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Roll No .....

MEMT-204

M.E./M.Tech., II Semester

Examination, June 2016

Theory of Random Signal

Time : Three Hours

Maximum Marks : 70

Note: Attempt any five questions. All question carry equal marks.

1. a) Explain how a random process can be describe by a set of indexed random variables.
   b) Explain power spectral density. State its important properties and prove any one property.

2. a) If X is a continuous random variable and Y = aX + b then, prove that

$$f_y(y) = \frac{1}{|a|} f_x \frac{(y-b)}{(a)}$$

   b) Define Central Limit Theorem and give its significance.

3. a) State and prove Chapman-Kolmogorov equation.
   b) Explain in brief :
      i) Gaussian process
      ii) Ergodic process

4. a) Explain Non stationary process in detail.
   b) Describe band limited process in detail.

5. a) Determine the parameters and sketch the lattice-ladder filter structure for the system with system function

$$H(z) = \frac{1 - 0.8z^{-1} + 0.15z^{-2}}{1 + 0.1z^{-1} - 0.72z^{-2}}$$

   b) Discuss how the Wiener filters are used for filtering and prediction purposes.

6. a) Define two dimensional Fourier transform. Discuss the applications of it.
   b) Discuss the forward and backward linear filter prediction.

7. a) Explain the parametric method of power spectrum estimation.
   b) Determine the autocorrelation y_{xx}(m) of the random sequence
   $x(n) = A\cos(\omega_1 n + \phi)$
   Where the amplitude A and the frequency ω_1 are (known) consists and ϕ is a uniformly distributed random phase over the interval $(0, 2\pi)$.

8. Consider the linear system described by the difference equation
   $y(n) = 0.8y\,(n-1) + x(n) + x(n-1)$
   Where $x(n)$ is a wide-sense stationary random process with zero mean and autocorrelation.

$$y_{xx}(m) = \left(\frac{1}{2}\right)^{|m|}$$

   a) Determine the power density spectrum of the output $y(n)$
   b) Determine the autocorrelation $y_{yy}(m)$ of the output
   c) Determine the variance σ_y^2 of the output

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