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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Electronics and Communication Engineering

Make-up Examination; Jan / Feb -2017

Digital Communication Theory

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii). Missing data, if any, may be suitably assumed.

UNIT - I

1 a. Define Random process and Random variable. Explain with suitable examples. 8

b. Consider random variable *X* defined by a probability function

$$f_x(x)=\begin{cases}K, & \text{a constant for } 2\le x\le 4\\ 0, & \text{elsewhere}\end{cases}$$

Determine : 6

i) The constant K

ii) $F_x(x)$

iii) $P(x\le 3.5)$.

c. Write properties of auto correlation. 6

2 a. State PSD (Power Spectral Density), and write any three properties of it. 8

b. Consider a random variable $X(t)=A\cos(wt+\theta)$, where *W* and θ are constant and *A* is a random variable uniformly distributed (*-a, a*). Find *Mx* and $Rx(t_1,t_2)$ and determine whether $X(t)$ is a wide sense stationary process. 6

c. A random variable *X* has the density

$$f_x(x)=\begin{cases}\frac{3}{32}\left(-x^2+8x-12\right), & 2\le x\le 6\\ 0 & \textit{Otherwise}\end{cases}$$ 6

Find the following :

i) m_0 ii) m_1 iii) μ_2.

UNIT - II

3 a. State and prove sampling theorem for an analog signal by sequence of impulses. Assume that the spectrum of $X(t)$ is band limited, it is zero outside the interval $-f_m < f < f_m$ and sample $X(t)$ impulse and sampled signals. 10

Contd….2

b. A waveform consisting of a sinusoid of fundamental frequency 500 Hz and its 3rd harmonic of amplitude 0.1 times that of the fundamental is sampled at the rate of 10,000 samples per second ideally. Sketch the neat figure of the spectrum of the sampled waveform showing first four components. 10

4 a. Describe the practical sample and hold circuit and its reconstruction with diagrams and equations. 10

b. A signal $X(t) = 2\cos 400\pi t + 6\cos 640\pi t$ is ideally sampled at $f_s = 500\ Hz$. If the sampled signal is passed through an ideal low pass filter with a cutoff frequency of 400 Hz, 10

i) Sketch the frequency spectrum of the sampled wave

ii) State what frequency components will appear in the output?

UNIT - III

5 a. Show that for large values of μ = A, the μ-law and A-law have the same companding gain Gc. 7

b. Explain adaptive delta modulation with block diagram and equations. 10

c. Sketch the block diagram of regenerative repeater in PCM system. 3

6 a. A DM system is designed to operate at 3 times the Nyquist rate for a signal with 3 kHz bandwidth, the quantizing step size is 250 mV. Determine :

i) The maximum amplitude of a 1 kHz input sinusoid for which the delta modulator does not show slope overload 6

ii) The post filtered output SNR for the signal of part (i).

b. Explain Differential Pulse Code Modulation (DPCM) with block diagram and equations. 10

c. Six independent message sources of bandwidths W, W, 2W, 2W, 3W, 3W Hz are to be transmitted on a time division multiplexed basis using a common communication channel,

i) Set up a scheme for accomplishing this multiplexing requirement with each massage signal sampled at its Nyquist rate 4

ii) Determine the minimum transmission bandwidth of the channel.

UNIT - IV

7 a. Sketch and derive power spectra of a NRZ bipolar format. 10

b. The binary data steam 011100101 are applied to the input of a modified duo-binary system,

i) Construct the modified duo-binary coder output and corresponding receiver output, without precoder. 10

ii) Suppose that due to error in transmission, the level produced by the third digit is reduced to zero. Construct a new receiver output.

Contd….3

8 a. Write binary data formats for a bit stream 1100110101, 6
i) NRZ polar ii) Machester iii) NRZ bipolar.

b. Explain Eye pattern for evaluating the combined effect of ISI and channel noise in case of Base band data transmission system. 6

c. Explain duo-binary encoder with precoder and duo-binary detector with relevant equations. 8

UNIT - V

9 a. Write equation to represent four symbols in QPSK. Explain signal space diagram of QPSK with neat sketch. Also explain its decision rule for the detection of the transmitted data sequence. 10

b. Calculate the error of probability for coherent binary phase shift keying. 10

10 a. With relevant block diagram, explain the working of coherent binary FSK transmitter and receiver. 10

b. Explain the working of DPSK transmitter and receiver with block diagrams. 10

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