5. 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 :

| {X} | [x1 | x2 | x3 | x4 | x5 | x6 | x7] |
|---|---|---|---|---|---|---|---|
| {P} | [0.05 | 0.15 | 0.2 | 0.05 | 0.15 | 0.3 | 0.1] |

(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.

## 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 $\sigma_{x_2}$ and $\sigma_{y_2}$ 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).

2. 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 :

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

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 1 1 0 0 1 1 0 :

(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 the rate of $2.5 \times 10^6$ 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 ½N0 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'.