

Printed Pages : 4

EEC404

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 0324**

Roll No.

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B. Tech.

(SEMESTER-IV) THEORY EXAMINATION, 2011-12

SIGNALS &amp; SYSTEMS

Time : 3 Hours ]

[ Total Marks : 100

Note : Answer all the Sections.

## Section – A

10 × 2 = 20

1. Attempt all the parts.

(a) Distinguish between Symmetric and Non-Symmetric signals with suitable example.

(b) Determine whether the following signal is periodic or not, if so find its period.

$$x(t) = \cos t + \sin \sqrt{2t}$$

(c) Explain BIBO and Time Invariance properties of the system.

(d) Prove the frequency-shifting property of Fourier Transform.

(e) Find the Nyquist-rate for the following signal

$$x(t) = [1 + 0.1 \sin (200 \pi t)] \cos (2000\pi t)$$

(f) Sketch

$$Z(t) = r(t + 2) - r(t + 1) - r(t - 1) + r(t - 2)$$

(g) What do you mean by Group Delay ?

(h) Establish the relationship between convolution and correlation function for CT-system.

(i) Find the total energy and total-power contained in the unit-step signal  $u(t)$ .

(j) Find the impulse-response of the system having gain.

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## Section – B

2. Attempt any **THREE** parts :

3 × 10 = 30

- (a) An LTI system has impulse response  $h(n) = [u(n) - u(n - 4)]$ . Find the output of the system if the input  $x(n) = [u(n + 10) - 2u(n + 5) + (n - 6)]$ . Sketch the output.
- (b) Use the properties of the Fourier Transform to show by induction that the Fourier Transform of

$$x(t) = \frac{t^{n-1}}{(n-1)!} e^{-\alpha t} u(t), \alpha > 0$$

$$\text{is } \left( \frac{1}{(a + jw)^n} \right)$$

- (c) Show that the Fourier Transform of a train of impulses of unit height separated by T secs is also a train of impulses of height  $\omega_0 = 2\pi/T$  separated by  $\omega_0 = 2\pi/T$  sec.
- (d) Determine the DTFT of the following signals :
- (i)  $x(n) = a^{|n-2|}, |a| < 1$
- (ii)  $x(n) = \left(\frac{1}{2}\right)^n u(n - 2)$
- (iii)  $x(n) = 2^n [u(n) - u(n - 6)]$
- (e) (i) Prove the time – shift property of uni-lateral Z – Transform.
- (ii) State and prove initial value theorem for Z – Transform.

## Section – C

Attempt **all** parts.

5 × 10 = 50

3. Attempt any **two** parts :

- (a) Explain causal and anti-causal signals with suitable examples.
- (b) Sketch  $\delta[n] = u(n) - u(n - 1)$
- (c) Derive the expression for convolution integral.

4. Attempt any **one** part.

(a) Evaluate the continuous time convolution integral

$$y(t) = e^{-2t}u(t) * U(t + 2)$$

(b) Determine whether each of the systems given below is linear, time invariant, causal and memory.

(i)  $y(t) = \cos(x(t))$

(ii)  $y(n) = 2x(n)u(n)$

(iii)  $y(t) = \frac{d}{dt} \{e^{-t} x(t)\}$

5. Attempt any **one** part.

(a) Explain the following properties of the Laplace Transform.

(i) Linearity

(ii) Time – Shifting

(iii) Time – Scaling

(iv) Conjugation

(b) Determine the Unilateral Laplace Transform of each of the following signals and specify the corresponding regions of convergence.

(i)  $x(t) = e^{-2t}u(t + 1)$

(ii)  $x(t) = \delta(t + 1) + \delta(t) + e^{-2(t+3)}u(t + 1)$

(iii)  $x(t) = e^{-2t}u(t) + e^{-4t}u(t)$

6. Attempt any **one** part.

(a) Determine the Z-Transform for the signal  $x[n]$  given below. Sketch the pole-zero plot and indicate the region of convergence.

$$x[n] = 7\left(\frac{1}{3}\right)^n u[n] - 6\left(\frac{1}{2}\right)^n u[n]$$

(b) A right sided sequence  $x[n]$  has Z – Transform

$$X[z] = \frac{3z^{-10} + z^{-7} - 5z^{-2} + 4z^{-1} + 1}{z^{-10} - 5z^{-7} + z^{-3}}$$

Determine  $x[n]$  for  $n < 0$ .



7. Attempt any **two** parts.

(a) Draw a block representation for the causal LTI system with system function

$$H(z) = \frac{1}{1 - \frac{1}{4}z^{-1}}$$

(b) Explain uni-lateral Z-Transform.

(c) Find the step-response of the RC – High Pass Filter.