2002 SCHEME

EC36

Third Semester B.E. Degree Examination, Dec.08 / Jan.09

Signals and Systems

Time: 3 hrs.   Max. Marks:100

Note : 1. *Answer any FIVE full questions.*
2. *Justify any assumptions made.*

1 a. Define a signal and a system. Explain any two properties of LTI systems. (06 Marks)

b. Show that the product of two even signals or two odd signals is an even signal, while the product of an even and an odd signal is an odd signal. (06 Marks)

c. Calculate the average power of each of the following signals:

i) $x(n) = u(n)$

ii) $x(t) = A\cos(\omega_0 t + \theta)$ (05 Marks)

d. If $x(n) = u(n) - u(n-5)$, sketch $x(n-2)$ and $x(2n)$. (03 Marks)

2 a. Check whether each of the following signals is periodic or aperiodic. If periodic, determine the fundamental period.

i) $x(t) = e^{j\pi t}$

ii) $x(n) = \cos 2n$ (06 Marks)

b. For the signal shown in figure Q2 (b), find the total energy. (06 Marks)

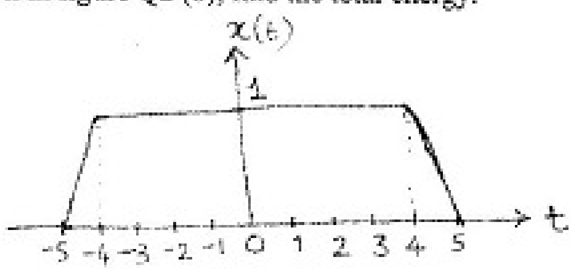

Fig. Q2 (b)

c. Given $x_1(n) = a^n u(n)$; $|a| < 1$ and $x_2(n) = b^n u(n)$; $|b| < 1$, find $x_1(n) * x_2(n)$ if i) $a \neq b$ ii) $a = b$. (08 Marks)

3 a. Determine the complete response of the system described by,

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

for the input $x(t) = \cos t\, u(t)$ with initial conditions $y(0) = -1$ and $\left.\frac{dy}{dt}\right|_{t=0} = 1$ (10 Marks)

b. Draw the direct form I and II realizations for the following systems,

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

ii) $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt}$ (10 Marks)

4 a. Obtain the DTFS coefficients of $x(n) = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$ and plot the magnitude spectrum. (07 Marks)

b. Find the FS representation for the signal $x(t) = \sin(2\pi t) + \cos(3\pi t)$ and sketch the magnitude spectrum. (07 Marks)

c. Find the time domain signal corresponding to $x(k) = \left(-\frac{1}{2}\right)^{|k|}$; $\omega_0 = 1$. (06 Marks)

5 a. Find the DTFT of

i) $x(n) = \{1, 3, \underset{\uparrow}{5}, 3, 1\}$

ii) $x(n) = u(n)$ **(10 Marks)**

b. Find the Fourier Transform of the function shown in figure Q5 (b) using recognizable transform pairs and properties. **(10 Marks)**

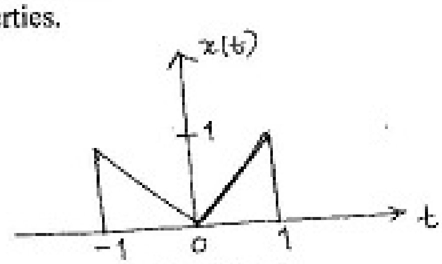

Fig. Q5 (b)

6 a. The impulse response of a continuous-time LTI system is given by,

$h(t) = \frac{1}{RC} e^{-t/RC} u(t)$

Find the frequency response and plot the magnitude and phase response. **(08 Marks)**

b. Obtain the frequency response and impulse response of the system described by the difference equation,

$y(n) + \frac{1}{2} y(n-1) = x(n) - 2x(n-1)$ **(06 Marks)**

c. Specify the Nyquist rate for each of the following signals,

i) $x_1(t) = \text{sinc}(200t)$

ii) $x_2(t) = \text{sinc}^2(200t)$ **(06 Marks)**

7 a. List the properties of ROC. **06 Marks)**

b. State and prove the following properties of z-transform:

i) Time shifting

ii) Time reversal **(06 Marks)**

c. Find the z-transform of each of the following sequences and indicate the ROC:

i) $x(n) = u(n+2)$

ii) $x(n) = na^n u(n)$ **(08 Marks)**

8 a. Find the inverse z-transform of x(z) using partial fraction method,

$x(z) = \frac{z}{3z^2 - 4z + 1}$; ROC: $|z| > 1$. **(05 Marks)**

b. Using long division method find the inverse z-transform of

$x(z) = \frac{z}{2z^2 - 3z + 1}$; ROC: $|z| < 1/2$. **(04 Marks)**

c. The output of a discrete-time LTI system is $y(n) = 2(1/3)^n u(n)$ when the input is u(n)

i) Determine the impulse response h(n) of the system.

ii) Determine the output when the input is $(1/2)^n u(n)$. **(11 Marks)**

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