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10EC/TE61

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Digital Communication

Time: 3 hrs.

Max. Marks:100

Note: *Answer FIVE full questions, selecting
at least TWO questions from each part.*

PART – A

1 a. State and prove sampling theorem for low pass signals assuming train of impulses for sampling. **(08 Marks)**
   b. Explain the principle of quadrature sampling of band pass signals. **(06 Marks)**
   c. The signal $g(t) = 4\cos(4\pi t)(\cos 400\pi t)$ is sampled at the rate of 500 samples per second:
      i) Determine the spectrum of the resulting sampled signal.
      ii) What is Nyquist rate for g(t)?
      iii) What is cut off frequency of ideal reconstruction filter? **(06 Marks)**

2 a. With a suitable block diagram, explain the functioning of PCM system. **(10 Marks)**
   b. Three independent message source of bandwidths 1 kHz, 1 kHz and 2 kHz respectively are to be transmitted using TDM scheme. Determine
      i) The commutator segment arrangement.
      ii) The speed of commutator if each signal is sampled at its Nyquist rate.
      iii) Minimum transmission bandwidth. **(05 Marks)**
   c. The bandwidth of signal input to PCM is restricted to 4 kHz. The input varies from −3.8 to 3.8 V and has average power of 30 mW. The required signal to noise ratio is 20 dB. The modulator produces binary output. Assume uniform quantization
      i) Calculate the number of bits required per sample.
      ii) Output of 30 such PCM coders are time multiplexed. What is the minimum required transmission bandwidth for multiplexed signal? **(05 Marks)**

3 a. With neat diagram, explain the operation of DPCM. **(06 Marks)**
   b. Derive the expression for output signal to quantization noise ratio of a delta modulator. **(10 Marks)**
   c. Assume a speech signal with a minimum frequency of 3.4 kHz and a maximum amplitude of 1 V. The speech signal is applied to a delta modulator with its bit rate at 25 kbps. Discuss the choise of an appropriate step size for a delta modulator. **(04 Marks)**

4 a. Describe Nyquist criteria for distortionless baseband transmission. **(06 Marks)**
   b. A binary data sequence is 10110100. Sketch the waveforms for the following formats:
      (i) Unipolar NRZ   (ii) Unipolar RZ   (iii) Polar NRZ   (iv) Polar RZ
      (v) Manchester coding (vi) Bipolar NRZ. **(06 Marks)**
   c. With a neat structure explain concept of adaptive equalization process. **(08 Marks)**

PART – B

5 a. Show that probability of symbol error for frequency shift keying is $P_e = \frac{1}{2} \text{erfc}\left(\sqrt{\frac{\varepsilon_b}{2N_0}}\right)$.

(12 Marks)

b. With a block diagram of QPSK transmitter and receiver explain generation and demodulation of a QPSK wave. **(08 Marks)**

6 a. Explain the importance of geometric interpretation of signals. Illustrate the geometric interpretation of signals for the case of 2-dimensional signal space with 3 signals. **(08 Marks)**

b. Three signals $S_1(t)$, $S_2(t)$ and $S_3(t)$ are as shown. Apply Gram-Schmidt procedure to obtain an orthonormal basis for the signals. Express the signals $S_1(t)$, $S_2(t)$ and $S_3(t)$ in terms of orthonormal basis functions. Also give the signal constellation diagram. **(12 Marks)**
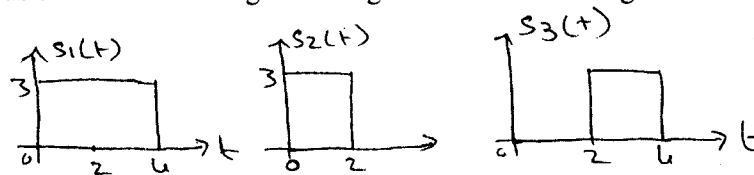

Fig. Q6 (b)

7 a. Derive the expression for maximum signal to noise power ratio of a matched filter.

(12 Marks)

b. Explain the working of a correlation receiver with block diagram of a detector and vector receiver. **(08 Marks)**

8 a. Explain direct sequence spread spectrum technique with block diagram. **(08 Marks)**

b. Differentiate slow frequency hopping and fast frequency hopping. **(05 Marks)**

c. A 3-stage shift register with a linear feedback generates the sequence : 01011100101110
   i) Determine the period of the given infinite sequence.
   ii) Verify the three properties of the PN sequence for the given sequence. **(07 Marks)**

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