USN | | | | | | | | | | | **10EC44**

Fourth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Signals & Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define signal and system with example. And briefly explain operations performed on independent variable of the signal. **(06 Marks)**

b. Determine whether the following signal is energy signal or power signal and calculate its energy or power

$x(t) = \text{rect}\left(\frac{t}{T_0}\right)\cos\omega_0 t.$ **(04 Marks)**

c. Find whether the following system is stable, memory less, linear and time invariant? $y(t) = \sin[x(t+2)]$ **(04 Marks)**

d. Two signals x(t) and g(t) as shown in Fig. Q1 (d). Express the signals x(t) interms of g(t). **(06 Marks)**

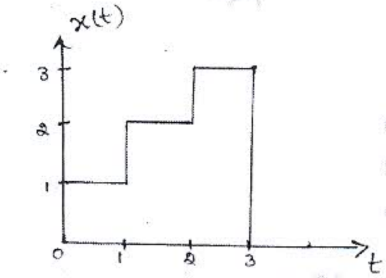

Fig. Q1 (d) – (i)

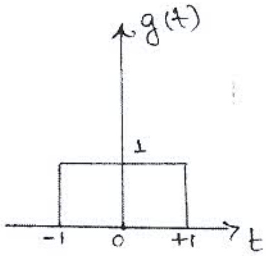

Fig. Q1 (d) – (ii)

2 a. Given the signal x(t) as shown in Fig. Q2 (a). Sketch the following:

i) $x(-2t+3)$ ii) $x\left(\frac{t}{2}-2\right)$ **(04 Marks)**

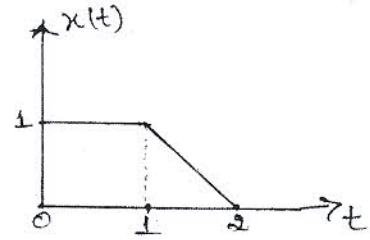

Fig. Q2 (a)

b. For a DT LTI system to be stable show that,

$S \stackrel{\Delta}{\equiv} \sum_{K=-\infty}^{K=+\infty} |h(K)| < \infty$ **(05 Marks)**

c. Two discrete time LTI systems are connected in cascade as shown in Fig. Q2 (c). Determine the unit sample response of this cascade connection. **(06 Marks)**

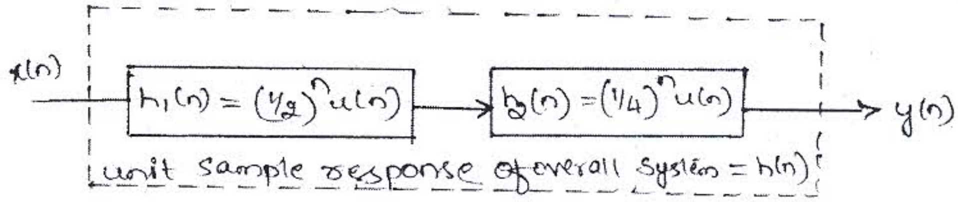

Fig. Q2 (c)

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.

d. Find convolution of 2 finite duration sequences,
$h(n) = a^n u(n)$ for all n and
$x(n) = b^n u(n)$ for all n
i) when $a \neq b$ ii) when $a = b$ **(05 Marks)**

3 a. Determine the LTI systems characterized by impulse response.

i) $h(n) = n\left(\frac{1}{2}\right)^n u(n)$ ii) $h(t) = e^{-t}u(t+100)$

Stable and causal. **(06 Marks)**

b. Find the forced response of the following system:

$y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$ for $x(n) = \left(\frac{1}{8}\right)^n u(n)$. **(08 Marks)**

c. Draw direct form II implementation for the system described by the following equation and indicate number of delay elements, adders, multipliers.
$y(n) - 0.25y(n-1) - 0.125y(n-2) - x(n) - x(n-2) = 0$ **(06 Marks)**

4 a. Prove the following properties of DTFS:
i) Convolution in time. ii) Modulation theorem. **(06 Marks)**

b. Determine the complex exponential Fourier series for periodic rectangular pulse train shown in Fig. Q4 (b). Plot its magnitude and phase spectrum. **(08 Marks)**

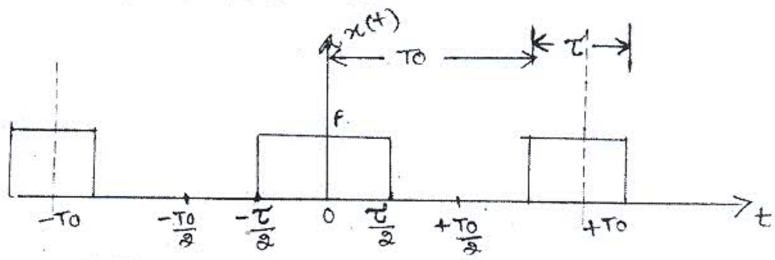

Fig. Q4 (b)

c. Determine the DTFS representation for the signal $x(n) = \cos\left(\frac{n\pi}{3}\right)$. Plot the spectrum of x(n). **(06 Marks)**

PART – B

5 a. State and prove the following properties of DTFT:
i) Parsevai's theorem ii) Linearity **(06 Marks)**

b. Find the DTFT of the signals shown,

i) $x(n) = \left(\frac{1}{4}\right)^n u(n+4)$ ii) $x(n) = u(n)$ **(08 Marks)**

c. Find the inverse Fourier transform of the rectangular spectrum shown, **(06 Marks)**

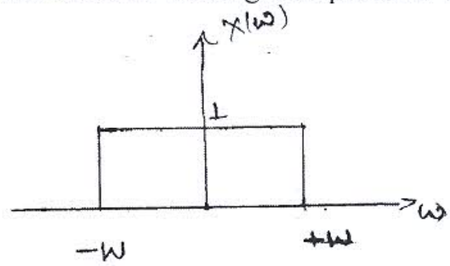

Fig. Q5 (c)

6 a. Consider the continuous time LTI system described by,

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

Using FT, find the output y(t) to each of the following input signals.

i) $x(t) = e^{-t}u(t)$

ii) $x(t) = u(t)$ **(08 Marks)**

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

i) $x(t) = \operatorname{sinc}^2(200t)$

ii) $x(t) = 2\operatorname{sinc}(50t)\sin(5000\pi t)$ **(06 Marks)**

c. An LTI system is described by $H(f) = \dfrac{4}{2 + j2\pi f}$ find its response y(t) if the input is $x(t) = u(t)$ **(06 Marks)**

7 a. Define ROC and list its properties. **(04 Marks)**

b. State and prove time reversal property of z-transform. **(04 Marks)**

c. Determine the inverse z-transform of $x(z) = \dfrac{1}{(1+z^{-1})(1-z^{-1})^2}$; ROC; $|z|>1$ **(06 Marks)**

d. Determine z-transform and ROC of $x(n) = \left(\dfrac{1}{3}\right)^n \sin\left(\dfrac{\pi}{4}n\right)u(n)$ **(06 Marks)**

8 a. A causal, stable discrete time system is defined by,

$$y(n) = \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n) - 2x(n-1)$$

Determine

i) System function H(z) and magnitude response at zero frequency.

ii) Impulse response of the system.

iii) Output y(n) for $x(n) = \delta(n) - \dfrac{1}{3}\delta(n-1)$ **(12 Marks)**

b. Solve the following difference equation for the given initial conditions and input,

$$y(n) - \frac{1}{9}y(n-2) = x(n-1)$$

With $y(-1) = 0$, $y(-2) = 1$ and $x(n) = 3u(n)$ **(08 Marks)**

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10EC44

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)**

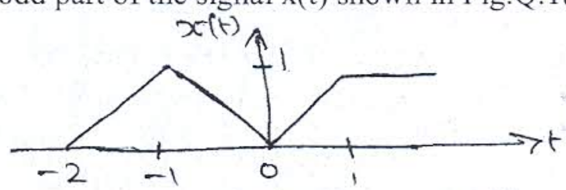

Fig.Q.1(a)

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) $x_1(t) . x_2(t)$
iii) $x_1(t/2)$
iv) $x_2(2t)$
v) $x_2(t) - x_1(t)$ **(08 Marks)**

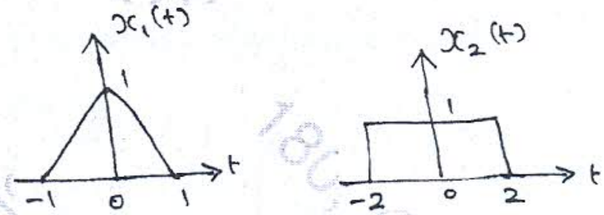

Fig.Q.1(b)

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)**

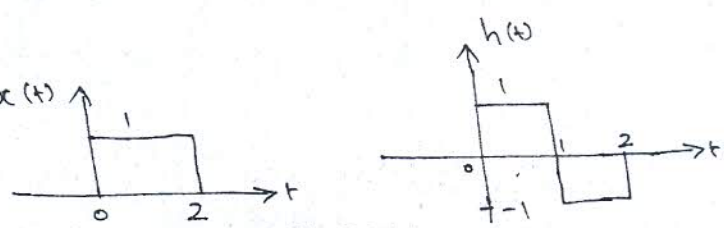

Fig.Q.2(a)

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)**

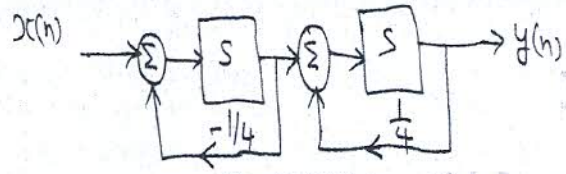

Fig.Q.3(c)

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

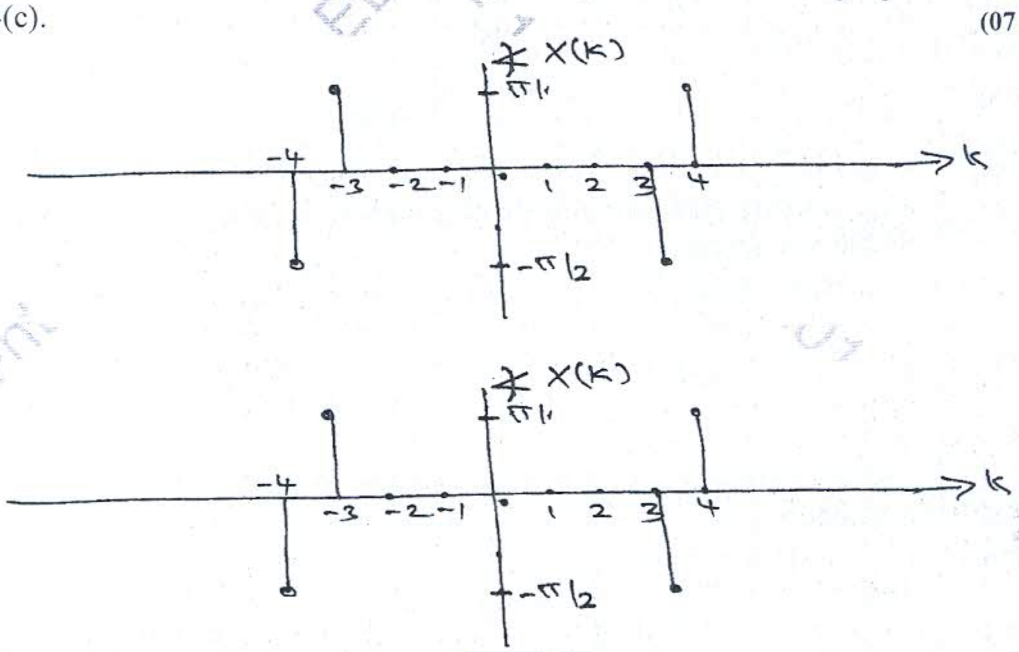

Fig.Q.4(c)

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)**

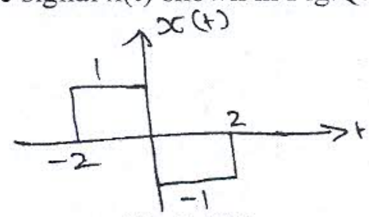

Fig.Q.5(b)

c. Find the inverse Fourier transform of

$X(jw) = \dfrac{jw}{(2+jw)^2}$ 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

$\delta_{To}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kTo)$ 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) $x(n) = -u(-n-1) + \left(\dfrac{1}{2}\right)^n u(n)$. **(08 Marks)**

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

c. Determine the inverse Z-transform of the function

$X(z) = \dfrac{3z^2 + 2z + 1}{z^2 + 3z + 2}$. **(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:

$y(n) - \dfrac{3}{2}y(n-1) + \dfrac{1}{2}y(n-2) = x(n)$, for $n \geq 0$ with initial conditions $y(-1) = 4$, $y(-2) = 10$

and i/p $x(n) = \left(\dfrac{1}{4}\right)^n u(n)$. **(08 Marks)**

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

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USN 1SB11EC038 **10EC44**

Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

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

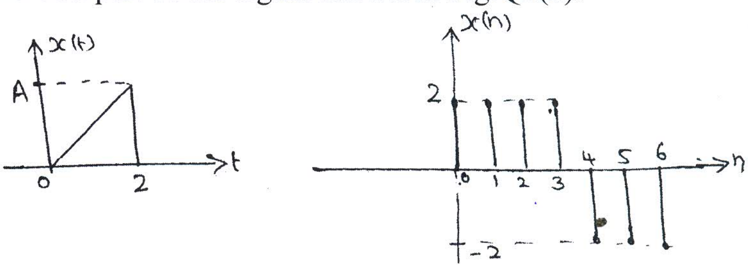

Fig.Q1(a)

b. Check whether the following signals is periodic or not and if periodic find its fundamental period.
(i) $x(n) = \cos(20\pi n) + \sin(50\pi n)$ (ii) $x(t) = [\cos(2\pi t)]^2$ **(06 Marks)**

c. Let x(t) and y(t) as shown in Fig.Q1(c). Sketch (i) $x(t)y(t-1)$ (ii) $x(t)y(-t-1)$ **(08 Marks)**

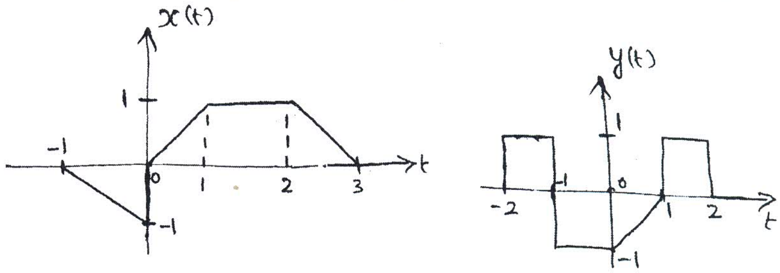

Fig.Q1(c)

2 a. Determine the convolution sum of the given sequences
$$x(n) = \{1, \underset{\uparrow}{-2}, 3, -3\} \quad \text{and} \quad h(n) = \{-2, \underset{\uparrow}{2}, -2\}$$ **(04 Marks)**

b. Perform the convolution of the following sequences:
$$x_1(t) = e^{-at} \quad ; \quad 0 \le t \le T$$
$$x_2(t) = 1 \quad ; \quad 0 \le t \le 2T$$ **(10 Marks)**

c. An LT1 system is characterized by an impulse response, $h(n) = \left(\frac{1}{2}\right)^n u(n)$. Find the response of the system for the input $x(n) = \left(\frac{1}{4}\right)^n u(n)$. **(06 Marks)**

3 a. Determine the following LT1 systems characterized by impulse reponse is memory, causal and stable.
(i) $h(n) = 2u(n) - 2u(n-2)$ (ii) $h(n) = (0.99)^n u(n+6)$. **(06 Marks)**

b. Find the natural response of the system described by a differential equation
$$\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} + 2y(t) = 2x(t), \quad \text{with } y(0) = 1, \text{ and } \left.\frac{dy(t)}{dt}\right|_{t=0} = 0$$ **(06 Marks)**

c. Find the difference equation description for the system shown in Fig.Q3(c). **(04 Marks)**

