CBCS SCHEME

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21EC51

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Digital Communication

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define M – ary QAM. Obtain the constellation of QAM for M = 4 and draw the signal space diagram. **(06 Marks)**

b. An FSK system transmits binary data at the rate of 2.5×10^6 bits/s. During the course of transmission, white Gaussian noise of zero mean and power spectral density 10^{-20} W/HZ is added to the signal. In the absence of noise, the amplitude of the received sinusoidal wave for digit 1 or 0 is 1 μv. Determine the average probability of symbol error for binary FSK using coherent detection. **(04 Marks)**

c. Derive the expression for error probability of BPSK using coherent detection. **(10 Marks)**

OR

2 a. Describe the QPSK signal with its signal space diagram. With a neat block diagram, explain the generation and detection of QPSK signals. **(10 Marks)**

b. Derive the expression for probability of symbol error of coherent binary FSK. **(10 Marks)**

Module-2

3 a. Explain the geometric representation of signals and express the energy of the signal in terms of the signal vector. **(10 Marks)**

b. With a neat block diagram, explain the digital PAM transmission through band limited baseband channels and obtain the expression for ISI. **(10 Marks)**

OR

4 a. Explain the correlation receiver using product integrator and matched filter. **(10 Marks)**

b. The waveforms of three signals are as shown :

$S_1(t) = 1,\ 0 < t < \frac{T}{3}$

$S_2(t) = 1,\ 0 < t < \frac{2T}{3}$

$S_3(t) = 1,\ \frac{T}{3} < t < T$

And zero otherwise. Using the Gram – Schmidt orthogonalization procedure, find an orthonormal basis for this set of signals. **(10 Marks)**

Module-3

5 a. Explain the generation of direct sequence spread spectrum signal, with relevant waveforms and spectrums. Also, explain the effect of dispreading on Narrowband interference. **(10 Marks)**

b. With a neat block diagram, explain the CDMA system based on IS-95. **(10 Marks)**

OR

6 a. With a neat block diagram, explain the frequency hopped spread spectrum techniques. **(10 Marks)**

b. Explain the model of spread spectrum digital communication system. Also, write a note on applications of DS spread – spectrum signals. **(10 Marks)**

Module-4

7 a. Define :
i) Self Information
ii) Entropy
iii) Rate of Information **(03 Marks)**

b. A black and white TV picture consists of 525 lines of picture information. Assume that each line consists of 525 picture elements and that each element can have 256 brightness levels. Pictures are repeated at the rate of 30 frames/ second. Calculate the average rate of information conveyed by a TV set to a viewer. **(05 Marks)**

c. An information source produces a sequence of independent symbols having the following symbol probabilities :

Symbols	A	B	C	D	E	F	G
Probability	1/3	1/27	1/3	1/9	1/9	1/27	1/27

Construct binary Huffman codes. Obtain code efficiency and redundancy. Draw tree diagram for the codes. **(12 Marks)**

OR

8 a. Explain different properties of code. Mention Kraft's inequality condition. **(10 Marks)**

b. Apply Shannon's binary encoding algorithm for the source emitting independent symbols having the following symbol probabilities:

Symbols	A	B	C	D	E	F	G
Probability	9/32	3/32	1/16	3/32	3/32	3/32	9/32

Obtain code efficiency and redundancy. Draw tree diagram for the codes. **(10 Marks)**

Module-5

9 a. The parity check bits of (6, 3) linear block code is given by :
$C_4 = d_1 + d_2$; $C_5 = d_1 + d_2 + d_3$; $C_6 = d_2 + d_3$ where d_1, d_2 , d_3 are message bits.
i) Find the generator matrix and parity check matrix for this code.
ii) Find all possible code vectors
iii) Draw encoder circuit
iv) How many errors can be detected and corrected.
v) If single error has occurred in the received vector [101110] detect and correct the error. **(10 Marks)**

b. For the convolution encoder shown in fig. 9(b). Find the encoder output produced for the message sequence [10011] using
i) Time domain approach
ii) Transform domain approach

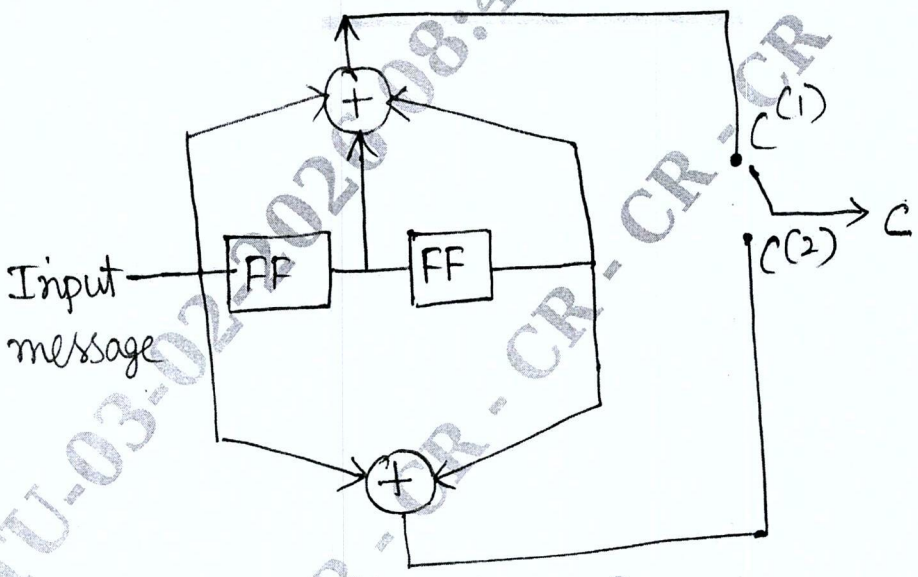

Fig. Q.9(b) **(10 Marks)**

OR

10 a. For the convolutional encoder shown in fig. 10(a)

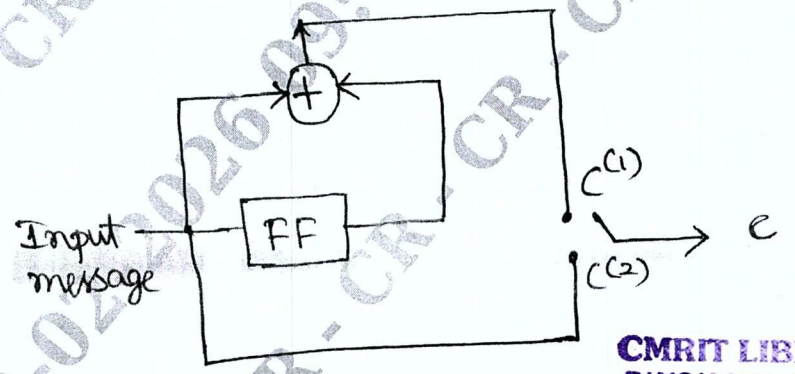

Fig. Q. 10 (a)

Draw state diagram, code tree and Trellis diagram. Find the code vector for the message sequence [1 0 1] **(12 Marks)**

b. Construct the standard array for (4,2) code. If $G = \left[\begin{array}{cc|cc} 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \end{array}\right]$

If R = [1 1 1 1] find the correct code vector. **(08 Marks)**