MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SIXTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
MAY/JUNE 2016
SUBJECT: DIGITAL COMMUNICATION (ECE – 302)

TIME: 3 HOURS   **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Consider a set of 3 finite energy signals:

$$S_1(t) = 1 , \qquad 0 \le t \le 1$$
$$S_2(t) = cos2\pi t , \ 0 \le t \le 1$$
$$S_3(t) = cos^2\pi t , \ 0 \le t \le 1$$

Obtain orthonormal basis functions for this set of signals using Gram-Schmidt orthogonalization procedure.

1B. Six independent message sources of bandwidths W, W, 2W, 2W, 3W, and 3W Hertz are to be transmitted on a time division multiplexed basis using common communication channel. Set up a scheme for accomplishing this multiplexing requirements, with each message signal sampled at its Nyquist rate. Also determine the minimum transmission bandwidth of the channel.

1C. Consider a signal g(t) having the Upper Cutoff frequency, f_u = 100KHz and the Lower Cutoff frequency f_l = 80KHz. Compute the minimum sampling rate.

(5+3+2)

2A. Explain slow-frequency hopping and fast-frequency hopping techniques used in spread spectrum modulation.

2B. Determine the output SNR in a DM system for a 1KHz sinusoid sampled at 32KHz without slope overload and followed by a 4KHz post reconstruction filter.

2C. Find the average information content in the 26 English alphabets assuming equal probability for each symbol.

(5+3+2)

3A. Obtain the expression for probability of bit error P_e in QPSK. Give signal space diagram.

3B. The binary data 010101110 are applied to the input of a modified duo-binary encoder. Construct the modified duo-binary coder output and corresponding receiver output without a precoder. Suppose that due to error during transmission, the level produced by the first digit is reduced to zero, construct the new receiver output and comment on your results.

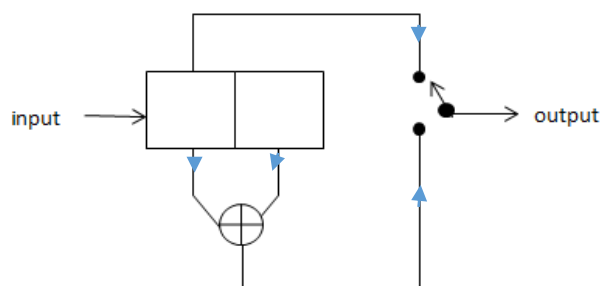3C. Consider a Convolution Encoder as shown in Fig 3C. Find The sequence of output symbols for the input [1 0 1].

Fig 3C.

(5+3+2)

4A. Explain the function of a correlator. Show that the set of orthonormal functions are statistically independent.

4B. Compare and contrast between natural and flat top sampling.

4C. Given A = 87.56 in a nonlinear quantizer using A-law, find the equivalent increase of SNR produced by the use of A-law companding. How many bits does this equivalent increase in SNR represent?

(5+3+2)

5A. A speech signal is sampled at 8 kHz and coded with Differential PCM the outputs of which belong to a set of 8 symbols. The symbols have the following probabilities.

$P(x_1) = 0.4$, $P(x_2) = 0.25$, $P(x_3) = 0.15$, $P(x_4) = 0.1$, $P(x_5) = 0.05$, $P(x_6) = 0.03$, $P(x_7) = 0.01$, $P(x_8) = 0.01$.

    (a) Find the entropy of the source in bit/symbol and bits/seconds
    (b) What would be the entropy if all symbols were equiprobable?

5B. Generate all the possible 16 code words for a (7,4) Hamming code.

5C. Find the impulse response of matched filter for the signal $s(t) = \frac{At}{T}$ in the interval $0 \leq t \leq T$. Find also the output of the filter and the value at t = T.

(5+3+2)

6A. An instantaneously adaptive delta modulator employs the following step size adaptation algorithm. i) $S_k = 2S_{k-1}$ if $B_k = B_{k-1}$ ii) $S_k = 0.5 S_{k-1}$ if $B_k = \overline{B_{k-1}}$, where S_k and S_{k-1} are the current and previous step size, B_k and B_{k-1} have opposite polarity. The minimum step size is 100 mV, so the amplitude of the steps when the input is zero is ± 50 mV. If a step input x(t) = 1.2 V is applied to the modulator at t = 0, show how the predictor output tracks the input by sketching the waveform. Sketch the binary output waveform of the delta modulator

6B. Explain the frequency division multiple access (FDMA) and compare it with time division multiple access (TDMA). What is CDMA?

6C. A PCM system uses a uniform quantizer followed by a seven bit binary encoder. The bit rate of the system is equal to 50 Mbps. What is the maximum message bandwidth for which the system operate successfully?

(5+3+2)