Code No: R2031043 **R20** SET - 1

III B. Tech I Semester Regular Examinations, Dec/Jan -2022-23
DIGITAL COMMUNICATIONS
(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) A Delta modulation system operates at 3 times Nyquist rate for a signal with 3KHz bandwidth. The step size is 250mV. Determine the maximum amplitude of a 1KHz input sinusoidal for which the system does not show slope overload distortion. Compare the data rate in delta modulation and PCM. [7M]
   b) With a neat process flow diagram, enumerate the salient features of adaptive delta modulation. [7M]

(OR)

2. a) Draw the block diagram of delta modulator and explain each block with mathematical modeling. [7M]
   b) A sinusoidal signal is transmitted using PCM. An output SNR of 55.8dB is required. Find the number of representation levels required to achieve this performance. [7M]

UNIT-II

3. a) Explain the generation and detection of ASK. [7M]
   b) Draw the block diagram of QPSK transmitter and coherent QPSK receiver and explain their operation. [7M]

(OR)

4. a) What is M-ary signaling? Draw the signal diagram for M-ary PSK. [7M]
   b) Explain Non-coherent detection method of BFSK signaling. [7M]

UNIT-III

5. a) Derive the error probability of BFSK modulation system. [7M]
   b) Explain the properties of matched filter. [7M]

(OR)

6. a) A bipolar binary signal is +1V or -1V during the interval (0,T) and additive white Gaussian noise with PSD($\eta/2$) =10^{-5} W/Hz is added to the signal. Find maximum bit rate that can be sent with a bit error probability, Pe≤10^{-4}. Note Q(3.71)= 10^{-4}. [7M]
   b) Determine the amount of probability of error in ASK receiver. [7M]

UNIT-IV

7. a) A memory less source emits messages m_1 and m_2 with probabilities 0.8 and 0.2, respectively. Find the Huffman binary code for this source. Determine the code efficiency. [7M]
   b) What are the properties of Entropy and with suitable example, explain the entropy of binary memory less source. [7M]

(OR)

|'''|'|'|''|''||'|||

8. a) An analog signal band limited to 10kHz is quantized in 8 levels of a PCM system with probabilities of 1/4, 1/5, 1/5, 1/10, 1/10, 1/20, 1/20 and 1/20 respectively. Calculate the entropy and the rate of information. [7M]

   b) Explain what is meant by mutual information, how channel capacity is defined and give the Shannon capacity formula for additive white Gaussian noise channel. [7M]

UNIT-V

9. a) Consider a (7, 4) linear block code whose parity check matrix is given by $H = \begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$ [7M]

   (i) Find the generator matrix
   (ii) How many error codes can be detected?
   (iii) Draw the circuit for encoder and syndrome computation.

   b) Write notes on Hamming code with an example showing single bit error correction. [7M]

(OR)

10. a) The generator matrix for a (6,3) block code is given by Obtain all the code words of this code. [7M]

$$G = \left[\begin{array}{ccc:ccc} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{array}\right]$$

   b) The generator polynomial of a (7,4) Hamming code is defined by $g(D)=1+D^2+D^3$. Develop the encoder and syndrome calculator for this code. [7M]

Code No: R2031043 **R20** SET - 2

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UNIT-I

1. a) What are the two major sources of noise in a PCM system? Derive the expression for the output signal to quantization noise ratio in PCM. [7M]
   b) Compare in detail the PCM, DPCM and Delta Modulation systems. [7M]

(OR)

2. a) In a binary PCM system, the output signal to quantizing noise ratio is to be held to a minimum value of 40dB. Determine the number of levels and find the corresponding signal to quantizing noise ratio. [7M]
   b) Explain the working of Adaptive delta modulation with necessary circuit diagram. [7M]

UNIT-II

3. a) Explain the process of generating FSK signals. [7M]
   b) Explain the generation and detection of binary PSK with necessary block diagram. [7M]

(OR)

