

Attempt any **four** parts of the following : (5×4=20)

- (a) A Gaussian channel has 1 MHz bandwidth. Calculate the channel capacity and maximum information rate if the signal power to noise spectral density ratio (S/N) is 10^5 Hz.
- (b) The parity check matrix of a (7, 4) Hamming code is as given :

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

Calculate the syndrome vector for single bit errors.

- (c) Define the term Burst error and error detection. How many types of redundancy checks corrected ?
- (d) For a (7, 4) cyclic code determine the generator matrix if $G(P) = 1 + P + P^3$.
- (e) Determine the Huffman code for the following message with their probabilities given :

$$\begin{array}{l} \{X\} \quad [x_1 \quad x_2 \quad x_3 \quad x_4 \quad x_5 \quad x_6 \quad x_7] \\ \{P\} \quad [0.05 \quad 0.15 \quad 0.2 \quad 0.05 \quad 0.15 \quad 0.3 \quad 0.1] \end{array}$$

- (f) Write the advantage and disadvantage of cyclic codes.

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2487

Roll No.

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B. Tech.

(SEM. VI) THEORY EXAMINATION 2011-12

DIGITAL COMMUNICATION

Time : 3 Hours

Total Marks : 100

Note : (1) Answer *all* questions.

(2) All questions carry equal marks.

1. Attempt any **four** parts of the following : (5×4=20)
- (a) What are the main elements of the digital communication system ? Sketch and explain the function of each element.
- (b) Differentiate between Base-band and Band-pass data transmission system.
- (c) If $Z = X + Y - C$, where X and Y are the independent random variables with variance σ_{x_2} and σ_{y_2} and C is constant. Find the variance of Z .
- (d) Write short note on Kraft Inequality.
- (e) Define the following terms :
- (i) Mutual information
 - (ii) Entropy
 - (iii) Channel capacity
 - (iv) Rate of Information.
- (f) Verify equations that is $I(X : Y) = H(Y) + H(X) - H(X, Y)$.

Attempt any **two** parts of the following : (10×2=20)

- (a) Discuss the properties of matched filter. Explain the block diagram of optimum receiver for binary coded signal and derive the expression for Probability of Error (P_e) for optimum filter receiver.
- (b) Explain the cause of ISI and discuss the Nyquist criterion for distortionless Baseband Binary transmission. Design a binary baseband PAM system to transmit data at a bit rate of 3600 bits/sec with a bit error probability less than 10^{-4} . The channel response is given by :

$$H_c(f) = \begin{cases} 10^{-2} & \text{for } |f| < 2400 \\ 0 & \text{elsewhere.} \end{cases}$$

The noise power spectral density is $G_n(f) = 10^{-14}$ watt/Hz.

- (c) Give four desirable properties of baseband line codes. Draw the following data formats for the data bit stream 1100110 :

 - (i) Unipolar RZ,
 - (ii) Polar NRZ,
 - (iii) Bipolar NRZ,
 - (iv) Manchester.

3. Attempt any **two** parts of the following : (10×2=20)

- (a) Write short notes on the following :
 - (i) Byte Interleaving T1 Carrier System,
 - (ii) T1 to T4 PCM TDM.
- (b) Explain the different type of digital carrier modulation schemes giving their merits and demerits for transmission data on band-pass channel. Determine the performance of a QPSK receiver in the presence of AWGN channel.

- (c) An FSK system transmits binary data at a rate of 2.5×10^6 bits per second. During the course of transmission, white Gaussian noise of zero mean and power spectral density 10^{-20} W/Hz is added to the signal. In the absence of noise, the amplitude of the received sinusoidal wave for digit 1 or 0 is 1 mV. Determine the average probability of symbol error for the following system configurations :

- (i) Coherent binary FSK
- (ii) Coherent MSK
- (iii) Noncoherent binary FSK.

4. Attempt any **two** parts of the following : (10×2=20)

- (a) What are the various characteristics of Spread Spectrum Signal ? Explain the principle of direct sequence and frequency hopped spread spectrum communication system.
- (b) Derive an expression for the probability of error of a DS spread spectrum using binary PSK. In a fast FH spread spectrum system, the information is transmitted via FSK with non-coherent detection. Suppose there are $N = 3$ hops/bit. Determine the probability of, for this system in an AWGN channel with power density $\frac{1}{2}N_0$ and $SNR = 13$ dB (total SNR over the 3 hops).
- (c) Explain the various types of multiuser systems. Determine and compare the capacity of FDMA, TDMA and CDMA in an ideal AWGN channel of bandwidth 'W'.