

Code No: 183CC

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**B. Tech II Year I Semester Examinations, February - 2024****SIGNALS AND SYSTEMS****(Common to ECE, EIE)****Time: 3 Hours****Max. Marks: 60****Note:** This question paper contains two parts A and B.i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of **ten questions** (numbered from 2 to 11) **carrying 10 marks each**. From each unit, there are two questions and the student should answer one of them. Hence, the student should answer five questions from Part-B.

PART – A**(10 Marks)**

- 1.a) State the two properties of unit impulse function. [1]
- b) State and explain the Dirichlet's conditions. [1]
- c) Define exponential Fourier series. [1]
- d) What is the practical use of the Hilbert transform? [1]
- e) What is a convolution of signals? [1]
- f) Final value theorem is for sequence $x[n]$ is given by _____ . [1]
- g) Find the Laplace Transform for the signal $x(t) = -5e^{8t} u(t)$. [1]
- h) Find the Z-transform and ROC for the signal $x(n) = a^n u(n)$. [1]
- i) Define autocorrelation. [1]
- j) Define Normalized energy and Energy spectral density. [1]

PART – B**(50 Marks)**

- 2.a) Prove the Orthogonality condition in the case of a signal represented by orthogonal signal space consisting of exponential functions, $\{e^{jm\omega_0 t}\}$ for 'n' integer.
- b) Find the odd and even components of the signal $\cos t + \sin t + \cos t \sin t$. [5+5]

OR

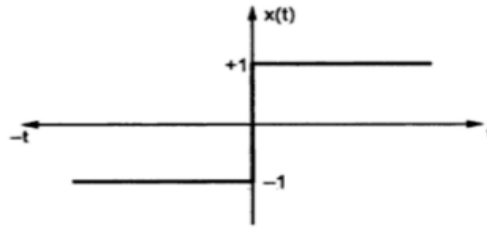
- 3.a) A function $f(t)$ is defined rectangular pulse given by:

$$f(t) = \begin{cases} 1 & 0 < t < \pi \\ -1 & \pi \leq t < 2\pi \end{cases}$$

Approximate above function by a finite series of Sinusoidal functions

- b) Define and derive the expression for evaluating mean square errors and its types. [5+5]

- 4.a) Compute the Fourier transform of each of the following signals i) $\left(\frac{\sin\pi t}{\pi t}\right)$ ii) $\left(\frac{\sin 2\pi t}{2\pi t}\right)$
 b) Find the Fourier Transform of the Signum function shown in figure. [5+5]



OR

- 5.a) Obtain the Fourier series representation of an impulse train given by

$$x(t) = \sum_{n=-\infty}^{\infty} \delta(t - n\tau_0).$$

- b) Derive the Fourier transform of

i) $x(t) = e^{-at} \sin(\omega t) u(t).$

ii) $x(t) = e^{-at} \cos(\omega t) u(t).$

[5+5]

- 6.a) Find the convolution of following functions

$$x(t) = \begin{cases} 1 & -3 < t < 3 \\ 0 & \text{otherwise} \end{cases} \quad h(t) = \begin{cases} 2 & 0 < t < 3 \\ 0 & \text{otherwise} \end{cases}$$

- b) The unit impulse response $h[n]$ of a DT LTI system is $h[n] = 1/5^n u[n]$. Use convolution to compute the system's response to the input $x[n] = u[-n-3]$. [5+5]

OR

- 7.a) Explain the characteristics of ideal LPF, HPF and BPF.

- b) Compute the response of an LTI system described by its impulse response

$$h[n] = \begin{cases} \alpha^n, & 0 \leq n \leq 6 \\ 0, & \text{otherwise} \end{cases} \quad \text{to the input signal } x[n] = \begin{cases} 1, & 0 \leq n \leq 4 \\ 0, & \text{otherwise} \end{cases}$$

[5+5]

- 8.a) Derive the relationship between Laplacian transform and Fourier Transforms.

- b) Determine the discrete time sequence associated with Z transform given below using power series method: $X(z) = (1 - (1/2)z^{-1}) / (1 + (1/2)z^{-1})$ with ROC $|z| > 1/2$. [5+5]

OR

- 9.a) Determine the Laplacian transform and ROC of signal $x(t) = e^{-at} u(-t).$

- b) Find the Z transform and ROC of the sequence $x(n) = r^n \cos(n\theta) u(n).$ [5+5]

- 10.a) A filter with $H(\omega) = 1/(1 + j\omega)$ is given an input $x(t) = e^{-2t} u(t)$. Find Energy density spectrum of the output.

- b) Determine the convolution by graphical method for $y(t) = h(t) * f(t)$ if $h(t) = e^{-t} u(t)$ and $f(t) = e^{-2t} u(t)$. [5+5]

OR

- 11.a) Determine the Nyquist sampling rate and Nyquist sampling interval for the signals.

i) $\text{sinc}(100\pi t)$

ii) $\text{sinc}^2(100\pi t)$

iii) $\text{sinc}(100\pi t) + \text{sinc}(50\pi t)$

iv) $\text{sinc}(100\pi t) + 3 \text{sinc}^2(60\pi t)$

- b) Explain Natural and flat-top sampling. [5+5]