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

(An Autonomous Institution affiliated to VTU, Belagavi)

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

Semester End Examination; Dec - 2017/Jan - 2018

Digital Communication Theory

Time: 3 hrs *Max. Marks: 100*

Note: *Answer **FIVE** full questions selecting **ONE** full question from each Unit.*

UNIT - I

1 a. Define the following : 6

i) Random Process ii) Ergodicity iii) Stationary Process.

b. List and state any three properties of auto correlation. 6

c. Define Random Process and Random Variable. Explain with suitable example. 8

2 a. Calculate the cross-correlation function $R_{xy}(\tau)$, given the two random process $x(t)$ and $y(t)$ defined as : 6

$$x(t) = A\cos w_0 t + B\sin w_0 t$$

$$y(t) = B\cos w_0 t - A\sin w_0 t.$$

Where A and B are random variables assumed to have zero mean and are uncorrelated. Also, A and B are assumed to have variances σ^2.

b. Consider the random process: $X(t) = A\cos(2\pi f_c t + \theta)$ where f_c and A are constants and θ is a random variable uniformly distributed over the interval (-π, π). Determine the autocorrelation function of $X(t)$. 6

c. The auto correlation function of a wide sense stationary process $X(t)$ is shown in Fig. Q.2(c). 8

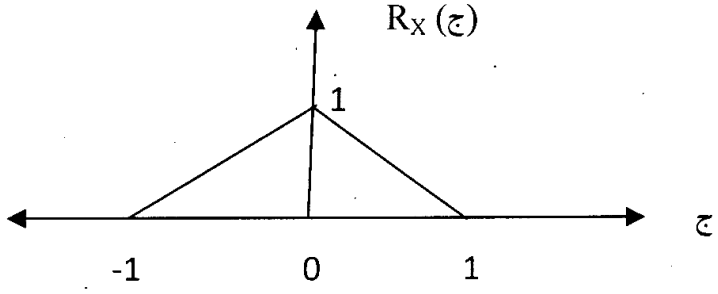

Figure Q.2(c)

Find the power spectral density $S_x(f)$ of the random process $X(t)$.

UNIT - II

3 a. A signal $g(t) = 2\cos\pi t + 640\pi t$ is ideally sampled at f_s = 500 Hz. If the sampled signal is passed through an ideal low pass filter with a cutoff frequency 400 Hz. What frequency components will appear in the filter output? 8

Contd….2

b. 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 $-f_m<f<f_m$. Sketch spectrum of signal $x(t)$ and its sampled version $x(nT_s)$. 8

c. Illustrate Quadrature sampling of band pass signal? With the help of spectrum and expression. 4

4 a. Compute the following for a signal $g(t) = 10\cos(20\pi t)\cos(200\pi t)$ which is sampled at the rate of 250 samples per second:

i) Sketch the spectrum of the sample signal

ii) Specify the cutoff ideal reconstruction filter so as to recover g(t) from $g_\delta(t)$ 10

iii) Specify the Nyquist rate for the signal g(t).

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

UNIT - III

5 a. Explain regenerative repeater in PCM system with block diagram. 6

b. Describe delta modulation with the help of block diagram and expressions. 8

c. A signal $m_1(t)$ is band limited to 3.6 kHz and three other signals $m_2(t)$, $m_3(t)$ and $m_4(t)$ are band limited to 1.2 kHz each. These signals are to be transmitted by means of TDM.

i) Setup a scheme for accomplishing this multiplexing requirement, with each message signal sampled at its Nyquist rate

ii) What must be the speed of the commutator in samples/second? 6

iii) Determine the minimum transmission bandwidth of the channel.

6 a. A delta modulator transmitter with a fixed step of 0.5 V is given a sinusoidal message signal. If the sampling frequency is twenty times the Nyquist rate. Determine;

i) The maximum permissible amplitude of the message signal, if slope overload is to be avoided 6

ii) The maximum destination SNR under the above condition.

b. Develop an expression for output signal to quantization noise ratio in PCM system. 10

c. Assume a speech signal with a minimum frequency of 3.4 kHz and maximum amplitude of 1 V. The speech signal is applied to a delta modulator with its bit rate at 25 kbps. Discuss the choice of an appropriate step size for the delta modulator. 4

UNIT - IV

7 a. Write the signalling data formats for a given bit stream 11011011in :

i) Unipolar ii) Manchester

iii) NRZ bipolar iv) Polar. 8

Contd….3

b. Compute the duobinary encoding sequence without a pre-coder for a given sequence 001101001. 4

c. Write duobinary encoder with pre-coder and duobinary detector block diagrams with related equations. 8

8 a. Sketch and derive power spectra of a NRZ unipolar format. 10

b. Explain eye pattern for evaluating the combined effect of ISI and channel noise with relevant diagrams. 10

UNIT - V

9 a. Write the 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. An FSK system transmits binary data at a rate of 10^6 bits per second. Assuming channel noise is additive white Gaussian with zero mean and power spectral density $2X10^{-20}$ W/Hz compute the average probability of error. Assume coherent detection and amplitude of received sinusoidal signal for both symbol '1' and '0' to be 1.2 microvolt. Given erf (3) = 0.99998, erf (3.3) = 0.999998. 10

10 a. Describe the frequency shift keying transmitter and receiver with the aid of block diagrams. 10

b. Explain BPSK with generation, reception block diagrams and equations to represent symbols '0' and 'l' 10

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