USN

10EC44

Fourth Semester B.E. Degree Examination, June/July 2016

Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Sketch the even and odd part of the signals shown in Fig. Q1(a). **(06 Marks)**

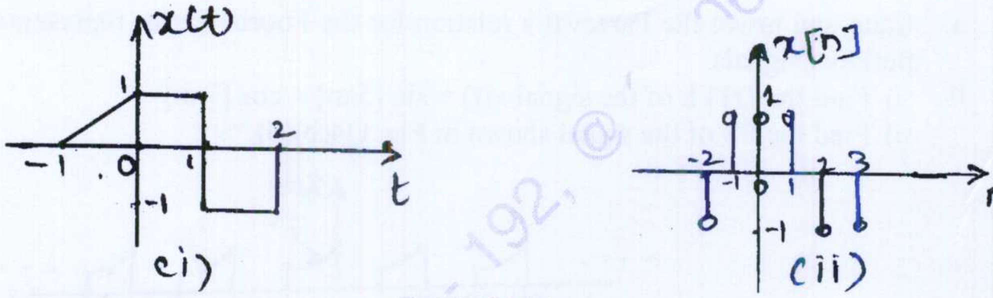

Fig.Q1(a)

b. For the signal x(t) and y(t) shown in Fig.Q1(b) sketch the signals :

i) $x(t+1) - y(t)$

ii) $x(t) \cdot y(t-1)$. **(06 Marks)**

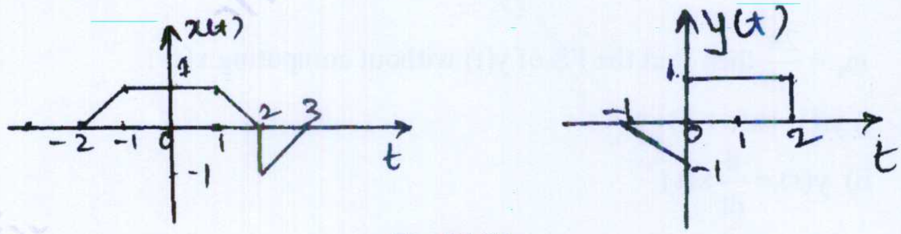

Fig.Q1(b)

c. Determine whether the system described by the following input/output relationship is i) memory less ii) causal iii) time invariant iv) linear.

i) $y(t) = x(2-t)$

ii) $y[n] = \sum_{k=0}^{\infty} 2^k x[n-k]$. **(08 Marks)**

2 a. Compute the following convolutions :

i) $y(t) = e^{-2t} u(t-2) * \{u(t-2) - u(t-12)\}$

ii) $y[n] = \alpha^n \{u[n] - u[n-6]\} * 2\{u[n] - u[n-15]\}$. **(14 Marks)**

b. Prove the following :

i) $x(t) * \delta(t-t_0) = x(t-t_0)$

ii) $x[n] * u[n] = \sum_{k=-\infty}^{n} x[k]$. **(06 Marks)**

3 a. Identify whether the systems described by the following impulse responses are memory-less, causal and stable.

i) $h(t) = 3\delta(t-2) + 5\delta(t-5)$

ii) $h[n] = 2^n u[-n]$

iii) $h[n] = (\frac{1}{2})^n \delta[n]$. **(09 Marks)**

b. Find the natural response and the forced response of the system described by the following differential equation : $\frac{d^2y(t)}{dt^2} - 4y(t) = \frac{d}{dt}x(t)$, if $y(0) = 1$ and $\frac{d}{dt}y(t)\big|_{t=0} = -1$. **(08 Marks)**

c. Write the difference equation for the system depicted in Fig. Q3(c). **(03 Marks)**

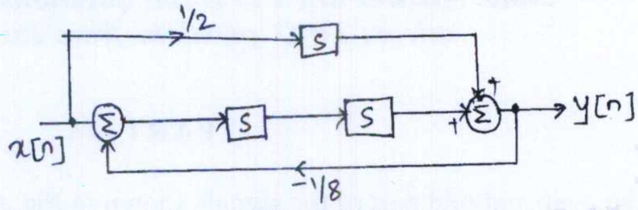

Fig. Q3(c)