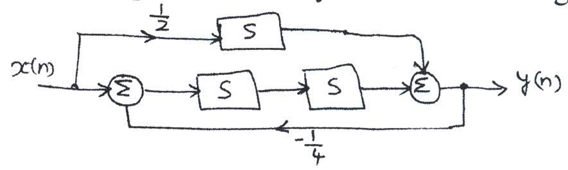

Fig.Q3(c)

d. By converting the differential equation to integral equation draw the direct form-I and direct form-II implementation for the system as

$$\frac{d^3y(t)}{dt^3}+4\frac{d^2y(t)}{dt^2}+2\frac{dy(t)}{dt}=x(t)+6\frac{d^2x(t)}{dt^2}$$ **(04 Marks)**

4 a. State and prove the following properties of DTFS: (i) Modulation (ii) Parseval's theorem. **(10 Marks)**

b. Find the Fourier series coefficients of the signal x(t) shown in Fig.Q4(b) and also draw its spectra. **(10 Marks)**

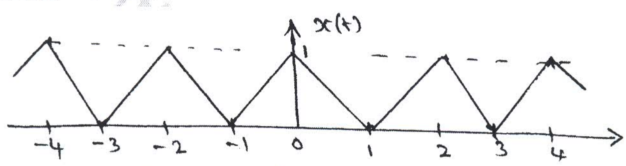

Fig.Q4(b)

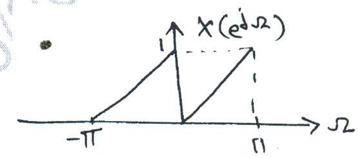

Fig.Q5(b)

PART – B

5 a. Find the DTFT of the following signals:
(i) $x(n) = a^{|n|}$; $|a| < 1$ (ii) $x(n) = 2^n u(-n)$ **(08 Marks)**

b. Determine the signal x(n) if its DTFT is as shown in Fig.Q5(b). **(06 Marks)**

c. Compute the Fourier transform of the signal

$$x(t)=\begin{cases}1+\cos\pi t & ; \ |t|\le 1\\ 0 & ; \ |t|>1\end{cases}$$ **(06 Marks)**

6 a. Find the frequency response of the system described by the impulse response
$h(t) = \delta(t) - 2e^{-2t}u(t)$
and also draw its magnitude and phase spectra. **(08 Marks)**

b. Obtain the Fourier transform representation for the periodic signal
$x(t) = \sin w_0 t$
and draw the magnitude and phase. **(07 Marks)**

c. A signal $x(t) = \cos(20\pi t) + ¼ \cos(30\pi t)$ is sampled with sampling period τ_s. Find the Nyquist rate. **(05 Marks)**

7 a. What is region of convergence (ROC)? Mention its properties. **(06 Marks)**

b. Determine the z-transform and ROC of the sequence $x(n) = r_1^n u(n) + r_2^n u(-n)$. **(07 Marks)**

c. Determine the inverse z-transform of the function, $x(z)=\dfrac{1+z^{-1}}{1-z^{-1}+0.5z^{-2}}$, using partial fraction expansion. **(07 Marks)**

8 a. An LT1 system is described by the equation
$y(n) = x(n) + 0.8\,x(n-1) + 0.8x(n-2) - 0.49y(n-2)$

b. Determine the transfer function H(z) of the system and also sketch the poles and zeros. **(06 Marks)**

c. Determine whether the system described by the equation
$y(n) = x(n) + b\,y(n-1)$ is causal and stable where $|b| < 1$. **(08 Marks)**

Find the unilateral z-transform for the sequence $y(n) = x(n-2)$, where $x(n) = \alpha^n$. **(06 Marks)**

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2002 SCHEME

USN | | | | | | | | | | | **EC36**

Third Semester B.E. Degree Examination, Dec. 2013 / Jan. 2014
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Define the following signals, with examples.
i) Continuous time and discrete time signals ii) Even and odd signals iii) Period and non period signals iv) Energy and power signals. **(08 Marks)**

b. Determine and sketch the even and odd components of the signals shown in Fig.1(b) (i) and Fig. 1(b)(ii). **(06 Marks)**

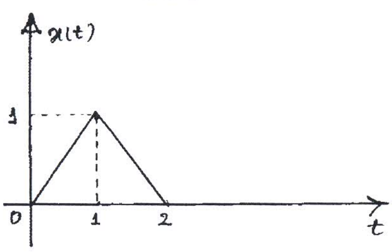


Fig.Q1(b) (i)

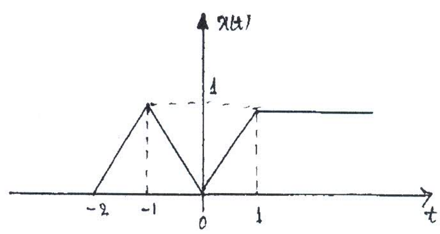


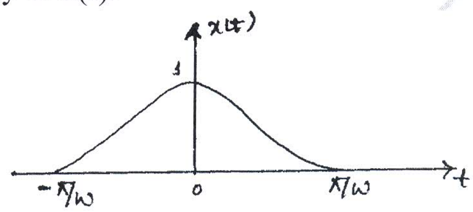
Fig. Q1(b) (ii)

c. The raised – cosine pulse x(t) shown in fig.Q1(c) is defined as

$$x(t)=\begin{cases}\frac{1}{2}[\cos(wt)+1] & -\lambda/w \le 1 \le \lambda/w \\ 0 & \text{otherwise}\end{cases}$$

Determine the total energy of x(t). **(06 Marks)**

Fig.Q1(c)



2 a. Fig.Q2(a)(i) shows the staircase like signal x(t) that may be viewed as the superposition of four rectangular pulses. Use the rectangular pulse shown in Fig.Q2(a)(ii), construct this waveform and express x(t) in terms of g(t). **(05 Marks)**

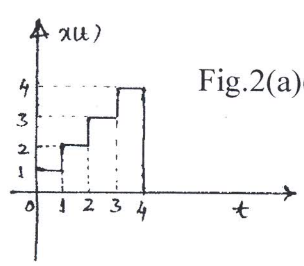
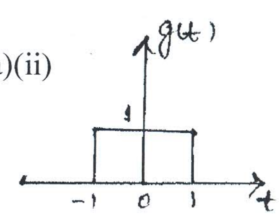


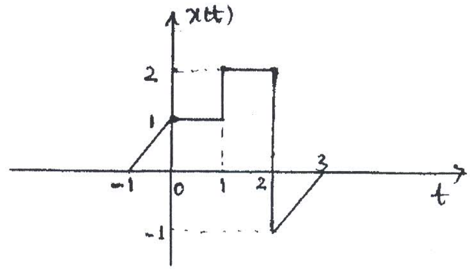
Fig.2(a)(i)

Fig.2(a)(ii)



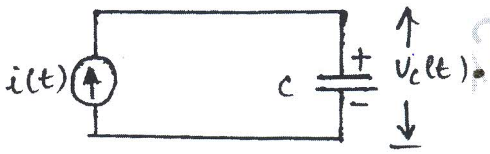
b. A continuous time signal x(t), shown in fig.Q2(b). Draw the signal, $y(t) = \{x(t) + x(2-t)\}\, u(1-t)$. **(05 Marks)**

Fig.Q2(b)



c. Consider the circuit shown in fig.Q2(c). Let x(t) = i(t) and y(t) = Vc(t)
i) Find the input – output relationship   ii) Determine whether the system is memory less , causal , linear and time – invariant. **(10 Marks)**

Fig.Q2(c)



3 a. Use the convolution integral to prove the following properties :
i) Distributive $x(t) * [\, h(t) + g(t)] = x(t) * h(t) + x(t) * g(t)$
ii) Associative : $\{x(t) * h(t)\} * g(t) = x(t) * \{h(t) * g(t)\}$
iii) Commutative $x(t) * h(t) = h(t) = h(t) * x(t)$. **(12 Marks)**

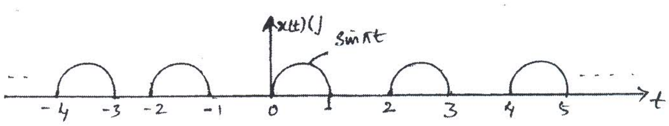
b. Given that $h(n) = 0.5^{n-1}\, u(n)$. $x(n) = \cos(0.2n)\, u(n)$. Determine the convolution of x(n) with h(n). **(08 Marks)**

4 a. The transfer function of linear shift invariant system is given by
$H(e^{jw}) = \dfrac{5}{1+e^{jw}}$. Obtain the output in Amplitude and phase form for the following input.
$x(n) = 6 + 2\cos 10n + \cos(20n + 0.19)$. **(12 Marks)**

b. Convert the following differential equation in to an integral equation and draw direct form I and direct form II realization.
$$\frac{d^2y(t)}{dt^2} + 5.\frac{dy(t)}{dt} + 4y(t) = x(t) + 3.\frac{dx(t)}{dt}.$$ **(08 Marks)**

5 a. Evaluate the FS representation of the signal shown in fig.5(a). Sketch the magnitude and phase spectra. **(12 Marks)**

Fig.Q5(a)

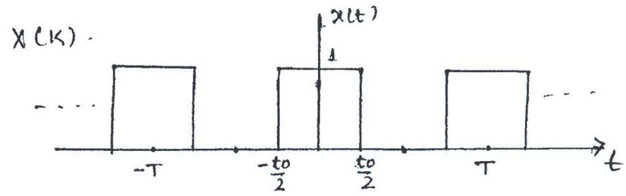


b. Determine the time signals represented by the following DTFS coefficients :
$$X[K] = \cos\left(\frac{10\pi k}{21}\right) + j\,\sin\left(\frac{4\pi}{21}k\right).$$ **(08 Marks)**

6 a. If $x(t) \xleftrightarrow{FS,W0} X[k]$ then, prove that $\dfrac{d}{dt}x(t) \xleftrightarrow{FS,Wo} j\,k\,wo\,x[k]$. **(08 Marks)**

b. Consider the rectangular pulse shown in fig.6(b). Using the derivative property find x(k). **(12 Marks)**

Fig.Q6(b)



7 a. List the properties of ROC of Z – transform. **(06 Marks)**

b. Find the Z – transform and associated ROC for each of the following sequence.

i) $x(n) = -bn\,u(-n-1)$ ii) $x(n) = \left(\frac{1}{3}\right)^n \sin\left(\frac{\pi}{4}n\right)\ u(n)$. **(14 Marks)**

8 a. Find the inverse Z – transform of x(z) using complex inverse integral method. Also verify the result using partial fraction expansion method.

$$X(z) = \frac{(z-1)^2}{z^2 - 0.12 - 0.56}.$$ **(12 Marks)**

b. Find inverse Z – transform by power series method.

$X(z) = \dfrac{z}{3z^2 - 4z + 1}$, where ROC are i) $|z| > 1$ ii) $|z| < \frac{1}{3}$. **(08 Marks)**

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10EC44

Fourth Semester B.E. Degree Examination, June/July 2013
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Determine whether the discrete time signal $x(n) = \cos\left(\frac{\pi n}{5}\right)\sin\left(\frac{\pi n}{3}\right)$ is periodic. If periodic, find the fundamental period. **(04 Marks)**

b. Determine whether the signal shown in Fig. Q1 (b) is a power signal or energy signal. Justify your answer and further determine its energy/power. **(06 Marks)**

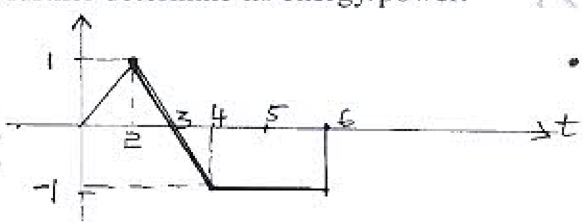

Fig. Q1 (b)

c. Given the signal $x(n) = (6 - n)\{u(n) - u(n-6)\}$ make a sketch of $x(n)$, $y_1(n) = x(4 - n)$ and $y_2(n) = x(2n - 3)$. **(04 Marks)**

d. Find and sketch the following signals and their derivatives:
i) $x(t) = u(t) - u(t-a);\ a > 0$ ii) $y(t) = t[u(t) - u(t-a)]\ ;\ a > 0.$ **(06 Marks)**

2 a. The impulse response of a discrete LTI system is give by, $h(n) = u(n+1) - u(n-4)$. The system is excited by the input signal $x(n) = u(n) - 2u(n-2) + u(n-4)$. Obtain the response of the system $y(n) = x(n)*h(n)$ and plot the same. **(07 Marks)**

b. Given $x(t) = t \quad 0 < t \le 1$ and 0 elsewhere
and $h(t) = u(t) - u(t-2)$, evaluate and sketch $y(t) = x(t)*h(t)$, $x(t)$ and $h(t)$. **(07 Marks)**

c. Show that : i) $x(t)*h(t) = h(t)*x(t)$
ii) $\{x(n)*h_1(n)\}*h_2(n) = x(n)*\{h_1(n)*h_2(n)\}$. **(06 Marks)**

3 a. Solve the difference equation, $y(n) - 3y(n-1) - 4y(n-2) = x(n)$ with $x(n) = 4^n u(n)$. Assume that the system is initially relaxed. **(06 Marks)**

b. Draw the direct form I and direct form II implementations for,

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

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

c. Define causality. Derive the necessary and sufficient conditions for a discrete LTI system to be causal in terms of the impulse response. **(04 Marks)**

4 a. Determine the DTFS coefficients of,

$x(n) = 1 + \sin\left\{\frac{1}{12}\pi n + \frac{3\pi}{8}\right\}$ **(06 Marks)**

4 b. Find the exponential Fourier series of the waveform shown in Fig. Q4 (b). **(08 Marks)**

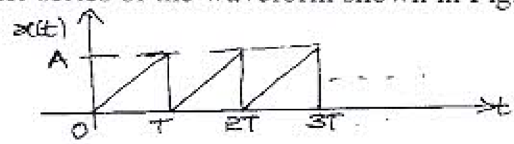

Fig. Q4 (b)

c. Explain the Direchlet conditions for the existence of Fourier series. **(06 Marks)**

PART – B

5 a. Find the DTFT of the signal x(n) given by $x(n) = u(n) - u(n-N)$; where N is any +ve integer. Determine the magnitude and phase components and draw the magnitude spectrum for N = 5. **(10 Marks)**

b. Determine the fourier transform of the following signals : i) $x(t) = e^{-3t}u(t-1)$ ii) $x(t) = e^{-3|t|}$. **(10 Marks)**

6 a. Determine the frequency response and the impulse response for the system described by the differential equation,

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = \frac{-d}{dt}x(t)$$ **(10 Marks)**

b. Determine the Nyquist sampling rate and Nyquist sampling interval for,

i) $x(t) = 1 + \cos 2000\pi t + \sin 4000\pi t$ ii) $x(t) = \left[\frac{\sin(4000\pi t)}{\pi t}\right]^2$ **(06 Marks)**

c. Explain briefly, the reconstruction of continuous time signals with zero order hold. **(04 Marks)**

7 a. Find the z-transform of the following and indicate the region of convergence:

i) $x(n) = a^n \cos\Omega_0(n-2)u(n-2)$

ii) $x(n) = n(n+1)a^n u(n)$ **(10 Marks)**

b. Find the inverse z-transform of the following:

i) $x(z) = \frac{z^4 + z^2}{z^2 - \frac{3}{4}z + \frac{1}{8}}$; $|z| > \frac{1}{2}$ by Partial fraction expansion method.

ii) $x(z) = \frac{1 - az^{-1}}{z^{-1} - a}$; $z > \frac{1}{a}$ by long division method. **(10 Marks)**

8 a. A discrete LTI system is characterized by the difference equation,

$y(n) = y(n-1) + y(n-2) + x(n-1)$

Find the system function H(z) and indicate the ROC if the system, i) Stable ii) Causal. Also determine the unit sample response of the stable system. **(10 Marks)**

b. Solve the following difference equation using the unilateral z-transform.

$$y(n) - \frac{7}{12}y(n-1) + \frac{1}{12}y(n-2) = x(n) \text{ for } n \geq 0$$

With initial conditions y(-1) = 2, y(-2) = 4 and $x(n) = \left(\frac{1}{5}\right)^n u(n)$. **(10 Marks)**

