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Name.....

Reg. No.....

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION
JULY 2009

EC/AI/IC 2K 403—SIGNALS AND SYSTEMS

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

Part A

I. (a) Plot $x(t) = t, 0 \le t \le 1$
$= 2, 1 \le t \le 3$
$= 1, 3 \le t \le 4$
$= 0$, otherwise

and $x(t - 3/2)$, $x(2t + 3)$, $x(3t + 2/3)$.

(b) What is impulse response ? Derive the relationship between input and output of an LTI system.

(c) State and prove Parseval's relation for continuous-time Fourier transform.

(d) What is aliasing ? Explain.

(e) Find the discrete-time Fourier transform of :

$$x(n) = \left(\frac{1}{2}\right)^n, \quad n \ge 0$$
$$= 0, \quad n < 0$$

and find its magnitude spectrum.

(f) State and prove any two properties of discrete Fourier series representation.

(g) State and prove time shifting property of one-sided Z-transform.

(h) Explain the procedure for determining the frequency response of the system from poles and zeros.

(8 × 5 = 40 marks)

Turn over

Part B

II. (a) Explain the following with an example for each :

(i) Linearity.

(ii) Time-invariant.

(iii) Stability.

(iv) Causality.

(v) Memoryless.

(15 marks)

Or

(b) (i) Check whether the signals given below are periodic or not. If it is periodic, find their periods.

(1) $x_1(t) = \sin\left(\frac{2\pi t}{3}\right) + 2\sin\left(\frac{16\pi t}{3} + \frac{\pi}{7}\right)$.

(2) $x_2(t) = 10\sin(5t) - 4\cos(7t)$.

(6 marks)

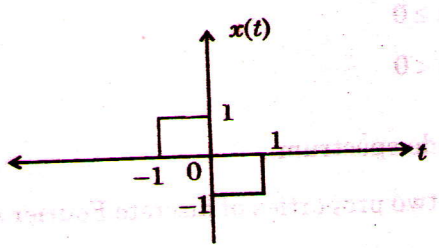
(ii) Find the convolution of the following signal with itself and plot the result.

$x(t) = 1, \ |t| \leq 1$

$= 0, \ |t| > 1.$

(9 marks)

III. (a) (i) Using differentiation property, find the Fourier transform of the signal shown below :



(7 marks)

(ii) Explain the frequency response of second order LTI system. (8 marks)

Or

(b) (i) Derive the magnitude and phase response of a distortionless system. (8 marks)

(ii) Find the Nyquist sampling rate of the signal

$$x(t) = 5\left[\frac{\sin(2000\pi t)}{\pi t}\right]^3 * \left[\frac{\sin(2000\pi t)}{\pi t}\right]^2$$

Where '*' is convolution operator.

(7 marks

IV. (a) (i) Show that DTFT of conjugate symmetric signal is purely real. (7 marks)

(ii) Find the discrete Fourier series representation of the periodic sequence $x(n) = \{0, 1, 2, 3, 4\}$ with period N = 5. (8 marks)

Or

(b) (i) Check whether the continuous time LTI system described by the differential equation is stable or not.

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6\,y(t) = x(t).$$

(9 marks)

(ii) What is inverse system ? Explain. (6 marks)

V. (a) (i) Explain the properties of ROC of Z-transform. (5 marks)

(ii) Check whether the system described by the input-output relations given below are stable.

1 $y(n) = e^{-x(n)}$.

2 $y(n) = \sum_{k=-\infty}^{n} 2^{n-k}\, x(k+1)$.

(6 marks)

(iii) Find the Z transform of :

$$x(n) = \left(\tfrac{1}{2}\right)^n \sin(3n)\; n \geq 0$$
$$= 0,\; n < 0.$$

Or

(4 marks)

(b) (i) Find the inverse Z-transform of :

$$X(z) = \frac{7 - 7.6z^{-1}}{1 - 2.4z^{-1} + z^{-2}}$$

for all possible ROCs.

(8 marks)

(ii) Find the impulse response of the system described by the difference equation.

$$y(n) = \frac{10}{3}\,y(n-1) - y(n-2) = x(n).$$

(7 marks)

[4 × 15 = 60 marks]