B.TECH/ECE/4TH SEM/ECEN 2202/2022

DIGITAL SYSTEMS DESIGN
(ECEN 2202)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) What are the basic gates in MOS logic family?
(a) NAND and NOR (b) AND and OR
(c) NAND and OR (d) AND and NOR.

(ii) A modulus -10 Johnson counter requires a minimum of
(a) 10 flip-flops (b) 5 flip-flops
(c) 4 flip-flops (d) 12 flip-flops.

(iii) The Excess-3 code is a
(a) cyclic code (b) weighted code
(c) self-complementing code (d) error correcting code.

(iv) A mod-2 counter, followed by a mod-5 counter is
(a) decade counter (b) mod-9 counter
(c) mod-11 counter (d) mod-7 counter.

(v) The memory which is ultraviolet erasable and electrically programmable is
(a) RAM (b) EEROM
(c) PROM (d) EPROM.

(vi) The fastest logic gate family is
(a) CMOS (b) ECL
(c) TTL (d) RTL.

(vii) An example of reflected code is
(a) BCD (b) ASCII
(c) GRAY (d) Hamming.

(viii) What will be the output from a D flip – flop if the clock is low and D = 0?
(a) 0 (b) 1
(c) No change (d) Toggle between 0 and 1.

(ix) Which of the following gives the correct number of multiplexers required to build a 32 × 1 multiplexer?
(a) Two 16 × 1 mux (b) Three 8 × 1 mux
(c) Two 8 × 1 mux (d) Three 16 × 1 mux.

(x) Active devices used in digital circuit s generally operates as
(a) Amplifier (b) Switches
(c) Rectifier (d) waveform generator.

Group - B

2. (a) Represent
(i) $(4578)_{10}$ in Gray code
(ii) $(572.61)_8$ in common binary code
(iii) Realize *Y= (AB)'+A+ (B+C)'* using NAND gates only.
[CO1/Evaluate/HOCQ]
(b) If the solutions of the equation $x^2-11x+22=0$ are $x=3, 6$ then determine the base of the numbers. [CO1/Evaluate/HOCQ]
(3 + 3 + 3) + 3 = 12

3. (a) Simplify the given Boolean expression using Quine-McCluskey procedure *f(A,B,C,D)= ∑m(1,4,6,7,8,9,10,11,15);* [CO1/Apply/IOCQ]
(b) Realize a Half-Subtractor using NAND gates only. [CO2/Apply/IOCQ]
8 + 4 = 12

Group - C

4. (a) Realize a full adder circuit using half adder and necessary logic gates.
[(CO2)(Remember/LOCQ)]
(b) Design a BCD adder that will add two 4 bit BCD numbers.
[(CO2)(Analyze/HOCQ)]
6 + 6 = 12

5. (a) Construct a *8:1* line multiplexer using 2:1 line multiplexers only.
[CO2/Apply/IOCQ]
(b) Implement the function *f* (A,B,C,D) = ∑*m* (0,1,2,4,6,9,10,12,14) using a *4:1* line Multiplexer. [CO2/Evaluate/HOCQ]
6 + 6 = 12

Group - D

6. (a) What is the advantage of J-K Flip-flop over S-R flip-flop?
[(CO3)(Remember/LOCQ)]
(b) Write the truth table, state table, excitation table and hence derive the characteristics equation of SR flip-flop. [(CO3)(Analyze/HOCQ)]

(c) Realize J-K flip-flop using S-R flip-flop. [(CO3)(Analyze/HOCQ)]

2 + 6 + 4 = 12

7. (a) Design a synchronous MOD 3 UP/DOWN Counter using D flip-flops. [CO3/Create/HOCQ]

(b) A clocked sequential circuit has four states A, B, C & D as show in the state diagram of Fig.1. Assume state assignments as A = 00, B = 01, C = 10 and D = 11. Prepare the state table and draw circuit using D flip-flops. [CO3/Evaluate/HOCQ]

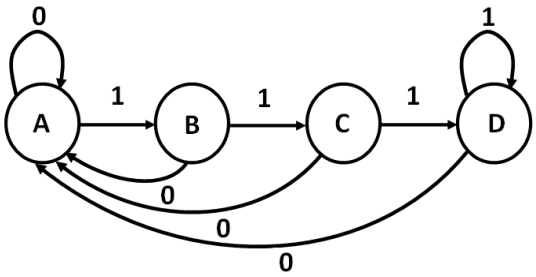

Fig. 1: State diagram of a clocked sequential circuit

6 + 6 = 12

Group - E

8. (a) Explain the operation of a successive approximation ADC with proper circuit diagram. [(CO4)(Remember/LOCQ)]

(b) Explain the operation of a 4-bit R-2R ladder type DAC with proper circuit diagram. [(CO4)(Understand/LOCQ)]

(c) What is the advantage of this type of DAC over counter type DAC? [(CO4)(Analyse/IOCQ)]

5 + 5 + 2 = 12

9. (a) Design a basic 2 input TTL NAND gate and explain. [(CO5)(Remember/IOCQ)]

(b) Explain the operation of a 3 bit twisted ring counter. [(CO3)(Understand/LOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	25	27.08	47.92

Course Outcome (CO):

After the completion of the course students will be able to

1. Make use of the concept of Boolean algebra to minimize logic expressions by the algebraic method, K-map method, and Tabular method.
2. Construct different Combinational circuits like Adder, Subtractor, Multiplexer, De-Multiplexer, Decoder, Encoder, etc.

3. Design various types of Registers and Counters Circuits using Flip-Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).
4. Outline the concept of different types of A/D and D/A conversion techniques.
5. Realize basic gates using RTL, DTL, TTL, ECL, and CMOS logic families.
6. Relate the concept of Flip flops to analyze different memory systems including RAM, ROM, EPROM, EEROM, etc.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question