

Fifth Semester B.E. Degree Examination, December 2010
Signals and Systems

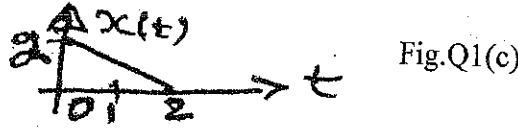
Time: 3 hrs.

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) $x(-t)$



- d. Determine whether the system given below is : i) Linear, ii) Time invariant, iii) Causal
 iv) Memoryless. (04 Marks)

$$y(t) = e^{x(t)}$$
 (06 Marks)

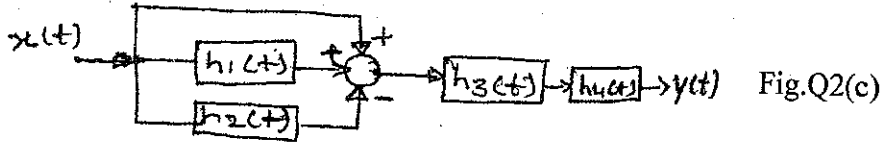
- 2 a. Obtain the convolution of the signals :

$$x(t) = \begin{cases} 2 & \text{for } -2 \leq t \leq 2 \\ 0 & \text{elsewhere} \end{cases} ; \quad h(t) = \begin{cases} 4 & \text{for } 0 \leq t \leq 2 \\ 0 & \text{elsewhere} \end{cases}$$

Also sketch the result.

- b. Determine the convolution sum of the sequences : (10 Marks)
 $x_1(n) = \{1, 1, 0, 1, 1\}$ and $x_2(n) = \{1, -2, -3, 4\}$. (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)



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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- 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)

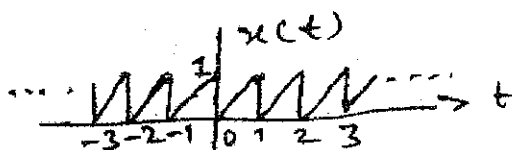


Fig.Q4(a)

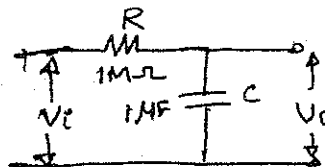


Fig.Q6(a)

- 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 :

$$x(t) = 1 + \cos \pi t, \text{ for } |t| \leq 1$$

$$= 0, \text{ for } |t| > 1$$
 (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 using partial fraction expansion method:

$$X(Z) = \frac{Z+1}{3Z^2 - 4Z + 1} \text{ ROC } |Z| > 1$$
 (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 $n \geq 0$ 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)