

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025

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. Explain generation and detection of BPSK with necessary figures and equations. (08 Marks)
- b. An FSK system transmits binary data at a rate of 10^6 bits/sec. Assuming channel noise is AWG with zero mean and power spectral density 2×10^{-20} watts/Hz. Determine the average probability of error. Assume coherent detection and amplitude of received sinusoidal signal for both symbol 1 and 0 to be 1.2 microvolt. (Take $\text{erf}(3) = 0.99998$). (06 Marks)
- c. With Geometric representation and expressions, explain 16-QAM. (06 Marks)

OR

- 2 a. Draw the block diagram of QPSK Transmitter and receiver and explain the operation. (08 Marks)
- b. A binary data stream 0010010011 needs to be transmitted using DPSK technique. Prove that the detected sequence remains invariant with the choice of initial bit. (08 Marks)
- c. In a digital communication system, the bit rate is 1 Mbps and carrier frequency of transmission is 100 MHz. Find the symbol rate of transmission and bandwidth requirement of the channel in 16-ary PSK system. (04 Marks)

Module-2

- 3 a. Explain the Geometric representation of set of M energy signals as linear combinations of N-orthonormal basis functions for $N = 2$ and $M = 3$ with necessary figures and expressions. (10 Marks)
- b. Two functions $S_1(t)$ and $S_2(t)$ are given in Fig Q3(b) for an interval $0 \leq t \leq T$ seconds. Using Gram-Schmidt procedure, express these functions in terms of orthonormal functions. Also sketch $\phi_1(t)$ and $\phi_2(t)$



Fig Q3(b)

(10 Marks)

OR

- 4 a. Discuss conversion of the continuous AWGN channel into a vector channel. (10 Marks)
- b. What is correlative coding? Explain Duobinary signaling scheme with necessary figures. (10 Marks)

Module-3

- 5 a. With a neat block diagram, explain the model of spread spectrum Digital communication system. (08 Marks)
- b. Define processing gain, probability of error and anti-jamming characteristics (ie Jamming Margin) of DS-SS system. (06 Marks)
- c. Write short notes on Pseudonoise sequence. (06 Marks)

OR

- 6 a. Explain the working of FH/MFSK transmitter and receiver with neat block diagram. (08 Marks)
- b. Explain CDMA based on IS-95, Forward link. (06 Marks)
- c. In a direct sequence, spread-spectrum modulation, it is required to have a jamming margin greater than 26dB. The ratio $\frac{E_b}{N_0}$ is set at 10. Determine the minimum processing gain and the minimum number of stages required to generate the maximum length sequence. (06 Marks)

Module-4

- 7 a. Define self information, average information, information rate and coding efficiency. (04 Marks)
- b. Refer the state diagram of the Markov source shown in Fig Q7(b). Find : i) probabilities of the state ii) Entropy of each state iii) Entropy of the source.

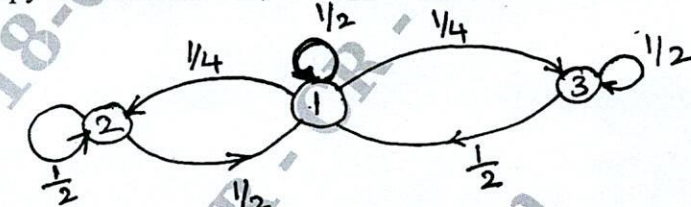


Fig Q7(b)

(10 Marks)

- c. For four symbols S_1, S_2, S_3 and S_4 having probabilities of occurrence given by 0.1, 0.2, 0.3 and 0.4. Construct a code using Shannon-Fane encoding algorithm and find the efficiency of coding. (06 Marks)

