R16

Code No: 133BQ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year I Semester Examinations, November/December - 2018

SIGNALS AND STOCHASTIC PROCESS

(Common to ECE, ETM)

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

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) Is the system described by the equation $y(t) = x(2t)$ time invariant or not? Why? [2]

b) Give the relation between bandwidth and Rise time of a signal. [3]

c) What are the effects of aliasing and how can you minimize the aliasing error? [2]

d) Distinguish between series and transform in the Fourier Representation of a signal. [3]

e) Let x(s) = L{x(t)}, determine the initial value, x(0) and the final value $x(\infty)$, for the following signal using initial value and final value theorems. [2]

$$x(s) = \frac{7s+6}{s(3s+5)}$$

f) How the stability of a system can be found in Z-Transform and what is the condition for causality in terms of Z-Transform. [3]

g) Prove that $R_{xy}(\tau) = R_{yx}(-\tau)$. [2]

h) If the customers arrive at a bank according to a Poisson process with mean rate 2 per minute, find the probability that during a 1-minute interval no customer arrives. [3]

i) Prove that the power spectral density of a real random process is an even function. [2]

j) Find the auto correlation function, whose spectral density is: [3]

$$s(\omega) = \begin{cases} \pi, & |\omega| \le 1 \\ 0, & otherwise \end{cases}$$

PART- B

(50 Marks)

2.a) Prove that the set $\sin mw_0t$ and $\sin nw_0t$ are orthogonal for $m \neq n$, where m = 0,1,2……. ∞ and n = 0,1,2…….. ∞, over to, $t_0 + \frac{2\pi}{\omega_0}$.

b) Explain the concepts of unit step function and Signum function. [5+5]

OR

3.a) Explain causality and physical reliability of a system and explain Paley-wiener criterion.

b) Consider a stable LTI system characterized by the differential equation: $\frac{dy(t)}{dt} + 2y(t) = x(t)$. Find its impulse response. [5+5]

4.a) Find the Fourier Transform of the signal $x(t) = e^{at}u(-2t)$.

b) Define sampling theorem for time limited signal and find the Nyquist rate for the following signals.
i) $rect\,300t$ ii) $10\cos 300\pi t$ [4+6]

OR

5.a) Derive the expression for trigonometric Fourier series coefficients.

b) Determine the exponential form of the Fourier series representation of the signal shown in figure 1. [4+6]

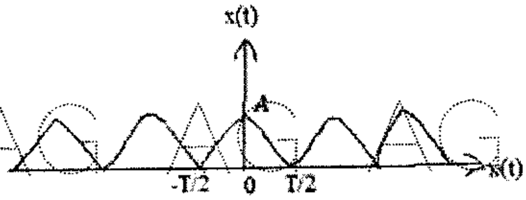

Figure 1

6.a) By using the power series expression technique, find the inverse Z-Transform of the following X(z).

$$X(z) = \frac{z}{2z^2 - 3z + 1};\ |z| < \frac{1}{2}.$$

b) Distinguish between the Laplace, Fourier and Z-Transforms. [7+3]

OR

7.a) Find the Laplace Transform of the periodic, rectangular wave shown in figure 2.

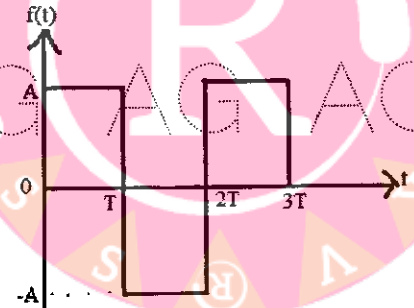

Figure 2

b) Find the Laplace Transform of following functions:
i) Exponential function
ii) Unit step function. [6+4]

8.a) Explain the characteristics of a first order and strict sense stationary process using relevant expressions.

b) State and prove the properties of auto correlation of a random process. [5+5]

OR

9.a) Find the mean, variance and Root Mean Square value of the process, whose auto correlation function is $R_{xx}(\tau)=\dfrac{25\tau^2+36}{6.25\tau^2+4}$

b) Consider two random processes $x(t)=3\cos(\omega t+\theta)$ and $y(t)=2\cos(\omega t+\phi)$, where $\phi=\theta-\dfrac{\pi}{2}$ and θ is uniformly distributed over $(0,2\pi)$, verify $\left|R_{xy}(\tau)\right|\le\sqrt{R_{xx}(0)R_{yy}(0)}$.

[5+5]

10.a) Derive the relation between input and output power spectral densities of a linear system.

b) The cross power spectrum of real random process x(t) and y(t) is given by:

$$S_{xy}(\omega)=\begin{cases} a+ib\omega, & \text{if } |\omega|\le 1 \\ 0, & \text{elsewhere} \end{cases}$$

Find the cross correlation function. [5+5]

OR

11.a) Consider a random process $X(t)=A_0\cos(\omega_0 t+\theta)$, where A_0 and ω_0 are constants and θ is a uniform random variable in the interval $(0,\pi)$, find whether X(t) is WSS process.

b) Show that $S_{yy}(\omega)=\left|H(\omega)\right|^2 S_{xx}(\omega)$. Where $S_{xx}(\omega)$ and $S_{yy}(\omega)$ are the power spectral density functions of the input x(t) and the output y(t) respectively and $H(\omega)$ is the system transfer function. [5+5]

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