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06EC44

Fourth Semester B.E. Degree Examination, June/July 2013
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish between :
i) Even and odd signals
ii) Periodic and non-periodic signals
iii) Energy and power signals. **(06 Marks)**

b. Sketch the following signals
$x(n) = \delta(n)$
$x(n) = -2u(-n)$
$x(t) = (t-1)\,u(t)$
$x(t) = 2u(t-1) - 2u(t-3)$. **(04 Marks)**

c. For the signal $x(n) = \{1, \underset{\uparrow}{2}, 3, 4\}$, sketch the signal $x(-2n+1)$. **(04 Marks)**

d. Determine whether the system $y(n) = x(n) + 3u(n+1)$ is
i) Linear ii) Time – invariant iii) Causal iv) Memory less v) Stable. **(06 Marks)**

2 a. Derive the expression for convolution sum. **(04 Marks)**

b. Convolve the signals $x_1(n) = 1\delta(n) + 2\delta(n-1) + 3\delta(n-2) + 4\delta(n-3)$ and $x_2(n) = \delta(n) + 2\delta(n-1) + 3\delta(n-2)$. **(06 Marks)**

c. State and prove associative property of convolution integral. **(06 Marks)**

d. Find the response $y(t) = x(t) * h(t)$ for the signal $x(t) = e^{at}\,u(t)$; $a > 0$ and impulse response $h(t) = u(t)$. **(04 Marks)**

3 a. For each of the impulse response listed below, determine whether the corresponding system is i) Causal ii) Memory less iii) Stable. i) $h(t) = e^{-2|t|}$ ii) $h(t) = e^{2|t|}u(t-1)$. **(06 Marks)**

b. Evaluate the forced response of the system
$y'(t) + 2y(t) = e^{-2t}u(t)$. **(04 Marks)**

c. Solve the homogeneous difference equation (find natural response)
$y(n) + y(n-1) + \frac{1}{2}y(n-2) = 0$ with $y(-1) = -1$ and $y(-2) = 1$. **(06 Marks)**

d. Draw direct for m – I and direct form – II implementations for the system
$$\frac{dy(t)}{dt} + 5y(t) = 3x(t).$$ **(04 Marks)**

4 a. State and prove the following properties of Fourier series
i) Time –shift
ii) Frequency –shift. **(06 Marks)**

b. Evaluate the DTFs representation for the signal
$$x(n) = \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right) + 1$$
Sketch the magnitude and phase spectra. **(08 Marks)**

c. For the signal $x(t) = \sin w_0 t$, find the Fourier series and draw its magnitude spectrum. **(06 Marks)**

PART – B

5 a. State and prove the following properties of DTFT
i) Frequency shift
ii) Frequency differentiation. **(06 Marks)**

b. Find the FT of the following signals
i) $x(t) = \delta(t)$
ii) $x(t) = e^{-at} u(t)$; $a > 0$. **(06 Marks)**

c. Find the inverse FT of
$$x(jw) = \frac{jw + 1}{(jw)^2 + 5jw + 6}.$$ **(08 Marks)**

6 a. Find the impulse response of
$$\frac{d^2}{dt^2} y(t) + 3\frac{d}{dt} y(t) + 2y(t) = 2\frac{d}{dt} x(t) + x(t)$$

b. By applying Fourier transform and IFT. **(08 Marks)**
State and prove sampling theorem for low pass signal. **(08 Marks)**

c. Consider the analog signal $x(t) = 3 \cos 50\pi t + 10 \sin 300\pi t - \cos 100\pi t$. What is the Nyquist rate for this signal? **(04 Marks)**

7 a. State and prove :
i) Linearity
ii) Differentiation in z – domain, properties of z – transform. **(06 Marks)**

b. Determine the z – transformation of
$x(n) = \{1, 2, \underset{\uparrow}{3}\}$

$x(n) = (2)^n u(n)$
$x(n) = \delta(n + 2)$
$x(n) = -(3)^n u(-n - 1)$. **(08 Marks)**

c. Find out the inverse z – transform of
$$x(z) = \frac{1}{1 - 4z^{-1}}, \text{ RoC} : |z| > |4|.$$
Using power series expansion. **(06 Marks)**

8 a. Find the unilateral z – transform of
$x(n) = \{1, 2, \underset{\uparrow}{3}, 4\}$

$y(n) = a^n u(n + 1)$; $a < 1$. **(06 Marks)**

b. Find the difference – equation description for a system with transform function :
$$H(z) = \frac{y(z)}{x(z)} = \frac{5z + 2}{z^2 + 3z + 2}.$$ **(06 Marks)**

c. Consider the system described the difference question $y(n) - 0.9y(n - 1) = x(n)$. Find output if the input is $x(n) = u(n)$ and the initial condition on the output is $y(-1) = 2$. **(08 Marks)**

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USN | | | | | | | | | | | 10EC44

Fourth Semester B.E. Degree Examination, December 2012
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

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.

PART – A

1 a. Determine whether the following systems are:
i) Memoryless, ii) Stable iii) Causal iv) Linear and v) Time-invariant.
- $y(n) = nx(n)$
- $y(t) = e^{x(t)}$ **(10 Marks)**

b. Distinguish between: i) Deterministic and random signals and
ii) Energy and periodic signals. **(06 Marks)**

c. For any arbitrary signal x(t) which is an even signal, show that $\int_{-\infty}^{\infty} x(t)dt = 2\int_{0}^{+\infty} x(t)dt$. **(04 Marks)**

2 a. Find the convolution integral of x(t) and h(t), and sketch the convolved signal, $x(t) = (t-1)\{u(t-1) - u(t-3)\}$ and $h(t) = [u(t+1) - 2u(t-2)]$. **(12 Marks)**

b. Determine the discrete-time convolution sum of the given sequences.
$x(n) = \{1, \underset{\uparrow}{2}, 3, 4\}$ and $h(n) = \{1, \underset{\uparrow}{5}, 1\}$ **(08 Marks)**

3 a. Determine the condition of the impulse response of the system if system is,
i) Memory less ii) Stable. **(06 Marks)**

b. Find the total response of the system given by,
$$\frac{d^2y(t)}{dt^2} + 3\frac{d}{dt}y(t) + 2y(t) = 2x(t) \text{ with } y(0) = -1;\ \left.\frac{d}{dt}y(t)\right/_{t=0} = 1 \text{ and } x(t) = \cos(t)u(t).$$ **(14 Marks)**

4 a. One period of the DTFS coefficients of a signal is given by, $x(k) = (1/2)^K$, on $0 \le K \le 9$. Find the time-domain signal x(n) assuming N = 10. **(06 Marks)**

b. Prove the following properties of DTFs: i) Convolution ii) Parseval relationship iii) Duality iv) Symmetry. **(14 Marks)**

PART – B

5 a. Find the DTFT of the sequence $x(n) = \alpha^n u(n)$ and determine magnitude and phase spectrum. **(04 Marks)**

b. Plot the magnitude and phase spectrum of $x(t) = e^{-at}u(t)$. **(08 Marks)**

c. Find the inverse Fourier transform of the spectra, $x(j\omega) = \begin{cases} 2\cos(\omega), & |\omega| < \pi \\ 0, & |\omega| > 0 \end{cases}$ **(08 Marks)**

6 a. Find the frequency response and impulse response of the system described by the differential equation.

$$\frac{d^2}{dt^2}y(t) + 5\frac{d}{dt}y(t) + 6y(t) = -\frac{d}{dt}x(t)$$ **(08 Marks)**

b. State sampling theorem. Explain sampling of continuous time signals with relevant expressions and figures. **(06 Marks)**

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

i) $x_1(t) = \sin c(200t)$ ii) $x_2(t) = \sin c^2(500t)$ **(06 Marks)**

7 a. Prove the complex conjugation and time-advance properties. **(06 Marks)**

b. Find the z-transform of the signal along with ROC.

$x(n) = n\sin\left(\frac{\pi}{2}n\right)u(n)$ **(06 Marks)**

c. Determine the inverse z-transform of the following x(z) by partial fraction expansion method,

$$x(z) = \frac{z+2}{2z^2 - 7z + 3}$$

if the ROCs are i) $|z| > 3$ ii) $|z| < \frac{1}{2}$ and iii) $\frac{1}{2} < |z| < 3$. **(08 Marks)**

8 a. A system has impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$, determine the input to the system if the output is given by,

$$y(n) = \frac{1}{3}u(n) + \frac{2}{3}\left(-\frac{1}{2}\right)^n u(n).$$ **(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 $x(n) = \left(\frac{1}{4}\right)^n u(n)$. **(12 Marks)**

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USN

06EC44

Fourth Semester B.E. Degree Examination, December 2012

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Make valid assumptions for any missing data.***

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.

PART – A

1 a. Write the formal definition of a signal and a system. With suitable examples, state the important differences between:
i) Continuous and discrete sinusoid ii) Even and odd symmetry waveforms **(10 Marks)**

b. Illustrate how the stability of an LTI system can be computed in time domain. **(02 Marks)**

c. The impulse response of an LTI system may be represented by

$$h[n]=\begin{cases}a^n & n\ge 0\\ b^n & n<0\end{cases}.$$

Determine the range of values of a and b so that the given system is stable. **(08 Marks)**

2 a. State and prove the following properties of convolution sum:
i) Commutative property ii) Associative property iii) Distributive property **(10 Marks)**

b. Find the convolution of two infinite duration sequences $x[n] = \alpha^n u[n]$, $h[n] = \beta^n u[n]$ when i) $\alpha > \beta$, ii) $\alpha = \beta$, iii) $\alpha < \beta$. **(10 Marks)**

3 a. Determine the total response y[n], $n \ge 0$ of a system described by the following difference equation using time domain method:

$$y[n]-3y[n-1]-4y[n-2]=x[n]+2x[n-1]$$

Assume $x[n] = 4^n u[n]$ and zero initial conditions. **(10 Marks)**

b. Obtain direct Form – II representation for the following differential equation representation

$$2\frac{d^3}{dt^3}y(t)+4\frac{d}{dt}y(t)+6y(t)=2x(t)+6\frac{d}{dt}x(t)$$ **(05 Marks)**

c. Obtain the difference equation representation for the following realized system shown in Fig.Q3(c). **(05 Marks)**

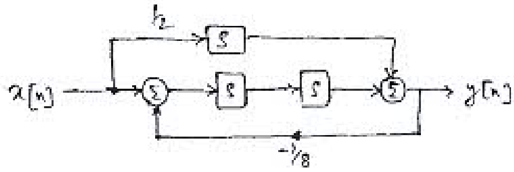


Fig.Q3(c)

4 a. Evaluate the discrete time Fourier series (DTFS) representation of x[n] and plot magnitude and phase spectrum when $x[n]=\cos\left(\frac{6\pi}{17}n+\frac{\pi}{3}\right)$. **(06 Marks)**

b. Determine the time domain signal x[n] when its discrete time Fourier coefficient specified as

$$X[K]=\cos\left(\frac{10\pi}{19}K\right)+j2\sin\left(\frac{4\pi}{19}K\right)$$ **(06 Marks)**

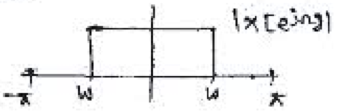
c. Determine the complex exponential Fourier series representation for the following continuous time signal x(t) where x(t) = cos 4t + sin 6t. Plot its spectrum. **(08 Marks)**

PART – B

5 a. Find the discrete time Fourier transformation of the time domain sequence $x[n] = \alpha^n u[n]$ and plot the magnitude and phase spectrum for the values of α (i) $\alpha = 0.5$, (ii) $\alpha = 0.9$. **(08 Marks)**

b. The DTFT of a time domain sequence is defined as

$$X(e^{j\Omega}) = \begin{cases} 1 & |\Omega| < W \\ 0 & W \le |\Omega| < \pi \end{cases}$$



Find its IDTFT and plot $x[n]$. **(06 Marks)**

c. For a moving average spectrum is described by $y[n] = \frac{1}{2}[x[n] + x[n-1]]$. Find its frequency response $H(e^{j\Omega})$ and plot amplitude and spectrum. **(06 Marks)**

6 a. The input to a discrete time system is given by $x[n] = \cos\left(\frac{\pi}{8}n\right) + \sin\left(\frac{3\pi}{4}n\right)$. Use the DTFT to find the output of the system $y[n]$, if the impulse response is given by

i) $h[n] = \frac{\sin(\pi/4\, n)}{\pi n}$ ii) $h[n] = (-1)^n \frac{\sin(\pi/2\, n)}{\pi n}$ **(10 Marks)**

b. Consider the continuous time domain analog signal given by $x(t) = 3\cos 100\pi t$.

i) Determine the minimum sampling rate required to avoid aliasing.

ii) Suppose the signal is sampled at $F_s = 200$ Hz, find the corresponding discrete time sequence.

iii) Suppose the signal is sampled at $F_s = 75$ Hz, find the corresponding discrete time sequence

iv) What is the frequency $0 < F < \frac{F_s}{2}$ of a sinusoid that yields samples identical to those obtained in part (iii)? **(10 Marks)**

7 a. Define z-transformation and its inverse. State the important condition for the existence of the z transformation using ROC. **(05 Marks)**

b. Explain how the ROC in the z domain can change if the corresponding time domain sequences can be left sided, right sided and two sided, while the length can be of finite or infinite duration. **(05 Marks)**

c. Give that $x[n] = \begin{cases} a^n & \text{for } 0 \le n \le N-1 \\ 0 & \text{otherwise} \end{cases}$. Let $a = 0.5$, $N = 8$. Find $z\{x[n]\}$ using:

i) Direct evaluation of finite sum of X [z], ii) Sample shifting property of X [z].
Plot its poles and zeros, ROC, and comment on stability. **(10 Marks)**

8 a. A causal LTI system is characterized by having input sequence $x[n] = \left(-\frac{1}{3}\right)^n u[n]$ and output sequence $y[n] = 3(-1)^n u[n] + \left(\frac{1}{3}\right)^n u[n]$. Determine its transfer function impulse response and difference equation representation. **(10 Marks)**

b. Solve the following difference equation using unilateral z transforms and find time domain solution:

i) $y[n+2] - 3y[n+1] + 2y[n] = 4^n u[n]$ for $y[0] = 0$, $y[1] = 1$.

ii) $y[n] + y[n-2] = \delta[n]$ zero initial conditions. **(10 Marks)**

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10EC44

Fourth Semester B.E. Degree Examination, June 2012
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

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.

