

III B. Tech I Semester Regular/Supplementary Examinations, December -2023
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

UNIT-I

1. a) Draw the PCM system block diagram and explain its operation. [7M]
b) What is slope overload distortion and granular noise distortion in delta modulation? How it is removed in adaptive delta modulation? [7M]
(OR)
2. a) Explain the techniques: Sampling, Quantization and Encoding in a PCM system with suitable diagrams. [7M]
b) With a neat sketch explain the principle and operation of Delta Modulation. [7M]

UNIT-II

3. a) Draw the block diagram of M-ary PSK system and explain its operation. [7M]
b) With a neat block diagram, explain the generation and recovery of BPSK? [7M]
(OR)
4. a) Draw and explain the generation of ASK? Draw the ASK waveform for the data 1 1 0 1 0 1 1 0 1 using unipolar signaling. [7M]
b) What are power spectra? Explain power spectra of BPSK and BFSK signals along with graphs? [7M]

UNIT-III

5. a) Derive the probability of error of QPSK system and explain its operation? [7M]
b) What is a correlator? Explain the optimum filter reception using correlator? [7M]
(OR)
6. a) Explain non-coherent detection methods of binary frequency shift keying scheme. [7M]
b) Explain about coherent binary PSK transmitter and receiver. Assuming channel noise to be additive white Gaussian obtain expression for probability of error. [7M]

UNIT-IV

7. a) Define entropy and conditional entropy. Write and explain the properties of entropy? [7M]
b) Explain Huffman coding with an example. [7M]
(OR)
8. a) What is information rate? Derive the expression for the Information rate. Write down the properties of mutual information? [7M]
b) A message source generates one of four messages randomly every microsecond. The probabilities of these messages are 0.4, 0.3, 0.2, and 0.1. Each emitted message is independent of the other messages in the sequence. Find the rate of information generated by this source (in bits per second). [7M]

UNIT-V

9. a) Derive the steps involved in generation of linear block codes. Define and explain the properties of syndrome. [7M]
b) With suitable example, explain about the Binary Cyclic Codes. [7M]
(OR)
10. a) Define Linear Codes and Systematic Linear codes? Distinguish between Linear Codes and Convolutional codes. [7M]
b) Explain encoding of convolution codes using time domain approach. [7M]

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UNIT-I

1. a) With the help of block schematic diagrams of the transmitter and the receiver, explain the working of binary PCM system. [7M]
b) Explain the operation of delta modulator and demodulator. [7M]
(OR)
2. a) What are the different types of noise in DM system? Explain. [7M]
b) Tabulate the comparisons between DM and PCM systems? [7M]

UNIT-II

3. a) With the help of block diagram, explain the modulation and detection of Differential Phase shift Keying. [7M]
b) List out the comparisons between QPSK, 16-PSK, QASK and 16-QASK modulation systems. [7M]
(OR)
4. a) For a fixed bit-error probability, comment on the bandwidth efficiencies and the average transmitted power requirements of BPSK and QPSK schemes. [7M]
b) What is the significance of power spectrum? Draw the power spectrum of BPSK and BFSK signals. [7M]

UNIT-III

5. a) Derive the probability error of BFSK system and explain its operation. [7M]
b) What is a matched filter? How it differs from an optimum filter. Derive an expression for impulse response of the matched filter. [7M]
(OR)
6. a) Explain coherent detection of PSK signals and derive probability of error. [7M]
b) Differentiate coherent and non-coherent detection techniques. [7M]

UNIT-IV

7. a) Explain the entropy of binary memory less source with suitable example? List out the properties of entropy? [7M]
b) Compare code efficiency of Shanon Fano coding and Huffman coding when five source messages have probabilities $m_1=0.4$, $m_2=0.15$, $m_3=0.15$, $m_4=0.15$, $m_5=0.15$. [7M]
(OR)
8. a) Define information and information rate? Briefly explain information capacity theorem? [7M]
b) Apply Shannon-Fano coding procedure of $M=2$ and $M=3$, $[x]=[x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8]$ with probability $[P]=[1/4, 1/8, 1/16, 1/16, 1/4, 1/16, 1/8, 1/16]$. [7M]

