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G 1621 (Pages : 4) Reg. No....................................

Name....................................

B.TECH. DEGREE EXAMINATION, MAY 2016

Fourth Semester

Branch : Electronics and Communication / Applied Electronics and Instrumentation / Electronics and Instrumentation / Information Technology

SIGNALS AND SYSTEMS (L A S T)

(Old Scheme—Prior to 2010 Admissions)

[Supplementary/Mercy Chance]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 4 marks.

1. What is BIBO stability ? Prove the condition on $h(t)$ for a system to be stable ?
2. Find the convolution sum of the following sequences :

   $x_1(n) = \{\underset{\uparrow}{1}, 2, 3\}, x_2(n) = \{\underset{\uparrow}{3}, 1, 4\}.$
3. Find the Fourier Transform of the rect function which is unity over the interval –0.5 to + 0.5, and zero elsewhere.
4. Find the Fourier Transform of the signal $x(t) = te^{-kt}\, u(t)$. What is the restriction on K for the Fourier Transform to exist ?
5. Find the Discrete Fourier Series representation of a periodic sequence $x(n) = \{1, 1, 0, 0\}$ with period N = 4.
6. Find the DTFT $x(\Omega)$ of the signal $x(n) = \{1, 2, 3, \underset{\uparrow}{2}, 1\}$ and evaluate $x(\Omega)$ at $\Omega = 0$.
7. Explain the properties of ROC of z-transform.
8. Determine the Laplace Transform of a unit ramp signal.
9. State the important properties of cross-correlation function $R_{xy}(\tau)$.
10. Give an auto correlation function $R_{xx}(\tau)$, can you determine a unique $x(t)$? Why ?

(10 × 4 = 40 marks)

Turn over

Part B

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. Check whether the following systems are :
    (a) Linear / non-linear.
    (b) Causal or non-causal.
    (c) Time variant / time invariant.
    (d) Stable / unstable ?

    (i) $y(t) = x(t^4)$. (ii) $y(n) = x(n) + nx(n-1)$.

(6 + 6 = 12 mark

Or

12. (a) Convolve the sequences $\alpha^n u[n]$ and $\beta^n u[n]$.

(4 mark

(b) Find the output response of the system described by the differential equation

$$\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 6y = 5e^{-t}.$$

(8 mark

13. Determine the complex exponential Fourier series expansion of the periodic signal

$$x(\theta) = \begin{cases} A\cos\theta & , \quad 0 \le \theta \le \pi \\ 0 & , \quad \pi \le \theta \le 2\pi \end{cases}$$

Or

14. (a) Calculate the energy contained in the signal $x(t) = 5e^{-3t}\, u(t)$ using time domain equatio and then using Parseval's theorem.

(8 marks)

(b) Use duality principle to find the Fourier Transform of $x(t) = 10$ Sinc $20t$.

(4 marks)

15. (a) Find the DTFS coefficients of the sequence $x(n) = \cos\left(\frac{6\pi n}{13} + \frac{\pi}{6}\right)$.

(6 marks)

(b) The signal $x(n) = \{1, 0.5\}$ is applied to a system with frequency response $H(\Omega)$ and the resulting output is $y[n] = \delta[n] - 2\delta[n-1] - \delta[n-2]$. Find $H(\Omega)$.

(6 marks)

Or

16. (a) Explain convolution and modulation properties of DTFT. (6 marks)

(b) Determine the response of the system if $x(n)=\cos\left(\frac{\pi n}{2}\right)$. The difference equation of the system is $y(n)=\frac{1}{2}y(n-1)+x(n)+\frac{1}{2}x(n-1)$.

(6 marks)

17. (a) Find z-transform of $x(n)=\left(\frac{1}{5}\right)^n u(n)+\left(\frac{1}{8}\right)^n u(n)$. (6 marks)

(b) Determine the poles and zeros for the differential equation $y(n)-\frac{5}{6}y(n-1)+\frac{1}{6}y(n-2)=x(n)-x(n-1)$ and also find out ROC.

(6 marks)

Or

18. (a) Using Laplace Transform, solve the differential equation $\frac{d^2y(t)}{dt^2}+y(t)=x(t)$, if $\frac{dy(0^-)}{dt'}=2$, $y(0^-)=1$ for input $x(t)=\cos 2t$.

(6 marks)

(b) The system function of a causal LTI system is $H(s)=\frac{s+1}{s^2+2s+2}$. Determine the response $y(t)$ when the input $x(t)=e^{-|t|}$.

(6 marks)

19. (a) Determine the autocorrelation function and energy spectral density of $x(t)=e^{-at}u(t)$.

(6 marks)

(b) A random variable X has the uniform distribution given by $f_x(x)=\begin{cases}\frac{1}{2\pi}, & 0\le x\le 2\pi\\ 0, & \text{otherwise}\end{cases}$

Determine $m_x, \overline{X}^2$ and σx.

(6 marks)

Or

Turn over

20. A stationary Random process X (t) has the following autocorrelation function $R_X(\tau) = \sigma^2 e^{-\mu|\tau|}$ where m and σ^2 are the constants. It is passed through a filter whose impulse response is $h(\tau) = \alpha e^{-\alpha t} u(\tau)$, where α is a constant and $u(t)$ is a step function.

    (i) Find the Power Spectral Density of random signal X (t).

    (ii) Find the Power spectral Density of the output random signal Y (t).

(6 + 6 = 12 marks)

[5 × 12 = 60 marks]