(Pages : 4) **A – 2751**

Reg. No. : .....

Name : .....

Sixth Semester B.Tech. Degree Examination, May 2016
(2013 Scheme)
13.604 : DIGITAL COMMUNICATION (T)

Time : 3 Hours Max. Marks : 100

***Instruction** : Students are **permitted** to **use** Q-function table.*

PART – A

Answer **all** questions. **Each** question carries **2** marks.

1. a) Find the range of permissible cut-off frequencies for the ideal lowpass filter for re-constructing the signal $x(t) = 10 \cos (600\pi t) \cos^2(1600\pi t)$ which is sampled at 4000 samples per second.

   b) A delta modulator has the message signal $m(t) = 4 \sin 2\pi(10)t + 5 \sin 2\pi(20)t$. Determine the minimum sampling frequency required to prevent slope overload distortion, assuming that Δ is 0.01π

   c) An audio signal of bandwidth 10 kHz is sampled at 24 kHz, quantized into 256 levels and coded using M-ary PAM with raised cosine pulses having roll-off factor 0.2. The channel bandwidth available for transmission is 30 kHz. Determine the smallest acceptable value of M.

   d) Draw the eye-diagram corresponding to a polar NRZ signal and mark the important parameters which can be obtained from it.

   e) Draw the constellation diagram of a typical 16-QAM modulation scheme.

   f) Draw the block schematic of QPSK receiver.

   g) Classify the following modulation schemes as either power efficient or bandwidth efficient :
      i) QPSK
      ii) 16-FSK
      iii) 16-QAM
      iv) 8-PAM.

P.T.O.

h) List any four properties to be satisfied by maximal length PN sequences.

i) Explain the difference between *coherence bandwidth* and *coherence time*.

j) For a signal with Rayleigh distributed amplitude, what is the probability that the received signal power is 20 dB or lower relative to the mean power ?

PART – B

Answer **any one full** question from **each** module.

Module – I

2. a) A PCM system needs to be designed for transmitting speech signals bandlimited to 3.5 KHz and sampled at 9 KHz. Specify the number of quantization levels and channel bandwidth needed for this system assuming that the average signal to quantization noise power ratio required is 30 dB and polar Non-Return to Zero (NRZ) signalling is to be used. **10**

b) Derive expressions for the prediction coefficients and prediction gain of a second order DPCM system. **10**

OR

3. a) Derive an expression for the signal to quantization noise ratio of a PCM system. **8**

b) Draw the block schematic of a ADPCM transmitter and explain its operation. **6**

c) Explain the difference between slope overload error and granular noise in the context of delta modulation and suggest a method to minimize these distortions simultaneously. **6**

Module – II

4. a) The result of a single pulse transmission is a received set of samples with values {0.05, 0.2, – 0.25, 1.0, 0.3, – 0.15, 0.1} where the left most sample is the earliest. Design a three tap equalizer that forces the Inter-Symbol Interference (ISI) to zero at one sampling point on each side of the main lobe. Calculate the value of equalized output pulse at sampling times 0, ± 1, ± 2, ± 3. After equalization what is the largest sample magnitude that contributes to the ISI and what is the sum of all ISI magnitudes. **12**

b) Derive Nyquist's criterion for distortion-less transmission of pulses. **8**

OR

5. a) The data stream 101101010 is applied to the input of a duobinary system with a pre-coder, assuming that the start bit is 1. Construct the duobinary coder output and corresponding receiver output. Also state the significance of partial response signalling. 10

   b) What is the importance of matched filter in communication receiver design ? Derive an expression for the output SNR of a matched filter. 10

Module – III

6. a) A bit error probability of 10^{-4} is required for a system at a data rate of 70 kbits/s when transmitted over an Additive White Gaussian Noise (AWGN) channel using a suitable passband coherent MPSK modulation scheme. The bandwidth available is 60 kHz. Assume that raised cosine with a roll-off factor of 0.5 is used for pulse shaping, and gray coding is used for bit assignment.

      i) What E_s/N_0 is required for the specified bit error probability ? 6

      ii) What is the corresponding E_b/N_0 ? 4

   b) Derive the expression for the bit error probability of QPSK. 6

   c) Draw the baseband waveform of the transmitted signal corresponding to the data sequence 10110111010 if BPSK modulation is used. 4

OR

7. a) A system using matched filter detection of equally likely BPSK signals, $s_1(t) = \sqrt{\frac{2E}{T}} \cos \omega_0 t$ and $s_2(t) = \sqrt{\frac{2E}{T}} \cos(\omega_0 t + \pi)$, operates in AWGN channel. Assume that $E[z(T)] = \pm \sqrt{E}$.

      i) Derive an expression for the bit error probability of this system in terms of the Euclidean distance of constellation, assuming coherent detection and optimal threshold. 6

      ii) Find the probability of bit error, P_{be} of this system if the E_b/N_0 of the received signal is 6.8 dB. 4

   b) What is Gram-Schmidt orthogonalization ? Discuss the step-by-step procedure if 3 signals are to be orthogonalized. 10

Module – IV

8. a) Illustrate how does a Direct-Sequence Spread Spectrum System provides protection against narrow band jamming interference and Inter Symbol Interference (ISI). 8

   b) Explain the difference between slow and fast frequency hoping spread spectrum systems. 6

   c) What are the advantages of diversity receivers in wireless communication ? Explain time diversity with an example. 6

OR

9. a) With suitable time-frequency illustrations, explain the difference between FDMA, TDMA and CDMA. 10

   b) With relevant block schematic, explain how a RAKE receiver can improve the performance of CDMA communication system. 10