PART – A

1 a. Give a brief classification of signals. **(04 Marks)**

b. Check whether the following systems are linear, causal and time invariant or not.

i) $\frac{d^2y(t)}{dt^2} + 2y(t)\frac{dy(t)}{dt} + 3t\,y(t) = x(t)$ ii) $y(n) = x^2(n) + \frac{1}{x^2(n-1)}$. **(08 Marks)**

c. Classify the following signals or energy signals or power signals:

i) $x(n) = 2^n u(-n)$ ii) $x(n) = (j)^n + (j)^{-n}$. **(05 Marks)**

d. A system consists of several sub-systems connected as shown in Fig.Q(1) d. Find the operator H relating x (t) to y (t) for the following sub-system operators:

H_1: $y_1(t) = x_1(t)\ x_1(t-1)$ H_3: $y(t) = 1 + 2x_3(t)$

H_2: $y_2(t) = |x_2(t)|$ H_4: $y_4(t) = \cos(x_4(t))$. **(03 Marks)**

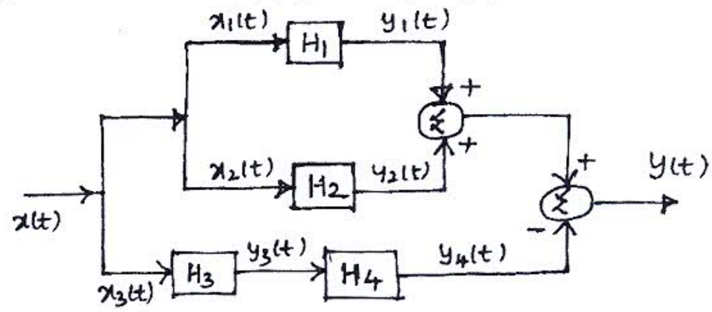

Fig.Q1(d)

2 a. Find the continuous-time convolution integral given below:

$Y(t) = \cos(\pi t)\{u(t+1) - u(t-3)\} * u(t)$. **(06 Marks)**

b. Consider the i/p signal x (n) and impulse responses (n) given below:

$$x(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}, \qquad h(n) = \begin{cases} \alpha^n & 0 \le n \le 6\ ,\ |\alpha| < 1 \\ 0\ , & \text{otherwise} \end{cases}.$$

Obtain the convolution sum y (n) = x(n) * h (n). **(08 Marks)**

c. Derive the following properties:

i) $x(n) \times h(n) = h(n) \times x(n)$ ii) $x(n) \times [h(n) \times g(n)] = [x(n) \times h(n)] \times g(n)$. **(06 Marks)**

3 a. For each impulse response listed below, determine whether the corresponding system is memoryless, causal and stable:

i) $h(n) = (0.99)^n u(n+3)$ ii) $h(t) = e^{-3t} u(t-1)$. **(08 Marks)**

b. Evaluate the step response for the LTI system represented by the following impulse response: $h(t) = u(t+1) - u(t-1)$. **(04 Marks)**

c. Draw direct form I implementation of the corresponding systems:

$$\frac{d^2y(t)}{dt^2} + 5\frac{d}{dt}y(t) + 4y(t) = x(t) + 3\frac{d}{dt}x(t).$$ **(04 Marks)**

d. Determine the forced response for the system given by:

$5\frac{dy(t)}{dt} + 10\,y(t) = 2\,x(t)$, with input $x(t) = 2\,u(t)$. **(04 Marks)**

4 a. State and prove time shift and periodic time convolution properties of DTFS. **(06 Marks)**

b. Evaluate the DTFS representation for the signal x (n) shown in Fig.Q4(b) and sketch the spectra. **(08 Marks)**

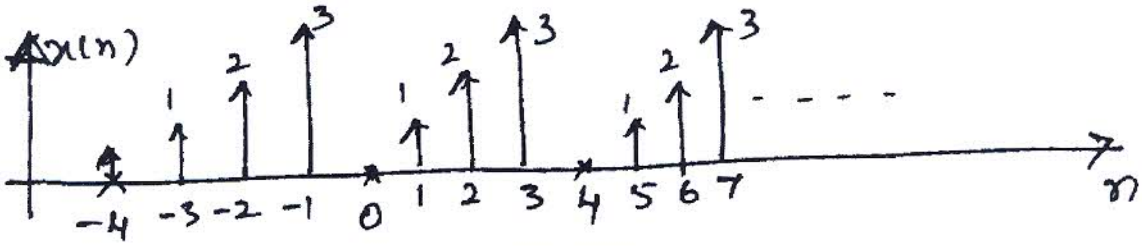

Fig.Q4(b)

c. Determine the time signal corresponding to the magnitude and phase spectra shown in Fig.Q4(c), with $W_o = \pi$. **(06 Marks)**

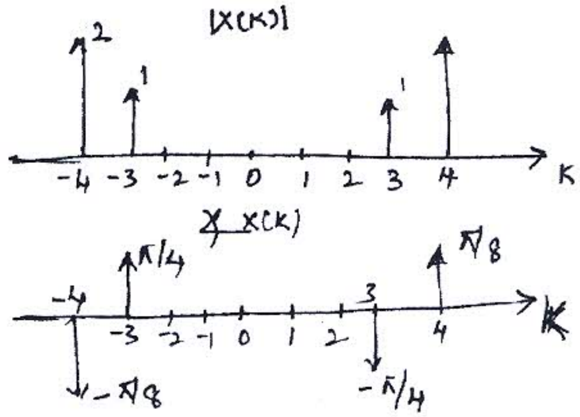

Fig.Q4(c)

PART – B

5 a. State and prove the frequency-differentiation property of DTFT. **(06 Marks)**

b. Find the time-domain signal corresponding to the DTFT shown in Fig.Q5(b). **(05 Marks)**

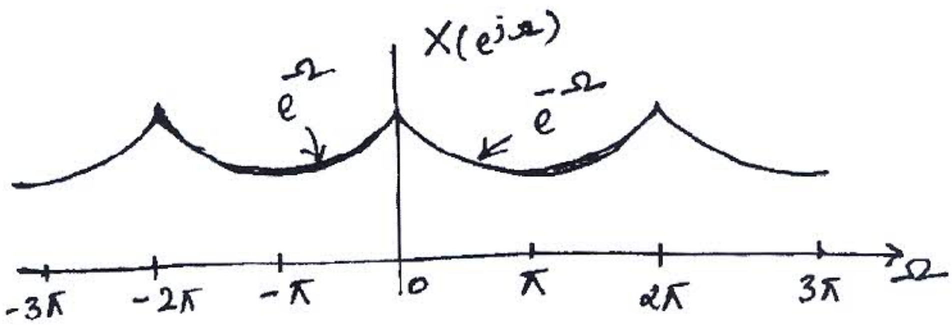

Fig.Q5(b)

c. For the signal x (t) shown in Fig.Q 5(c), evaluate the following quantities without explicitly computing x (w). **(09 Marks)**

i) $\int_{-\infty}^{\infty} x(w)\, dw$ ii) $\int_{-\infty}^{\infty} |x(w)|^2\, dw$ iii) $\int_{-\infty}^{\infty} x(w)\, e^{i2w}\, dw$.

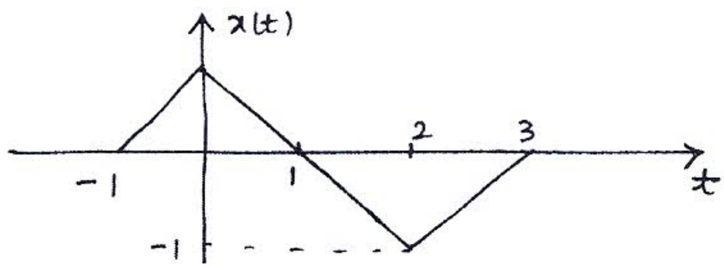

Fig.Q5(c)

6 a. The input and output of causal LTI system are described by the differential equation.

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

i) Find the frequency response of the system
ii) Find impulse response of the system
iii) What is the response of the system if $x(t) = te^{-t}u(t)$. **(10 Marks)**

b. Find the frequency response of the RC circuit shown in Fig.Q6(b). Also find the impulse response of the circuit. **(10 Marks)**

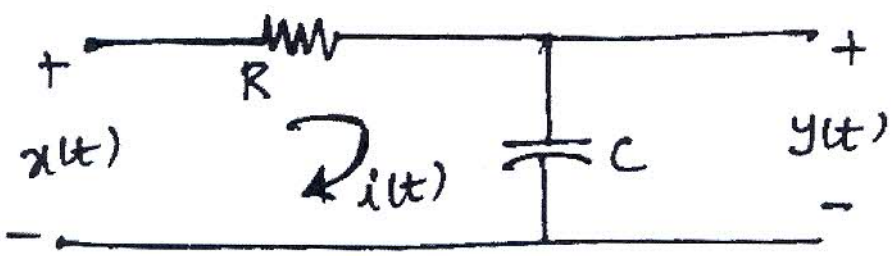

Fig.Q6(b)

7 a. Briefly list the properties of Z-Transform. **(04 Marks)**

b. Using appropriate properties, find the Z-transform $x(n) = n^2\left(\frac{1}{3}\right)^n u(n-2)$. **(06 Marks)**

c. Determine the inverse Z-transform of $x(z) = \frac{1}{2 - 4z^{-1} + 2z^{-2}}$, by long division method of:

i) ROC; $|z| > 1$. **(04 Marks)**

d. Determine all possible signals x (n) associated with Z-transform. **(06 Marks)**

$$x(z) = \frac{\left(\frac{1}{4}\right)z^{-1}}{\left[1 - \left(\frac{1}{2}\right)z^{-1}\right]\left[1 - \left(\frac{1}{4}\right)z^{-1}\right]}.$$

8 a. An LTI system is described by the equation
$y(n) = x(n) + 0.81\,x(n-1) - 0.81\,x(n-2) - 0.45\,y(n-2)$. Determine the transfer function of the system. Sketch the poles and zeros on the Z-plane. Assess the stability. **(05 Marks)**

b. A systems has impulse response h (n) $(1/3)^n$ u (n). Determine the transfer function. Also determine the input to the system if the output is given by:

$$y(n) = \frac{1}{2}u(n) + \frac{1}{4}\left(-\frac{1}{3}\right)^n u(n).$$ **(05 Marks)**

c. A linear shift invariant system is described by the difference equation.

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + x(n-1)$$

with $y(-1) = 0$ and $y(-2) = -1$.
Find:
i) The natural response of the system.
ii) The forced response of the system and
iii) The frequency response of the system for a step. **(10 Marks)**

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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.

USN | | | | | | | | | |

06EC44

Fourth Semester B.E. Degree Examination, June 2012
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Find the even and odd components of the following signals :

i)

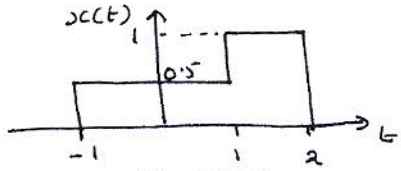

Fig. Q1(a)

ii) $x[n]=[1,2,\underset{\uparrow}{0},1,-2]$. **(04 Marks)**

b. Determine if following signals are energy or power signals :

i) $x(t) = A;\ -T/2 \le t \le T/2$
$= 0$; elsewhere

ii) $x[n] = [1/4]^n\, u[n]$ **(06 Marks)**

c. Given x(t) as shown in Fig. Q1(c), plot $x(2t+2)$ and $x(-t-1)$. **(04 Marks)**

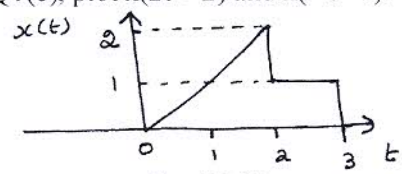

Fig. Q1(c)

d. The input –output relationship in a system is given by $y[n] = x[n-5] + x[n-7]$, where x[n] is the input and y[n] the output. Determine the properties of the system. **(06 Marks)**

2 a. Prove that if the impulse response h(t) and the input x(t) are unit step functions the output is a ramp. **(05 Marks)**

b. If $h(t) = u(t) - u(t-3)$ and $x(t) = u(t) = u(t-1)$, determine the output y(t). **(08 Marks)**

c. If the input of a discrete LTI system is

$x[n]=[1,\underset{\uparrow}{3},2,2]$ and the impulse response is,

$h[n]=[1,\underset{\uparrow}{4},2,1]$, find the output. **(07 Marks)**

3 a. The output of an LTI system is given by $y[n] = x[n+1] + 2x[n] - x[n-1]$. Find the impulse response if x[n] is the input. Is the system stable? **(04 Marks)**

b. Obtain the natural response of a system described by the differential equation :

$$\frac{d^2y(t)}{dt^2}+\frac{2dy(t)}{dt}+y(t)=\frac{dx(t)}{dt};\qquad y(0)=1;\left.\frac{dy(t)}{dt}\right|_{t=0}=1.$$ **(06 Marks)**

c. Determine the impulse response of an LTI system described by the difference equation :

$y[n]-0.6y[n-1]+0.08y[n-2]=x[n]$. **(06 Marks)**

d. Draw the direct form I and II representations for a system described by the equation :

$$\frac{dy(t)}{dt}+5y(t)=x(t).$$ **(04 Marks)**

4 a. Find x(t) if the Fourier - Series coefficients are as shown in Fig. Q4(a). The phase spectrum is a null spectrum. **(06 Marks)**

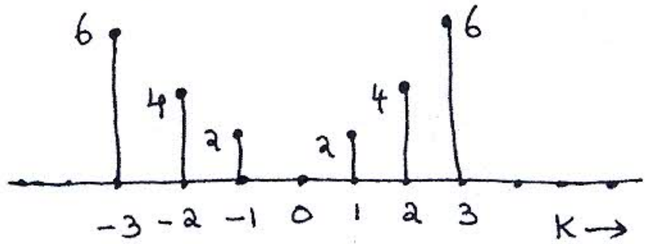

Fig. Q4(a)

b. Determine the Fourier – Series of the signal $x(t) = 3\cos\left(\frac{\pi}{2}t + \frac{\pi}{3}\right)$. Plot the magnitude and phase spectra. **(07Marks)**

c. Show that if x[n] is real and even, its Fourier coefficients are real. Hence find the DTFS coefficients for the signal $x[n] = \sum_{P=-\infty}^{\infty} \delta[n-2p]$. **(07 Marks)**

PART – B

5 a. Find the FT of the sig—function sgn(t) defined by,

$$\text{sgn}(t) = \begin{cases} +1 & t > 0 \\ 0 & t = 0 \\ -1 & t < 0 \end{cases}$$

plot the magnitude and phase spectrum. **(07 Marks)**

b. If the Fourier transform of x(t) is X(jw) then, find the Fourier transform of x(at). **(06 Marks)**

c. Find the DTFT of the signal $x[n] = u[n+2] - u4[n-3]$. **(07 Marks)**

6 a. Find the FT of the train of unit impulses shown in Fig. Q6(a). **(07 Marks)**

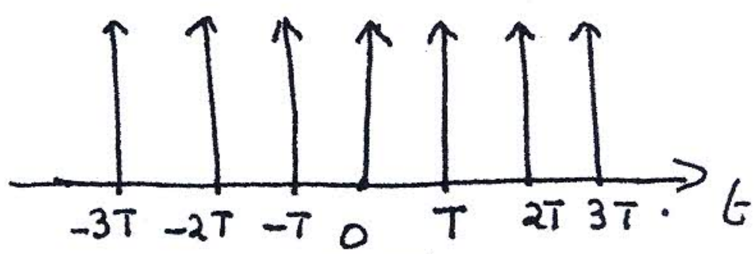

Fig. 6(a)

b. Determine the difference equation description for the system with the impulse response $h[n] = \delta[n] + 2(\frac{1}{2})^n u[n] + (-\frac{1}{2})^n u[n]$. **(06 Marks)**

c. Find the frequency response and impulse response of the system described by the differential equation :

$$2\frac{dy(t)}{dt} + 3y(t) = 7x(t).$$ **(07 Marks)**

7 a. Determine the Z-transform of

$$x[n] = -u[-n-1] + (\tfrac{1}{4})^n u[n].$$

Determine the ROC and pole – zero locations of x(t). **(05 Marks)**

b. If the z-transform of x[n] is X(Z), derive the Z – transform of $a^n x[n]$. **(05 Marks)**

c. Using Z-transform, find the convolution of $x[n] = [\underset{\uparrow}{1}, 2, -1, 0, 3]$ and $y[n] = [\underset{\uparrow}{1}, 2, -1]$. **(05 Marks)**

d. Find the inverse Z – transform of

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

8 a. Given the Z –transform of the impulse response h[n] is

$$H(z) = \frac{1}{\left(1-\frac{1}{3}z^{-1}\right)\left(1-\frac{3}{2}z^{-1}\right)}.$$ **(06 Marks)**

What are the possible ROC? Comment on the stability and causality in each case.

b. Determine the transfer function and impulse response of the system described by

$$y[n] - \frac{1}{2}y[n-1] = 2x[n-1].$$ **(07 Marks)**

c. If the impulse response is given by $h[n] = (\frac{1}{3})^n u[n] + (\frac{1}{2})^{n-2} u[n-1]$, find the difference equation of the system. **(07 Marks)**

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Fourth Semester B.E. Degree Examination, December 2011

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. A continuous-time signal x(t) is shown in Fig.Q1(a). Sketch and label each of the following :

i) $x(t)u(1-t)$ ii) $x(t)[u(t)-u(t-1)]$ iii) $x(t)\,\delta\left(t-\frac{3}{2}\right)$

iv) $x(t)\,[u(t+1)-4(t)]$ v) $x(t)\,u(t-1)$ **(10 Marks)**

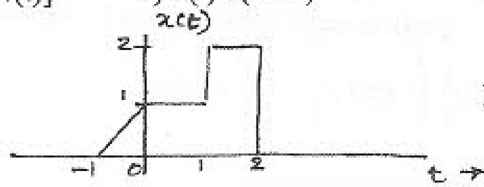

Fig.Q1(a)

b. Consider the following sinusoidal signal. Determine whether each x(n) is periodic and if it is find its fundamental period.

i) $x(n) = 10\sin(2n)$ ii) $x(n) = 15\cos(0.2\pi n)$ iii) $x(n) = 5\sin[6\pi n/35]$ **(06 Marks)**

c. If $x(n) = \{1\ 2\ 3\ \underset{\uparrow}{4}\ 5\ 6\ 7\}$, find : i) $y(n) = x(2n-3)$, ii) $y(n) = x(-2n+1)$ **(04 Marks)**

2 a. Find the convolution of x(t) with h(t), where

$x(t) = A[u(t)+u(t-T)]$ and $h(t) = A[u(t)-u(t-2T)]$ **(10 Marks)**

b. A discrete system has impulse response $h(n) = a^n u(n+3)$. Is this system BIBO stable, causal and memory less? **(03 Marks)**

c. The impulse response of the system is given by $h(t) = e^{-2|t|}$, find the step response of the system. **(07 Marks)**

3 a. Determine the condition of the impulse response of the system if system is :

i) memory less ii) causal iii) stable iv) invertible. **(10 Marks)**

b. Solve the differential equation : $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2x(t)$, with initial conditions $y(0) = 0$, $y'(0) = 1$ for the input $x(t) = \cos t\, u(t)$. **(10 Marks)**

4 a. Determine the Fourier series representation of the following signals :

i) $x(t) = 3\cos\left[\frac{\pi}{2}t + \frac{\pi}{4}\right]$ ii) $x(t) = 2\sin(2\pi t - 3) + \sin 6\pi t$ **(10 Marks)**

b. Determine the Fourier series representation for the square wave shown in Fig.Q4(b).

