END TERM EXAMINATION

THIRD SEMESTER [B.TECH] DECEMBER 2024

Paper Code: ECC-205	Subject: Signals and Systems
Time: 3 Hours	Maximum Marks: 60

Note: *Attempt five questions in all including Q.No.1 which is compulsory. Select one question from each unit. Assume missing data, if any.*

Q1 Attempt **all** questions:

- a) Check whether the signal $x(t) = 2\cos(50\pi t) + \sin(10\pi t)$ is periodic or aperiodic. If periodic, determine the fundamental period. **(4)**

- b) A discrete time signal is described by $x[n]=[1, 2, 3, 2, 1]$. Determine $x[n/2]$. **(4)**

- c) Find Discrete Time Fourier Transform of signal $x[n]=2^n u[n]$. **(4)**

- d) State and prove final value theorem of Z-Transform. **(4)**

- e) Write the Dirichlet conditions for existence of Fourier Transform. **(4)**

UNIT-I

Q2 a) A continuous time signal is expressed by **(7)**
$x(t) = 1 + \sin\omega_0 t + 2\cos\omega_0 t + \cos\left(2\omega_0 t + \frac{\pi}{4}\right)$, where ω_0 is the fundamental frequency of the signal. Determine the Fourier series coefficients of $x(t)$. Also, sketch their magnitude plot.

b) State and explain sampling theorem **(3)**

OR

Q3 Let $x(t)=u(t-3)-u(t-5)$ and $h(t)=e^{-3t}u(t)$. **(10)**
Compute
- a) $y(t) = x(t)*h(t)$
- b) $g(t) = [dx(t)/dt]*h(t)$
- c) How is $g(t)$ related to $y(t)$?

UNIT-II

Q4 a) Consider a causal LTI system with frequency response **(7)**
$H(j\omega) = \frac{1}{3+j\omega}$.
For a particular input $x(t)$ this system is observed to produce the output $y(t) = e^{-3t}u(t) - e^{-4t}u(t)$. Determine $x(t)$.

b) Find the Fourier Transform of signal of Signal $x(t) = \frac{1}{1+t^2}$. **(3)**
However, the Fourier Transform of $g(t) = e^{-|t|}$ is given as:
$G(\omega) = \frac{2}{1+\omega^2}$.

OR

Q5 a) Determine whether the signal $y(t)=x(t)+x(t-2)$ is **(7)**
(a) Linear or nonlinear, (b) Static or dynamic, (c) Causal or non-causal and (d) Time variant or time invariant.

b) Consider an LTI system with the differential equation (3)
$\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 3y(t) = \frac{dx(t)}{dt} + 2x(t)$. Find the frequency response & impulse response.

UNIT-III

Q6 a) Compute the Discrete Time Fourier Transform of the following (7)
functions.
i. $x[n] = u[n-2]-u[n-6]$
ii. $x[n] = (1/2)^{-n}u[-n-1]$

b) Find Inverse Discrete Time Fourier Transform of a signal (3)

$$X(e^{j\omega}) = \frac{e^{-j\omega} - \frac{1}{5}}{1 - \frac{1}{5}e^{-j\omega}}$$

OR

Q7 a) Find the circular convolution of the following sequences: (7)

$x_1[n] = \{1, -1, 2, 3\}; x_2[n] = \{0, 1, 2, 3\}$

b) Compute 4-point DFT of $x[n] = \{1, 2, 1, 2\}$ (3)

UNIT-IV

Q8 a) Determine the Z-Transform and ROC of the signal (7)

$$x[n] = 7(\frac{1}{3})^n u[n] - 6(\frac{1}{2})^n u[n]$$

b) Write the properties of Region of Convergence. (3)

OR

Q9 Consider a signal y[n] which is related to two signals $x_1[n]$ and $x_2[n]$ (10)
by

$$y[n] = x_1[n+3] * x_2[-n+1]$$

Where $x_1[n] = (\frac{1}{2})^n u[n]$ and $x_2[n] = (\frac{1}{3})^n u[n]$

Given that

$$a^n u[n] \overset{z}{\leftrightarrow} \frac{1}{1-az^{-1}}, |z| > |a|$$

Use the properties of Z-Transform to determine the Z-Transform Y(z) of y[n].

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