R18

Code No: 156CV

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, July - 2023

SIGNALS AND SYSTEMS

(Electrical and Electronics Engineering)

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

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a)	Describe exponential and sinusoidal signals.	[2]
b)	Discuss the classification of signals and systems based on their properties.	[3]
c)	Define Trigonometric Fourier series and Exponential Fourier series.	[2]
d)	Explain the concept of continuous-time periodic signals and their representation using Fourier series.	[3]
e)	Define a Linear Time-Invariant (LTI) system and discuss its properties.	[2]
f)	Discuss the ideal characteristics of low-pass, high-pass, and band-pass filters.	[3]
g)	Define the Laplace transform and its significance in signal processing.	[2]
h)	Explain the concept of the Region Of Convergence (ROC) in the Z-transform and its importance in determining the convergence and stability of a signal.	[3]
i)	Explain the concept of aliasing.	[2]
j)	Explain how correlation can be used to detect periodic signals in the presence of noise.	[3]

PART – B

(50 Marks)

2.a)	Design a digital filter system using orthogonal functions for signal approximation. Compare the performance of different orthogonal functions.	
b)	Consider a continuous-time signal $x(t) = 2\cos(2\pi ft + \pi/4) + 3\sin(4\pi ft)$, where f = 100 Hz. Determine the average power of the signal.	[5+5]
	OR	
3.a)	What is Signum function? Explain in brief.	
b)	Explain the analogy between vectors and signals.	[5+5]
4.a)	Find the Fourier series representation of a periodic function f(t) with a period $T = 2\pi$, given by $f(t) = \lvert\sin(t)\rvert$, $-\pi \le t \le \pi$. Determine the coefficients and sketch the spectrum.	
b)	Analyze the effects of truncating a Fourier series on the reconstructed signal.	[6+4]
	OR	
5.a)	Evaluate the convergence of the Fourier series for a given periodic signal f(t) defined as $f(t) = t^2$, $-\pi \le t \le \pi$.	
b)	Compute the Fourier transform of a signal $x(t) = \cos(2\pi ft)u(t)$, where f is the frequency of the cosine waveform.	[5+5]

6. Design a system that implements an ideal Low-Pass Filter (LPF) characteristic with a cutoff frequency of 1 kHz. Determine the transfer function of the system, analyze its frequency response, and discuss the implications of the ideal LPF on signal transmission. [10]

OR

7. Find the transfer function H(s) of a Linear Time-Invariant (LTI) system with an impulse response $h(t) = te^{-2t}.u(t)$. Determine the system's frequency response and discuss its properties. [10]

8. Use waveform synthesis to find the Laplace transform of the signal $x(t) = tu(t) + e^{-2t}\cos(4t)u(t)$. Determine the ROC and discuss the properties of the Laplace transform. [10]

OR

9. Determine the Z-transform of the discrete sequence $x[n] = n^2u[n]$. Analyze its frequency content and discuss the relationship between the Z-transform and the Discrete Fourier Transform (DFT) of the sequence. [10]

10. Evaluate the effect of under-sampling on a band-limited signal. Discuss the aliasing implications in signal reconstruction. Provide examples and explain how the choice of sampling rate affects the accuracy of the reconstructed signal. [10]

OR

11. Determine the auto-correlation function of a signal x(t) and discuss its properties. Analyze the relationship between the auto-correlation function and the energy density spectrum of the signal. Explain how the auto-correlation function can be used to estimate the periodicity or randomness of a signal. [10]

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