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Question Paper Code : 90477

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Fifth Semester

Electronics and Communication Engineering

EC 8501 — DIGITAL COMMUNICATION

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A communication system consists of six messages with probabilities 0.125, 0.125, 0.125, 0.125, 0.25, 0.25. Determine the entropy of the communication system.

2. What is the channel capacity of a voice communication channel having bandwidth of 3100 Hz and SNR as 25 dB?

3. An audio signal comprising of a single sinusoidal term $x(t) = 5 \cos (1000 \pi t)$ is quantized using 8 bit PCM. Determine the signal-to-quantization noise ratio.

4. The binary data 1100001 is transmitted over a baseband channel. Draw the line coding waveforms for the transmitted data using (a) Unipolar RZ and (b) split phase Manchester.

5. What are the benefits and drawbacks of Nyquist pulse shaping?

6. What are the essential requirements of an equalizer?

7. Determine the bandwidth for an binary FSK signal with two frequency offsets placed at 32kHz and 24kHz, and a bit rate of 4 kbps.

8. Distinguish between coherent and non-coherent detection.

9. What are the desirable properties of linear block code?

10. What is convolutional code? Write the significance.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Prove that the entropy for a discrete source is maximum when the output symbols are equally probable. (7)

(ii) A source X has an infinitely large set of outputs with probability of occurrence given by $p(x_i) = 2^{-i}, i = 1, 2, 3, \ldots\ldots$. What is the average self- information of the source? (6)

Or

(b) Consider a discrete source with source probabilities {0.2, 0.18, 0.1, 0.1, 0.1, 0.061, 0.059, 0.04, 0.04, 0.04, 0.04, 0.03, 0.01}. Construct binary optimal code using Huffman procedure for this source. Calculate the efficiency of the code?

12. (a) Draw and explain encoder and decoder structures of DPCM. Demonstrate the need for Adaptive DPCM.

Or

(b) Explain the need for line coding schemes. What are the desirable properties for line coding schemes?

13. (a) What is correlative coding? Explain its use by illustrating duo binary signalling.

Or

(b) (i) What is the importance of equalization in communication system and mention the advantages. (4)

(ii) Explain adaptive equalizer with a neatly labelled block diagram. (9)

14. (a) Draw and explain BPSK modulation and demodulation system. What is the advantage of DPSK over BPSK?

Or

(b) Explain the necessity for carrier synchronization. Draw and explain Costas loop carrier synchronization system.

15. (a) The generator polynomial of a (7, 4) cyclic code is $1 + X + X^3$. Develop encoder and syndrome calculator for this code.

Or

(b) Using systematic procedure, compute the hamming code for the data sequence 11 0 0 0 11 0.

PART C — (1 × 15 = 15 marks)

16. (a) Consider a binary block code with encoding matrix

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

(i) Find the parity check matrix.

(ii) Determine how many errors the code can detect and correct.

(iii) Draw the encoder and syndrome computation circuit.

(iv) Devise a decoder circuit for this code. (5+4+3+3)

Or

(b) (i) Let X and Y be two discrete random variables that takes values $x_1, x_2, \ldots, x_M$ and $y_1, y_2, \ldots y_L$ respectively. Let $Z = X + Y$. Show that $H(Z / X) = H(Y / X)$. (8)

(ii) Suppose a TV displays 30 frames/second. There are 2×10^5 pixels per frame, each pixel requires 16 bits for colour display. Calculate the bandwidth required to support the transmission of TV video signal for SNR of 28dB. (7)