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Total Pages : 5

015405

May 2023

B.Tech. (ENC) - IV SEMESTER

Theory of Signal & System (ECP-406)

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

1. (a) Sketch the waveform for the following signal :

$x(t) = 2r(t) - 2r(t-1) - u(t-1) + u(t-2) - 2r(t-2) + 2r(t-3)$. (1.5)

(b) State whether $x(t) = \cos 2t + \sin\left(\frac{t}{5}\right)$ is periodic or not. If periodic, find the fundamental period of $x(t)$. (1.5)

(c) Evaluate the following integral :

$$\int_{-\infty}^{+\infty} e^{-0.5t}\, \delta(t-3)\, dt \qquad (1.5)$$

(d) What will be the overall impulse response $h[n]$ if the two system having their impulse responses as $h_1[n]$ and $h_2[n]$ are connected in series and parallel? (1.5)

(e) Determine the response of the LTI system whose input $x[n]$ and impulse response $h[n]$ are given by $x[n] = \left(\frac{1}{3}\right)^n u[n]$ and $h[n] = \delta(n-4)$. (1.5)

(f) State any three properties of ROC of Laplace transform. (1.5)

(g) Give the relationship between Fourier transform and Laplace transform. (1.5)

(h) Find the Fourier transform of $x(t) = sgn(t)$. (1.5)

(i) What is the need of sampling. (1.5)

(j) State the convolution property of z-transform. Also mention what will be the ROC after convolution. (1.5)

PART–B

2. (a) Verify whether the following system is Linear/ Non-Linear, Time Variant/ Invariant, Static/ Dynamic, Causal/ Non-causal, Invertible/ Non-invertible and Stable / Unstable : (7)

$$y(t) = e^t x(t)$$

(b) Given $x[n] = \{1, 4, 3, -1, 2\}$ with origin at 3. Plot the following signals :

(i) $x[-n-1]$

(ii) $x\left[-\frac{n}{2}\right]$

(iii) $x[-2n+1]$

(iv) $x\left[-\frac{n}{2}+2\right]$. (8)

3. (a) Perform the convolution of the following causal signals :

$x_1(t) = tu(t)$ and $x_2(t) = e^{-5t}u(t)$. (6)

(b) State and prove distributive property of linear convolution. (4)

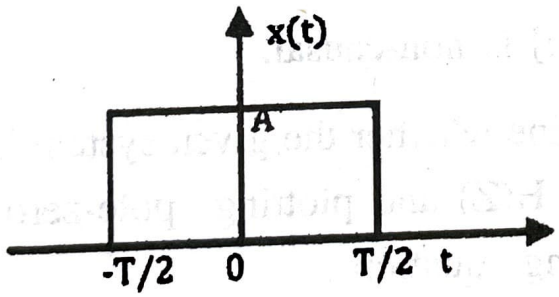
(c) Determine the unit step response of the following system whose impulse response is given by :

$$h(t) = u(t+2) + u(t-2).$$ (5)

4. (a) Perform the circular convolution of two sequences, $x_1[n] = \{1, 2, 1, 1\}$ and $x_2[n] = \{2, 3, 1, 1\}$. (5)

(b) State and prove Parseval's theorem of Fourier Transform. (5)

(c) Find the Fourier transform of a rectangular pulse given below : (5)



5. (a) Determine the Laplace transform of the following signal and also plot the ROC. (5)

$$x(t) = e^{-5t}u(t) - e^{-4(t-1)}u(t-1)$$

(b) Find the inverse Laplace transform of $X(s) = \frac{1}{(s+5)(s-3)}$, if the ROC is :

(i) $-5 < \text{Re}[s] < 3$

(ii) $\text{Re}[s] > 3$

(iii) $\text{Re}[s] < -5$. (6)

(c) Determine the initial value, $x(0)$ and the final value, $x(\infty)$ for the following signal : (4)

$$X(S) = \frac{s+1}{s^2+2s+2}.$$

6. (a) State and prove sampling theorem for a band limited signal. (5)

(b) Determine the inverse z-transform of

$X(z) = \frac{1+z^{-1}}{1+z^{-1}+z^{-2}}$ using long division method, if:

(i) $x[n]$ is causal.

(ii) $x[n]$ is non-causal. (6)

(c) Determine whether the given system is stable or not by finding H(Z) and plotting pole-zero diagram for the following equation :

$$x[n] = (0.5)^n u[n] \left(\frac{1}{3}\right)^n u[n]. \quad (4)$$

7. (a) The input-output of a causal LTI system are related by the differential equation

$$\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+8y(t)=2x(t).$$

(i) Find the impulse response, $h(t)$.

(ii) Find the response $y(t)$ of the system if $x(t) = u(t)$. (8)

(b) Let $x[n] = [-1, 2, -3, 4, -5]$. The DTFT of $x[n]$ is given as $X(e^{jw})$. Find :

(i) the inverse FT of $X(e^{j(w-\pi)})$.

(ii) $\int_{-\pi}^{\pi} \left|X(e^{jw})\right|^2$. (7)