(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 131601 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. VI) THEORY EXAMINATION 2013-14

DIGITAL COMMUNICATION

Time : 3 Hours *Total Marks : 100*

Note :– Attempt all questions.

1. Attempt any **four** parts : **(5×4=20)**

   (a) Explain with the help of neat diagram, the method for Generation and Demodulation of DPSK.

   (b) Explain the function of Equalizer. In a certain binary communication system that uses Nyquist's criterion pulses, a received pulse $p_r(t)$ has the following non zero sample values :

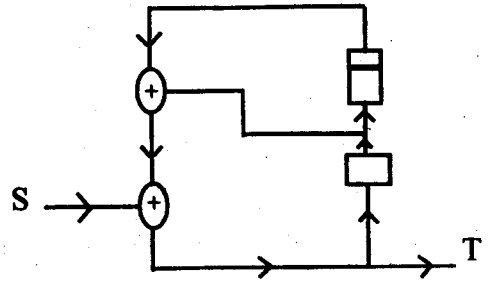
   $p_r(0) = 1$

   $p_r(T_b) = 0.1$ $p_r(-T_b) = 0.3$

   $p_r(2T_b) = -0.02$ $p_r(-2T_b) = -0.07$

   Determine the tap settings of a three, zero - forcing equilizer.

(c) Design a Descrambler for the Scrambler shown below. If a sequence S = 101010100000111 is applied to the input of this scrambler, determine the output sequence T. Verify that if this T is applied to the input of the descrambler, the output is the sequence S.



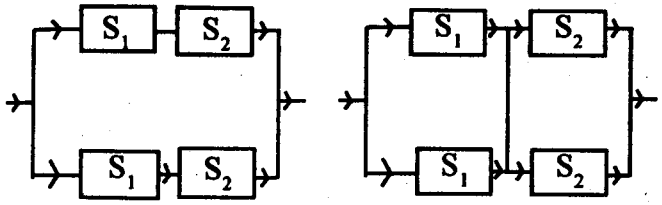
(d) What are the advantages and disadvantages of M-ary digital carrier modulation ? Explain M-ary QAM transmitter and receiver with neat block diagram.

(e) (i) What do you understand by Intersymbol Interference (ISI) ?

(ii) Explain the Generation and Detection of ASK with neat diagram.

2. Attempt any **four** parts : **(5×4=20)**

(a) Network reliability improves when redundant links are used. The reliability of the network can be improved building two sub networks in parallel. Thus, if one sub network fails, the other will still connect. Determine the reliability of the networks given that the failure probability of links S_1 and S_2 is p each.



(b) A binary symmetric channel has an error probability Pe. The probability of transmitting 1 is Q. If the receiver detects an incoming digit 1, what is the probability that the originally transmitted digit was

(i) 1

(ii) 0 ?

(c) For an RV x with PDF

$$P_x(x) = \frac{1}{2\sqrt{2\pi}} e^{-x^2/32} u(x)$$

(i) Sketch PDF and state if this is Gaussian RV.

(ii) Determine $P(x \geq 1)$ and $P(1 \leq x \leq 2)$

(iii) How to generate RV x from another RV ?

(d) A duobinary line code requires only half of the bandwidth. In this code, 0 is transmitted by no pulses and 1 is transmitted by pulses p(t) or -p(t). A 1 is used by the same pulse as that used to encode the preceding 1 if the two 1's are separated by an even number of 0's. It is encoded by the

negative of the pulse used to encode the preceding 1 if the two 1's are separated by an odd number of 0's. Random binary digits are transmitted every Tb seconds. Assuming P(0) = P(1) = 0.5, show that

