Sr. No. - 008405

May 2024

B.Tech. – IV SEMESTER

Signal and Systems (ECC-01)

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

Instructions:

1. *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2. *Answer any four questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART -A

Q1 (a) Let x(n) = [1, -4,3,1,5,2] be a sequence . Represent x(n) in terms of weighted shifted impulse function. (1.5)

(b) Compare energy and power signals. (1.5)

(c) Why ROC consists of strips of the s-plane parallel to the $j\omega$ axis? (1.5)

(d) Derive the condition for stability of continuous LTI system. (1.5)

(e) Perform convolution of $x_1(t) = u(t-2)$ and $x_2(t) = \delta(t+6)$ using convolution theorem of Laplace transform. (1.5)

(f) Write the properties of ROC of Z-transform. (1.5)

(g) Determine the Nyquist sampling rate for $x(t) = \sin(200\pi t) + 3\sin^2(120\pi t)$. (1.5)

(h) State and prove Parseval's theorem. (1.5)

(i) What are the advantages of state space analysis of discrete time system? (1.5)

(j) Distinguish between Fourier series and Fourier transform. (1.5)

PART -B

Q2 (a) Plot the signal $u(t-2) + u(t-4)$. Check the linearity, causality and time invariance of system $y(t) = x(2-t)$. Also test the stability of the system $h(t) = e^{-5|t|}$. (7.5)

(b) Perform convolution of the two sequences $x_1(n) = \{1, 1, 3\}$ and $x_2(n) = \{1, 4, -1\}$. Also determine the impulse response for two cascaded LTI systems having impulse response $h_1(n) = u(n)$ and $h_2(n) = \delta(n) + 2\,\delta(n-1)$. (7.5)

Q3 (a) Write the conditions for existence of Fourier series. Explain trigonometric form of Fourier series representation of a periodic signal with example. (7.5)

(b) Find the Fourier transform of the following signal $x(t) = t\,e^{-at}u(t)$. (7.5)

Q4 (a) Discuss the relationship between Z- transform and Fourier transform. Determine the signal x(n) for the following given Discrete-Time Fourier Transform $X(e^{j\omega}) = e^{-j\omega}\ for\ -\pi \le \omega \le \pi$. (7.5)

(b) State and prove time reversal property of DTFT. Compute the circular convolution of the sequences $x(n) = \{0,1,2,3\}$ and $h(n) = \{2,1,1,2\}$ using graphical and matrix method. (7.5)

Q5 (a) Determine the impulse response and step response of the causal system given as $y(n) - y(n-1) - 2y(n-2) = x(n-1) + 2x(n-2)$. (7.5)

(b) State and prove differentiation in Z-domain property. Determine the Z - transform of the signal $x(n) = \left(\frac{1}{3}\right)^n [u(n) - u(n-6)]$. (7.5)

Q6 (a) What are the eigen function and eigen value of LTI continuous time system? Determine the Laplace transform of the signal $x(t) = e^{-2t}u(-t) + e^{-3t}u(-t)$ and find its ROC. (7.5)

(b) Using Laplace transform, solve the following differential equation (7.5)

$$\frac{d^2y(t)}{dt^2} + y(t) = x(t)$$

If $\frac{dy(0^-)}{dt} = 2, y(0^-) = 1$ for input $x(t) = \cos 2t$.

Q7 (a) What are the effects of aliasing? Explain the methods used to reconstruct the analog signal from the sampled signal. (7.5)

(b) Describe multi- input and multi- output representation. Find the state transition matrix for the continuous time system parameter matrix, $A = \begin{bmatrix} -3 & 0 \\ 0 & -2 \end{bmatrix}$ (7.5)

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