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301501

December, 2019

B.Tech. (CE/CSE) - V SEMESTER

SIGNALS & SYSTEMS (ESC-501)

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) What is random signal? Give an example. (1.5)

(b) Find the Nyquist rate for the signal $x(t) = 1 + \cos 10\pi t$, in Hz. (1.5)

(c) Convolve the signal $x[n] = \{1, 2, -2\}$ with $h[n] = \{1, 2, -2\}$. (1.5)

(d) Evaluate the integral $\int_{-10}^{10} \cos \pi t + \delta(2t - 10) dt$. (1.5)

(e) A signal $x(t) = 2 \cos 400\pi t + 6 \cos 600\pi t$ is sampled with a sampling frequency 800 Hz. Write the resultant discrete signal. (1.5)

(f) Find the response y(t) for the given input signal $x(t) = u(t)$ and $h(t) = \delta(t-1)$. (1.5)

(g) Write the Parseval's relation for continuous time Fourier transform. (1.5)

(h) Find the Fourier series representation of an impulse train. (1.5)

(i) State the purpose of Fourier Series and Fourier Transform. (1.5)

(j) Find the inverse DTFT of $X(e^{j\omega}) = 2e^{j\omega} + 1 - 2e^{-2j\omega}$. (1.5)

PART - B

2. (a) State the importance of ROC. Find the Laplace transform $\delta(t)$, $u(t)$ and $r(t)$. (7)

(b) Derive the relationship between autocorrelation and energy spectral density of an energy signal. (8)

3. (a) How the unit pulse function $\pi(t)$, unit step function $u(t)$ and ramp function $r(t)$ can be related? Also provide the mathematical representation and graphical representation of the above three function. (7)

(b) Determine whether the signals are periodic or not? If a signal is periodic, determine its fundamental period. (i) x(t) = cos (π/3)t + sin (π/4)t (ii) x(n) = cos (n/4). (8)

4. (a) Find the Fourier series representation for the signal x(t) = 2 + cos 4t + sin 6t and plots its magnitude and phase spectrum. (10)

(b) Write the various application of signal and system theory. (5)

5. (a) Given the differential equation representation of a continuous time system. $\frac{d}{dt}y(t)+2y(t)=x(t)$, find the response y(t) for the input x(t) = e–3t u(t) using Laplace transform. (5)

(b) State and prove sampling theorem for low pass signals. Also, discuss the effect of under-sampling ? (10)

6. (a) A continuous time LTI system is represented by the following differential equation.

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

Determine the impulse response of the system using Fourier transform. (3)

(b) Explain the following system properties, from the perspective of impulse response (i) Linearity (ii) causality (iii) time-invariance. (12)

7. (a) Derive the condition for stability of a discrete time LTI system in terms of its impulse response. (3)

(b) A system has input-output relationship given by $y(n) = nx(n)$. Determine whether the system is causal, linear, time invariant or stable. (6)

(c) State and prove the time shifting and frequency shifting properties of Fourier transform. (6)