BE, PART-III 5TH SEMESTER (IT) FINAL EXAMINATION, DECEMBER 2011
COMMUNICATION SYSTEMS (IT-501)

F.M.= 70 Time= 3 Hrs.

Use separate answerscript for each half

First Half

Answer Q.4 and any **two** questions from the rest

1. (a) Compare amplitude and frequency modulation.
   (b) For tone modulation with amplitude modulation index $\mu = 1$ and 0.5 and baseband signal $m(t) = A\cos(\omega_m t)$
   (i) Draw the waveforms of baseband, carrier and amplitude modulated signals both in time and frequency domain.
   (ii) Calculate efficiency of modulation in each case.
   (iii) What is the bandwidth of the modulated signal?

   5 + 10 = 15

2. (a) An angle modulated waveform is described by equation,
   $$\varphi(t) = 10\cos(2 \times 10^6 \pi t + 10\cos 200\pi t)$$
   (i) Find power of the modulated signal.
   (ii) Maximum frequency deviation.
   (iii) Modulation index.
   (iv) Bandwidth of the signal.
   (b) Draw the block diagram of superheterodyne receiver and explain its functionality.

   8 + 7 = 15

3. (a) Why preemphasis and deemphasis is required in frequency modulation.
   (b) For an analog signal m(t) band limited to B Hz., what is the minimum channel bandwidth for transmission of pulse code modulated version of m(t).
   (c) For an audio telephone line what is the minimum sampling frequency?
   (d) How can performance analysis be done for delta modulation in terms of granular noise and slope overload?

   2 + 4 + 4 + 5 = 15

4. Write short notes on (any one):
   (a) Performance of Bipolar line coding.
   (b) Foster Seeley FM Discriminator. 5

Second Half

Answer any THREE questions. The questions are of equal value. Two marks are reserved for neatness and to the point answer.

5. a) What is meant by entropy of a source? Prove that the entropy of a discrete memoryless source is maximum when the messages are equiprobable.
   b) What is meant by mutual information I(x;y)? Derive the expression of I(x;y) in terms of input symbol probabilities and the channel matrix for a discrete memoryless channel

   c) For a continuous random variable x constrained to a peak magnitude M (-M<x<M), show that the entropy is maximum when X is uniformly distributed in the range (-M, M) and has zero probability density outside this range.
   Show that the maximum entropy is given by log 2M.
   d) What is meant by symmetric channel? Write down the channel matrix of binary symmetric channel (BSC).

   (1+2)+(1+3)+2+(1+1)

6. a) Explain mathematically why white Gaussian noise is the worst possible noise in terms of interference with signal transmission. Show mathematically that the channel capacity of two cascaded BSC's is less than a single BSC.
b) Derive the expression of capacity of a band-limited additive white Gaussian noise channel. From the expression, show that capacity is finite even for infinite bandwidth channel and also write when the capacity can be made infinite.
c) What is meant by binary erasure channel? Write its channel matrix.

(2+2)+(3+2)+(1+1)

7. a) Sketch the constellation diagram of 16 QASK. Describe a scheme with block diagram for generation of 16-QASK signal. Show mathematically that bit error performance of 16-QASK is inferior to QPSK but superior to 16-PSK.
b) For a BPSK modulator with a carrier frequency of 70 MHz and an input bit rate of 10 Mbps, determine the maximum and the minimum upper and lower side frequencies, draw the output spectrum, determine the minimum Nyquist bandwidth and calculate the transmission bandwidth.
c) Comment on bit error probability of DPSK and DEPSK with an example.

(1+2+3)+3+2

8. a) Briefly explain the operation of integrate-and-dump filter and show that signal-to-noise ratio gets maximum value at the end of the bit interval.
b) Prove that the performance of matched filter and correlator are identical.
c) Find the transform of the output of the matched filter for an input of
S(t) =1 volt $0 \leq t \leq 1$ (t in second)
=0 otherwise
If the input to the matched filter consists of the signal, S(t), plus additive white noise of two sided spectral density of 10^{-6} watts/Hz, find the maximum (S/N) output.

(3+1)+4+3

(3+1)+4+3

9.a) What are the critical differences between block codes and convolutions codes. Develop a mathematical form of Hamming bound for a (n, k) code capable of correcting 't' number of errors? What does this bound signify?
b) A (6,3) code is generated according to the generating matrix G given below. The receiver receives ***r=100011.*** Determine the corresponding data word if the channel is BSC (binary symmetric channel) and maximum likelihood decision is used.

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

c) Prove that a cyclic code polynomial c(x) can be generated by the data polynomial d(x) of degree (k-1) and a generator polynomial g(x) of degree (n-k).

Find a generator polynomial g(x) for a (7,4) cyclic code, and find code vectors for the data vector 1010.

(2+2+1)+2+(2+2)