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Question Paper Code : 80529

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

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. Mention the significance of entropy of a source in relation to uncertainty.

2. Calculate the SNR in dB required to achieve an intended channel capacity of 20Mbps through a communication channel of 3 MHz bandwidth?

3. Why is predictor used in differential pulse code modulation system?

4. Mention the difference between waveform coding technique and line coding technique.

5. State the Nyquist pulse shaping criterion for distortionless baseband transmission.

6. When will a linear time invariant system function as matched filter?

7. In a binary FSK system, it is required to transmit 750 bps binary data sequence. Determine the minimum bandwidth of the binary FSK signal if the separation between two carrier frequencies is 2500 Hz.

8. Define DPSK technique and mention its advantages.

9. Give the need for error control coding and mention its types.

10. What is a convolutional code? How is it different from a linear block code?

[redacted]

PART B — (5 × 13 = 65 marks)

11. (a) Let X and Y be two discrete random variables that take on values $x_1, x_2, \ldots, x_m$ and $y_1, y_2, \ldots, y_N$ respectively.

(i) Define entropy H(X), joint entropy H(X,Y), conditional entropies H(Y/X) and average mutual information I(X;Y) (ii) Show that H(X/Y) $\leq$ H(X) with equality if and only if X and Y are independent. (4+9)

Or

(b) Define the capacity of discrete memoryless channel and explain the classification of channels. Calculate the capacity of the discrete memoryless channel with matrix

$$\begin{bmatrix} 1-p-q & p & q \\ p & 1-p-q & q \end{bmatrix}$$

12. (a) Draw the block diagram of the encoder and decoder of adaptive differential pulse code modulation system and explain.

Or

(b) Derive the expression for the power spectral density of Manchester encoding data format.

13. (a) Show that the output signal of a matched filter is proportional to a shifted version of the autocorrelation function of the input signal to which the filter is matched.

Or

(b) A band-limited signal $x(t)$ having bandwidth W is designed with the following controlled ISI

$$x(nT_b) = \begin{cases} 2 \ \ for\, n = 0 \\ 1\, for \ \ n = 1 \\ -1 \ \ for\, n = 2 \\ 0 \ \ otherwise \end{cases}$$

where $T_b = \frac{1}{2W}$. Determine the spectrum $X(f)$ and plot its magnitude. Also plot the signal $x(t)$.

14. (a) Explain in detail the generation and detection of binary PSK system. Derive the expression for its BER.

Or

(b) Draw the block diagram of QAM signal receiver with decision directed carrier phase estimation and explain.

15. (a) The polynomial $g(X) = 1 + X + X^4$ is the generator polynomial for the (15, 11) Hamming binary cyclic code. Determine generator matrix G and parity check matrix H for this code in systematic form.

Or

(b) A convolutional code is described by the following matrix

$G = [1 \;\; 1 + D^2 \;\; 1 + D + D^2]$

(i) Draw the encoder (4)

(ii) Draw the trellis diagram for the input length L = 5 (5)

(iii) Determine the coded sequence for the message sequence 10110. (4)

PART C — (1 × 15 = 15 marks)

16. (a) Construct a code using the code alphabets (–1, 0, 1 } for the following set of source probabilities using Huffman coding procedure and compute the coding efficiency for the constructed code.

(0.2, 0.18, 0.12, 0.10, 010, 0.08, 0.06, 0.06, 0.06, 0.04}

Or

(b) A binary baseband digital communication system employs the signal

$$s(t) = \begin{cases} \frac{1}{\sqrt{T}} & for\ 0 \le t \le T \\ 0 & otherwise \end{cases}$$

(i) Determine the impulse response of the matched filter for this signal (5)

(ii) Derive and plot the response of the matched filter and determine the output of the matched filter at $t = T$ (5)

(iii) Suppose the signal is passed through a correlator that correlates the signal $s(t)$ with itself. Derive and plot the output of the correlator and find the output of the correlator at $t = T$. (5)

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