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

PAPER ID : 2487 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. VI) EVEN THEORY EXAMINATION 2012-13

DIGITAL COMMUNICATION

Time : 3 Hours *Total Marks : 100*

Note :– (1) Answer **all** questions.

(2) All questions carry equal marks.

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

(a) What are the various advantages of Digital Transmission System ? Draw a block diagram and explain the working principle of a digital and data communication system.

(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) Draw a Block diagram for BFSK generation and BFSK detection techniques. Binary data is transmitted over a telephone line with a usable bandwidth of 2400 Hz using FSK signalling. The transmit frequency are 2025 Hz and 2225 Hz and the data rate is 300 bps. The average SNR power ratio at the output of the channel is 6 dB, calculate probability of error for the coherent and non coherent demodulation schemes.

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

(a) If $Z = X + Y - C$, where X and Y are the independent random variable with variance σ_{x2} and σ_{y2} and C is constant. Find the variance of Z.

(b) $X(t) = A \cos (w_c t + \phi)$, where A and w_c are constant while ϕ is a random variable with an uniform pdf $f_\phi(\phi) = 0.5\pi \quad -\pi < \phi < \pi$.

(i) Find the mean and autocorrelation function and the psd of X(t). Show that X(t) is wide sence stationary.

(ii) Find the autocorrelation by time averaging.

(c) X and Y are independent, zero mean, Gaussion random variable with variance σ_{x2} and σ_{y2}. Let $z = \frac{X+Y}{2}$ and $w = \frac{X-Y}{2}$ (i) Find the Joint pdf $f_{zw}(z, w)$ (ii) Find the marginal pdf $f_z(z)$.

(d) Consider the signal $s(t) = (A/T)\, t \cos 2\pi f_c t \quad 0 < t < T$

$0 \quad$ otherwise

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

(ii) Determine the output of the match filter at t = T.

(e) Determine the optimum transmitting and receiving filters for binary communication systems that transmit data at a rate of 4800 bits/sec over a band limited channel with frequency magnitude response $|H_c(f)| = \frac{1}{\sqrt{1+\left(\frac{f}{w}\right)^2}}, |f| \le w$.

Where W = 4800 Hz, the additive noise is zero mean, white, Gaussian with spectrical density $\eta/2 = 10^{-15}$ W/Hz.

(f) Draw the following data formates for the 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) Differentiate between base-band data transmission systems and band-pass data transmission system. How will you design an optimum receiver for a band-pass data transmission system ?

(b) Write short notes on the following :

(i) Schwarz Inequality

(ii) Geometric representation of signals

(iii) Gram Schmidt Orthogonalization.

(c) Explain the block diagram of optimum receiver for binary coded signal and drive the expression for Probability of Error (P_e) for optimum filter receiver.

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

(a) What are the various characteristics of Spread Spectrum Signal ? A rate 1/2 convolution code with dmin = 10 is used to encode a data sequence at a rate of 1000 bits/sec. The modulation is binary PSK. The DS spread spectrum sequence has a chirp rate of 10 MHz. Determine the following (i) Coding gain (ii) Processing gain (iii) Jamming Margin assuming $E_b/J_o = 10$.

(b) Compare the performance of direct sequence spread spectrum system with frequency hopped spread spectrum system. 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 for this system in an AWGN channel with power density 1/2 N0 and SNR = 13 dB (total SNR over the 3 hops).

(c) Explain the various types of multi user communication systems. How will you design an optimum receiver for multi user CDMA signal transmission ?

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

(a) Define the following terms :

(i) Mutual information

(ii) Entropy

(iii) Channel capacity

(iv) Rate of Information

(b) A Gaussian channel has 1 MHz bandwidth. Calculate the channel capacity and maximum information rate if the signal power to noise spectrical density ratio (S/η) is 10^5 Hz.

(c) Consider a (7, 4) block code generated by

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

. Explain how the errors syndrome S helps in correcting a single error.

(d) Design a block code with a minimum distance of three and a message block size of eight bits.

(e) The generator polynomial of a (6, 3) cyclic code is $g(x) = 1 + x^2$. Find all the codewords of the code.

(f) Write short notes on the following :

(i) Convolution code

(ii) Turbo code.