f(A,B,C,D)=\Pi_M(0,2,3,8,9,12,13,15)$ (ii) $f(A,B,C,D)=\Sigma_M(1,3,7,11,15)+\Sigma d(0,2,5)$	08	L3	CO1
	b.	Simplify the following Boolean expression using K-Map and draw the corresponding logic diagram $f(A,B,C,D,E)=\Sigma m(0,2,4,6,8)+d(3,7,11,15)$	06	L3	CO1
	c.	Simplify the following Boolean expression using K-Map $f(a,b,c,d)=\Pi_M(3,4,5,6,7)+ d(0,1,2)$and implement the simplified expression using only NOR gates.	06	L3	CO1
		Module- 2			
Q3	a.	Represent the decimal number 5,137 in (a) BCD, (b) excess-3 code. (c) 2421 code, and (d) 6311 codes	08	L3	CO1
	b.	Implement the following functions using active high output 3:8 line decoder, $f1(A,B,C,D)=\Sigma m(0,1,2,5,7,11,15)$ $f2(A,B,C,D)=\Pi m(1,3,4,11,13,14)$	06	L3	CO2
	c.	Describe the function and logic of a magnitude comparator, providing a truth table to demonstrate its output behavior and implement the simplified expression using HDL.	06	L3	CO2
		OR			
Q4	a.	Represent the decimal number 8465 in (a) 8421, (b) Gray code. (c) 2421 code, and (d) 4321 codes	08	L3	CO1

	b.	Implement the following Boolean functions with multiplexer i)F1 (A, B, C, D) = ∑(1, 3, 4, 11, 12, 13, 14, 15) ii)F(A, B, C, D) = ∏(3, 8, 12)	06	L3	CO2
	c.	A logical design is needed to map the three-bit inputs to the 7-segment display that displays the numbers from '0' to '7' (Hint: Use three variable K-Map). Simplify and generate a boolean function and write its logical circuit design	06	L3	CO2
Module – 3					
Q5	a.	Describe the concept of an up counter and provide an example HDL code to demonstrate its implementation.	06	L3	CO2
	b.	A PN flip-flop has four operations: clear to 0, no change, complement, and set to 1, when inputs P and N are 00, 01, 10, and 11, respectively a) Derive the characteristic equation. b)Show how the PN flip-flop can be converted to a D flip-flop	06	L3	CO2
	c.	Design a serial 2's complementer with a shift register and a flip-flop. The binary number is shifted out from one side and it's 2's complement shifted into the other side of the shift register.	08	L3	CO2
OR					
Q6	a.	Writean HDL program to design and implement a 4-bit BCD up counter.	06	L3	CO2
	b	A sequential circuit has two JK flip-flops A and B, two inputs x and y, and one output z. The flip-flop input equations and circuit output equation are given below Derive the state equations for A and B $J_A = Bx + B'y'$ $K_A = B'xy'$ $J_B = A'x$ $K_B = A + xy'$ $z = Ax'y' + Bx'y'$	06	L3	CO2
	b.	Design a Mod-6 synchronous counter (with help of a mod-10 counter) using D flip-flops and T flip-flops. Include the necessary logic diagrams and explain the operation.	08	L3	CO2
Module – 4					
Q7	a.	The memory units that follow are specified by the number of words times the number of bits per word. How many address lines and input–output data lines are needed in each case? (a) 8K x 16 (b) 2G x 8 (c) 16M x 32 (d) 256K x 64	06	L3	CO3
	b.	Tabulate the PLA programming table for the four Boolean functions listed below. Minimize thenumbers of product terms A(x, y, z) = ∑(1, 2, 4, 6) B(x,y, z) = ∑(0, 1, 6,7) C(x, y, z) = ∑(2,6) D(x, y, z) = ∑(1, 2, 3,5,7)	08	L3	CO3
	c.	The MOS transistor is bilateral (ie current may flow from source to drain or from drain to source). On the basis of this property derive a circuit that implements the Boolean function Y=(AB+CD+AED+CEB)′	6	L3	CO3
OR					
Q8	a.	(i) How many 32K X 8 RAM chips are needed to provide a memory capacity of 256K bytes? (ii) How many lines of the address must be used to access 256K bytes? How many of these lines are connected to the address inputs of all chips	06	L3	CO3
	b.	Obtain the 15-bit Hamming code word for the 11-bit data word 11001001010.	08	L3	CO3
	c.	Design a PLA circuit to implement the functions	06	L3	CO3

		$F_1 = A'B + AC + A'BC'$ $F_2 = (AC + AB + BC)'$.			
Module – 5					
Q9	a.	An eight-bit DAC produces an output voltage of 2.0 V for an input code of 01100100. What will the value of V_{OUT} be for an input code of 10110011?	08	L3	CO4
	b.	An ADC has the following characteristics: resolution, 12 bits; full-scale error, 0.03% F.S.; full-scale output, +5 V. (a) What is the quantization error in volts? (b) What is the total possible error in volts?	08	L3	CO4
	c.	What is the largest value of output voltage from an eight-bit DAC that produces 1.0 V for a digital input of 00110010?	04	L3	CO4
OR					
Q10	a.	A 12-bit DAC has a full-scale output of 15.0 V. Determine the step size, the percentage resolution, and the value of V_{OUT} for an input code of 011010010101.	08	L3	CO4
	b.	 With the help of the above waveform design a SAC circuit that generate each time cycles	08	L3	CO4
	c.	An eight-bit Successive Approximation Converter has a resolution of 20 mV. What will its digital output be for an analog input of 2.17 V?	04	L3	CO4

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