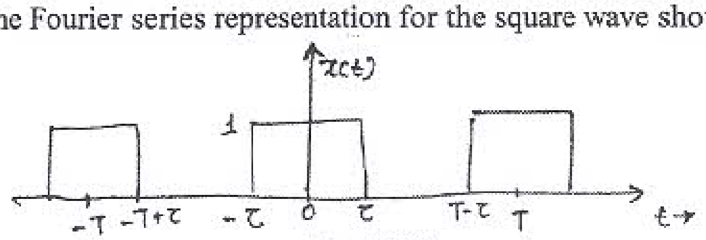

Fig.Q4(b) **(10 Marks)**

PART – B

5 a. Use the differentiation in time and differentiation in frequency properties to determine the FT of Gaussian pulse defined by $g(t) = \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}}$. **(10 Marks)**

b. Find the FT of $x(t) = \frac{1}{1+jt}$. **(05 Marks)**

c. Find the inverse FT of $x(j\omega) = \frac{(1-j\omega)}{6+j\omega+\omega^2}$. **(05 Marks)**

6 a. State and prove Rayleigh's energy theorem. **(08 Marks)**

b. Find the frequency response and impulse response of the system with input x(t) and output y(t) is given by :
i) $x(t) = e^{-2t}u(t)$ and $y(t) = e^{-3t}u(t)$ ii) $x(t) = e^{-2t}u(t)$ and $y(t) = 2t\,e^{-2t}u(t)$ **(08 Marks)**

c. Determine the difference equation description for the system with impulse response.

$$h(n) = 3\delta(n) + 2\left(\frac{1}{2}\right)^n u(n) + \left(-\frac{1}{2}\right)^n u(n)$$ **(04 Marks)**

7 a. Determine the ZT of the following sequence :
i) $x(n) = \alpha^{|n|}$ for $|\alpha| < 1$ ii) $x(n) = n^2u(n)$. **(10 Marks)**

b. Find the inverse ZT of :
i) $x(z) = \frac{16z^2 - 4z + 1}{8z^2 + 2z - 1}$ for $|z| > \frac{1}{2}$ ii) $x(z) = e^{z^2}$ for all z $|z| \neq \infty$. **(10 Marks)**

8 a. A system has the transfer function,

$$H(z) = \frac{2}{1-0.9e^{j\frac{\pi}{4}}z^{-1}} + \frac{2}{1-0.9e^{j\frac{\pi}{4}}z^{-1}} + \frac{3}{1+2z^{-1}}.$$

Find the impulse response assuming the system is (i) stable and (ii) causal. **(10 Marks)**

b. A system is described by the difference equation :

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

Find the transfer function of the system. **(05 Marks)**

c. State and prove final value theorem in ZT. **(05 Marks)**

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06EC44

Fourth Semester B.E. Degree Examination, June/July 2011

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. Find and sketch the following signals and their derivatives:
i) $x(t) = u(t) - u(t-a)$; $a > 0$ ii) $y(t) = t[u(t) - u(t-a)]$; $a > 0$. **(06 Marks)**

b. Given the signal $x[n] = (8-n)\{u[n] - u[n-8]\}$, determine and sketch :
i) $y_1[n] = x[4-n]$ ii) $y_2[n] = x[2n-3]$. **(04 Marks)**

c. Determine whether the following signals are energy or power signals. Find the corresponding energy or power associated with the signal.
i) $x[n] = (\frac{1}{4})^n u[n]$ ii) $x[n] = u[n]$ **(04 Marks)**

d. Fig.Q1(d)(i) shows a staircase like signal x(t) that may be viewed as a superposition of four rectangular pulses. Starting with the rectangular pulse shown in Fig.Q1(d)(ii), construct the waveform and express x(t) in terms of g(t). **(06 Marks)**

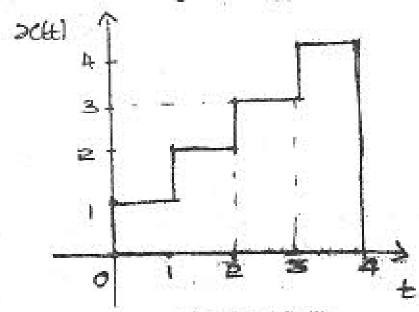

Fig.Q1(d)(i)

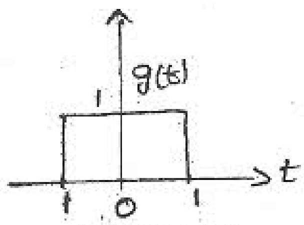

Fig.Q1(d)(ii)

2 a. Show that : i) $x(t) * h(t) = h(t) * x(t)$
ii) $\{x[n] * h_1[n] * h_2[n] = x[n] * \{h_1[n] * h_2[n]\}$ **(06 Marks)**

b. Given $x(t) = u(t) - u(t-3)$ and $h(t) = u(t) - u(t-2)$, evaluate and sketch $y(t) = x(t) * h(t)$. **(06 Marks)**

c. A LTI system has the impulse response given by $h[n] = u[n] - u[n-10]$. Determine the output of the system when the input is $x[n] = u[n-2] - u[n-7]$ using the convolution sum. Show the details of your computation. Sketch all the sequence. **(08 Marks)**

3 a. A discrete LTI system is characterized by the unit sample response $h[n] = \frac{1}{2}\delta[n] + \delta[n-1] + \frac{1}{2}\delta[n-2]$. Determine :
i) Frequency response $H(e^{j\Omega})$ and plot the magnitude component
ii) Steady state response of the system for the input $x[n] = 5\cos\frac{\pi n}{4}$
iii) Total response of the system for the input $x[n] = u[n]$ assuming that the system is initially at rest. **(10 Marks)**

b. Determine whether the system described by the following are stable or causal:
i) $h[n] = (\frac{1}{2})^n u[n]$ ii) $h(t) = e^t u(-1-t)$ **(06 Marks)**

3 c. Determine the differential equation representation for the block diagram shown in Fig.Q3(c). **(04 Marks)**

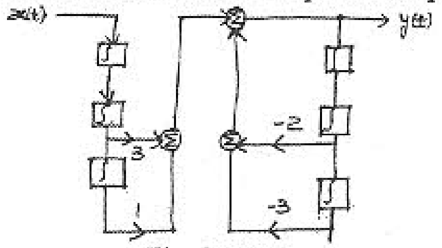

Fig.Q3(c)

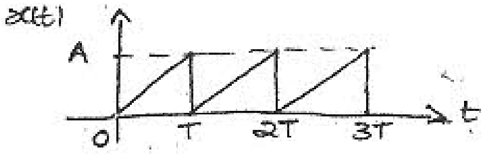

Fig.Q4(b)

4 a. Evaluate the DTFS representation for the signal $x[n] = \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right) + 1$. Sketch the magnitude and phase spectra. **(08 Marks)**

b. Find the exponential Fourier series of the waveform shown in Fig.Q4(b). **(08 Marks)**

c. Explain the orthogonality of complex sinusoidal signals. **(04 Marks)**

PART – B

5 a. Find the DTFT of the signal $x[n] = n(\frac{1}{2})^{|n|}$. **(07 Marks)**

b. Determine the signal x[n] if its spectrum is shown in Fig.Q5(b). **(07 Marks)**

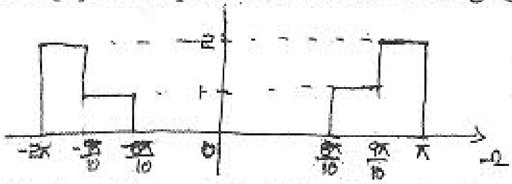

Fig.Q5(b)

c. Determine the Fourier transform of the following signals :

i) $x(t) = e^{-3t}u(t-1)$ ii) $x(t) = e^{-a|t|}$ **(06 Marks)**

6 a. Find the frequency response and impulse response of the system described by the differential equation : $\frac{d^2}{dt^2}y(t) + 3\frac{dy(t)}{dt} + 2y(t) = 2\frac{d}{dt}x(t) + x(t)$. **(08 Marks)**

b. The output of a system in response to an input $x(t) = e^{-2t}u(t)$ is $y(t) = e^{-t}u(t)$. Find the frequency response and the impulse response of this system. **(08 Marks)**

c. Obtain an expression for the Fourier transform in terms of DTFT. **(04 Marks)**

7 a. Find the z-transform of the following and indicate the region of convergence : **(12 Marks)**

i) $x[n] = \alpha^{|n|}$; $0 < |\alpha| < 1$; ii) $x[n] = 2^n \sin\Omega_0(n-2)u(n-2)$; iii) $x[n] = n(n-1)a^n u[n]$

b. Find the inverse z transform of the following :

i) $X(z) = \frac{z^4 + z^2}{z^2 - \frac{3}{4}z + \frac{1}{8}}$; $|z| > \frac{1}{2}$ ii) $X(z) = \frac{1 - az^{-1}}{z^{-1} - a}$; $|z| > \frac{1}{a}$ **(08 Marks)**

8 a. A discrete LTI system is characterized 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 of H(z) and indicate the ROC if the system is (i) stable, (ii) causal. Also determine the unit sample response of the stable system. **(09 Marks)**

b. Solve the following difference equation using the unilateral z transform :

$x[n-2] - 9x[n-1] + 18x[n] = 0$ with the initial conditions $x[-1] = 1$ and $x[-2] = 9$. **(07 Marks)**

c. A system is described by the difference equation :

$$y[n] - y[n-1] + \frac{1}{4}y[n-2] = x[n] + \frac{1}{4}x[n-1] - \frac{1}{8}x[n-2].$$

Find the transfer function of the inverse system. Does a stable and causal inverse system crust? **(04 Marks)**

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EC/IT/EE/BM/ML/TE36

IV ~~Third~~ Semester B.E. Degree Examination, June/July 2011

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Sketch the signal $x(t) = 2u(t) - r(t-1) + 2r(t-2) - r(t-3) + u(t-4) - 3u(t-5)$. Mark the values at salient points. **(06 Marks)**

b. Discuss classification of signals, with suitable examples. **(06 Marks)**

c. Two systems with impulse response $h_1(t) = e^{-2t}u(t)$ and $h_2(t) = 2\delta(t) + \delta^1(t)$ respectively are connected in cascade. The input to the first system is $e^{-3t}u(t)$. Determine the output of the cascade system. Is there any speciality of these two systems? **(08 Marks)**

2 a. The impulse response of a system is $h(t) = e^{-t}.u(t)$. If the input to this system is $x(t) = u(t+1) - u(t-3)$, determine the output of the system. Sketch this output signal. **(10 Marks)**

b. Explain the concept of convolution, with an example. **(06 Marks)**

c. If $y(t) = x(t) * h(t)$, then show that $\dfrac{dx(t)}{dt} * h(t) = \dfrac{dy(t)}{dt}$. **(04 Marks)**

3 a. The difference equation of a discrete time system is given by $y(n) + 2y(n-1) + y(n-2) = x(n) - x(n-1)$ when the input $x(n)$ is 3^{-n} for $n \geq 0$ and 2^n for $n < 0$. With the initial conditions $y(-1) = 1$ and $y(-2) = -1$, solve for $y(n)$. **(14 Marks)**

b. Determine the impulse response of the system characterized by $\dfrac{d^2y}{dt^2} + \dfrac{3dy}{dt} + 2y = x$, where x and y represent the input $x(t)$ and the output $y(t)$. **(06 Marks)**

4 a. The following sketch, Fig.Q4(a) represents the realization of a discrete time system. Here Δ denotes unit time delay. All of the nodes are additive. Formulate the difference equation of the system. **(08 Marks)**

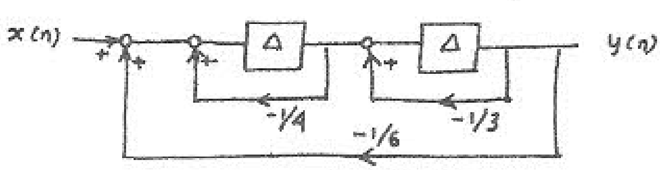


Fig.Q4(a)

b. Determine the Fourier transform of $x(t) = u(t+a) - u(t-a)$. From this result and the symmetry property of Fourier transform, find the Fourier transform of the signal.

$$y(t) = \frac{\sin 10(t+1)}{(t+1)} + \frac{\sin 10(t-1)}{(t-1)}$$ **(12 Marks)**

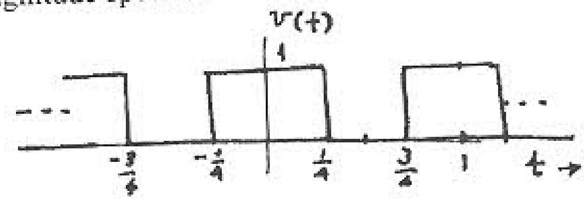
5 a. Determine the inverse Fourier transform of X(w) relating to a continuous time function x(t), if $X(w) = \dfrac{(2+jw)}{(1+jw)(3+jw)}$. **(06 Marks)**

b. Evaluate the discrete time Fourier transform for the sequence $x(n) = (0.5)^n u(n) + 2^{-n} u(-n-1)$. **(08 Marks)**

c. A casual linear stable time invariant system has an output y[n] and input x[n] related by $y[n] - \frac{1}{6}y(n-1) - \frac{1}{6}y(n-2) = x(n)$. Determine the impulse response of this system using discrete time Fourier transform. **(06 Marks)**

6 a. Derive Parseval's theorem. **(08 Marks)**

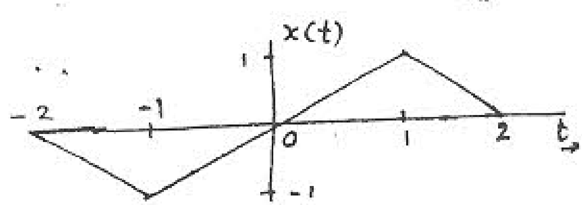
b. A periodic voltage Ʊ(t) is applied across an RC series circuit. Determine the Fourier series (exponential) expansion for the voltage across the capacitor. Take RC = 0.1. Also sketch the output voltage magnitude spectrum. **(12 Marks)**



7 a. Evaluate the discrete time Fourier series coefficient for the sequence x(n) = {…, 0, 0, 0, 2, 1, 2, …} of period 6. **(08 Marks)**

b. Without explicitly computing X(w), the Fourier transform of x(t), given below, evaluate the following quantities :

i) $\int_{-\infty}^{\infty} X(w)\,dw$ ii) $\underline{|X(w)}$ iii) $\int_{-\infty}^{\infty} |X(w)|^2\,dw$