4 a. State and prove the Parseval's relation for the Fourier series representation of discrete time periodic signals. **(06 Marks)**

b. i) Find the DTFS of the signal $x(t) = \sin[5\pi n] + \cos[7\pi n]$

ii) Find the FS of the signal shown in Fig. Q4(b)(ii). **(08 Marks)**

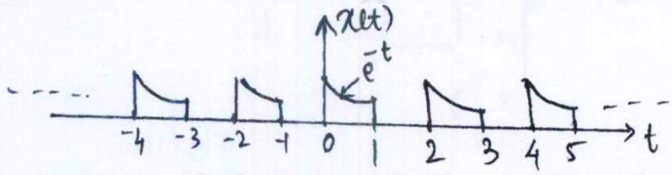

Fig. Q4(b)(ii)

c. If the FS representation of periodic signal x(t) is $x(t) \xleftrightarrow{FS;\omega_0} \frac{2\sin[K\omega_0 T_0]}{T K \omega_0}$ where $\omega_0 = \frac{2\pi}{T}$ then find the FS of y(t) without computing x(t) :

i) $y(t) = x(t+2)$

ii) $y(t) = \frac{d}{dt}x(t)$. **(06 Marks)**

PART – B

5 a. i) Compute the DTFT of $x[n] = (\frac{1}{3})^n u[n+2] + (\frac{1}{2})^n u[n-2]$

ii) Find FT of the signal shown in Fig. Q5(a)(ii). **(10 Marks)**

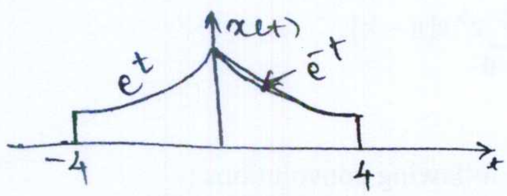

Fig. Q5(a)(ii)

b. Find inverse FT of the following $x(j\omega)$:

i) $x(j\omega) = \frac{j\omega}{(j\omega)^2 + 6j\omega + 8}$

ii) $x(j\omega) = j \cdot \frac{d}{d\omega} \frac{e^{3j\omega}}{2 + j\omega}$. **(10 Marks)**

6 a. Determine output of the LTI system whose I/P and the impulse response is given as :
i) $x(t) = e^{-2t}u(t)$ and $h(t) - e^{-3t}u(t)$
ii) $x[n] = (⅓)^n u[n]$ and $h[n] = \delta[n-4]$. **(08 Marks)**

b. Find the Fourier transform of the signal $x(t) = \cos \omega_0 t$ where $\omega_0 = \frac{2\pi}{T}$ and T the period of the signal. **(04 Marks)**

c. State the sampling theorem and briefly explain how to practically reconstruct the signal. **(08 Marks)**

7 a. State and prove differentiation in z – domain property of z – transforms. **(06 Marks)**

b. Use property of z – transforms to compute x(z) of :
i) $x[n] = n \sin(\pi n/2)\, u[-n]$
ii) $x[n] = (n-2)\,(½)^n\, u[n-2]$. **(06 Marks)**

c. Find the inverse z – transforms of
i) $x(z) = \frac{z^2 - 2z}{\left(z^2 + \frac{3}{2}z - 1\right)} \quad \frac{1}{2} < |z| < 2$
ii) $x(z) = \frac{z^3}{\left(z - \frac{1}{2}\right)} \quad |z| > \frac{1}{2}$. **(08 Marks)**

8 a. Determine the impulse response of the following transfer function if :
i) The system is causal
ii) The system is stable
iii) The system is stable and causal at the same time : $H(z) = \frac{3z^2 - z}{(z-2)\left(z + \frac{1}{2}\right)}$. **(08 Marks)**

b. Use unilateral z – transform to determine the forced response and the natural response of the system described by: $y[n] - \frac{1}{4}y[n-1] - \frac{1}{8}y[n-2] = x[n] + x[n-1]$ where $y[-1] = 1$ and $y[-2] = 1$ with I/P $x[n] = 3^n u[n]$. **(12 Marks)**

* * * * *