VIT
Vellore Institute of Technology

Final Assessment Test – November 2019

Course: ECE4001 - Digital Communication Systems
Class NBR(s): 0994 / 0999 / 1002 / 1006 / 1012 Slot: A2+TA2
Time: Three Hours Max. Marks: 100

General Instructions:

1. Students are permitted to use erf, erfc and Q tables.
2. Make necessary assumptions if any data is required.

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS EXAM MALPRACTICE

Answer ALL Questions

(100 Marks)

1. a) Assume an analog signal x(t) is sampled by train of impulses with proper Nyquist rate. Derive the sampled signal in frequency domain. Draw the spectrum of the sampled signal with and without aliasing effect. Also discuss about the spectrum. **[7]**

   b) Find the Nyquist rate and Nyquist interval for the given signal. **[3]**

$$x(t) = \left(\frac{1}{2\pi}\right)\cos(200\pi t)\cos(300\pi t)$$

2. a) A voice signal m(t) is in the frequency range 5 kHz to 15 kHz. The signal is amplitude-modulated (AM) to generate an AM signal $s(t)=A(1+m(t))\cos 2\pi f_c t$, where fc=600kHz. The AM signal $s(t)$ is to be digitized and archived. This is done by first sampling $s(t)$ at 1.2 times the Nyquist frequency, and then quantizing each sample using a 256-level quantizer. Determine the bitrate of the coded bits. **[5]**

   b) List the disadvantages of delta modulation and explain in detail with a block diagram how its performance can be significantly improved? **[5]**

3. A band-limited signal m(t) of 3 kHz bandwidth is sampled at rate of 33⅓ % higher than the Nyquist rate. The maximum allowable error in the sample amplitude is 0.5% of the peak amplitude m_p. Assume binary encoding. Find the minimum bandwidth of the channel to transmit the encoded binary signal. **[10]**

4. A binary data is represented as a line coded waveform as shown in Figure 1. Derive the power spectral density for the waveform. **[10]**

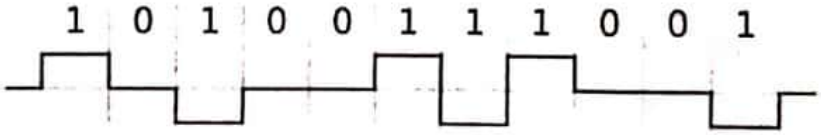

Figure 1

5. Consider the four waveforms shown in Figure 2. **[10]**
   i. Determine the basis functions.
   ii. Represent all the signals by using basis functions and signal vectors.

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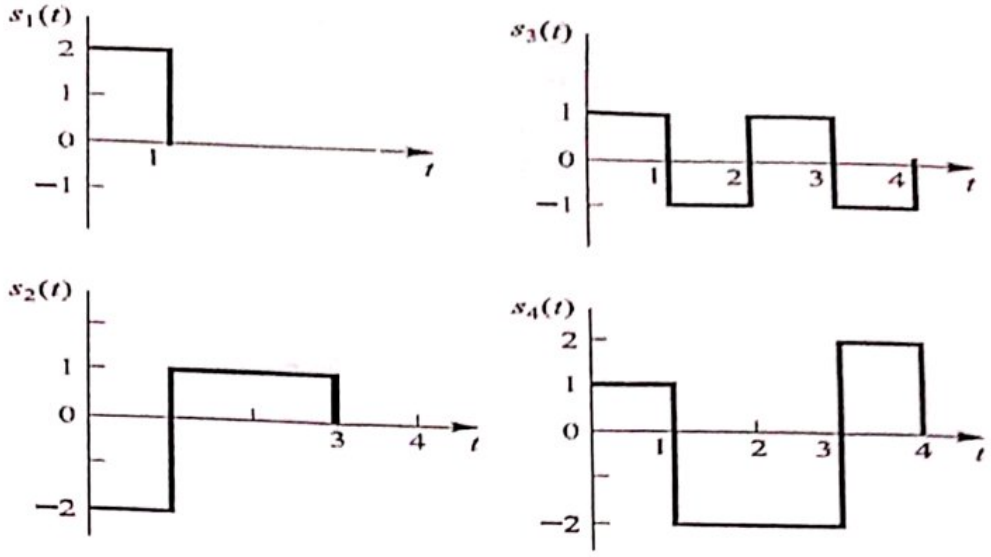

Figure 2

6. Determine the message points and the associated signal vectors for binary frequency shift keying and draw the signal space diagram. Find the probability of error. [10]

7.(a) I) A continuously operating coherent BPSK system makes errors at the average rate of 100 errors per day. Data rate is 1 kbps. The single sided noise power spectral density is 10^{-10} W/Hz. [6]

i. Assuming the system to be wide sense stationary, what is the average bit error probability with QPSK signal transmission?

ii. If the value of signal power is adjusted to be 10^{-6}W, will this energy of QPSK signal is adequate to maintain the error rate?

II) Calculate the distance between any two message points of a coherent BPSK and QPSK system. [4]

OR

7.(b) I) Consider a digital communication system with an on–off keying signal and a matched filter receiver. The non-zero symbol at the input of the matched filter receiver is a rectangular pulse with amplitude 100 *m*V and period 10 *m*sec. The noise at this point is known to be white Gaussian and has an RMS voltage of 140 *m*V as measured in a noise bandwidth of 10 kHz. Determine the average energy per symbol and noise PSD. [6]

II) Set up a block diagram for generation of special binary FSK signal s(t) with continuous phase by using the representation given below, [4]

$$s(t) = \sqrt{\frac{2E_b}{T_b}}\cos\left(\frac{\pi t}{T_b}\right)\cos(2\pi f_c t) \mp \sqrt{\frac{2E_b}{T_b}}\sin\left(\frac{\pi t}{T_b}\right)\sin(2\pi f_c t)$$

8. a) Consider a binary sequence {0, 1, 0, 1, 0, 1}. This bit sequence is modulated using DPSK and transmitted over an ideal channel. Describe the process and detect the transmitted bits without reference signal at receiver. [6]

b) What are the basic blocks required to demodulate BASK signal non-coherently? Construct the non-coherent receiver for the transmitted BASK signaling scheme. [4]

9. a) Define ISI? Derive the condition to avoid ISI. [8]

b) What is sensitivity of an eye? [2]

10.(a) Draw the block schematic and construct the PN sequence for the Feedback Taps [5, 4, 2, 1]. Verify its property. [10]

OR

10.(b) Illustrate the variation of the frequency of a slow FH/MFSK signal with time for one complete period of the PN sequence. Input data sequence is 01111110001001111010, generate PN sequence of length 15. FH/MFSK signal has the following parameters. [10]

Number of bits per MFSK Symbol= 2

Number of MFSK tones = 4

Length of PN segment per hop = 3

Total number of frequency hops= 8

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