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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

Semester End Examination; Dec - 2016/Jan - 2017

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 terms related to random process : 6

i) Mean ii) Correlation iii) Covariance Function.

b. A Random variable has a probability density function, 6

$$f_x(x) = \begin{cases} \frac{5}{4}\left(1-x^4\right) & 0 \le x \le 1 \\ 0 & elsewhere \end{cases}$$ Find;

i) $E[X]$ *ii)* $E[4X+2]$ *iii)* $E\left[X^2\right]$.

c. What is Gaussian process? Mention the properties of Gaussian process. 8

2 a. Define and mention the properties of power spectral density. 10

b. Let two random process $X(t)$ *and* $Y(t)$ be defined by; 10

$X(t) = A\cos\omega_0 t + B\sin\omega_0 t$ $\quad$ $Y(t) = B\cos\omega_0 t - A\sin\omega_0 t.$

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

Find the cross-correlation function $R_{xy}(\tau)$.

UNIT - II

3 a. Explain the generation and re-construction of band-pass signal $g(t)$. 10

b. Determine the Nyquist rate and the Nyquist sampling interval for the following signals and also plot the spectrum, 10

i) $g_1(t) = \text{Sin c}(100\pi t)$ ii) $g_2(t) = \text{Sin c}^2(100\pi t)$

iii) $g_3(t) = \text{Sin c}(100\pi t) + S\text{in}c(50\pi t)$.

4 a. Discuss the concept of practical sample and hold circuit along with block diagram and spectrum of the output signals. 10

b. A signal $g(t) = 10\cos(20\pi t)\cos(200\pi t)$ is sampled at the rate of 250 samples/second, 10

i) Sketch the spectrum of the sampled signal

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

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

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UNIT - III

5 a. Distinguish the characteristics of midtread and midriser quantizer along with variation of quantization error with input. 10

b. Explain the processing gain of DPCM system. 4

c. For a binary PCM signal, determine 'L', if the compression parameter μ = 100 and minimum $[SNR]_0$, dB = 45 dB. Determine the $[SNR]_0$ in dB with this value of L. 6

6 a. A PCM system uses a uniform quantizer followed by a 7-bit encoder. The bit rate of the system is 50 M bits/sec.

(i) What is the message bandwidth for which the system operates satisfactorily? 10

(ii) Determine the output signal-to-quantizing noise ratio when a sinusoidal modulating wave of frequency 1 MHz is applied to the input.

b. With a neat block diagram, explain adaptive sub-band coding scheme in Transmitter and receiver. 10

UNIT - IV

7 a. Sketch the encoded waveform for the bit stream 011011 for the following schemes,

i) RZ Uni-Polar ii) NRZ Uni-Polar iii) NRZ polar 10

iv) Biphase v) NRZ bipolar.

b. Explain adaptive equalizing filter for base band data transmission. 10

8 a. A multi-level digital communication system transmits one of the 16 possible levels over the channel every 0.8 ms. 6

i) What is the minimum number of bits corresponding to each level?

ii) What is the baud rate? iii) What is the bit rate?

b. Show that power spectra of discrete PAM signal is $S_x(f) = a^2 T_b \sin c^2(fT_b)$. 10

c. Sketch and explain ISI. 4

UNIT - V

9 a. Derive probability of error for a coherent FSK system. 10

b. With transmitter and receiver block diagram, explain coherent QPSK system. 10

10a. A binary data is transmitted using ASK over an AWGN channel at a rate 24 MBPS. The carrier amplitude at the receiver is 1 mV. Noise power spectral density, $N_o/2 = 10^{-15} w/Hz$. 8

Find the average probability of error, if the detection is (i) Coherent (ii) Non-coherent.

b. With necessary waveforms and block diagrams, explain continuous phase modulation scheme. 12

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