USN

06EE52

Fifth Semester B.E. Degree Examination, December 2010

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Distinguish between : i) Energy signal and power signal
ii) Even and odd signals. **(06 Marks)**

b. Determine whether or not the following signal is periodic. If it is periodic, determine its fundamental period : $x(n) = \sin\left[\frac{1}{3}(\pi n)\right] \cos\left[\frac{1}{5}(\pi n)\right]$ **(04 Marks)**

c. For the signal x(t) shown in Fig.Q1(c), sketch :
i) $x[2(t-2)]$ ii) $x(-2t-1)$ iii) $x\left(\frac{t}{2}+2\right)$ iv) $x(-t)$

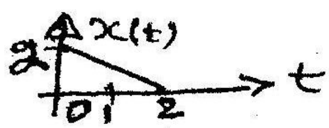

Fig.Q1(c)

(04 Marks)

d. Determine whether the system given below is : i) Linear, ii) Time invariant, iii) Causal iv) Memoryless .
$$y(t) = e^{x(t)}$$ **(06 Marks)**

2 a. Obtain the convolution of the signals :
$$x(t) = \begin{cases} 2 & \text{for } -2 \le t \le 2 \\ 0 & \text{elsewhere} \end{cases} \quad ; \quad h(t) = \begin{cases} 4 & \text{for } 0 \le t \le 2 \\ 0 & \text{elsewhere} \end{cases}$$
Also sketch the result. **(10 Marks)**

b. Determine the convolution sum of the sequences :
$$x_1(n) = \{1, 1, \underset{\uparrow}{0}, 1, 1\} \text{ and } x_2(n) = \{1, -2, -3, \underset{\uparrow}{4}\}.$$ **(06 Marks)**

c. Obtain the expression for output y(t) in terms of input x(t) and overall impulse response for the system shown in Fig.Q2(c). **(04 Marks)**

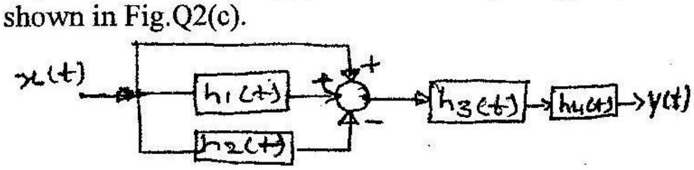

Fig.Q2(c)

3 a. Distinguish between forced response and free response. Find the forced response for the system given by $\frac{d^2y(t)}{dt} + 3\frac{dy(t)}{dt} + 2y(t) = x(t) + \frac{d}{dt}x(t)$ with input $x(t) = 5u(t)$. **(08 Marks)**

b. Draw the direct form – I and direct form – II implementations for the system described by the difference equation, $y(n) - \frac{1}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + \frac{1}{2}x(n-1)$. **(06 Marks)**

c. For each of the impulse responses, determine whether the corresponding system is memory less, causal and stable : i) $h(t) = e^{2t}u(t-2)$ ii) $h(n) = 2^n u(-n)$ **(06 Marks)**

4 a. Find the complex Fourier co-efficient for the periodic waveform x(t) shown on Fig.Q4(a). Also draw the amplitude and phase spectra. **(08 Marks)**

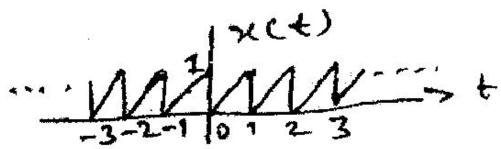

Fig.Q4(a)

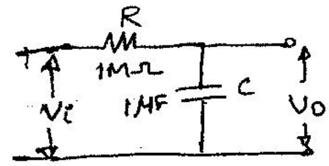

Fig.Q6(a)

b. Determine the DTFS coefficients of the signal $x(n) = \cos\left(\frac{\pi n}{3}\right)$. Also sketch magnitude spectrum. **(06 Marks)**

c. Find the time domain signal corresponding to the DTFS coefficients X(K):

$$X(K) = \cos\left(\frac{6\pi}{17}K\right).$$ **(06 Marks)**

PART – B

5 a. Compute the Fourier transform of the signal : $x(t) = 1 + \cos\pi t$, for $|t| \le 1$; $= 0$, for $|t| > 1$ **(08 Marks)**

b. Find the DTFT of the signal, $x(n) = 2^n u(-n)$. **(06 Marks)**

c. State and prove the properties of DTFT : i) Time shift , ii) Convolution. **(06 Marks)**

6 a. Obtain the impulse response of the network shown in Fig.Q6(a). Determine the frequency response $H(j\omega)$ of the network. Determine the frequency at which $|H(j\omega)|$ falls to $\frac{1}{2}$. **(12 Marks)**

b. Find the Nyquist rate for each of the following signals:

i) $x(t) = 25e^{i500\pi t}$ ii) $(t) = [1 + 0.1\sin(200\pi t)]\cos(2000\pi t)$

iii) $x(t) = 10\,\text{sinc}\,5t$ iv) $x(t) = 2\,\text{sinc}(50\pi t)\sin(5000\pi t)$ **(08 Marks)**

7 a. Define z-transform of a signal. What do you mean by ROC? Mention the properties of ROC. **(08 Marks)**

b. Find the Z.T. of : i) $x(n) = \alpha^n u(n)$, ii) $x(n) = -u(-n-1) = \left(\frac{1}{2}\right)^n u(n)$. **(06 Marks)**

c. Find the inverse Z.T. of the following suing partial fraction expansion method:

$$X(Z) = \frac{Z+1}{3Z^2 - 4Z + 1} \quad \text{ROC } |Z| > 1$$ **(06 Marks)**

8 a. A causal LTI system is described by the difference equation, $y(n) = y(n-1) + y(n-2) + x(n-1)$. Find the system function H(Z), plot the poles and zeros and indicate the ROC. Also determine the impulse response of the system. **(06 Marks)**

b. Solve the following difference equation using unilateral Z.T.:

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

for $n \ge 0$ with initial conditions $y(-1) = 4$, $y(-2) = 10$ and $x(n) = \left(\frac{1}{4}\right)^n u(n)$. **(10 Marks)**

c. Discuss the stability, causality and anticausality of systems from the nature of their transfer function. **(04 Marks)**

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