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B.E/B.TECH (Full time) DEGREE END SEMESTER EXAMINATIONS April/May 2014

Electronics and Communication Engineering

Fourth semester

EC8401 Communication Theory

(REGULATION 2012)

Time: 3 Hour Max. Mark:100

Answer ALL Questions

Part-A(10X 2 =20 Marks)

1 Define Hilbert transform. What is the Hilbert transform of $x(t) = \cos 600\pi t$.

2 Compare the different AM modulation schemes in terms of power and bandwidth.

3 What is the relation between FM and PM?

4 A carrier wave of frequency 100 MHz is frequency-modulated by a sinusoidal wave of amplitude 20 volts and frequency 100 kHz. The frequency sensitivity of the modulator is 25 kHz per volt. Determine the approximate bandwidth of the FM signal, using Carson's rule?

5 Define Stationary and ergodic process.

6 Define correlation and covariance.

7 Define Noise Figure and Noise Temperature.

8 What is the need for pre-emphasis and de-emphasis?

9 Why companding is used?

10 Define TDM and FDM.

Part-B (5X 16 =80 Marks)

11i) What is the equation of FM waveform? (2)

ii) How do you get narrowband FM from the above equation? (6)

iii) How do you demodulate an FM signal? Explain. (8)

12 a) An AM signal has the form $u(t) = [20 + 2\cos 3000\pi t + 10\cos 6000\pi t]\cos 2\pi f_c t$ where f_c = 100 kHz.

i) Sketch the spectrum (voltage) of u(t) (3)

ii) Determine the power in each of the frequency components. (3)

iii) Determine the modulation index (3)

iv) Determine the sidebands power, the total power and the ratio of the sidebands power to the total power. (3)

v) How do the envelope detector demodulate AM waveform? Explain. (4)

(or)

12 b i) Prove that the Synchronous demodulator recovers the message signal from DSB-SC signal (8)

ii) Draw the block diagram of superheterodyne receiver and explain. (8)

13 a i) State central limit theorem and explain. (6)

ii) Find the autocorrelation of a non-periodic square waveform represented by (10)

$$x(t) = \begin{cases} 1 & \text{for } 0 < t < 1 \\ -1 & \text{for } 1 < t < 2 \end{cases}$$

(or)

b i) A White Gaussian noise of zero mean and power spectral density $N_o/2$ is applied to an ideal low pass filter of bandwidth B and passband magnitude response of one. Derive the power spectral density and the autocorrelation at the filter output and plot them on a graph. (8)

b ii) A random signal x(t), characterized by the autocorrelation function $R_x(\tau) = \exp(-2a|\tau|)$ Where 'a' is a constant, is applied to the low-pass RC filter. Determine the power spectral density and autocorrelation of the random process at the filter output. (8)

14 a i) Derive $(SNR)_o/(SNR)_c$ for FM system. (10

ii) Discuss the different types of noise. (6)

(OR)

14 b i) How do you represent a narrowband noise in terms of in-phase and quadrature component?(5)

ii) Derive the Effective temperature for cascaded system. (5)

iii) The effective temperature of a particular stage receiver is required to be 300 K. The effective temperatures and gains of stages 2 through 4 are as follows. T_2=600K T_3=T_4=2000K G_2=13 dB and g_3=g_4=20 dB. Compute the required gain G_1. (6)

15 a i) Draw the block diagram of PCM and explain each block. How is PCM made adaptive?(10)

ii) A speech signal has a total duration of 10 seconds. It is sampled at the rate of 8 Khz and then encoded. The signal-to-(quantization) noise ratio is required to be 40db. Calculate the minimum storage capacity needed to accommodate this digital speech signal. (6)

(or)

b i) Draw the block diagram of delta modulation and explain. How is delta modulator made

adaptive? (6)

ii) Consider a low-pass signal with a bandwidth of 3 kHz. A linear delta modulation system, with step size of 0.1v, is used to process the signal at a sampling rate ten times the Nyquist rate. Calculate the maximum amplitude of a test sinusoidal signal of frequency 1 kHz, which can be processed by the system without slope-overload distortion. (5)

iii) Derive the expression for mean squared error(quantization) of a uniform quantizer. (5)