NEW SCHEME

EC36

USN | | | | | | | | | | |

Third Semester B.E. Degree Examination, January/February 2004

EC / TE / ML / IT / BM / EE

Signals and Systems

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Define a signal and a system. Explain any two properties of a LTI system. **(6 Marks)**

(b) Find and sketch the even and odd components of the following

i) $x[n] = e^{-(n/4)}\, u[n]$

ii) $x(t) \begin{cases} = t & 0 \le t \le 1 \\ = 2-t & 1 \le t \le 2 \end{cases}$ **(6 Marks)**

(c) Find the periodicity of the signal $x[n] = cos\left(\frac{2\pi n}{5}\right) + cos\left(\frac{2\pi n}{7}\right)$ **(3 Marks)**

(d) A rectangular pulse $x(t) \begin{cases} = A & 0 \le t \le T \\ = 0 & elsewhere \end{cases}$

is applied to an integrator circuit. Find the total energy of the output $y(t)$ of the integrator. **(5 Marks)**

2. (a) Given the impulse response of system $h[n]$ as $\beta^n\, u[-n]$ $\beta > 1$, find the response of the system for the input $u[-n]$ **(7 Marks)**

(b) The impulse response of a system is $h(t) = e^{2t}\, u(t-1)$. Check whether the system is stable, causal and memoryless system. **(7 Marks)**

(c) Find the overall impulse response of a cascade of two systems having identical impulse responses $h[t] = 2\{u(t) - u(t-1)\}$ **(6 Marks)**

3. (a) Obtain the block diagram representation (direct from I and II) for a system modelled by the equation

$$4\frac{d^3y(t)}{dt^3} - 3\frac{dy(t)}{dt} + y(t) = x(t) + \frac{dx(t)}{dt}$$ **(7 Marks)**

(b) Find the total response of an LTI system described by the equation $4y[n] + 4y[n+1] + y[n+2] = x[n]$ with input $x[n] = 4^n\, u[n]$, initial conditions being $y[-1] = 0,\ y[-2] = 1$ **(7 Marks)**

(c) Find the natural response for the system described by the equation

$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 4e^{-3t}$ for $t \ge 0$. Also $y(0) = 3 \quad y'(0) = 4$. **(6 Marks)**

4. (a) Determine the complex Fourier coefficients for the signal

$x(t) \begin{cases} = t+1 & -1 \le t \le 0 \\ = 1-t & 0 \le t < 1 \end{cases}$ which repeats periodically with T=2 units. Plot the amplitude and phase spectra of the signal. **(8 Marks)**

(b) State and prove the following of Fourier transform

i) Time shifting property

ii) Time differentiation property

iii) Parsedval's theorem. (12 Marks)

5. (a) Using convolution theorem, find inverse Fourier transform of

$$X(\omega) = \frac{1}{(a+j\omega)^2}$$

(6 Marks)

(b) The transfer function of a system is $H(\omega) = \frac{16}{4+j\omega}$

Find time domain response y(t) for input $x(t) = u(t)$. (7 Marks)

(c) Define the DTFT of a signal. Establish the relation between DTFT and Z transform of a signal. (7 Marks)

6. (a) Determine the DTFT of the following signals

(i) $x[n] = (0.5)^{n+2}\ u[n]$

(ii) $x[n] \begin{cases} = 1 & -5 \le n \le 5 \\ = 0 & \text{elsewhere} \end{cases}$ Plot $X(\Omega)$ (7 Marks)

(b) Define and prove the following for DTFS representation of signals.

i) Modulation of two signals ii) Convolution of two signals. (7 Marks)

(c) Define and explain Nyquist sampling theorem with relevant figures. (6 Marks)

7. (a) Determine Z transform, ROC, pole-zero locations of the following functions :

i) $a^n cos(\Omega_0 n)\ u[n]$. for $\Omega_0 = 2\pi$ get pole zero plot.

ii) $(0.2)^n\ \{u[n] - u[n-4]\}$ (10 Marks)

(b) Prove the following properties of Z transform mentioning ROC

i) Time shifting property

ii) Time reversal property

iii) Differentiation in z domain. (10 Marks)

8. (a) Determine inverse Z transform of sequence $X(z) = sinZ$. (4 Marks)

(b) A LTI system is represented by its system function $H(z) = \frac{z^2}{z^2 - \frac{z}{6} - \frac{1}{6}}$. Find system response when the input $x[n] = 4u[n]$. Assume initial conditions as $y[-1] = 0,\ y[-2] = 12$ (8 Marks)

(c) Consider a system described by the difference equation

$$y[n] - 2y[n-1] + 2y[n-2] = x[n] + \tfrac{1}{2}x[n-1]$$

Find system function $H(z)$ and unit sample response $h[n]$ of the system. Also find the stability of the system. (8 Marks)

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