USN

Fourth Semester B.E. Degree Examination, June/July 2014
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. Determine the even and odd part of the signal x(t) shown in Fig.Q.1(a). **(06 Marks)**

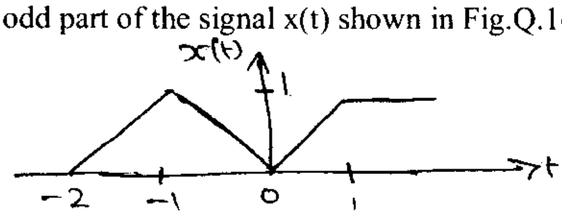

Fig.Q.1(a)

b. The signal $x_1(t)$ and $x_2(t)$ are shown in Fig.Q.1(b). Sketch the following signals:

i) $x_1(t) + x_2(t)$

ii) $x_1(t) \cdot x_2(t)$

iii) $x_1(t/2)$

iv) $x_2(2t)$

v) $x_2(t) - x_1(t)$ **(08 Marks)**

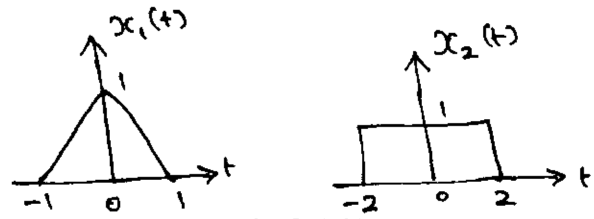

Fig.Q.1(b)

c. Check whether each of the following signals is periodic or not. If periodic determine its fundamental period:

i) $x(n) = \cos(2n)$

ii) $x(n) = (-1)^n$

iii) $x(n) = \cos\left(\frac{\pi}{8}n^2\right)$ **(06 Marks)**

2 a. Perform the convolution of the following signals shown in Fig.Q.2(a) and also sketch the o/p signal y(t). **(08 Marks)**

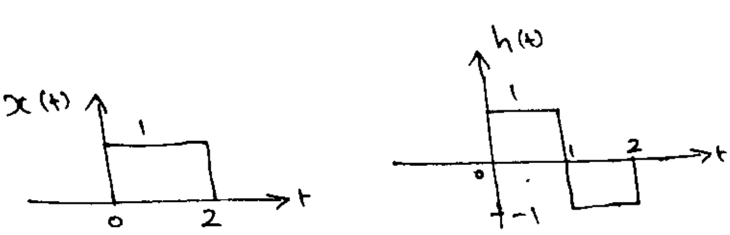

Fig.Q.2(a)

b. Compute the convolution sum of
$x(n) = \alpha^n [u(n) - u(n-8)]$, $|\alpha| < 1$ and $h(n) = u(n) - u(n-5)$. **(08 Marks)**

c. Compute the convolution of two sequences $x_1(n) = \{\underset{\uparrow}{1}, 2, 3\}$ and $x_2(n) = \{1, 2, \underset{\uparrow}{3}, 4\}$. **(04 Marks)**

3 a. Check the followings are stable, causal and memoryless:

i) $h(t) = e^{-t}\, u(t + 100)$

ii) $h(t) = e^{-4|t|}$

iii) $h(n) = 2u(n) - 2\, u(n - 2)$

iv) $h(n) = \delta(n) + \sin(n\pi)$. **(08 Marks)**

b. Find the total response of the system given by

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2x(t) \quad \text{with} \quad y(0) = -1, \quad \left.\frac{dy(t)}{dt}\right|_{t=0} = 1 \quad \text{and input}$$

$x(t) = \cos t\; u(t)$. **(07 Marks)**

c. Find the difference equation corresponding to the block diagram shown in Fig.Q.3(c). **(05 Marks)**

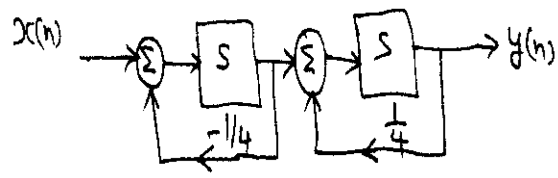

Fig.Q.3(c)

4 a. If $x(n) \xleftrightarrow{DTFS} X(k)$ and $y(n) \xleftrightarrow{DTFS} Y(k)$, then prove that $x(n).y(n) \xleftrightarrow{DTFS} X(k) \circledast Y(k)$. **(07 Marks)**

b. Obtain the DTFS coefficients of $x(n) = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$. Draw the magnitude and phase spectrum. **(06 Marks)**

c. Determine the time domain signal corresponding to the following spectra shown in Fig.Q.4(c). **(07 Marks)**

