CBCS SCHEME

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21EC51

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 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 $0 \le t \le T$ seconds. Using Gram –Schmidt procedure, express these functions in terms of orthonormal functions. Also sketch $\phi_1(t)$ and $\phi_2(t)$

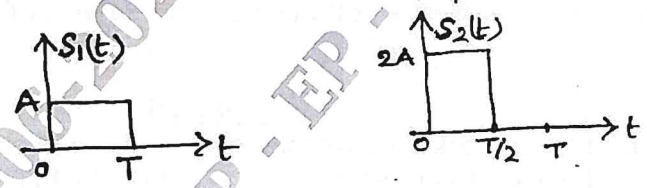

Fig Q3(b) **(10 Marks)**

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 Psendonoise 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 $\frac{E_b}{No}$ 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.

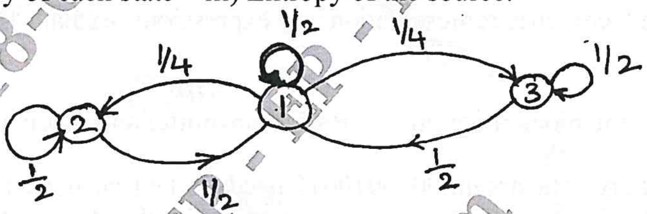

Fig Q7(b) **(10 Marks)**

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 $P(x_1) = 0.1$. 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)**

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.

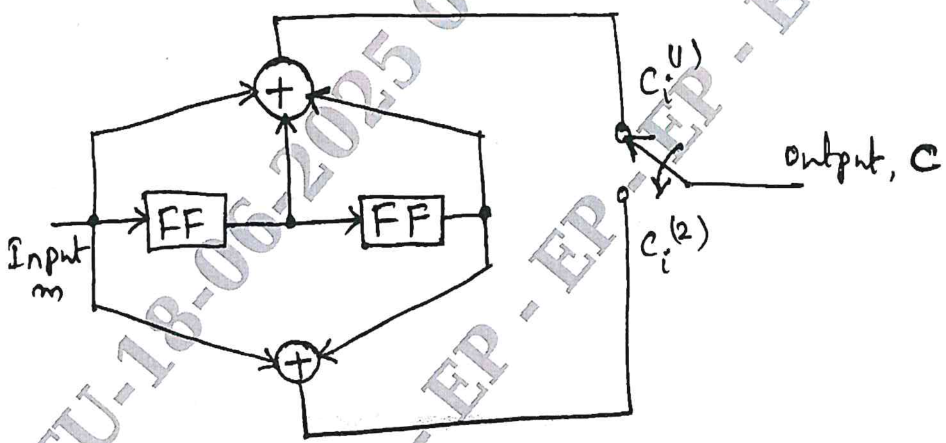

Fig Q10(a) **(10 Marks)**

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

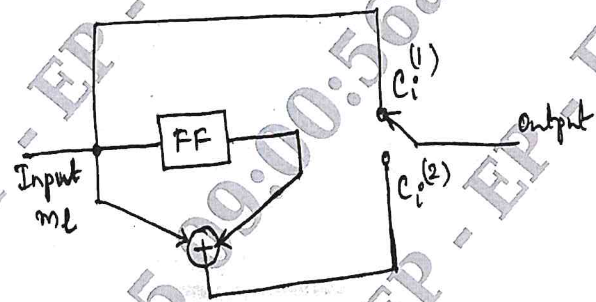

Fig Q10(b) **(10 Marks)**

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