Printed Pages : 4

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

PAPER ID : 0324 Roll No. | | | | | | | | | | |

B. Tech

(SEMESTER-IV) THEORY EXAMINATION, 2011-12

SIGNALS & SYSTEMS

Time : 3 Hours] *[Total Marks : 100*

Note : Answer **all** the Sections.

Section – A

1. Attempt **all** the parts. $10 \times 2 = 20$

(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.

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

(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.

Section – B

2. Attempt any **THREE** parts : $3 \times 10 = 30$

(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

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

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. $5 \times 10 = 50$

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.
