VIT®
Vellore Institute of Technology

Final Assessment Test – May 2024

Course: BECE306L - Digital Communication Systems

Class NBR(s): 1166 / 1168

Slot: A2+TA2

Time: Three Hours

Max. Marks: 100

- KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

General Instruction: Error Function table to be permitted

Answer ALL Questions

(10 X 10 = 100 Marks)

1. a) State sampling theorem with appropriate figures and examples. What is aliasing and explain how it will affect a digital communication system? [5]

   b) Evaluate the Nyquist rate and Nyquist interval for the following signals [5]

   (i) $m_1(t) = \frac{1}{2\pi}\cos(4000\pi t)\, cos(1000\pi t)$

   (ii) $m_2(t) = sinc(700t) + sinc(500t)$

2. a) A Television signal having a bandwidth of 4.2 MHz is transmitted using PCM system. Given that the number of quantization levels is 512. Determine: [5]

   (i) Code word length

   (ii) Transmission bandwidth

   (iii) Final bit rate

   (iv) Output signal to quantization noise ratio.

   b) For a sinusoidal modulating signal [5]

   $m(t) = A\cos\omega_m t$

   $\omega_m = 2\pi f_m$

   Prove that the maximum output signal-to-quantizing-noise ratio in a delta modulation system under the assumption of no slope overload is given by

   $$SNR_0 = \left(\frac{S}{N_Q}\right)_0 = \frac{3f_s^3}{8\pi f_m^2 f_M}$$

   Where $f_s = 1/T$, is the sampling rate and f_M is the cutoff frequency of a low-pass filter at the output end of the receiver.

3. What are the desirable properties of digital waveform? To transmit a bit sequence 10011011, draw the resulting waveforms using: [10]

   (i) Unipolar RZ

   (ii) Unipolar NRZ

   (iii) Bipolar RZ

   (iv) AMI RZ

   (v) Manchester.

4. a) What is Inter Symbol Interference (ISI) and what is Nyquist criterion for zero ISI? [5]

   b) Explain eye pattern and its properties. [5]

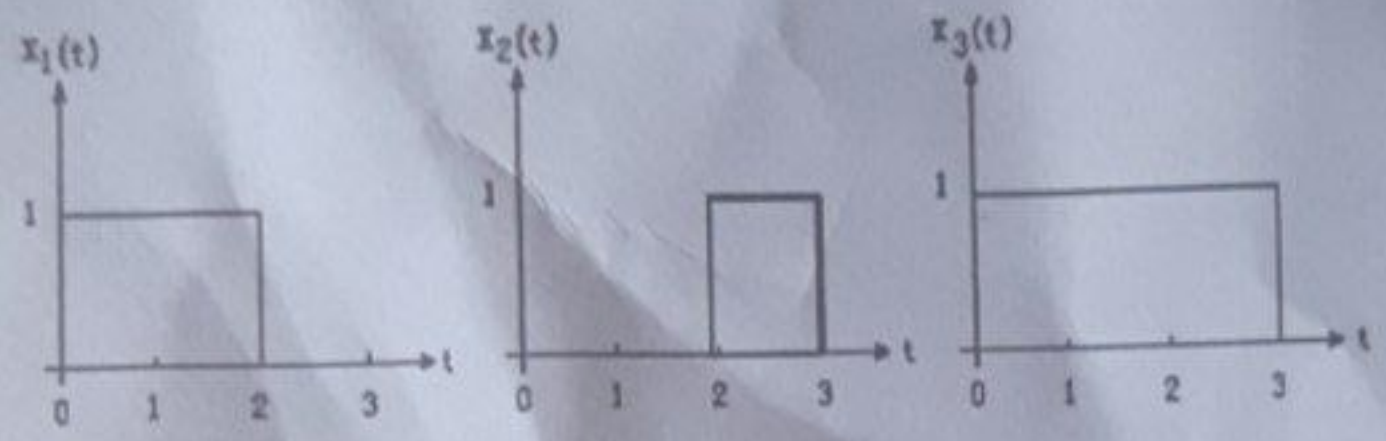
5. (a) A binary data is transmitted over an AWGN channel using BPSK at a rate of 1 Mbps. It is desired to have average probability of error $P_e \leq 10^{-4}$. Noise power spectral density is $N_0/2 = 1\times10^{-12}$ W/Hz. Determine the average carrier power required at the receiver input, if the detector is of coherent type. [5]

(b) Compare BPSK, BASK and BFSK modulation schemes. [5]

6.(a) What is QPSK modulation? Explain with the transmitter receiver block diagrams and appropriate waveforms. Derive the average probability of error of QPSK modulation. [10]

OR

6.(b) Use the Gram-Schmidt procedure to find a set of orthonormal basis functions corresponding to the signals shown below. [10]



7. a) What are the properties of PN sequence? [5]

b) Consider the linear feedback shift register, involving three flip flops. The inputs 0 applied to the first flip-flop is equal to modulo-2 sum of s1 and s3. It is assumed that the initial state of the shift register is 100. Evaluate the output PN sequence. [5]

8.(a) Consider the Input samples x(n)= {2.1, 2.2, 2.3, 2.6, 2.7,2.8}. Explain how encoding and decoding is done in Differential Pulse Code Modulation (DPCM). Assume first order prediction filter $\hat{x}(n) = x_q(n-1)$. [10]

OR

8.(b) Explain delta modulation with transmitter and receiver diagrams. Also, tabulate the comparison between PCM, DPCM, DM and ADM. [10]

9. a) Explain different multiple access techniques with examples. [5]

b) Explain Direct Sequence Spread Spectrum (DSSS) and Frequency- Hop Spread Spectrum (FHSS). What are the differences between them? [5]

10. Find H(X), H(Y), H(X,Y), H(X/Y), H(Y/X) and mutual information I(X,Y) for the channel whose P (X, Y) is [10]

$$P(X,Y) = \begin{array}{c} \\ X_1 \\ X_2 \\ X_3 \end{array} \begin{array}{c} \begin{array}{cc} Y_1 & Y_2 \end{array} \\ \begin{bmatrix} 0.25 & 0.25 \\ 0.15 & 0.15 \\ 0.1 & 0.1 \end{bmatrix} \end{array}$$

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