BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
ME 1ST SEMESTER (ICE) FINAL EXAMINATION, 2013
Sub: Advanced Communication Systems (ICE-901)

F.M = 70 Time = 3 Hrs.

Answer any FIVE questions. The questions are of equal value.

1.a) Develop the discrete time equations for the encoding and decoding operations of Delta modulation (DM). Draw the block diagram showing the elements constituting such a system.

b) A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is equal to 50×10^6 b/s.

i) What is the maximum message bandwidth for which the system operates satisfactorily?

ii) Determine the output signal-to-quantization noise ratio when a full-load sinusoidal modulating wave of frequency 1 MHz is applied to the input.

c) Data at a rate of 6 kbit/s is to be transmitted over a leased line of bandwidth 4kHz using Nyquist criterion pulses. Determine the maximum value of the roll-off factor r that can be used.

(4+3)+(2+2)+3

2.(a) What is duobinary system? What is its usefulness? " Duobinary filter introduces ISI in controlled amount"-justify the statement. What are the errors affecting the quality of a duobinary signal during its generation or detection? Detail out the remedial measures when such errors occur.

(b) An audio signal of bandwidth 4kHz is sampled at a rate of 25% above the Nyquist rate and quantized. The quantization error is not to exceed 0.1% of the signal peak amplitude. The resulting quantized samples are now coded and transmitted by 4-ary pulses.

(i) Determine the minimum number of 4-ary pulses required to encode each sample.

(ii) Determine the minimum transmission bandwidth required to transmit this data with zero ISI.

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

3.(a) A binary encoded PCM baseband data with polar signaling is transmitted through an additive white Gaussian channel with PSD $\eta/2$. Show that an integrate and dump receiver cannot be wrong more than half the time on the average.

(b) If the integrate and dump receiver in (a) is designed as optimum filter that minimizes probability of error, derive the expression of transfer function H(f) and the corresponding minimum probability of error (P_e)min.

(c) Find the signal shape at output of the matched filter for an input

$S(t) = A \quad 0 \leq t \leq T$

$= 0$ otherwise

Label all the important points and axes (3 + 7 + 4)

4. a)What is a QASK signal? Sketch the constellation diagram of 16 QASK. What is the spectral efficiency of 16-QASK?
b)Describe a scheme with block diagram for generation of 16-QASK signal. How is it demodulated? Describe the technique with the help of a block diagram.
c) Comment on error rate of QPSK, 16 MPSK and 16 QASK with proper mathematical expressions. (4+2+1)+(3+2)+2

5) a) Develop BFSK technique with block diagram representation using two balanced modulators. From this block diagram representation, develop mathematical expression of BFSK signal, show the spectrum and geometrical representation of orthogonal BSK.
"When compared BPSK and BFSK for transmission bandwidth and noise immunity (P_e value), the latter shows inferior performance and seems to be useless "--- Counter argue this statement to show its use with other modulation in hostile environment..
b) A frequency-hopping spread spectrum system is to have the following parameters:
Message bit rate=2400 bp (after error correcting code)
Hops per message bit=16
Frequency multiplication=8
Processing gain $\geq$ 45 dB
$f_l\ t_l=1$
(i) Find the smallest number of frequencies required if this number is to be a power of 2.
(ii) Find the bandwidth of the spread spectrum signal.
(2+5+2)+5

6 a) What is meant by frequency hopping (FH) spread spectrum system? Derive the expression of process gain (PG) in case of fast FH system. Briefly explain the operation of FH transmitter using block diagram.
b) Derive the expression of probability of bit error (P_e) in a K-user communication system (transmitting in same radio frequency f_0) with equal power P_s using code division multiple access (CDMA) with uncorrelated and distinct spreading codes.
b) The signal power received for a desired signal of 100 Kb/s bit rate signal is 1mW. The chip frequency used is 100 MHz. A jamming signal is employed at the carrier frequency, the received power of which is 1W. Find (a) processing gain, (b) error probability without jamming and with jamming. Noise power spectral density=10^{-9} W/Hz .
(2+2+3)+3+4

7. Write short notes on any **two**
a) Single tone jamming in SS system
b) Delta Sigma modulation
c) Match Filtering
7x2=14