

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SIXTH SEMESTER EXAMINATION, MAY 2024

THIRD YEAR [BATCH 2021-24]

PHYSICS (HONOURS)

Paper : CC 14

Date : 15/05/2024

Time : 11 am – 1 pm

Full Marks : 50

Answer **any five** questions:

[5×10]

1. a) Given a TTL circuit, the switching time required for logic '1' to logic '0' is 34 ns. It is known that the propagation delay (t_p) is 40 ns. What is the time taken for the TTL circuit to switch from logic '0' to logic '1'.

- b) A TTL -based configuration has the following parameters :

$$I_{OH(max)} = -0.8mA, I_{IH(max)} = 16\mu A, I_{OL(max)} = 4mA, I_{IL(max)} = -0.1mA \text{ Calculate the fan out.}$$

- c) Draw the circuit diagram of CMOS Inverter and explain how it works.

- d) Realise the Function $F = \overline{(A+B)} \cdot (AB+C)$ with CMOS.

- e) What is a monolithic IC?

[2+2+2+3+1]

2. a) Write the first 10 decimal digits in base 3.

- b) Convert $(2CAFE.5)_{16}$ to binary.

- c) Subtract 1100 from 1110 using 2's complement method.

- d) Write down the basic postulates of Switching Algebra and using these postulates prove the following identity algebraically.

$$B + \bar{A}C = (A + B + C)(\bar{A} + B + C)(\bar{A} + B + \bar{C})$$

[2+2+2+(2+2)]

3. a) Find the complement of the following Boolean function -

$$(B\bar{C} + \bar{A}D)(\bar{A}\bar{B} + C\bar{D})$$

- b) If $A \oplus B = C$ then find (i) $B \oplus C$ (ii) $A \oplus C$ (iii) $A \oplus B \oplus C$

- c) Find the Implicants, Prime Implicants and Essential Prime Implicants of the given expressions.

$$f(A, B, C) = \sum m(0, 1, 3, 6, 7)$$

$$f(A, B, C) = \sum m(0, 1, 2, 3, 4, 6)$$

- d) Convert $Y = AB + C$ to a standard form.

[2+2+4+2]

4. a) Implement a full adder using decoder.

- b) Implement the following functions only using 2:1 MUX, in this question complements for inputs are not available.

i) NAND ii) NOR iii) XOR iv) $F(A, B, C) = \sum m(0, 2, 5, 6)$

- c) Implement $Y(A, B, C) = \sum m(1, 3, 5, 6)$ using a multiplexer

[3+4+3]

5.
 - a) What is the difference between race condition and race around condition?
 - b) Write state table and state diagram of J-K Flip Flop.
 - c) Design a mod -8 ripple up counter using the +ve edge trigger clock.
 - d) Implement a synchronous counter with counting sequence 0,3,5,6,0... [2+3+2+3]

6.
 - a) Explain how to generate a VSB signal.
 - b) A Certain AM transmitter is radiating 125 kW when a certain audio sinusoidal wave is modulating it to a depth of 70 % and 144.5 kW when a second sinusoidal audio wave also modulate it simultaneously with the first one. What is the depth of the modulation for the second audio sinusoidal wave.
 - c) What is Voltage-Controlled Oscillator or VCO? Draw a schematic circuit diagram of a VCO and state its principle of operation. Derive the relevant expression to prove that it can be used for the generation of FM wave. [3+2+(0.5+2.5+2)]

7.
 - a) PM transmission may be performed using FM transmitter and receiver respectively. In this context explain the relevant theory for generation and detection of PM wave using corresponding system required for FM transmission.
 - b) State how pulse modulation technique is different from digital modulation technique. Mention the theory for producing PAM with schematic diagram. Also draw the block diagram for extracting message from PAM with brief description of its operation.
 - c) A message signal, represented by the equation $v(t) = \frac{5\pi}{2} \sin(1000\pi t) \cdot \cos(500\pi t)$, is converted into PCM digital output. The PCM system has 256 levels. Determine the minimum data speed of the channel in *bps* or *bits/second*. [3+(1+2.5+1.5)+2]

8.
 - a) Mention how Delta Modulation (DM) is superior than Differential PCM or DPCM. Draw block diagram for DM modulator and demodulator and mention in brief the working principles for both.
 - b) Discuss in brief the FSK modulation scheme. Mention how ASK modulators can be used for designing an FSK modulator.
 - c) A message signal is sampled at 8 kHz and then transmitted through (i) 8-ary PSK system and (ii) 8-ary FSK system respectively. Determine the required bandwidth for transmission. [(1+3)+(3+1)+2]

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