C 48095 (Pages 2) Name........................

Reg. No.........................

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, JUNE 2008

EC/AI/IC 2K 403—SIGNALS AND SYSTEMS

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

I. (a) Determine whether the following signals are energy or power or neither :—

1 $x(t) = 10\exp\left[j(50\pi t + 10)\right]$

2 $x(t) = 5\sin\left(2\pi t + \pi/3\right)$.

(b) Explain about (1) causality and (2) invertability of a system.

(c) State and prove integration property of Fourier transform.

(d) State sampling theorem for low-pass band limited signal and explain.

(e) Derive the necessary and sufficient condition for BIBO stability of an LTI system.

(f) Find the discrete Fourier series representation of $x(n) = \{1, 0, 1, 0\}$ with period N = 4.

(g) Explain the properties of region of convergence of Z-transform.

(h) A system is described by the difference equation :

$$y(n) = 0.5\,y(n-1) + x(n).$$

Find its system function and plot pole-zero diagram.

(8 × 5 = 40 marks)

II. (a) Show that convolution operation obeys (i) commutative property and (ii) associative property.

(7 + 8 = 15 marks)

Or

(b) For the systems represented by following functions, determine whether every system is, (i) linear ; (ii) time-invariant ; and (iii) causal.

(i) $y(t) = 10\,x(t) + 5$.

(ii) $\dfrac{dy(t)}{dt} + ty(t) = x(t)$

(iii) $y(t) = \exp\{x(t)\}$.

(3 × 5 = 15 marks)

Turn over

III. (a) (i) State and prove Parsavel's theorem for deterministic energy signal. (8 marks)

(ii) State and prove any two Properties of Hilbert transform. (7 marks)

Or

(b) A system has the impulse response $h(t) = t\pi \exp(-4\pi t)\, u(t)$, where $u(t)$ is unit step signal, and input to the system is $x(t) = 4\cos(4\pi t) + 4\cos(12\pi t)$. Find and plot the amplitude and phase spectra for the input and output signals of the system.

IV. (a) (i) Determine the discrete-time Fourier transform of the following signals :—

1 $x(n) = 2^n\, u(-n)$.

2 $$x(n) = 2 - \frac{1}{2}n, \quad |n| \le 4$$
$$= 0, \quad |n| > 4.$$

(8 marks)

(ii) Determine the inverse DTFT of $X(w) = \cos^2(w) t \sin^2(3w)$. (7 marks)

Or

(b) Determine the transfer function of the system described by the differential equation :

$$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 9y(t) = \frac{d^2x(t)}{dt^2} + 3\frac{dx(t)}{dt} + 2x(t)$$

and hence find the output of the system for $x(t) = u(t)$ by assuming zero initial conditions.

V. (a) (i) State and prove convolution property of Z-transform. (8 marks)

(ii) Determine Z-transform of $x(n) = \left(\frac{1}{2}\right)^n \cos(w_o n)\, u(n)$. (7 marks)

Or

(b) Determine the impulse response of the system having difference equation :

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + x(n-1).$$

[4 × 15 = 60 marks]