Bengal Engineering & Science University, Shibpur

M.E. (ETC) 1st SEMESTER FINAL EXAMINATION, 2013-14

Advanced Digital Communication (ETC-929)

Time: 3 hours **Full marks: 70**

Answer any **FIVE** questions

1. a) The probability density function(PDF) of a Gaussian signal $X(t)$ is given by

$$p_X(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-x^2/2\sigma^2}$$

The signal is applied to the input of a half-wave rectifier circuit (Fig.1). Assuming an ideal diode, determine probability density function (PDF) and cumulative distribution function (CDF) of the output signal amplitude Y.

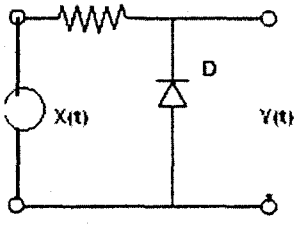

Fig.1

b) Let $X(t)$ be a stationary process with mean μ_X and autocorrelation function $R_X(\tau)$. This process is applied to an LTI system with impulse response $h(t)$. Determine the mean and autocorrelation function of the output process as a function of $h(t)$, μ_X and $R_X(\tau)$.

7+7

2. a) Write an analytical expression of an 8-PSK modulated signal and draw its constellation diagram.
b) Derive an expression of the bit error rate in BFSK modulation scheme considering the presence of additive white Gaussian Noise.

5+9

3. a) A pair of signals $s_i(t)$ and $s_k(t)$ have a common duration T. Show that

$$\int_0^T (s_i(t) - s_k(t))^2 \, dt = \| \underset{\sim}{s_i} - \underset{\sim}{s_k} \|^2$$

Where $\underset{\sim}{s_i}$ and $\underset{\sim}{s_k}$ denote the vector representations of the signals $s_i(t)$ and $s_k(t)$ respectively

b) Establish the equivalence between a correlation receiver and a matched filter for detection of binary signals in additive White Gaussian noise.

7+7

4. With a neat block diagram explain the operation of a MSK modem. Write down its key advantages over BPSK, QPSK and BFSK. Compare the performance of MSK modulation with that of GMSK.

7+3+4

5. Explain the concept of spread spectrum modulation. Derive an expression for the power of a narrowband jamming signal at the output of spread DSSS/BPSK receiver. Hence justify the following: the processing gain of a spread spectrum system may be expressed as the ratio of the spread bandwidth of the transmitted signal to the bandwidth of message signal for a DSSS/BPSK system. Make necessary assumptions.

3+7+4

6. Write down some applications of spread spectrum modulation. Explain the advantages of multicarrier modulation over single carrier modulation. With a neat block diagram, discuss the principle of operation an OFDM communication.

3+4+7

7. Write down short notes on any **two**
    a. Gaussian Process
    b. Maximum likelihood decoding
    c. Frequency hopping spread spectrum modulation

7×2