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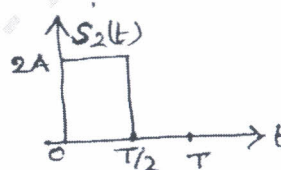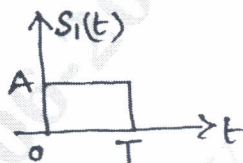

Fig Q3(b)　　　　　　　　　　　　　　　　　　　**(10 Marks)**

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 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 $\dfrac{E_b}{No}$ 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
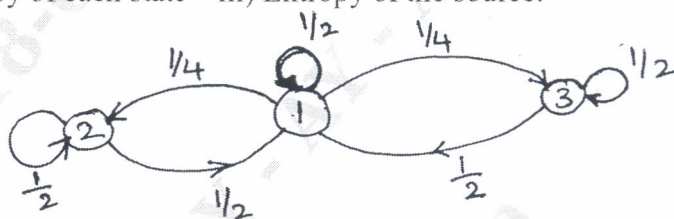   the state   ii) Entropy of each state   iii) Entropy of the source.

                          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 $r = \dfrac{1}{2}$ 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.
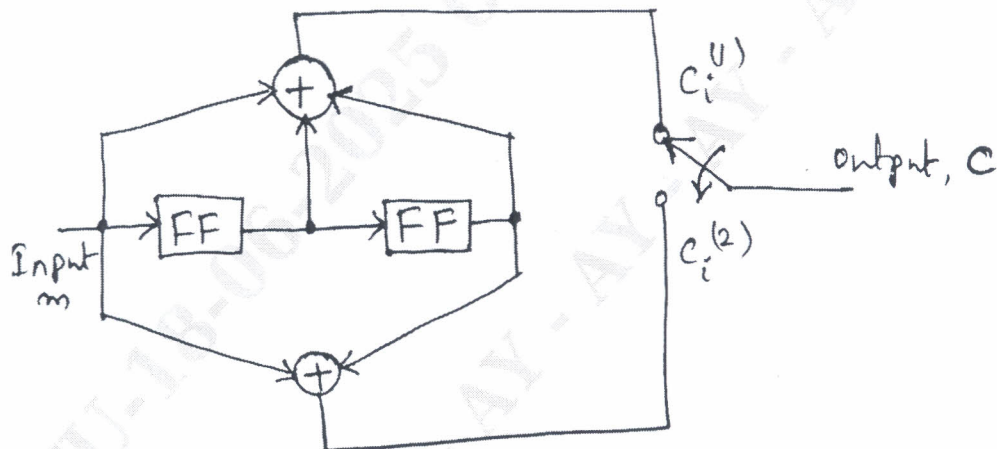

Fig Q10(a) **(10 Marks)**

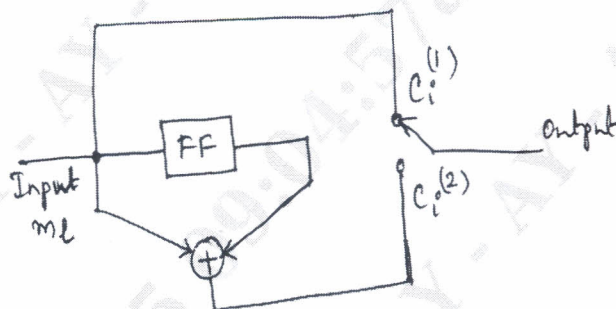b. For the convolution encoder shown in Fig Q10(b), draw the state diagram, tree diagram and find d_{free}.

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

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