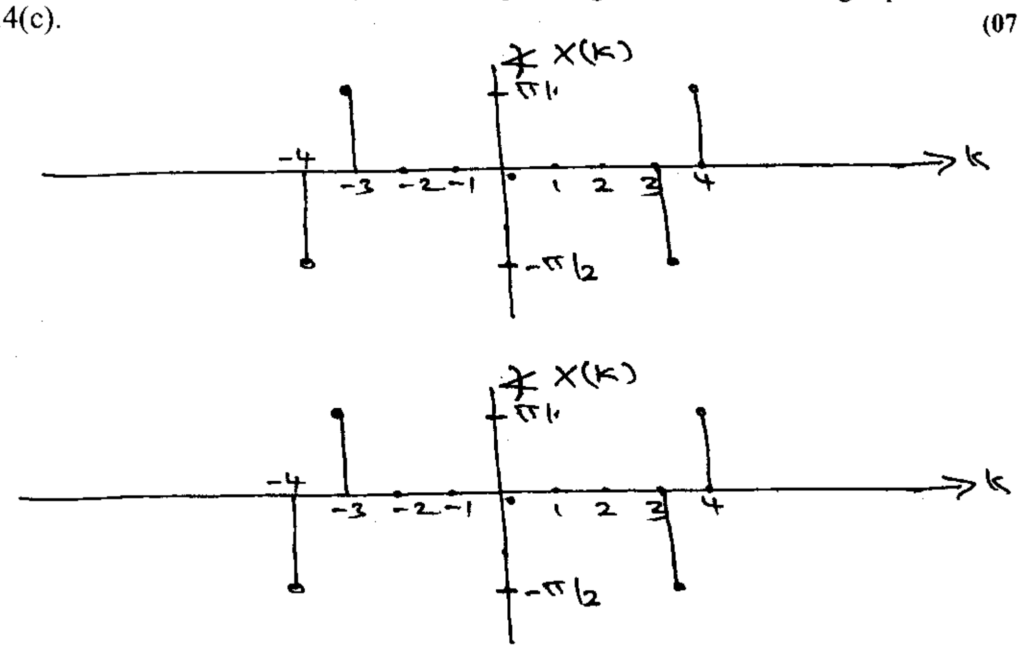

Fig.Q.4(c)

PART – B

5 a. Let $F\{x_1(t)\} = x_1(j\Omega)$ and $F\{x_2(t)\} = x_2(j\Omega)$ then prove that

$$F\{x_1(t).x_2(t)\} = \frac{1}{2\pi}\int_{\lambda=-\infty}^{\infty} x_1(j\lambda)x_2(j\Omega - \lambda)d\lambda.$$ **(07 Marks)**

b. Find the Fourier transform of the signal x(t) shown in Fig.Q.5(b). **(06 Marks)**

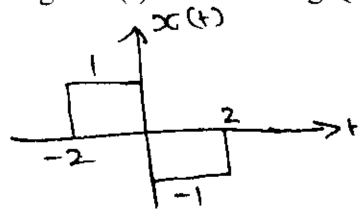

Fig.Q.5(b)

c. Find the inverse Fourier transform of

$X(jw) = \frac{jw}{(2+jw)^2}$ using properties. **(07 Marks)**

6 a. Draw the frequency response of the system described by the impulse response $h(t) = \delta(t) - 2e^{-2t}\,u(t)$. **(07 Marks)**

b. Find the Fourier transform of the periodic impulse train

$\delta_{T_0}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kTo)$ and draw the spectrum. **(08 Marks)**

c. A signal $x(t) = \cos(10\pi t) + 3\cos(20\pi t)$ is ideally sampled with sampling period Ts. Find the Nyquist rate. **(05 Marks)**

7 a. Determine Z-transform of the following DTS and also find the ROC:

i) $x(n) = 0.8^n\,u(-n-1)$

ii) $x(n) = -u(-n-1) + \left(\frac{1}{2}\right)^n u(n)$. **(08 Marks)**

b. It $x(n) \xleftrightarrow{Z} X(z)$, with ROC = R then prove that $n.x(n) \xleftrightarrow{Z} -z\frac{X(z)}{dz}$ with ROC = R. **(06 Marks)**

c. Determine the inverse Z-transform of the function

$X(z) = \frac{3z^2 + 2z + 1}{z^2 + 3z + 2}$. **(06 Marks)**

8 a. Determine the impulse response of the sequence described by $y(n) - 2y(n-1) + y(n-2) = x(n) + 3x(n-3)$. **(08 Marks)**

b. Solve the following difference equation using unilateral Z-transform:

$y(n) - \frac{3}{2}y(n-1) + \frac{1}{2}y(n-2) = x(n)$, for $n \geq 0$ with initial conditions y(-1) = 4, y(-2) = 10 and i/p $x(n) = \left(\frac{1}{4}\right)^n u(n)$. **(08 Marks)**

c. Define stability and causality with respect to Z-transform. **(04 Marks)**

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