CBCS SCHEME

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18EE35

# Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
## Digital System Design

Time: 3 hrs. Max. Marks: 100

***Note: Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. What are prime implicants and essential prime implicants? Write them for the function $y = \sum m (0, 1, 2, 5, 6, 7, 8, 9, 10, 13, 14, 15)$ and hence realize using NAND gates. **(06 Marks)**

b. Simplify the following Boolean expression using K-map $f(A, B, C, D, E) = \sum m (0, 2, 4, 6, 8, 16, 18, 20, 22, 24, 26, 28, 30) + dc (3, 7, 11, 15, 19, 23, 27, 31)$. **(06 Marks)**

c. Using Quine-Mc Cluskey method, obtain a minimal SOP expression of $f(a, b, c, d) = \sum m(1, 2, 6, 9, 10, 14) + dc(7, 8, 12)$. **(08 Marks)**

**OR**

2 a. Minimize the following expression in POS form using K-map:
i) $f(A, B, C, D) = \pi M(0, 2, 3, 8, 9, 12, 13, 15)$
ii) $f(A, B, C, D) = \pi M(0, 2, 4, 10, 11, 14, 15)$. **(06 Marks)**

b. Design logic circuit that has 4 inputs, the output will be high when the majority of the inputs are high. Use K-map to simplify and realize using NAND gates. **(06 Marks)**

c. Minimize the following expression using K-map and realize using NAND gates only:
i) $f(A, B, C, D) = \sum m(0, 1, 4, 8, 9, 10) + dc(2, 11)$
ii) $f(a, b, c, d) = \sum m(0, 1, 5, 6, 7, 8, 9) + dc(10, 11, 12, 13, 14, 15)$. **(08 Marks)**

### Module-2

3. a. What is a multiplexer? Design a 8:1 MUX and realize using NAND gates. **(06 Marks)**

b. Realize using active high output 3 to 8 line decoder circuit and external gates
i) $F_1(A, B, C, D) = \sum m(0, 1, 2, 5, 7, 11, 15)$
ii) $F_2(A, B, C, D) = \pi m(3, 6, 7, 14)$. **(08 Marks)**

c. Draw the interface diagram of ten key interface to a digital system using decimal to BCD encoder. **(06 Marks)**

**OR**

4 a. Implement the Boolean expression $F(P, Q, R, S) = \sum m(0, 1, 3, 4, 8, 9, 15)$ using a 8:1 MUX choosing QRS as select lines. **(06 Marks)**

b. Design 1 bit comparator using
i) Basic gates ii) Decoder of 2 to 4 line converter. **(06 Marks)**

c. Write the sum and carryout equations of 4 bit look ahead parallel adder and hence realize the complete fast adder circuit. **(08 Marks)**

### Module-3

5 a. What is race around condition in JK flip flops? Explain how to overcome from this problem. Explain with the help of waveform and logic diagram. **(06 Marks)**

b. Explain the application of SR latch at a switch debouncer circuit. **(06 Marks)**

c. Realize JK and T flip flop using NAND gates and hence derive the characteristic equation for the same. **(08 Marks)**

**OR**

6 a. With help of waveforms and output tabular column, explain master slave JK flip flop. **(08 Marks)**

b. Explain negative edge triggered D-flip flop and hence derive an expression for characteristic equation. **(06 Marks)**

c. Convert SR flip flop to a flip flop. **(06 Marks)**

## Module-4

7 a. Explain universal shift register using 4:1 multiplexers. **(08 Marks)**

b. With the help of wave form, logic diagram and output table, explain MOD5 ripple counter. **(06 Marks)**

c. Design a synchronous MOD 3 counter with the following sequence using clocked JK flip flop. Count sequence : 0, 1, 2, 0, 1, 2..... **(06 Marks)**

**OR**

8 a. Explain MOD8 synchronous up down counter. **(06 Marks)**

b. With the help of waveforms, logic diagram and output table with respect to clock, explain MOD8 Johnson counter. **(08 Marks)**

c. Determine the frequency $F_{max}$ for the synchronous MOD16 counter it delay $t_{pd}$ for each flip flop is 50ηs and $t_{pd}$ for each AND gate is 20ηs. Compare this with $F_{max}$ for a MOD16 ripple counter. Determine the $F_{max}$ for the MOD32 parallel counter. What has to be done to convert from MOD16 to MOD32 parallel counter? **(06 Marks)**

## Module-5

9 a. Explain Mealy and Moore model of a clocked synchronous sequence network. **(10 Marks)**

b. Analyze the synchronous circuit

i) Write down the excitation and output function

ii) Form the state table and diagram

iii) Give a word description of the circuit operation.

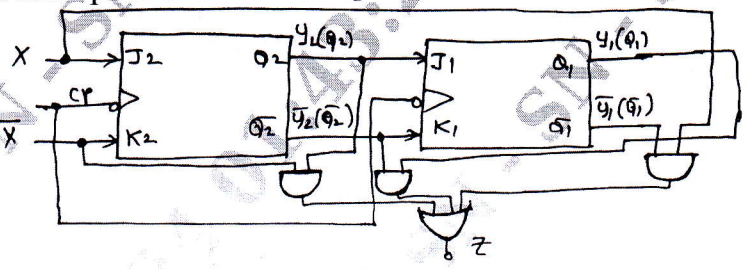


Fig.Q.9(b)

**(10 Marks)**

**OR**

10 a. Construct transition table, state table and state diagram for the given circuit.

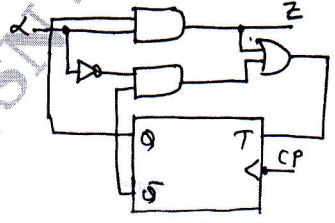


Fig.Q.10(a)

**(10 Marks)**

b. Design a synchronous counter using JK F/f to count the sequence 0, 1, 2, 4, 5, 6, 0, 1, 2..... use state diagram and stable table. For the states 011 and 111, next state is 000. **(10 Marks)**

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