Code No: RT22042 **R13** SET - 1

II B. Tech II Semester Regular Examinations, May/June - 2015
RANDOM VARIABLES AND STOCHASTIC PROCESSES
(Electronics and Communications Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

~~~~~~

PART-A

1. a) What are the conditions for a function to be a random variable?
   b) Prove that the zeroth central moment is always one.
   c) Define marginal distribution function.
   d) Prove that $R_{xx}(\tau)$ is an even function.
   e) Find whether given power spectrum $\frac{\cos 8\omega}{2+\omega^4}$ is valid or not.
   f) What are the causes of thermal noise?

PART-B

2. a) Explain about the distribution and density functions of exponential RV with neat sketches.
   b) The random variable X has the discrete variable in the set {-1,0.5,0.7,1.5,3}, the corresponding probabilities are assumed to be {0.1,0.2,0.1,0.4,0.2} plot its distribution function.

3. a) State and prove the properties of variance of a random variable.
   b) A random variable X has a pdf

$$f_X(X) = \begin{cases} \frac{1}{2}\cos x \ \ for -\frac{\pi}{2} < x < \frac{\pi}{2}. \\ 0 \qquad otherwise \end{cases}$$

Find the mean value of the function $g(x)=4x^2$

|''|''|||''|'''|||'|
~~~~~~

4. a) Explain central limit theorem with equal and uneual distributions.
   b) The joint density function for X and Y is

$$f_{X,Y}(x,y)=\begin{cases}\frac{xy}{9} & for\ 0<x<2, 0<y<3\\ 0 & otherwise\end{cases}$$

   Find the conditional density functions.

5. a) With neat sketches explain the classification of random process based on time t and amplitude of random variable x .
   b) Consider a random process $X(t)=A\ Cos\omega t$, where ω is a constant and A is a random variable uniformly distributed over (0,1). Find the auto correlation and auto covariance of X(t).

6. a) Define power density spectrum and write down its properties.
   b) The PSD of X(t) is given by

$$S_{XX}(\omega)=\begin{cases}1+\omega^2 \text{for} |\omega|.<1\\ 0 \quad otherwise\end{cases},$$

7. a) List out the properties of band-limited random process.
   b) Find the mean square value of the output response for a system having $h(t)=e^{-t}u(t)$ and input of white noise $N_o/2$.

Code No: RT22042 **R13** SET - 2

II B. Tech II Semester Regular Examinations, May/June - 2015
RANDOM VARIABLES AND STOCHASTIC PROCESSES
(Electronics and Communications Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

~~~~~~

PART-A

1. a) Give example for continuous random variable and discrete random variable.
   b) What is the physical significance of variance?
   c) State central limit theorem.
   d) Define cross covariance function.
   e) Find whether given power spectrum $\frac{\omega^2}{\omega^6+3\omega^2+3}$ is valid or not.
   f) Define noise figure.

PART-B

2. a) Explain about the distribution and density functions of Gaussian RV with neat sketches.
   b) If the probability density of a random variable is given by
   $$f_X(x)=\begin{cases} x & for\ 0<x<1 \\ (2-x) & for\ 1<x<2 \end{cases}$$
   Find (i) P{0.2< x <0.8} (ii) P{0.6< x <1.2}

3. a) State and prove the properties of the characteristic function of a random variable.
   b) Let X be a random variable which can take on the values 1,2 and 3 with respective probabilities 1/3, 1/6, 1/2. Find its third moment about the mean.

4. a) Define joint probability density function. list out its properties.
   b) The joint density function of X and Y is given by
   $$f_{XY}(x,y)=\begin{cases} a\,x^2 y & for\ 0<x<y<1 \\ 0 & elsewhere \end{cases}$$
   i) Find 'a' so that the function is valid density function ii) find the marginal density functions.
~~~~~~

5. a) Explain stationary and ergodic random processes.
   b) Prove that the random process $X(t) = \text{Cos}(\omega_c t + \Theta)$ is WSS if it is assumed that ω_c is a constant and Θ is uniformly distributed variable in the interval $(0, 2\pi)$.

6. a) Define cross power density spectrum. List out its properties.
   b) Consider the random process $X(t) = A\cos(\omega_0 t + \Theta)$, where A and ω_0 are real constants and Θ is a uniformly distributed on the interval $(0, \pi/2)$. Find the average power of X(t).

7. a) Find output response of cross correlation when random process X(t) is applied to an LTI system having input response h(t).
   b) Find the noise band width of a system having the transfer function $|H(\omega)|^2 = \dfrac{1}{1 + (\omega/\omega_0)^4}$, where ω_0 is a real constant.