UNIT-V

9. a) Prove that a linear block code with a minimum distance d_{\min} can correct up to $(d_{\min} - 1)/2$ errors in each code word, where $(d_{\min} - 1)/2$ denote the largest integer number greater than $(d_{\min} - 1)/2$. [7M]
- b) Consider (7, 4) linear code whose generator matrix is [7M]

$$G = \begin{bmatrix} 1 & 0 & 0 & 0 & : & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & : & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & : & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & : & 0 & 1 & 1 \end{bmatrix}$$

- i) Find the minimum weight of this code. ii) Prove equation $\mathbf{eH}^T = 0$.
(OR)
10. a) What is a block-code? Analytically compare the error performance of a block coded system with other codes. [7M]
- b) With an example, explain the decoding using Viterbi algorithm. [7M]

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UNIT-I

1. a) With a neat sketch explain the principle and operation of PCM? [7M]
b) The information in an analog signal voltage waveform is to be transmitted over a PCM system in an accuracy of $\pm 0.1\%$ (full scale). The analog voltage waveform has a bandwidth of 100 Hz and an amplitude range of -10 V to +10 V.
i) Find the minimum sampling rate required.
ii) Find the number of bits in each PCM word.
iii) Minimum bit rate required in the PCM signal.
iv) Find the minimum absolute channel bandwidth required for the transmission of the PCM signal.
(OR)
2. a) Explain quantization error and derive an expression for maximum SNR in PCM system that uses linear quantization. [7M]
b) 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]

UNIT-II

3. a) Explain the modulation and detection of M-ary QASK with suitable diagrams. [7M]
b) Compare 16-ary PSK, 16-ary FSK, and 16-ary QASK in context to error probability and transmission BW. [7M]
(OR)
4. a) Draw the block diagram of BPSK demodulator. Explain each block in detail. [7M]
b) What are the advantages of M-ary Signaling Schemes? Explain the signal diagram for M-ary PSK with neat sketch? [7M]

UNIT-III

5. a) What do you mean by optimum filter? List and explain the characteristics of optimum filter? [7M]
b) Explain in detail about QPSK and find the probability of Error? [7M]
(OR)
6. a) What is coherent reception? With a neat sketch, explain the non-coherent detection of FSK. [7M]
b) What is BFSK? Derive an expression for probability of error for BFSK. [7M]

UNIT-IV

7. a) Explain the procedure to calculate the coding efficiency using Huffman coding [7M]
with an example.
- b) A discrete memory less source has five symbols x_1, x_2, x_3, x_4 and x_5 with probabilities 0.4, 0.19, 0.16, 0.15 and 0.15 respectively attached to every symbol. Construct a Shannon–Fano code for the source and calculate code efficiency. [7M]

(OR)

8. a) Explain the following: i) Shannon's Source Coding Theorem [7M]
ii) Channel Capacity
- b) A message source generates one of four messages randomly every microsecond. The probabilities of these messages are 0.4, 0.3, 0.2, and 0.1. Each emitted message is independent of the other messages in the sequence. Find the source entropy? [7M]

UNIT-V

9. a) Explain tree diagram, trellis diagram and state transition diagram of convolutional codes. [7M]
- b) Explain the decoding process using Viterbi algorithm with example. [7M]
- (OR)
10. a) Find a generator polynomial $g(x)$ for a (7,4) cyclic code, and find code vectors for the data: 0001 [7M]
- b) If G and H are the generator and parity check matrices, respectively, then show that $GH^T = 0$. [7M]

UNIT-V

9. a) Explain about Error detection and Correction capabilities of Hamming codes [7M]
with example.
- b) Explain the trellis diagram decoding using Viterbi decoding algorithm. [7M]
- (OR)
10. a) Given a generator matrix $G = [1 \ 1 \ 1]$. Construct a (3, 1) code. How many errors [7M]
can this code correct?
- b) Determine the Hamming bound for a ternary code (whose three code symbols [7M]
are 0, 1, and 2).

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