Total No. of printed pages = 7

EC 131603

Roll No. of candidate | | | | | | | | | |

2017

B.Tech 6th Semester End-Term Examination

DIGITAL COMMUNICATION

Full Marks–100 Pass Marks–35 Time–Three hours

The figures in the margin indicate full marks for the questions.

Section – A

Answer *all* questions.

1. Answer the following : 3×10=30

   (a) Plot the pdf curve for a Gaussian random process.

   (b) Let X be a random variable having a mean m_x. Also, let Y=aX+b, where a and b are constants. Determine mean of the random variable Y.

   (c) List any three advantages of Digital Communication over Analog Communication.

[Turn over

(d) Illustrate aliasing phenomenon in sampling of signals. How can we avoid it ?

(e) Determine the Nyquist rate for the following signal :

(i) $X(t)=2 \cos (200\pi t) \cos(300\pi t)$

(ii) $x(t)= 4 \cos^2(400\pi t)$

(f) A speech signal has a total duration of 10 s. It is sampled at the rate of 8 kHz and then encoded. The SNR_q is required to be 40dB. Calculate the minimum storage capacity needed to accommodate this digitized speech signal.

(g) Why differential PCM is preferred over standard PCM for voice signal ?

(h) Briefly state the need for Pulse Shaping in digital baseband transmission.

(i) Plot the corresponding ASK and FSK waveform for the binary data : 1011010.

(j) Can we measure information content in a given digital data stream ? Explain how.

Section – B

Answer any *eight* questions. 5×8=40

2. (a) Why do we need robust quantization technique in digitization process? Plot the normalized input-output curve for A-law and μ-law companding.

(b) Draw the block diagram of PCM transmitter and receiver. Why do we need repeaters in PCM ?

(c) What are granular noise and slope overload distortion in delta modulation? How can we counter them ?

(d) A linear delta modulator is designed to operate on speech signals limited to 3.4 kHz. The specifications of the modulator are as follows :

Sampling rate = $10f_{Nyquist}$, where $f_{Nyquist}$ is the Nyquist rate of the speech signal.

Step size $\Delta=100mV$

The modulator is tested with a 1 kHz sinusoidal signal. Determine the maximum amplitude of this test signal required to avoid slope over load.

(e) Given the data stream 1110010100, sketch the transmitted sequence of pulses for each of the following :

(i) Unipolar NRZ

(ii) Polar NRZ

(iii) Unipolar RZ

(iv) Bipolar RZ

(v) Manchester code

(f) Draw the block diagram QPSK transmitter and receiver. Write the expression for QPSK wave based on basis function.

(g) Explain briefly MSK modulation scheme with constellation diagram.

(h) What do you mean by Information Theory ? State Shannon channel capacity theorem.

(i) Explain Nyquist solution for Zero ISI. Is it a practical solution ?

(j) A binary FSK system transmits data at a rate of 2 Mbps over an AWGN channel. The noise is zero mean with PSD, $\frac{No}{2} = 10^{-20} W / Hz$.

The amplitude of received signal in the absence of noise is 1μV. Determine the average probability of error, Pe for coherent detection of FSK.

Take erfc (2.5) =0.00041.

(k) Explain Matched Filter receiver with relevant block diagram.

(l) Compare Frequency hopping spread spectrum (FHSS) and Direct sequence spread spectrum (DSSS) system.

Section – C

Answer any *three* questions.

10×3=30

3. (a) Draw the block diagram of Digital Communication system. Explain briefly function of each block.

(b) Show that the average probability of error in a PCM receiver depends solely on the ratio of peak signal energy to the noise power spectral density measured at the receiver input.

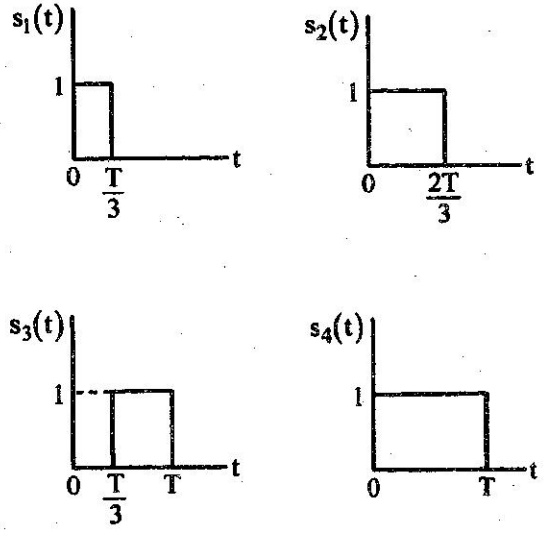
i.e. $\left[Pe = \frac{1}{2} \text{erfc} \left(\frac{1}{2} \sqrt{\frac{E_{max}}{N_0}} \right) \right]$

(c) Derive the PSD for Unipolar Non-return-to-zero (NRZ) line code. Why it is not suitable to be used with coupled devices in transmission path ?

(d) For the waveforms $s_1(t)$, $s_2(t)$, $s_3(t)$ and $s_4(t)$ given in the figure below :

(i) Using the Gram-Schmidt orthogonalization procedure, find an orthonormal basis for the set of signals.

(ii) Construct the corresponding signal-space diagram.



(e) Write short notes on any *two* topics :

(i) ISI

(ii) Midriser type quantizer

(iii) Adaptive Delta Modulator

(iv) CDMA

(v) AWGN