10. (a) For discrete time processes, find the autocorrelation function.

(b) The auto covariance function allows to isolate the noise. Prove that statement. 14

11. Discuss Ergodicity in detail. 13

OR

12. Discuss the systems that minimize Mean Square Error. 13

Faculty of Engineering & Technology
Seventh Semester B.E. (Electronics Engg.)
(C.B.S.) Examination
ELECTIVE–I : RANDOM SIGNAL THEORY

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Solve Question No. **1** **OR** Questions No. **2**.

(3) Solve Question No. **3** **OR** Questions No. **4**.

(4) Solve Question No. **5** **OR** Questions No. **6**.

(5) Solve Question No. **7** **OR** Questions No. **8**.

(6) Solve Question No. **9** **OR** Questions No. **10**.

(7) Solve Question No. **11** **OR** Questions No. **12**.

(8) Due credit will be given to neatness and adequate dimensions.

(9) Assume suitable data wherever necessary.

(10) Diagrams and Chemical equations should be given wherever necessary.

(11) Illustrate your answers wherever necessary with the help of neat sketches.

(12) Use of non programmable calculator is permitted.

1. Suppose a random variable is equally likely to fall anywhere in the interval [a, b]. Then the PDF is of the form

$$f_x(x) = \begin{cases} \frac{1}{b-a} & , \quad a \le x \le b \\ 0 & , \quad \text{otherwise} \end{cases}$$

find & sketch the corresponding CDF. 13

OR

2. Find and plot the CDFs corresponding to each of the following PDFs.

(a) $f_x(x) = \begin{cases} 1 & , \quad 0 \le x < 1 \\ 0 & \quad \text{otherwise} \end{cases}$

(b) $f_x(x) = \begin{cases} x & 0 \le x < 1 \\ 2-x & 1 \le x < 2 \\ 0 & \text{otherwise} \end{cases}$ 13

3. Prove the following properties of the Gamma function.

(a) $\Gamma(x+1) = x\,\Gamma(x)$

(b) $\Gamma(1/2) = \sqrt{\pi}$ 13

OR

4. Prove the following properties of conditional CDFs.

(a) $F_{X|A}(-\infty) = 0, F_{X|A}(\infty) = 1$

(b) $0 \le F_{X|A}(x) \le 1$ 13

5. Prove the theorem :

(a) $E[aX + b] = a\,E[X] + b$ 7

(b) Define the expected value of a random variable X which has a PDF, $f_x(x)$. 7

OR

6. (a) Define moments of a random variable X. 7

(b) Discuss the central moment of the random variable X. Also define variance. 7

7. If two random variables have a covariance of zero, they are said to be uncorrelated. Prove the statement. 13

OR

8. Prove that uncorrelated Gaussian random variables are independent. 13

9. Let $\{x_n\}$ be an uncorrelated, weakly stationary, discrete time random process with zero mean. Find the power spectral density of such a process. When is it called White ? 14

OR