OR

- 8 a. A discrete memoryless source has an alphabet $x = \{x_1, x_2, x_3, x_4\}$. It is known that $P(x_1) = 0.4, P(x_2) = 0.3, P(x_3) = 0.2$ and $P(x_4) = 0.1$. Find $H(x)$ and show that $I(x_1, x_2, x_3, x_4) > H(x)$. (04 Marks)
- b. A source produces six symbols x_1, x_2, x_3, x_4, x_5 and x_6 with probabilities 0.3, 0.25, 0.20, 0.12, 0.08, 0.05. Construct Binary Huffman code. Find efficiency of coding and draw decision tree. (10 Marks)
- c. Explain in brief, the methods of controlling errors, types of errors and types of codes. (06 Marks)

CMRIT LIBRARY
BANGALORE - 560 037

Module-5

- 9 a. Consider a linear block code with $n = 6$ and $k = 3$. The check bits of this code are derived using the discrete relations given below : Take $D = [0 \ 0 \ 1]$
 $C_4 = d_1 \oplus d_2$
 $C_5 = d_1 \oplus d_2 \oplus d_3$
 $C_6 = d_2 \oplus d_3$
 - i) Find Generator matrix, G
 - ii) Find all the code-words of the linear block code
 - iii) Find the error detecting and error correcting capabilities of the code. (08 Marks)
- b. Consider a single error correcting code (Hamming code) for a message block of size equal to 11. How many check bits are required? Find a parity check matrix for this code. (08 Marks)
- c. Draw the syndrome calculator circuit for a (7,4) single error correcting code. (04 Marks)

OR

- 10 a. Refer the code rate $r = \frac{1}{2}$ and constraint length $k = 3$ convolution encoder shown in Fig Q10(a) below. Find C for the message $m = \{1, 1, 0, 1\}$ using Time domain approach and transform domain approach.

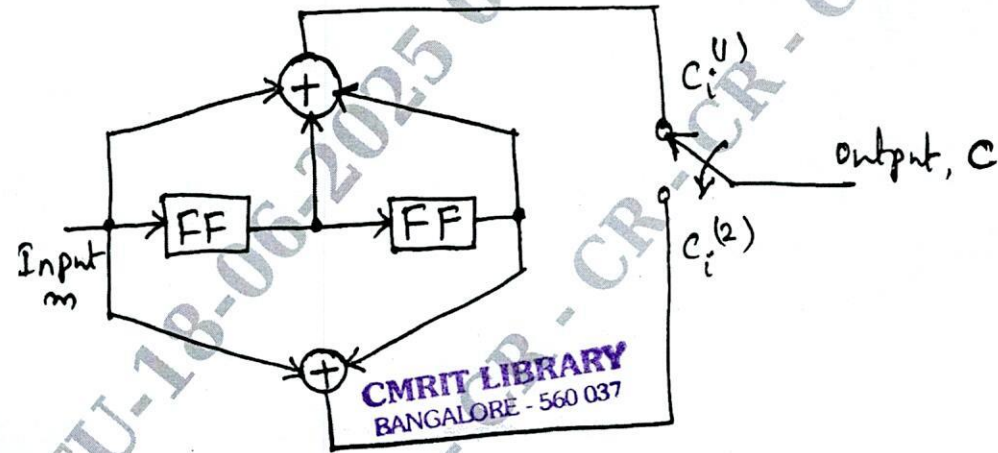


Fig Q10(a)

(10 Marks)

- b. For the convolution encoder shown in Fig Q10(b), draw the state diagram, tree diagram and find d_{free} .

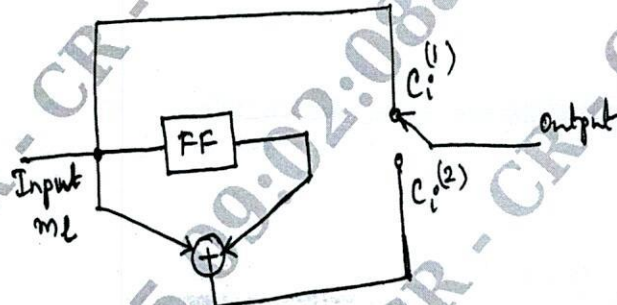


Fig Q10(b)

(10 Marks)
