Bengal Engineering & Science University, Shibpur

M.E. (ETC) 1st SEMESTER FINAL EXAMINATION, 2012-13

Advanced Digital Communications(ETC-929)

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

Answer any **FIVE** questions

1. a) A stationary random process $X(t)$ is applied at the input of a linear time-invariant (LTI) system. Derive an expression for the power spectral density (PSD) of the output random process in terms of the PSD of $X(t)$ and frequency response of the system.

   b) A running integrator is defined by

$$y(t) = \int_{-T} x(\tau) d\tau$$

   where $x(t)$ is the input, $y(t)$ is the output, and T is the integration period. Both $x(t)$ and $y(t)$ are sample functions of stationary processes $X(t)$ and $Y(t)$, respectively. Show that the power spectral density (PSD) $S_Y(f)$ of the integrator output is related to that of the integrator input $S_X(f)$ as

$$S_Y(f) = T^2 \operatorname{sinc}^2(fT)\, S_X(f)$$

   c) "Truly stationary process cannot occur in real life". Give your views and justify them.

6+6+2

2. a) Draw constellation diagram of QPSK modulation scheme. Derive an expression of bit error rate in QPSK modulation scheme considering the presence of additive white Gaussian Noise. Justify use of Grey encoding in QPSK modulation.

4+7+3

3. a) Derive an expression for the power spectral density of a random binary non return to zero signal where bit 1 and 0 are represented by $+A$ and $-A$ volts respectively. Duration of each bit is T seconds. Make necessary assumptions.

   b) With a neat block diagram explain the operation of a MSK modem. Compare the performance of MSK modulation with that of QPSK.

6+8

4. Define spread spectrum modulation. Explain its differences with other wideband modulation schemes such as PCM and FM. Derive an expression for probability of error of a DSSS-BPSK receiver in presence of single-tone jamming signal. Discuss the 'Near-Far' problem in DSSS systems.

2+3+6+3

5. Write down the properties of PN sequence. Compare this with that of Gold sequence. If the target probability of error for a DSSS-CDMA system is 10^{-3}, determine the processing gain required to support 20 simultaneous users.

4+4+6

6. Discuss granular noise and overload distortion in quantization process. Describe the Lloyd-Max algorithm. Prove that signal-to-noise ratio (SNR) at the output of a uniform quantizer improves by 6dB for increase of one bit/sample. Consider a random input with zero mean and variance σ_x^2 and peak value x_{max}. The quantizer is designed with zero overload.

4+5+5

7. Discuss the problems of broadband wireless communication using single carrier. Explain the advantages of multicarrier modulation for the same. Mention some applications of OFDM. Explain the importance of cyclic prefix in OFDM communication.

4+4+3+3

8. Write short notes(any **two**)
   a) Maximum likelihood decoding
   b) Adaptive Differential Pulse Code Modulation (ADPCM)
   c) Rake receiver

7×2