4. a) Find the transmitted Phase sequence for this input binary sequence {b} = {-1, 1, 1, -1, 1, -1, -1, 1} and sketch the transmitted waveform for QPSK? [7M]
   b) Describe the process of detecting DPSK signals. [7M]

UNIT-III

5. a) Binary data is transmitted over a telephone line with a usable bandwidth of 2400 Hz using the FSK signaling scheme. The transmit frequencies are 2025 Hz and 2225 Hz, and the data rate is 300 bits/sec. The average signal to noise power ratio at the output of the channel is 6 dB. Calculate the Probability of error for the coherent and non-coherent demodulation schemes. [7M]
   b) Show that the impulse response of a matched filter is a time reversed and delayed version of input signal. [7M]

(OR)

6. a) Obtain the probability of error in coherent BFSK system. [7M]
   b) What is frequency shift keying? Explain Non-coherent detection of FSK. [7M]

UNIT-IV

7. a) A source with 6 emitting messages A,B,C,D,E & F having possibly P(A)=1/3, P(B)=1/4, P(C)=P(D)=1/8, P(E)=P(F)=1/12. Find coding efficiency using Shannon Fano coding. [7M]
   b) Prove the relation I(X : Y)=H(X)+H(Y)-H(X,Y). [7M]

(OR)

|'''|'|'|''|''||'|||

8. a) A Gaussian channel has 5MHz bandwidth. Calculate the channel capacity if the signal power to noise spectral density ratio is 10^6Hz. Also find the maximum information rate at which the information is transmitted. [7M]

   b) Calculate efficiency for the following message ensemble using Huffman coding [7M]

$$[X] = [x1, x2, x3, x4, x5, x6, x7]$$
$$[P] = [0.4, 0.2, 0.12, 0.08, 0.09, 0.15, 0.04]$$

UNIT-V

9. a) The generator polynomial of a (7,4) systematic cyclic code is g(x) = $1+x+x^3$. Find the code words for the messages (0110), (1011) using shift register method. [7M]

   b) Design a convolutional coder of constraint length 6 and rate efficiency ½. Draw its tree diagram and Trellis diagram. [7M]

(OR)

10. a) What are convolutional codes? How are they different from block codes? [7M]

    For a systematic (6,3) linear block code, the parity matrix P is given by

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

    (i) Find all possible code words.

    (ii) If the received bit pattern R=101100, find actual codeword transmitted.

    b) Draw the state diagram, tree diagram, and trellis diagram for k=3, rate 1/3 code generated by g1(x) = 1+x2, g2(x) = 1+x and g3(x) = 1+x+x2. [7M]

Code No: R2031043 **R20** SET - 3

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UNIT-I

1. a) What is quantization? Give the limits of quantization error. A sinusoidal signal is transmitted using PCM. An output SNR of 55.8dB is required. Find the number of representation levels required to achieve this performance. [7M]
   b) Describe the different companding methods in PCM. [7M]

(OR)

2. a) A voice frequency signal band limited to 3 MHz is transmitted with the use of the DM system. The pulse repetition frequency is 30,000 pulses per second, and the step size is 40 mV. Determine the maximum possible speech signal amplitude to avoid a slope overload. [7M]
   b) Explain the working of DPCM with neat circuit diagram. [7M]

UNIT-II

3. a) Describe the generation and detection of coherent BFSK with neat diagrams. [7M]
   b) Explain the generation and detection in QPSK system. [7M]

(OR)

4. a) Compare BPSK and BFSK. [7M]
   b) How DPSK is different from PSK? Explain the generation and detection of DPSK. [7M]

UNIT-III

5. a) Obtain the probability of error in BPSK. [7M]
   b) Explain about non-coherent detection of FSK. [7M]

(OR)

6. a) Derive an expression for BER of BPSK scheme. [7M]
   b) Find the probability of error using matched filter. [7M]

