

Bengal Engineering & Science University, Shibpur

B. E. (CST 5TH Semester) Examination, 2012

Subject: Analog and Digital Communication (ET 507)

Time : 3hrs

Full marks: 70

Answer any FIVE questions

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1. (a) What do you mean by LTI system? Show that for a discrete time causal LTI system $h(n) = 0$, for $n < 0$
- (b) Determine and sketch the convolution of the following two signals: $x(t) = 1$ for $-1 < t < +1$ and 0 otherwise; $h(t) = \delta(t+1) + 2\delta(t+2)$.
- (c) Find the autocorrelation function of sine wave signal $g(t) = A \sin(\omega_0 t + \phi)$, $\omega_0 = \frac{2\pi}{T}$.
[6+4+4]
2. (a) Consider an LTI system with input output related through the following equation:
$$y(t) = \int_{-\infty}^t e^{-t-\tau} x(\tau - 2) d\tau$$
, What is the impulse response for this system?
- (b) Find the Fourier transform of $f(t) = \text{rect}\left(\frac{t}{\tau}\right)$
- (c) Write short notes on Noise in communication system.
[5+4+5]
3. (a) Why modulation is needed? Define modulation index in AM & FM.
- (b) Derive the expression for power in AM. An AM signal with a carrier of 1 KW power has 200 watt in each sideband. Find the percentage modulation. Write down the advantages of FM over AM.
- (c) Given $v(t) = 12 \cos(6 \times 10^8 t + 5 \sin 1250 t)$, Determine carrier frequency, modulating frequency and modulation index of the above signal.
[4+6+4]
4. (a) With proper diagram explain different Line coder: NRZ Polar, NRZ Bipolar, Split Phase Manchester.
- (b) For a binary PCM systems find out the expression for Signal to Quantization Noise ratio in dB scale.
A signal $m(t)$ band limited to 3 kHz is sampled at a rate 33.33% higher than the Nyquist rate. Maximum quantization error is 0.5% of the peak amplitude m_p . Find the minimum bandwidth of a channel required to transmit the encoded binary signal.
- (c) What is Multiplexing? Differentiate between TDM and FDM.
[4+6+4]

5. (a) Define Entropy in Information theory.
 (b) An analog signal is band limited to f_m Hz and sampled at Nyquist rate. The samples are quantized into 4 levels. Each level represents one symbol. The probabilities of these 4 symbols are $P(x_1) = P(x_4) = 1/8$ and $P(x_2) = P(x_3) = 3/8$. Find out the information rate.
 (c) Show that channel capacity of an ideal AWGN channel with infinite bandwidth is given by $C_\infty \cong 1.44 \frac{S}{\eta} b/sec$, where S is the average signal power and $\frac{\eta}{2}$ is the power spectral density of white Gaussian noise.

[4+6+4]

6. (a) Define Delta Modulation, What do you mean by Slope Overload Distortion?
 (b) Draw the block diagram of DPSK system and explain its working.
 (c) Explain how QPSK differs from PSK in term of transmission bandwidth and bit information it carries? Give the equation for average probability of symbol error for binary PSK.

[5+5+4]

7. (a) Write Shannon's channel capacity theorem.
 (b) Explain Cyclic codes. For pattern 110101 and Message 1010001101 Find CRC.
 (c) If Message 1001101 and parity bits $r_1: 1,3,5,7,9,11$, $r_2: 2,3,6,7,10,11$, $r_4: 4,5,6,7,8,9,10,11$ find out transmitted bit using Hamming code.

[2+6+6]

8. Write short notes (any two)
 (a) ISI (b) Matched filter (c) QPSK (d) Pulse modulation
 (e) Direct Sequence Spread Spectrum.

[7+7]