(12 Marks)

8 a. Determine the z-transform, identify the ROC and pole-zero location for $x(n) = \left(-\frac{1}{5}\right)^n u(n) - 3\left(\frac{1}{7}\right)^n u(-n)$. **(08 Marks)**

b. A system has a transfer function $\dfrac{2z}{2z-1}$. For an input $x(n) = \left(\frac{1}{3}\right)^n$, $n \geq 0$ and $= \left(\frac{1}{2}\right)^{-n}$, $n < 0$; determine the output. **(12 Marks)**

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USN

Fourth 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) Periodic and non-periodic signals and ii) Deterministic and random signals. **(04 Marks)**

b. A signal x(t) is as shown in figure Q1 (b). Find its even and odd parts. **(06 Marks)**

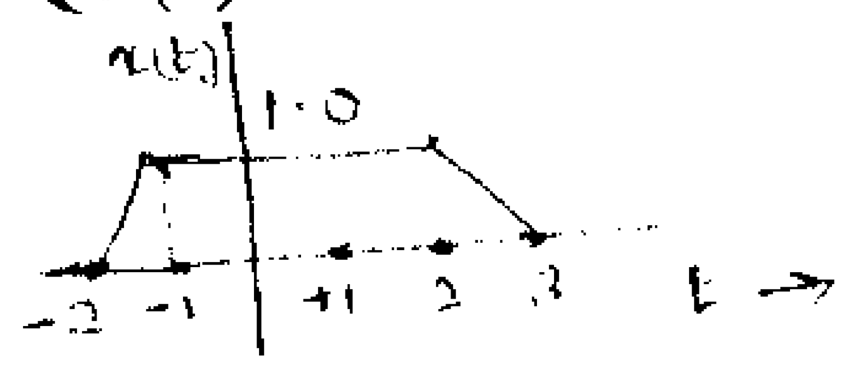

Fig. Q1 (b)

c. Two signals x(t) and g(t) are as shown in figure Q1 (c). Express the signals x(t) in terms of g(t). **(06 Marks)**

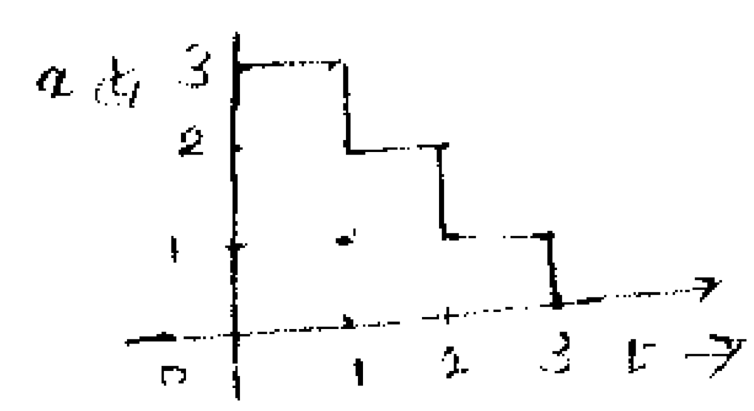

Fig. Q1 (c) – (i)

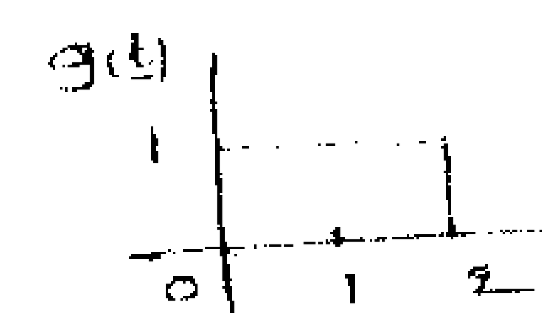

Fig. Q1 (c) – (ii)

d. A system is described by $y(n)=(n+1)x(n)$. Test the system for (i) memory less (ii) Causality (iii) Linearity (iv) Time invariance and (v) Stability. **(04 Marks)**

2 a. An LTI system has impulse response $h(n)=[U(n)-U(n-4)]$. Find the output of the system if the input $x(n)=[U(n+10)-2U(n+5)+U(n-6)]$. Sketch the output. **(08 Marks)**

b. Show that an aribitrary signal x(n) can be expressed as a sum of weighted and time shifted impulses, $x(n)=\sum_{K=-\infty}^{\infty}x(k)\delta(n-k)$. **(04 Marks)**

c. An LTI system is described by an impulse response $h(t)=[U(t-1)-U(t-2)]$. Find the output of the system if the input x(t) is as shown in figure Q2 (c). Sketch the output. **(08 Marks)**

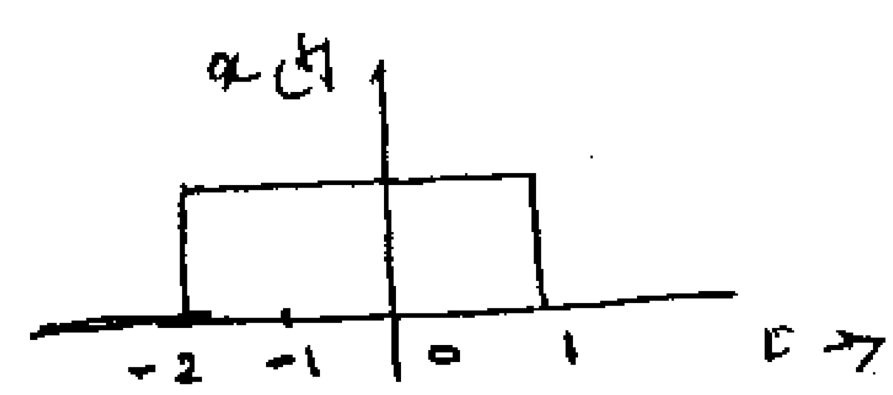

Fig. Q2 (c)

3 a. Two LTI systems with impulse responses $h_1(n)$ and $h_2(n)$ are connected in cascade. Derive the expression for the impulse response if the two systems are replaced by a single system. **(04 Marks)**

b. An LTI system has its impulse response, $h(n)=4^{-n}U(2-n)$. Determine whether the system is memory less, stable and causal. **(04 Marks)**

c. A system is described by a differential equation,

$\frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t)=x(t)+\frac{dx(t)}{dt}$. Determine its forced response if the input $x(t)=[\cos t+\sin t]U(t)$ **(06 Marks)**

3 d. Draw the direct form I and direct form II implementations for the following difference equation, $y(n)+\frac{1}{2}y(n-1)-y(n-3)=3x(n-1)+2x(n-2)$. **(06 Marks)**

4 a. State and prove convolution property of continuous time Fourier series. **(06 Marks)**

b. Find the DTFS co-efficients of the signal shown in figure Q4 (b), **(08 Marks)**

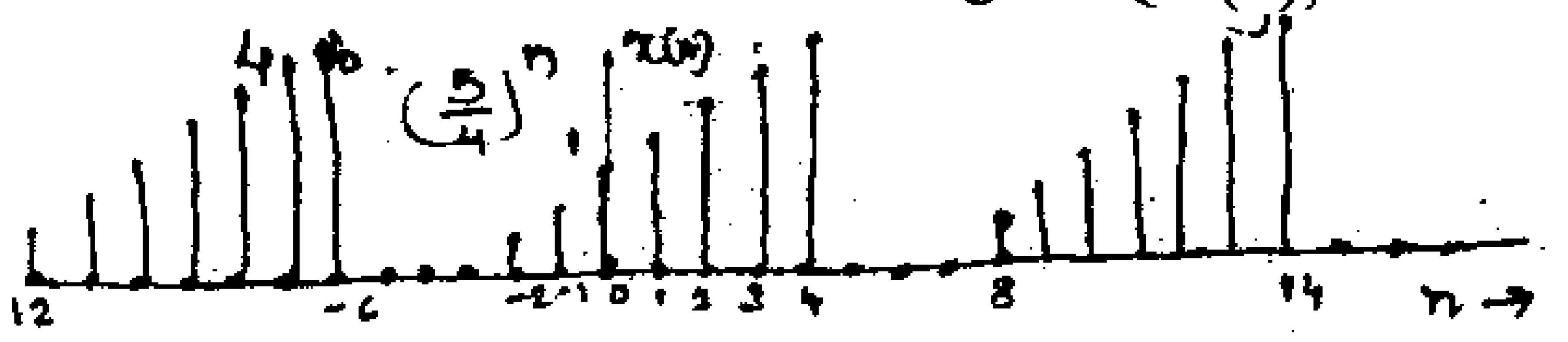

Fig. Q4 (b)

c. Determine the time domain signal x(t), whose Fourier co-efficient are,

$X(K)=\frac{3}{2}e^{-J\frac{\pi}{4}}, K=-1$; $X(K)=\frac{3}{2}e^{J\frac{\pi}{4}}, K=1$; $X(K)=0$ otherwise. **(06 Marks)**

PART - B

5 a. State and prove the following properties of Fourier transform:

i) Frequency shifting property ii) Time differentiation property **(06 Marks)**

b. Show that the Fourier transform of a train of impulses of unit height separated by T secs is also a train of impulses of height $\omega_0=\frac{2\pi}{T}$ separated by $\omega_0=\frac{2\pi}{T}$ sec. **(08 Marks)**

c. Find the DTFT of following signals and draw its magnitude spectrum:

i) $x(n)=a^nU(n)$; $|a|<1$ ii) $x(n)=\delta(n)$ unit impulse. **(06 Marks)**

6 a. The system produces an output $y(t)=e^{-t}u(t)$ for an input of $x(t)=e^{-2t}u(t)$. Determine the frequency response and impulse response of the system. **(08 Marks)**

b. State and prove sampling theorem for low pass signals. **(07 Marks)**

c. Find the Nyquist rate for the following signals:

i) $x(t)=25e^{J500\pi t}$ ii) $[x(t)]=[1+0.1\sin(200\pi t)]\cos(2000\pi t)$ **(05 Marks)**

7 a. State and prove time reversal and differentiation in Z-domain properties of Z-transforms. **(06 Marks)**

b. Find the Z-transforms of following sequences including R.O.C.: i) $x(n)=-\left(\frac{1}{2}\right)^n u(-n-1)$

ii) $x(n)=\alpha^{|n|}$ $|\alpha|<1$ **(06 Marks)**

c. The Z-transform of sequence x(n) is given by, $X(z)=\frac{z(z^2-4z+5)}{(z-3)(z-2)(z-1)}$

Find x(n) for the following ROC's:

i) $2<|z|<3$ ii) $|z|>3$ iii) $|z|<1$. **(08 Marks)**

8 a. Solve the following linear constant co-efficient difference equation using z-transform method: $y(n)-\frac{3}{2}y(n-1)+\frac{1}{2}y(n-2)=\left(\frac{1}{4}\right)^n u(n)$ with initial conditions, $y(-1)=4$, $y(-2)=10$. **(10 Marks)**

b. A causal system has input x(n) and output y(n). Find the impulse response of the system if,

$x(n)=\delta(n)+\frac{1}{4}\delta(n-1)-\frac{1}{8}\delta(n-2)$; $y(n)=\delta(n)-\frac{3}{4}\delta(n-1)$

Find the output of the system if the input is $\left(\frac{1}{2}\right)^n u(n)$. **(10 Marks)**

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2002 SCHEME

USN | | | | | | | | | |

EC36

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

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

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.

1 a. How are signals classified? Explain with the notation. **(06 Marks)**

b. List the operations performed on dependent and independent variables of the signals. **(06 Marks)**

c. A discrete-time signal x(n) is defined by,

$$x(n) = \begin{cases} 1, & n = 1, 2 \\ -1, & n = -1, -2 \\ 0, & n = 0 \text{ and } |n| > 2 \end{cases}$$

Find y(n)=x(2n+3) **(08 Marks)**

2 a. Given,

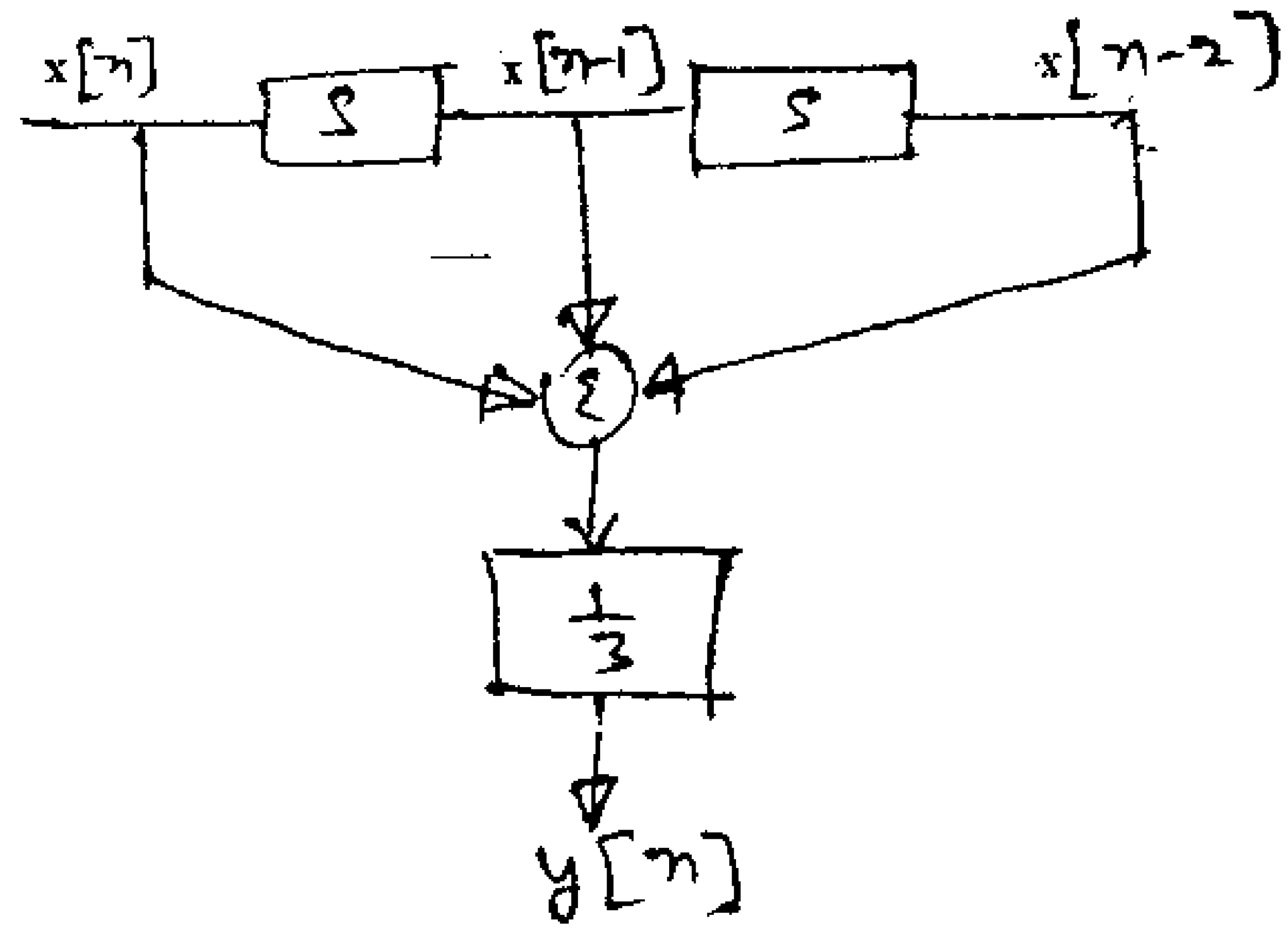

Fig. Q2 (a)

Obtain the parallel form of implementation. **(05 Marks)**

b. Explain the properties of systems in,
i) Stability
ii) Causality.
iii) Invertibility
iv) Time invariance
v) Linearity. **(15 Marks)**

