**R16**

**Code No: 133BQ**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech II Year I Semester Examinations, February - 2024**

**SIGNALS AND STOCHASTIC PROCESS**

**(Electronics and Communication Engineering)**

**Time: 3 Hours** **Max. Marks: 75**

**Note:** i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

## PART – A

**(25 Marks)**

| | | |
|---|---|---|
| 1.a) | Define signal bandwidth and system bandwidth. | [2] |
| b) | Give the relation between bandwidth and Rise time of a signal. | [3] |
| c) | State "time shift" property of Fourier transform. | [2] |
| d) | Find the Fourier transform of $x(t) = e^{j\omega 0t}$. | [3] |
| e) | How the stability of a system can be found in Z-Transform and what is the condition for causality in terms of Z-Transform. | [2] |
| f) | Write the differentiation in time property of Laplace transform. | [3] |
| g) | Explain about second order stationary process. | [2] |
| h) | List the properties of Cross correlation function. | [3] |
| i) | Prove that the power spectral density of a real random process is an even function. | [2] |
| j) | Define Cross-Power Spectrum function. | [3] |

## PART – B

**(50 Marks)**

| | | |
|---|---|---|
| 2.a) | Explain the concepts of unit step function and Signum function. | |
| b) | Derive expressions for mean and variance for Gaussian variable. | [5+5] |

**OR**

| | | |
|---|---|---|
| 3.a) | State and Prove the Convolution property of Fourier transform. | |
| b) | Derive the relation between Trigonometric and exponential Fourier series Coefficient. | [5+5] |

| | | |
|---|---|---|
| 4.a) | Explain the need for sampling and clearly discuss the process of sampling low pass signals and derive conditions for optimum reconstruction of signal. | |
| b) | Explain how random processes are classified with neat sketches. | [6+4] |

**OR**

| | | |
|---|---|---|
| 5.a) | State and prove multiplication property of continuous time Fourier series. | |
| b) | Find the Fourier transform of symmetrical gate pulse and sketch the spectrum. | [5+5] |

| | | |
|---|---|---|
| 6.a) | Find the inverse Laplace transform of $x(s) = 5(s+5)/ s(s+3)(s+7)$; $Re(s) > -3$. | |
| b) | A Random Process $X(t)= A \cos(2\pi f_c t)$, where A is a Gaussian Random Variable with zero mean and unity variance, is applied to an ideal integrator, that integrates with respect to 't', over (0 ,t). Check the output of integrator for stationarity. | [5+5] |

**OR**

7.a) Find X(z) and sketch the zero-pole plot and the ROC for a < 1 and a > 1 for the signal $x[n] = a^{|n|}$

b) Find the Z-transform of
i) $x(t) = a^n \sin(n\pi)\, u(n)$
ii) $x(t) = u(n) - u(n-4)$. [5+5]

8.a) State and prove the properties of auto correlation of a random process.

b) If the PSD of X(t) is $S_{xx}(\omega)$. Find the PSD of dx(t)/dt. [5+5]

**OR**

9.a) X(t) is a random process with mean =3 and Autocorrelation function $R_{xx}(\tau) = 10[\exp(-0.3|\tau|)+2]$. Find the second central Moment of the random variable Y=X(3)-X(5).

b) What is random processes? Classify random processes and explain. [5+5]

10.a) If $Y(t) = A\cos(w_0 t+\theta)+N(t)$, where "θ" is a uniform random variable over $(-\pi,\pi)$, and N(t) is a band limited Gaussian white noise process with PSD=K/2. If "θ" and N(t) are independent, find the PSD of Y(t).

b) Differentiate between stationary and ergodic random processes. [5+5]

**OR**

11.a) Derive the expression for the Cross Spectral Density of the input Process X(t) and the output process Y(t) of an LTI system in terms of its Transfer function.

b) Explain the following:
i) Time average function
ii) Time auto correlation function. [5+5]

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