Roll No. .....

Total Pages : 5

015406

August/September 2022
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) State the two properties of unit impulse function. (1.5)

(b) Determine whether the following signals is energy or power signal. Also calculate its energy and power

$$x(t) = e^{-2t}\, u(t).$$ (1.5)

(c) What is the overall impulse response $h(t)$ when two systems with impulse response $h_1(t)$ and $h_2(t)$ are connected in :

(i) parallel (ii) series. (1.5)

(d) State the necessary and sufficient condition on impulse response for LTI system to be causal. (1.5)

(e) Find the Fourier Transform of a DC signal of amplitude 1. (1.5)

(f) What do you mean by aliasing? (1.5)

(g) What is the relationship between DTFT and z-transform? (1.5)

(h) What is the ROC of z-transform for a finite duration anti-causal sequence? (1.5)

(i) State any *two* properties of ROC of Laplace Transform. (1.5)

(j) Determine the Laplace Transform of $\delta(t-3)$. (1.5)

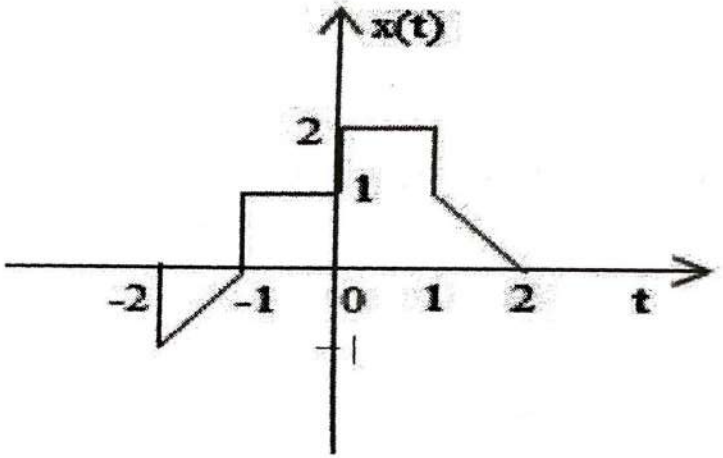
PART-B

2. (a) Check whether the following systems are Linear/Non-Linear, Time Variant/Invariant, Static/Dynamic, Causal/Non-causal and Stable/Unstable :

(i) $y(n) = x(n^2)$ (ii) $y(t) = ax(t) + b$. (10)

(b) A continuous time signal $x(t)$ is shown below. Sketch and label carefully each of the following signal :

1. $x(t-1)$.
2. $x(2-t)$.
3. $x(t).\left[\delta\left(t-\frac{3}{2}\right)-\delta\left(t+\frac{3}{2}\right)\right]$.
4. $x(2t+1)$. (5)



3. (a) Find the frequency response of a linear shift invariant system whose input and output satisfy the difference equation :

$y[n] - 0.5y[n-1] = x[n] + 2x[n-1] + x[n-3]$. (5)

(b) Consider $h[n] = \{1, 3, 2, -1, 1\}$ with origin at 3, and $x[n] = u[n] - u[n-3]$, determine the output $y[n]$ of the LTI system? (5)

(c) Derive the expression for convolution sum if the input $x[n]$ and impulse response $h[n]$ is given. (5)

4. (a) Determine the circular convolution of two sequence $x_1[n] = \{1, 2, 1, 0\}$ with $x_2[n] = \{1, 0, 1, 1\}$. (5)

(b) State and prove the convolution property of DTFT. (5)

(c) Determine the Fourier Transform of the following :

(i) $x(t) = sgn(t)$ (ii) $x(t) = \cos w_0 t$. (5)

5. (a) Using Laplace transform, find the impulse response of an LTI system described by the differential equation :

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t)$$

with all initial condition as zero. (7)

(b) Find the inverse Laplace transform of

$$X(s) = \frac{4}{(s+4)(s+2)},$$

if the ROC is :

(i) $-2 > Re[s] > -4$.

(ii) $Re[s] > -2$.

(iii) $Re[s] < -4$. (8)

6. (a) A Linear LTI system is characterized by the following difference equation :

$$y(n) - \frac{3}{2}y(n-1) + \frac{1}{2}y(n-2) = x(n), \quad n \geq 0$$

Where $x(n) = \left(\frac{1}{4}\right)^n u(n)$

Subject to $y(-1) = 4$ and $y(-2) = 10$.

Determine the Zero Input Response and Zero State Response. (8)

(b) Determine the z-transform of $x(n) = a^n \cos w_0 n\, u(n)$. Find the condition for ROC also. (7)

7. (a) State and prove sampling theorem. (5)

(b) Determine the Fourier Transform of $x(t) = e^{-a|t|}$. (5)

(c) Determine the z-transform and sketch the pole zero plot with the ROC for

$$x[n] = (0.5)^n\, u[n] - \left(\frac{1}{3}\right)^n u[n].$$ (5)