3 a. Explain how the causality condition is satisfied in impulse response convolution integral. **(06 Marks)**

b. Find the step response of a RC circuit whose impulse response is,

$$h(t) = \frac{1}{RC} e^{-\frac{t}{RC}} u(t)$$ **(06 Marks)**

c. Obtain the magnitude and phase response for a series RC circuit, whose impulse response is,

$$h(t) = \frac{1}{RC} e^{-\frac{t}{RC}} n(t)$$ **(08 Marks)**

4 a. Distinguish between Fourier series and Fourier transform. (04 Marks)

b. Find the Fourier transform of a gate function shown in figure Q4 (b). (08 Marks)

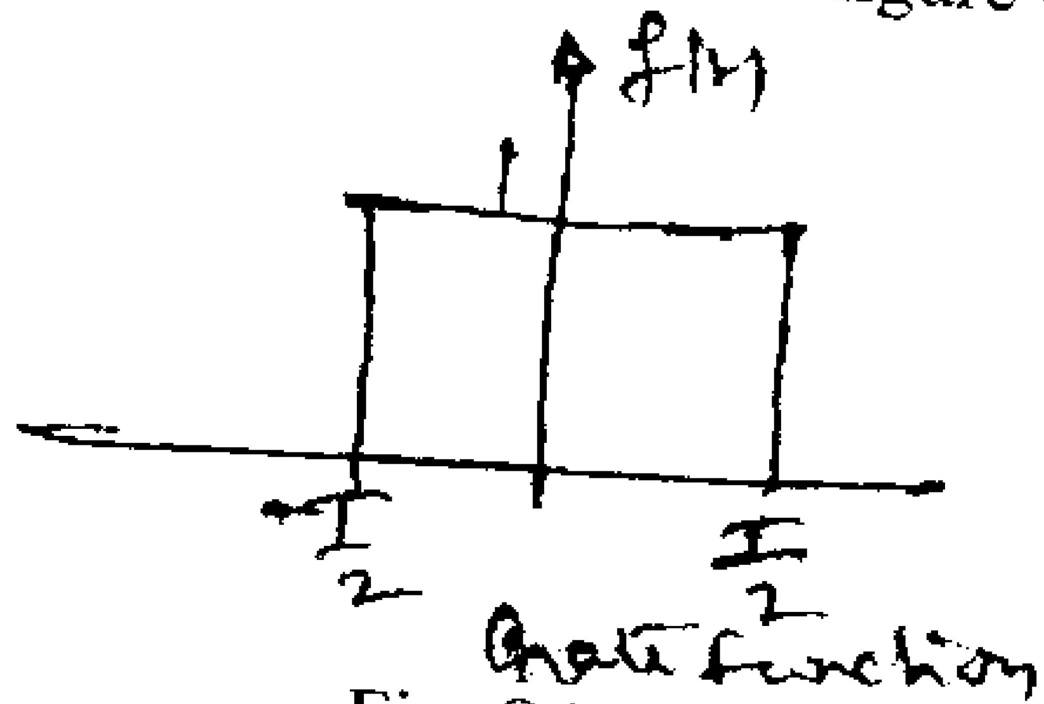

Fig. Q4 (b)

c. Find the Fourier transform of, $f(t) = e^{-at}u(t)$. (08 Marks)

5 a. Define Fourier series. What are Dirichlet conditions? (06 Marks)

b. Obtain the exponential Fourier series for the half wave rectified sine wave shown in figure Q5(b). (10 Marks)

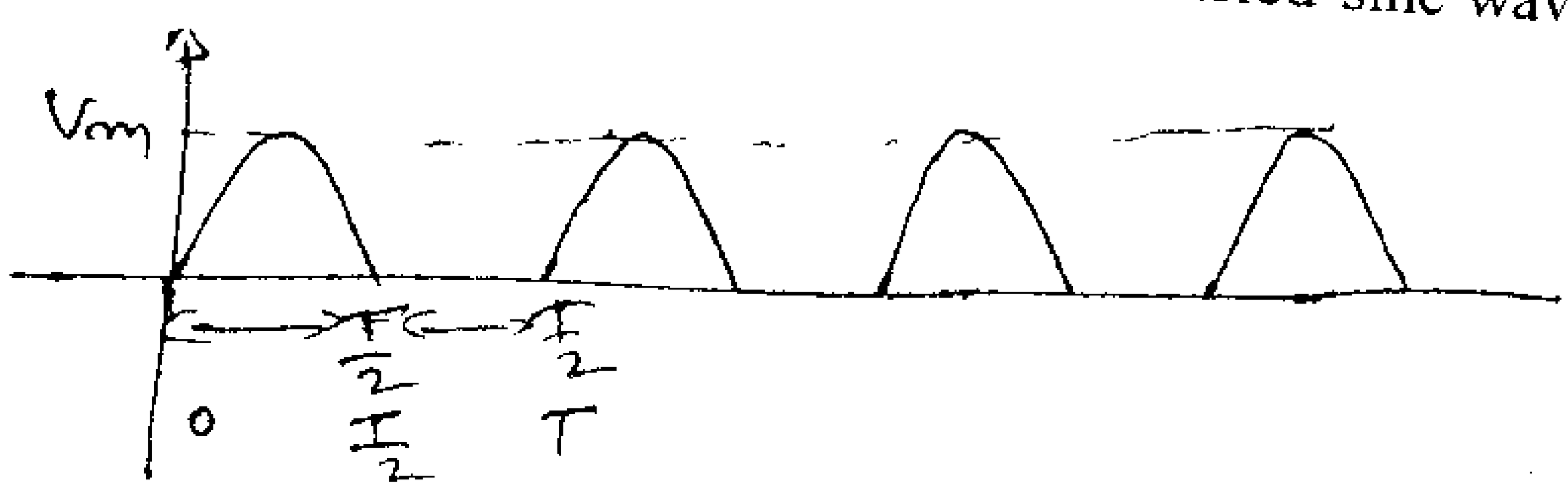

Fig. Q5 (b)

c. List the advantages of using the exponential form of the Fourier series. (04 Marks)

6 a. What is odd and even symmetry? What are quarter wave and half wave symmetries? Provide examples. How would they reduce the computational effort? (06 Marks)

b. Find the Fourier transform of a shifted impulse function. (06 Marks)

c. State and prove time scaling property of a FT. (08 Marks)

7 a. State and prove the initial and final value theorems, applied to z-transforms. (10 Marks)

b. Solve the following difference equation, by the use of the z-transform method:

$x(k+2) + 3x(k+1) + 2x(k) = 0$

$x(0) = 0, x(1) = 1$ (10 Marks)

8 a. Obtain the z-transform of,

$$x(s) = \frac{1}{s(s+1)}$$ (10 Marks)

b. Find z-transforms of an unit step function delayed by 1 sampling period and 4 sampling periods respectively. An appropriate theorem may be used. (10 Marks)

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Master set

2002 SCHEME

USN | | | | | | | | | | **EC36**

Third Semester B.E. Degree Examination, May/June 2010
Signals and Systems

Time: 3 hrs.   Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Express the signals shown in figures below, in terms of basic functions: **(06 Marks)**

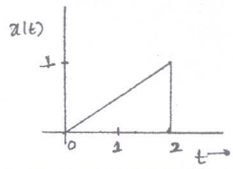
Fig. Q1(a) – (i)

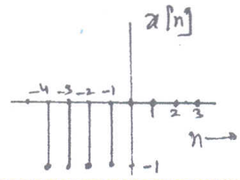
Fig. Q1(a) – (ii)

b. A triangular pulse signal is shown in figure Q1 (b). Sketch each of the following signals derived from x(t): i) $x(3t+2)$ ii) $x(-2t-1)$ **(08 Marks)**

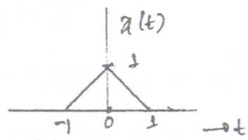
Fig. Q1 (b)

c. Determine whether the following signals are periodic. If periodic, determine the fundamental period:

i) $x(t) = \cos t + \sin\sqrt{2}t$;   ii) $x(n) = \cos\frac{n\pi}{3} + \sin\frac{n\pi}{4}$ **(06 Marks)**

2 a. Compute the convolution sums y(n) given below,

i) $y(n) = \left(\frac{1}{2}\right)^n u(n-2) * u(n)$ ii) $y(n) = \beta^n u(n) * \alpha^n u(n)$; $|\beta| < 1$, $|\alpha| < 1$ **(06 Marks)**

b. Determine the output of an LTI system described by the difference equation,

$y(n) - \frac{1}{2}y(n-1) = 2x(n)$ for the input $x(n) = 2\left(-\frac{1}{2}\right)^n u(n)$ with $y(-1) = 3$. **(08 Marks)**

c. Convert the following differential equation into integral equation and draw direct form I and direct form II representation. $\frac{d^3y(t)}{dt^3} + 2\frac{dy(t)}{dt} + 3y(t) = x(t) + 3\frac{dx(t)}{dt}$ **(06 Marks)**

3 a. Evaluate the continuous time convolution integral, $y(t) = e^{-2t}u(t) * u(t+2)$. **(08 Marks)**

b. Evaluate the step response for the LTI system with impulse response h(t)=tu(t). **(06 Marks)**

c. For each of the impulse response given below, determine whether the corresponding system is memory less causal and stable.

i) $h(t) = e^{2t}u(t)$ ii) $h(n) = \delta(n) + \sin(n\pi)$ **(06 Marks)**

4 a. Find the Fourier series for the signal x(t) shown in figure Q4 (a). Sketch the magnitude and phase spectra. **(06 Marks)**

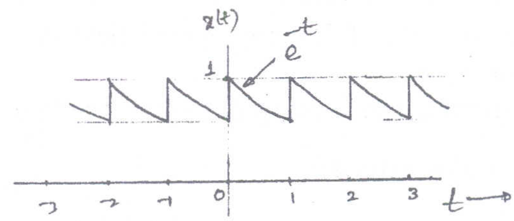
Fig. Q4 (a)

4 b. Use properties to find the FT of the following signals:

i) $x(t) = \sin(\pi t)e^{-2t}u(t)$ ii) $x(t) = e^{-3|t-2|}$ **(08 Marks)**

c. Use partial fraction expansion and obtain the inverse FT for the signal, $X(\omega) = \dfrac{-j\omega}{(j\omega)^2 + 3j\omega + 2}$. **(06 Marks)**

5 a. Obtain DTFS representation for the signal shown in figure Q5 (a). Sketch the magnitude and phase spectra. **(06 Marks)**

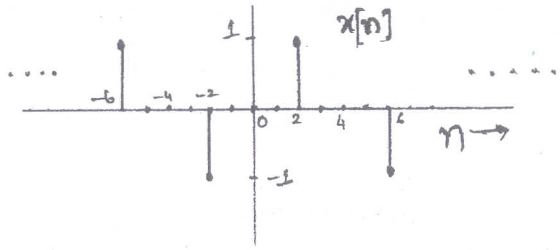

Fig. Q5 (a)

b. State and prove the following properties of DTFT:

i) Time shift ii) Frequency differenciation. **(08 Marks)**

c. Find inverse DTFT of the signal, $X(\Omega) = \dfrac{6}{e^{-j2\Omega} - 5e^{-j\Omega} + 6}$ **(06 Marks)**

6 a. Find the frequency response and the impulse response of the systems described below:

i) $x(t) = e^{-3t}u(t)$; $y(t) = e^{-3(t-2)}u(t-2)$

ii) $x(n) = \left(\dfrac{1}{2}\right)^n u(n)$; $y(n) = \dfrac{1}{4}\left(\dfrac{1}{2}\right)^n u(n) + \left(\dfrac{1}{4}\right)^n u(n)$ **(06 Marks)**

b. The input to a discrete time system is given by,

$x(n) = \cos\left(\dfrac{n\pi}{4}\right) + \sin\left(\dfrac{3\pi}{4}n\right)$

Use DTFT to find the output of the system y(n), if the impulse response is given by,

i) $h(n) = \dfrac{\sin\dfrac{n\pi}{2}}{n\pi}$; ii) $h(n) = (-1)^n \dfrac{\sin\left(\dfrac{n\pi}{2}\right)}{n\pi}$ **(08 Marks)**

c. State and prove the sampling theorem. **(06 Marks)**

7 a. Explain the significance of ROC of z transform. State and explain four of its properties. **(06 Marks)**

b. Find the z transform x(z) and sketch the pole-zero plot with ROC for the following sequences:

i) $x(n) = \left(\dfrac{1}{3}\right)^n u(n) + \left(\dfrac{1}{2}\right)^n u(-n-1)$ ii) $x(n) = a^{n+1}u(n+1)$ **(08 Marks)**

c. Find the inverse z transform of the following signals:

i) $x(z) = \dfrac{z}{2z^2 - 3z + 1}$; $|z| < \dfrac{1}{2}$ ii) $x(z) = \dfrac{z}{2z^2 - 3z + 1}$; $|z| > 1$ **(06 Marks)**

8 a. Obtain unilateral z transform of $x(n) = a^{n+1}u(n+1)$. **(06 Marks)**

b. State and prove the following properties of z transform: i) Time shift property ; ii) Diffrentiation in z. **(08 Marks)**

c. Use the unilateral z transform to determine the impulse response of a system described by,

$y(n) - \dfrac{1}{4}y(n-2) = x(n-1)$ **(06 Marks)**

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Master set

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06EC44

Fourth Semester B.E. Degree Examination, May/June 2010
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

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.

PART – A

1 a. Give the classification of signals. **(08 Marks)**

b. Determine and sketch the even and odd part of the signals shown in Fig.Q1(b). **(12 Marks)**

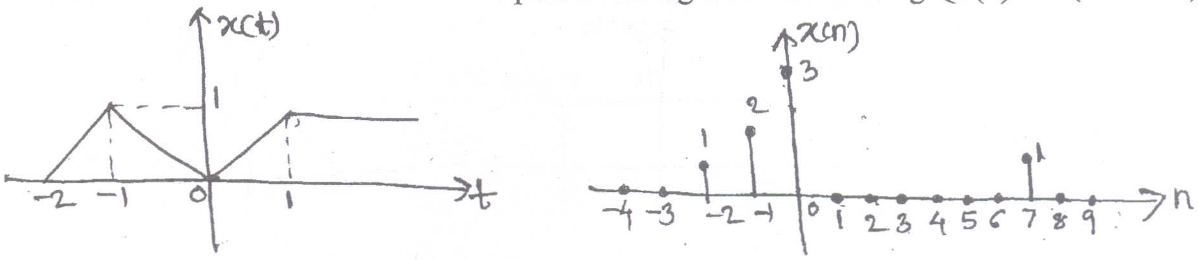

Fig.Q1(b)

2 a. Derive the expression for convolution integral. **(05 Marks)**

b. Verify which of the following systems are linear, causal and invertible:

i) $y(t) = ax(t) + b$ ii) $y(t) = x^2(t)$ iii) $y(n) = \sqrt{x(n)}$ iv) $y(n) = x(4n + 1)$. **(10 Marks)**

c. For a discrete LTI (DLTI) system to be BIBO stable,

Show that $S \triangleq \sum_{K=-\infty}^{\infty} |h(k)| < \infty$ **(05 Marks)**

3 a. By direct evaluation of convolution sum, determine the step response of a discrete system whose unit impulse response $h(n) = (½)^{-n} u(-n)$. Sketch the response and hence verify whether the system is stable and causal. **(08 Marks)**

b. Obtain $x(t) * y(t)$ for the signals

$$x(t) = u(t) - u(t-2)$$
$$y(t) = t\,[u(t) - u(t-1)]$$

Sketch the convolved signal $x(t) * y(t)$. **(08 Marks)**

c. Draw block diagram representations for causal LTI systems whose input output relation is

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

iii) $y(t) = -\frac{1}{2}\frac{dy(t)}{dt} + 4x(t)$ iv) $\frac{dy(t)}{dt} + 3y(t) = x(t)$ **(04 Marks)**