Code No: RT22042 **R13** SET - 3

II B. Tech II Semester Regular Examinations, May/June - 2015
RANDOM VARIABLES AND STOCHASTIC PROCESSES
(Electronics and Communications Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

~~~~~~

PART-A

1. a) What are the applications of Poisson's random variable?
   b) If K is a constant, then for a random variable X, prove that $Var(KX)=K^2 var(X)$.
   c) What is the probability density function of sum of two random variables?
   d) State the conditions for a WSS random process.
   e) Find whether given power spectrum $e^{-(w-1)^2}$ is valid or not.
   f) Illustrate transfer function of idealized system.

PART-B

2. a) Explain about the distribution and density functions of Binomial RV with neat sketches.
   b) If the probability density of a random variable is given by

$$f_X(x)=\begin{cases} C.\exp\left(-\frac{x}{4}\right) & for\ 0 \le x < 1 \\ 0 & otherwise \end{cases}$$

   Find the value of 'C' evaluate $F_X(0.5)$.

3. a) What is meant by expectation? State and prove its properties.
   b) If X is a discrete random variable with probability mass function given as below table

X	-2	-1	0	1	2
P(X)	1/5	2/5	1/10	1/10	1/5

   find (i)E(X) (ii)$E(X^2)$ (iii)E(2X+3) (iv)$E[(2X+1)^2]$
~~~~~~

4. a) Prove that sum of two statistically independent random variables is equal to the convolution of their individual density functions.

   b)The joint PDF of a bi-variate (X,Y) is given by

   $$f_{XY}(x,y) = \begin{cases} k\,xy & \text{for } 0 < x < y < 1 \\ 0 & \text{otherwise} \end{cases}$$ where k is a constant. (i)find the value of k (ii)are X and Y are independent.

5. a) What is random process? Explain Gaussian random process.

   b) Given E[X]=6 and $R_{XX}(t, t+\tau)=36+25\exp(-\tau)$ for a random process X(t). Indicate which of the following statements are true. (i) is Ergodic (ii) is wide sense stationary.

6. a) Derive the relation between cross power spectrum and cross correlation function.

   b) Find the average power of the WSS random process X(t) which has the power spectral density, $S_{XX}(\omega) = \frac{\omega^2 - 17}{(\omega^2+49)(\omega^2+16)}$.

7. a) Derive the expression for effective noise temperature of a cascaded system in terms of its individual input noise temperature.

   b) Prove that $S_{YY}(\omega)=|H(\omega)|^2 S_{XX}(\omega)$.

Code No: RT22042 **R13** SET - 4

II B. Tech II Semester Regular Examinations, May/June - 2015
RANDOM VARIABLES AND STOCHASTIC PROCESSES
(Electronics and Communications Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

~~~~~~

PART-A

1. a) List out any two properties of conditional density function.
b) State Chebychev's inequality.
c) Define correlation coefficient of joint random variable.
d) Distinguish between stationary and non-stationary random processes.
e) Find whether given power spectrum $\cos^2(\omega)\exp(-8\omega^2)$ is valid or not.
f) Draw power spectrum of a band limited process.

PART-B

2. a) Explain about the distribution and density functions Rayleigh RV with neat sketches.
b) Let x be a continuous random variable with density function

$$f_X(x) = \begin{cases} \frac{x}{9} + k & \text{for } 0 \le x \le 6 \\ 0 & \text{other wise} \end{cases}$$ (i) Find the value of k (ii) Find $P\{2 \le x \le 5\}$

3. a) State and prove properties of moment generating function.
b) Find the variance of X for a uniform probability density function.

4. For two random variables X nad Y, $f_{XY}(x,y) = 0.3\,\delta(x+1)\,\delta(y) + 0.1\,\delta(x)\delta(y) + 0.1\delta(x)\,\delta(y-2) + 0.15\delta(x-1)\,\delta(y+2) + 0.2\delta(x-1)\,\delta(y-1) + 0.15\delta(x-1)\,\delta(y-3)$ Find (a) the correlation (b) the covariance (c) the correlation coefficient of X and Y (d) Are X and Y either uncorrelated or orthogonal.
~~~~~~

5. a) What is auto correlation function. List out its properties.

   b) A random process is described by $X(t)=A^2\cos^2(\omega_c t+\Theta)$ A and ω_c are constants and Θ is a random variable uniformly distributed between $\pm\pi$. Is X(t) wide sense stationary.

6. a) Power spectrum and auto correlation functions are a Fourier transform pairs. Prove this statement.

   b) A WSS random process X(t) which has the power spectral density,

   $$S_{XX}(\omega)=\frac{\omega^2}{(\omega^4+10\omega^2+9)}.$$

   Find the auto correlation and mean square value of the process.

7. a) Find output response of auto correlation when random process X(t) is applied to an LTI system having input response h(t).

   b) Find the overall noise figure and equivalent input noise temperature of the system shown below. Assume the temperature is 27^0C

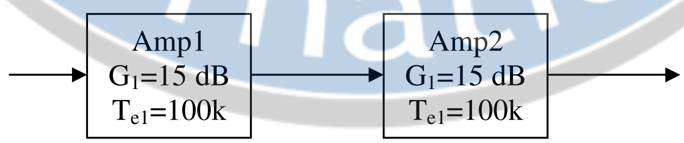

Figure : Two stage amplifier