Mid Semester Examination 2024
Department of Physics, School of Physical Sciences
DOON UNIVERSITY, DEHRADUN
Integrated M.Sc. Physics IV semester
Course: PHC- 253, Digital Systems and Applications

Time allowed – 3 hours   Max.Marks-50

General Instructions

- *This question paper contains three sections A, B, and C.*
- *Section A contains 5 question 2 mark each*
- *Section B Contains 4 question 3 mark each*
- *Section C contains 2 question 4 mark each.*
- *Attempt all question.*

Section A   6 x 2 = 12

1. What is Duty cycle

2. In a digital communication system, why might a demultiplexer be used at the receiving end?

3. Show $A(\bar{B}+C)$ using NOR gate only

4. Conversion of (.4375) to binary.

5. Conversion of $(AB6)_{16}$ to decimal equivalent

6. What is Race around Condition in flip flops?

   OR

   Define SR latch.

Section B   6 x 3 = 18

7. What is the primary difference between a multiplexer (MUX) and a demultiplexer (DEMUX)? Illustrate your answer with appropriate diagrams.

8. Explain how to calculate the duty cycle of a 555 timer in astable mode and provide the formula.

9. What is the primary difference between an encoder and a decoder? Illustrate your answer with appropriate examples.

10. Find X when $(429)_{10} = X_{16}$.

11. What is a binary counter, and how does it work? Illustrate your answer with the design and operation of a 3-bit binary counter.

12. Design an astable 555 timer circuit to generate a square wave with a frequency of 1 kHz and a duty cycle of 60%. Provide the values of the resistors (R_A and R_B) and the capacitor (C) used in your design. Show all calculations and explain the steps involved.

OR

Describe the difference between a D flip-flop and a JK flip-flop. Provide one typical use case for each type. (Draw truth table)

Section C   4 x 5 = 20

13. Minimize the following Boolean function using K map

    (a) $F (A, B, C, D) = \Sigma\, m\, (0, 1, 2, 4, 5, 8, 9, 10, 11)$

    (b) $F (P, Q, R, S) = \pi\, (0,1,3,5,6,7,10,14,15)$

14. Explain the working principle of a 555 timer in astable mode and explain the formula for the time period, Duty cycle and frequency of oscillation.

15. Explain the working principle of a digital encoder and provide an example of a 4-to-2 binary encoder. Describe the function of a 3-to-8 decoder and provide a truth table illustrating its operation.

16. Compare and contrast synchronous and asynchronous counters. What are the advantages and disadvantages of each type?

OR

(a) State and verify Distributive law.

(b) Express P+ Q'R in canonical SOP form

(c) Represent (X+Y)(Y+Z)(Z+X) using NOR gate only