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**CBCS SCHEME**

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**21EC51**

# Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026
## Digital Communication

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

### Module-1

1 a. With neat block diagram and signal space diagram, explain the generation and coherent detection of BPSK signal. **(10 Marks)**

b. Binary data transmitted at a rate of $10^6$ bps over a ℓ/w link. Assuming channel noise in AWGN with zero mean and PSD at the receiver input is $\left(\frac{NO}{2}\right)$ i.e $10^{-10}$ W/Hz, find the average carrier power required to maintain an average probability of error Pe $\leq 10^{-4}$ for coherent binary PSK, Note erfe (2.8) = $2 \times 10^{-4}$. **(06 Marks)**

c. Define ASK and PSK with waveforms. **(04 Marks)**

**OR**

2 a. With neat block diagram, explain the generation and coherent detection of Binary frequency shift keying. **(10 Marks)**

b. With neat block diagram and waveforms, explain the generation and coherent detection of QPSK. **(10 Marks)**

### Module-2

3 a. Explain the geometric representation of signals, show that energy of the signals is equal to the squared length of the vector representing it. **(10 Marks)**

b. Explain the gram-Schmitt orthogonalization procedure. **(10 Marks)**

**OR**

4 a. Using gram-Schmitt orthogonalization procedure, find the orthonormal basis functions for the set of given signals, Fig Q4(a).

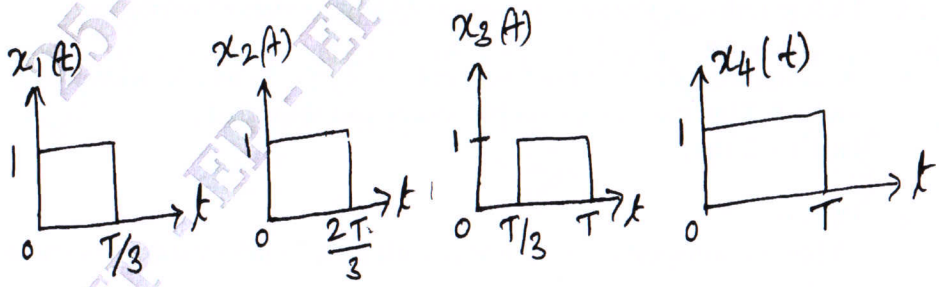


Fig Q4(a) **(12 Marks)**

b. With neat block diagram, explain briefly the base band binary data transmission system. **(08 Marks)**

## Module-3

5 a. For the following maximum length sequence generator obtain the O/P sequence. Assume the initial state 100, Fig Q5(a)

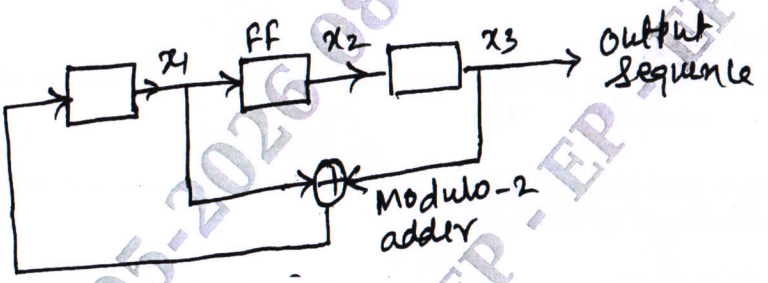


Fig Q5(a) **(06 Marks)**

b. Briefly, explain the properties of maximum length sequences. **(06 Marks)**

c. Explain with a neat block diagram, the DS-spread coherent PSK transmitter and receiver. **(08 Marks)**

**OR**

6 a. What is meant by Frequency Hop Spread Spectrum? Briefly explain slow FH-SS with neat diagram. **(10 Marks)**

b. Write a note on CDMA as a application of spread spectrum. **(06 Marks)**

c. A PN sequence is generated using linear feedback shift register with number of stages equal to 10. The chip rate is $10^7$/sec. Find :
   i) PN sequence length
   ii) Chip duration of PN sequence
   iii) Period of the PN sequence **(04 Marks)**

## Module-4

7 a. Define Entropy, state and prove any two properties of entropy. **(06 Marks)**

b. A source emits one of the four symbols $S_1$, $S_2$, $S_3$ and $S_4$ with probability of 7/16, 5/16, 1/8 and 1/8. Find the entropy of this source and show that :
$H(S^2) = 2\ H(s)$ **(10 Marks)**

c. Define :
i) Self information ii) Entropy iii) Rate of information iv) Source efficiency. **(04 Marks)**

**OR**

8 a. A source emits an independent sequence of symbols from an alphabet consisting of five symbols A, B, C, D and E with probabilities of $\frac{1}{4}, \frac{1}{8}, \frac{1}{8}, \frac{3}{16}$ and $\frac{5}{16}$ respectively. Find the Shannon binary code for each symbol and efficiency of the coding scheme. **(14 Marks)**

b. What is a Prefix Code? Explain with an example. **(06 Marks)**

## Module-5

9 a. For Systematic (7, 4) Linear block codes. The parity matrix P is given by Fig Q9(a).

i) Find the code words for the message bits 0101, 1110 and 0111

ii) Draw the corresponding encoding circuit

iii) A single error has occurred in the received vector $R_A = 0111110$ detect and correct the error

$$P = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

Fig Q9(a)

**(14 Marks)**

b. What is meant by linear block codes and systematic codes? What is the error detection and correlation capabilities of linear block codes. **(06 Marks)**

**OR**

10 a. For a (2, 1, 3) Convolution Encoder. Find the output sequence for the input message d = 10111, using Time domain approach for $g^{(1)} = 1011$, $g^{(2)} = 1111$. **(10 Marks)**

b. Draw the state transition table, state diagram for (2, 1, 2) convolution encoder with impulse response.
$g^{(1)} = 111$, $g^{(2)} = 101$ and input d = [10111]. **(10 Marks)**

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