UNIT-IV

7. a) What is information and information rate? Explain information capacity theorem. [7M]
   b) Apply Shannon-Fano encoding algorithm to the source emitting 8 messages A, B, C, D, E, F, G, H having probabilities 0.30, 0.20, 0.15, 0.12, 0.10, 0.07, 0.04, 0.02 respectively. Find the code words, average code word length and code efficiency. [7M]

(OR)

8. a) What is a binary symmetric channel? Write down its transition matrix in terms of *p*, the transition probability [7M]
   b) A memoryless source emits six messages with probabilities 0.3, 0.25, 0.15, 0.12, 0.1 and 0.08. Construct a Huffman code. Determine its average word length, code efficiency and redundancy. [7M]

UNIT-V

9. a) Explain the sequential decoding of convolutional codes with one example. [7M]
   b) Design encoder for the (7,4) binary cyclic code generated by $g(x)=1+x+x^3$ and verify the operation using the message vector {1 0 0 1} [7M]

(OR)

10. a) parity check matrix of (6,3) block code is given by [7M]

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

   (i) Find all code words
   (ii) If the received code word is 110110, what is the actual transmitted codeword?

   b) The generator polynomial of a (7, 4) cyclic code is $g(x)= 1+x+x^3$. [7M]
   i) Find the random error correcting capability and efficiency of this code.
   ii) Generate systematic cyclic code word for the message 1110 and 1010.

Code No: R2031043 **R20** SET - 4

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*****

UNIT-I

1. a) What is the need for quantization? Derive the expression for SNR in PCM. [7M]
   b) The delta modulator is designed to operate at 10KHz. The quantization step size is 100mV. What is the maximum amplitude of a 5KHz input signal for which the delta modulator does not show slope overload distortion? [7M]

(OR)

2. a) Discuss about the various elements of PCM system. [7M]
   b) Describe the limitations in Delta modulation. Discuss how to overcome them. [7M]

UNIT-II

3. a) Explain the generation of QPSK scheme with signal space representation. [7M]
   b) With a neat sketch, explain the modulation and detection of 8-PSK. [7M]

(OR)

4. a) Draw and explain the coherent system of signal reception. [7M]
   b) Compare binary signaling schemes and M-ary Signaling Schemes. [7M]

UNIT-III

5. a) Clearly explain coherent and Non-coherent detection systems. [7M]
   b) What is matched filter? Discuss and derive the relations of its properties. [7M]

(OR)

6. a) Draw and explain the signal constellation in BFSK. With the help of it obtain the probability of error. [7M]
   b) A set of binary data is sent at the rate of R_b=100Kbps over a channel with 60dB transmission loss and power spectral density $\eta=10^{-12}$ W/Hz at the receiver. Determine the transmitted power for a bit error probability $P_e=10^{-3}$ for PSK, FSK and QPSK modulation schemes. [7M]

UNIT-IV

7. a) A binary channel matrix is given by [7M]
   |2/3 1/3 |
   |1/10 9/10 |
   P(x1)=1/3 and P(x2)=2/3. Determine H(x), H(Y), H(Y/X) and I(X:Y)
   b) Explain Shannon- Fano coding with an example. [7M]

(OR)

|'''|'|'|''|''||'|||

8. a) Calculate efficiency for the following message ensembles using Huffman coding [X]= [x1 x2 x3 x4 x5 x6 x7] [P]= [0.4 0.2 0.12 0.08 0.08 0.08 0.04] [7M]
   b) Define Mutual Information. Explain its properties. [7M]

UNIT-V

9. a) What are the different methods of decoding of convolutional codes? Explain the trellis diagram decoding using Viterbi decoding algorithm. [7M]
   b) Draw the state diagram, tree diagram, and trellis diagram for k=3, rate 1/3 code generated by $g_1(x) = 1+x2$, $g_2(x) = 1+x$ and $g_3(x) = 1+x+x2$. [7M]

(OR)

10. a) What are the properties of Entropy and with suitable example, explain the entropy of binary memory less source. [7M]
    b) Discuss the characteristics of cyclic codes. Give the encoding procedure to generate systematic cyclic codes. [7M]