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S.E. (Information Technology) Semester- IV (Revised Course 2007-08)
EXAMINATION Nov/Dec 2019
Signals & Systems

[Duration : Three Hours]

[Total Marks : 100]

Instructions:

- 1) Draw neat labeled diagrams wherever necessary in pencil.
- 2) Assume data if required.
- 3) Answer any five question by selecting at least one question from each module.

MODULE 1

QUESTION 1

- a) Determine whether the following signals are periodic. If they are periodic find (12mks) the fundamental period.
- a) $x(t) = t^2 \cos(\pi t)$
 - b) $x(t) = \cos(6\pi t) + \sin(7t)$
 - c) $x(t) = t - \sin(\pi t/4)$
- b) Explain following properties of system (6mks)
- A] Linearity
 - B] Time variance
 - C] Stability
- c) Write a short note on Singularity functions (2mks)

QUESTION 2

- a) For the signal given below (12mks)
- A] $x(t) = (\cos(2\pi t))^2$
 - B] $x(t) = \sin(2\pi t) + t - \cos(\pi t/4)$

Calculate

- i) Compute the Fundamental period
 - ii) Sketch the single sided and double sided amplitude and phase spectra
- b) State the necessary conditions for energy & power signal. (8mks)
Determine if the following signal is an energy or power signal
 $x(t) = e^{-2t}u(t)$

MODULE 2

QUESTION 3

- a) Sketch the trapezoidal signal $x(t)$ and compute it's Fourier transform using suitable FT properties (12mks)

$$x(t) = \begin{cases} 5 + t & -3 < t < -1 \\ 1 & -1 < t < 1 \\ 1 - (t - 2) & 1 < t < 2 \\ 0 & \text{otherwise} \end{cases}$$

* State the FT properties used in derivation.

- b) State and prove Parseval's theorem (8mks)

QUESTION 4

- a) Obtain an expression for the coefficients of the exponential Fourier series (8mks)

- b) Write a short note on Rate of Convergence of Fourier Spectra (4mks)

- c) Find the coefficients of the complex exponential Fourier series for a half-rectified sine wave, defined by (4mks)

$$x(t) = \begin{cases} A \sin \omega_0 t, & 0 \leq t \leq T_0/2 \\ 0, & T_0/2 \leq t \leq T_0 \end{cases}$$

With $x(t) = x(t + T_0)$

MODULE 3

QUESTION 5

- a) Find the Laplace transform of the following signals (5mks)

$$x(t) = e^{-at} \sin \omega_0 t$$

- b) Find Inverse Laplace transform: (5mks)

$$X(s) = \frac{10}{s^2 + 10s + 6}$$

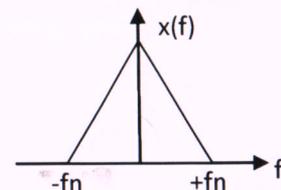
- c) Explain the following properties of Laplace Transform (10mks)

- (i) Laplace transform of derivatives
- (ii) Laplace transform of Convolution

QUESTION 6

- a) What is aliasing and aliasing error? Draw a sampled waveform $X_s(f)$ for different conditions. (12mks)

- i) $f_s > 2f_n$
- ii) $f_s = 2f_n$
- iii) $f_s < 2f_n$ for input spectrum given below



- b) Find the inverse Laplace transform

$$X(s) = \frac{3s+4}{(s+1)(s+2)^2}$$

(8mks)

MODULE 4

QUESTION 7

- a) Explain Initial value theorem

(5mks)

- b) Find Inverse Z transform of $X(z) = (2z + 1)/(z^2 + 6z + 8)$

(5mks)

Obtain cascade and parallel realization of

(10mks)

$$H(z) = (1/4 z^{-1} - 1)^2 / (1 - 1/2 z^{-1})(1 - 1/4 z^{-1})$$

QUESTION 8

- a) Design step invariant digital filter for analog prototype

(8mks)

$$H_a(s) = 0.3(s + 3)/(s + 2)(s + 2)$$

- b) Use a long division method to determine $x(0), x(1), x(2), x(3)$ for the following function of z

(5mks)

$$X(z) = 2 + z^{-1} / (1 - 1/4 z^{-1})^2$$

- c) Derive an equation for pulse transfer function encountered in discrete time Rectangular integration and draw a schematic of its implementation.

(7mks)