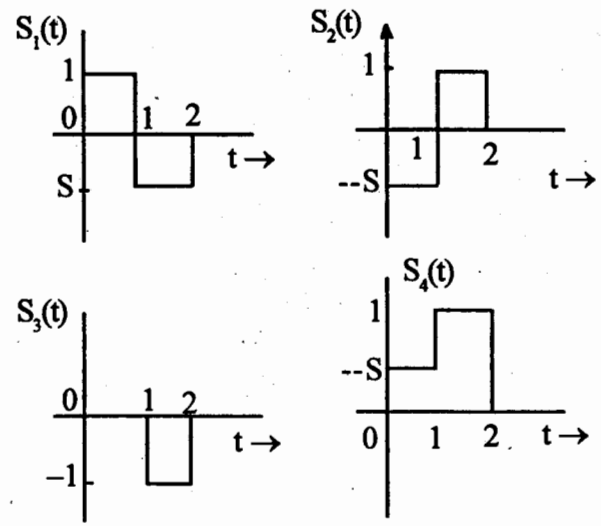
$$S_y(f) = \frac{|P(f)^2|}{T_b} \text{Cos}^2(\pi f Tb)$$

Find Sy(f) if p(t), the basic pulse used is a half-width rectangular pulse.

(e) For the Random binary process. Determine Rx(z) and Sx(f) if the probability of transition (from 1 to -1 or vice versa) at each node is 0.5.

3. Attempt any **two** parts : **(10×2=20)**

(a) A signal space consists of four signals. Determine a suitable set of orthogonal basis vectors and the dimensionality of the signals. Represent these signals geometrically in the vector space.



(b) Prove that the output signal of a matched filter is proportional to a shifted version of Autocorrelation function of the input signal to which the filter is matched.

(c) Determine the error probability of the optimum receiver for PSK signals each with energy E. We are required to transmit 2.08×10^6 binary digits per second with $P_b \leq 10^{-6}$. The channel noise PSD is $S_n(w) = 10^{-8}$ Determine the Transmission bandwidth and signal power required in binary and 16-ary ASK.

4. Attempt any **two** parts : **(10×2=20)**

(a) (i) Explain frequency hopping Spread Spectrum with FSK modulation with the help of Transmitter and Receiver.

(ii) Explain Direct Sequence Spread Spectrum with QAM system.

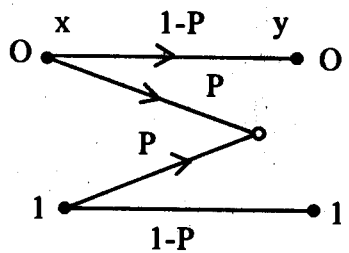
(b) Let the AWGN noise n(t) have a spectrum N/2. If the AWGN noise n(t) is ideally band-limited to 1/2Tc, show that if the spreading signal c(t) has autocorrelation function : $R_C(\tau) = \sum_i \delta(\tau - i \cdot L Tc)$

then the PSD of x(t) = n(t)c(t) for DSSS system is approximately is : $S_x(f) = \int_{-\infty}^{\infty} S_n(\nu)\, S_c(f - \nu)\, d\nu = N/2$.

(c) Explain multiuser Detection for Maximum Likelihood receiver and Decorrelator receiver with neat block diagram.

5. Attempt any **two** parts : **(10×2=20)**

(a) (i) In data communication using error detecting code, an automatic request for retransmission (ARQ) enables retransmission of the data in error. In such a channel, the data in error is erased. Hence, there is an erase probability p, but the probability of error is 0. Determine H(x), H(x/y) and I(x;y) assuming the two transmitted messages equiprobable.



(ii) What is hamming distance ? Give relation between minimum distance and error detecting and correcting capability. Determine a Hamming code.

(b) Explain cyclic codes. The generator polynomial $g(x) = x^3 + x + 1$ to construct a systematic (7,4) cyclic code.

(i) What are the error correcting capabilities of this code ?

(ii) Construct the decoding table.

(iii) If the received word is 1101100, determine the transmitted data word.

(c) The generator polynomial $g(x) = x^{10} + x^8 + x^5 + x^4 + x^2 + x + 1$ generates a cyclic BCH (15,5) code.

(i) Determine the cyclic code generating matrix.

(ii) For encoder input data d = 10110, find the corresponding codeword.

(iii) Show how many errors this code word can correct.