4 a. Give the significance of time and frequency domain representation of signals. Give examples. **(04 Marks)**

b. Find the CT exponential FS of the signal shown in Fig.Q4(b). **(10 Marks)**

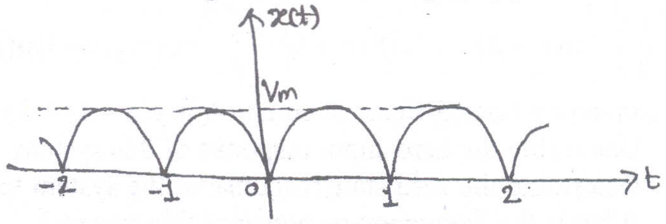

Fig.Q4(b)

c. State and prove the periodic time shift and periodic time convolution properties of DTFS (Discrete time Fourier series). **(06 Marks)**

PART – B

5 a. Obtain the DTFT of the following DT aperiodic sequences:
i) $x(n) = \delta(n) - 3\delta(n-3) + 2\delta(n-4)$ ii) $x(n) = (1/2)^n u(n) - (1/3)^n u(-n-3)$
iii) $x(n) = nu(n) - u(n-1)$ iv) $x(n) = \cos w_o n\, u(n)$ **(04 Marks)**

b. State and prove the Parseval's relation for DTFT. What is the significance of this relation? **(06 Marks)**

c. Using the time differentiation property of CTFT, find the spectrum of the following signals as shown in Fig.Q5(c). Plot the spectrum. **(10 Marks)**

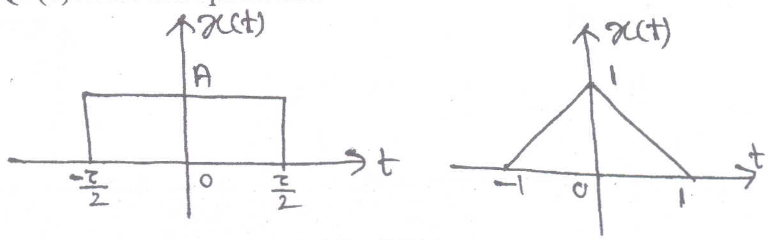

Fig.Q5(c)

6 a. A particular discrete-time system has input x(n) and output y(n). The Fourier transforms of these signals are related by the equation $Y(e^{jw}) = ZX(e^{jw}) + e^{-jw}X(e^{jw}) - \frac{dX(e^{jw})}{dw}$.
Is the system linear? Clearly justify your answer. What is y(n) if x(n) = δ(n)? Is the system causal? **(06 Marks)**

b. Consider a causal and state LTI system S having frequency response $H(w) = \frac{jw+4}{6-w^2+5jw}$.
i) Obtain the differential equation for the system.
ii) Determine the impulse response h(t) of S
iii) What is the output of S when the input is $x(t) = e^{-4t}u(t) - te^{-4t}u(t)$ **(10 Marks)**

c. If $x(t) \leftrightarrow X(f)$
Show that $x(t)\cos w_0 t \leftrightarrow \frac{1}{2}[X(f-f_0) + X(f+f_0)]$ where $w_0 = 2\pi f_0$. **(04 Marks)**

7 a. What is region of convergence of X(z), where X(z) is the z-transform of x(n). State all the properties of R.O.C. **(05 Marks)**

b. Determine the Z-transform of the following sequences including R.O.C.
i) $\delta(n+5)$ ii) $\left(\frac{1}{2}\right)^{n+1} u(n+3)$ iii) $\left(-\frac{1}{3}\right)^n u(-n-2)$
iv) $2^n u(-n) + \left(\frac{1}{4}\right)^n u(n-1)$ v) $\alpha^{|n|}$ for $0 < \alpha < 1$. **(15 Marks)**

8 a. State and prove time reversal property. Find value theorem of Z-transform. Using suitable properties, find the Z-transform of the sequences
i) $(n-2)\left(\frac{1}{3}\right)^{n-2} u(n-2)$ ii) $(n+1)\left(\frac{1}{2}\right)^{n+1} \cos w_0(n+1)u(n+1)$ **(10 Marks)**

b. Consider a system whose difference equation is $y(n-1) + 2y(n) = x(n)$
i) Determine the zero-input response of this system, if y(-1) = 2.
ii) Determine the zero state response of the system to the input $x(n)=(1/4)^n u(n)$.
iii) What is the frequency response of this system?
iv) Find the unit impulse response of this system. **(10 Marks)**

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Fourth Semester BE Degree Examination, Dec.09-Jan.10
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Standard notations are used.
3. Missing data be suitably assumed.

PART – A

1 a. Sketch :
i) $y(t) = r(t+1) - r(t) + r(t-2)$
ii) $z(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$. **(04 Marks)**

b. i) Is the signal $y(t) = \cos(20\pi t) + \sin(50\pi t)$ periodic? What is the period of $y(t)$?
ii) What is the power and energy of the signal, $x(t) = A\cos(wt + \theta)$? **(04 Marks)**

c. Determine the properties of the capacitive system, if the voltage across it $v_c(t) = \frac{1}{c}\int_{-\infty}^{t} i(z)\,dz$, considering $i(t)$ as the input and $v_c(t)$ as output. **(06 Marks)**

d. A discrete time system is given by $y[n] = x[n]\,x[n-1]$. Determine its properties. **(06 Marks)**

2 a. The impulse response is given by $h(t) = u(t)$. Determine the output of the system, if $x(t) = e^{-\alpha t}u(t)$. State any assumptions made. **(06 Marks)**

b. Determine the natural response and forced response of a system described by the relationship: $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt}$

$$y(0) = 0\ ;\ \frac{dy(t)}{dt}(0) = 1\ ;\ x(t) = e^{-2t}u(t).$$ **(08 Marks)**

c. Obtain the direct form I and II block representation of a system described by the input-output relationship, $\frac{d^2y(t)}{dt^2} + y(t) = 3\frac{dx(t)}{dt}$. **(06 Marks)**

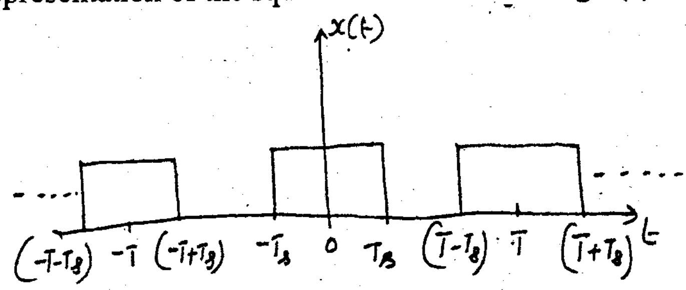
3 a. The impulse response of an LTI system is given by $h[n] = u[n]$. Determine the output if $x[n] = 3^n u[-n]$. **(08 Marks)**

b. If the output of an LTI system is given by: $y[n] = x[n+1] + 2x[n] - x[n-1]$, determine impulse response and comment on the system causality and stability. **(06 Marks)**

c. Determine the step response of a relaxed system whose input output relationship is given by: $y[n] + 4y[n-1] + 4y[n-2] = x[n]$. **(06 Marks)**

4 a. Determine the FS representation of the square wave shown in Fig.4(a). **(07 Marks)**

Fig.4(a)



b. If the FS representation of a signal x (t) is x [k], derive the FS of a signal x (t – to) [time shift property of FS]. **(06 Marks)**

c. Determine the DTFS for the sequence $x[n] = \mathrm{Cos}^2\left[\frac{\pi}{4}n\right]$. **(07 Marks)**

PART – B

5 a. Show that the Fourier Transform of a rectangular pulse described by:

$$x(t) = 1 \;;\; -T \le t \le T$$
$$= 0 \;;\; |t| > T$$

is a sinc function. Plot the magnitude and phase spectrum. **(07 Marks)**

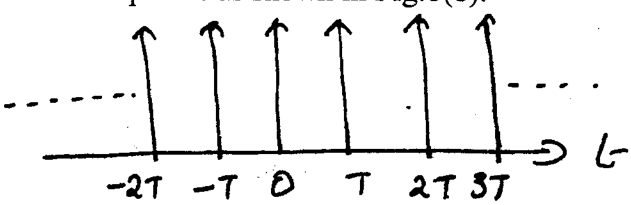
b. If $y(t) = \frac{dx(t)}{dt}$, where x (t) is a non-periodic sigal, find the Fourier Transform of y (t) in terms of x (jw). **(06 Marks)**

c. Determine the PTFT of the signal, $x[n] = \{1, 1, \underset{\uparrow}{1}, 1, 1\}$ and sketch the spectrum $x(e^{j\Omega})$ over the frequency range $-\pi \le \Omega \le \pi$. **(07 Marks)**

6 a. The input $x(t) = e^{-3t}u(t)$ when applied to a system, results in an output $y(t) = e^{-t}u(t)$. Find the frequency response and impulse response of the system. **(07 Marks)**

b. Find the FT of a train of unit impulses as shown in Fig.6(b). **(07 Marks)**

Fig.6(b)



c. Find the FT pair corresponding to the discrete time periodic signal: $x[n] = \mathrm{Cos}\left[\frac{2\pi}{N}n\right]$. **(06 Marks)**

7 a. Find the z - transform and RoC of $x[n] = \alpha^{|n|}$. What is the constraint on α? **(06 Marks)**

b. Using properties of z – transform, find convolution of $x[n] = \left[\underset{\uparrow}{1}, 2, -1, 0, 3\right]$ and $y[n] = \left[\underset{\uparrow}{1}, 2, -1\right]$. **(06 Marks)**

c. Determine x [n] if $x(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - z^{-1}\right)}$ for i) RoC of $|z| < \frac{1}{2}$ and ii) RoC of $1 < |z| < 2$. **(08 Marks)**

8 a. Find x [n] if $x(z) = \frac{16z^2 - 4z + 1}{8z^2 + 2z - 1}$; RoC : $|z| > \frac{1}{2}$. **(06 Marks)**

b. Prove the time shift property of unilateral z-transform. **(06 Marks)**

c. Determine the transfer function and difference equation if the impulse response is $h[n] = \left[\frac{1}{3}\right]^n u[n] + \left[\frac{1}{2}\right]^{n-2} u[n-1]$. **(08 Marks)**

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Fourth Semester B.E. Degree Examination, June-July 2009
Signals and Systems

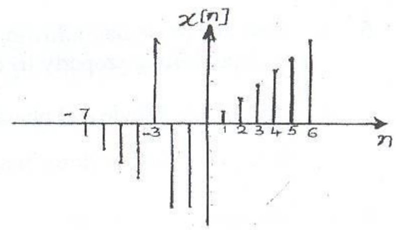
Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. A function x[n] is defined by

$$x[n] = \begin{cases} -(n+8) & \text{for } -8 < n < -3 \\ 6 & \text{for } n = -3 \\ -6 & \text{for } -3 < n < 0 \\ n & \text{for } -1 < n < 7 \\ 0 & \text{otherwise} \end{cases}$$



Sketch $y[n] = 3.x[n/2 + 1]$ **(04 Marks)**

b. Perform the following operations (addition & multiplication) on given signals. Fig.1(b).
(i) $y_1(t) = x_1(t) + x_2(t)$ (ii) $y_2(t) = x_1(t) . x_2(t)$

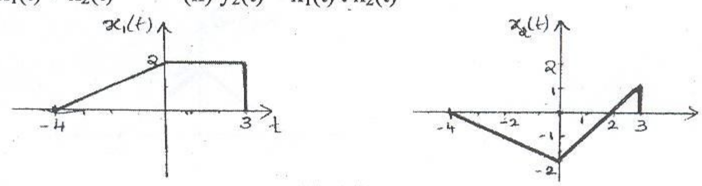


Fig.1(b) **(04 Marks)**

c. Distinguish between i) Energy signal & power signal ii) Even & odd signal. **(06 Marks)**

d. Explain the following properties of systems with suitable example:
i) Time invariance ii) Stability iii) Linearity. **(06 Marks)**

2 a. Find the convolution integral of x(t) & h(t) and sketch the convolved signal:
$x(t) = \delta(t) + 2\delta(t-1) + \delta(t-2)$, $h(t) = 3$, $-3 \le t \le 2$. **(08 Marks)**

b. Determine the convolution sum of the given sequence
$x(n) = \{3, 5, -2, 4\}$ and $h(n) = \{3, 1, 3\}$ **(06 Marks)**

c. Show that i) $x(t) * \delta(t - t_0) = x(t - t_0)$

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

3 a. The impulse response of the system is $h(t) = e^{-4t}u(t-2)$. Check whether the system is stable, causal and memoryless. **(06 Marks)**

b. Draw the direct form-I & direct form-II implementation of the following difference equation. $y(n) - \frac{1}{4}y(n-1) + y(n-2) = 5x(n) - 5x(n-2)$ **(06 Marks)**

c. Find the forced response of the system shown in Fig.3(c), where x(t) = const. **(08 Marks)**

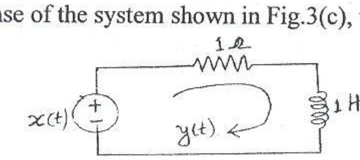


Fig.3(c)

4 a. State the condition for the Fourier series to exist. Also prove the convergence conditio[n] [Absolute integrability]. (06 Marks)

b. Prove the following properties of Fourier series. i) Convolution property ii) Parseval relationship. (06 Marks)

c. Find the DTFS harmonic function of x(n) = A cos ($2\pi n/No$). Plot the magnitude and phas[e] spectra. (08 Marks)

PART – B

5 a. State and prove the following properties of Fourier transform.
i) Time shifting property ii) Differentiation in time property iii) Frequency shifting property (09 Marks)

b. Plot the Magnitude and phase spectrum of $x(t) = e^{-|t|}$ (06 Marks)

c. Determine the time domain expression of $X(jw) = \dfrac{2jw+1}{(jw+2)^2}$ (05 Marks)

6 a. The spectrum X(jw) of signal is shown in Fig.6(a). Draw the spectrum of the sampled signal at i) half the Nyquist rate ii) Nyquist rate and iii) Twice the Nyquist rate. Mark the frequency values clearly in the figure. (12 Marks)

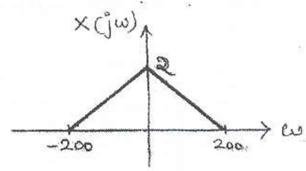


Fig.6(a)

b. Define and explain Nyquist sampling theorem with relevant figures. Give significance of this theorem. (08 Marks)

7 a. Describe the properties of Region of convergence and sketch the ROC of two sided sequences, right sided sequence and left sided sequence. (10 Marks)

b. Find the inverse Z-transform of

$$X(z) = \frac{1}{(z^2 - 2z + 1)(z^2 - z + \frac{1}{2})}$$ using partial fraction method. (10 Marks)

8 a. Solve the difference equation $y(n+2) - \frac{3}{2}y(n+1) + \frac{1}{2}y(n) = \left(\frac{1}{4}\right)^n$ for $n \geq 0$ with initial conditions y(0) = 10 and y(1) = 4. Use z-transform. (12 Marks)

b. Explain how causality and stability is determined in terms of z-transform. Explain the procedure to evaluate Fourier transform from pole zero plot of z-transform. (08 Marks)

Third Semester B.E. Degree Examination, June-July 2009

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. The trapezoidal pulse x(t) shown in figure Q1 (a) is defined by,

$$x(t)=\begin{cases}5-t & 4\le t\le 5\\ 1 & -4\le t\le +4\\ t+5 & -5\le t\le -4\\ 0 & \text{otherwise}\end{cases}$$

Determine the total energy of x(t), **(05 Marks)**

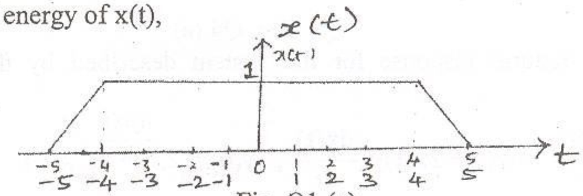


Fig. Q1 (a)

b. Given the signal x(t) and y(t) in figure Q1(b) and figure Q1 (c) respectively. Carefully sketch the following signals. i) x(t)y(t-1) ii) x(t+1)y(t-2). **(05 Marks)**

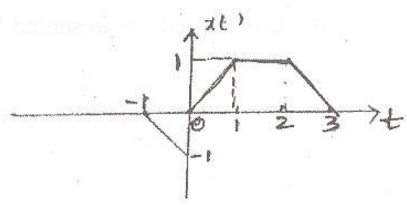


Fig. Q1 (b)

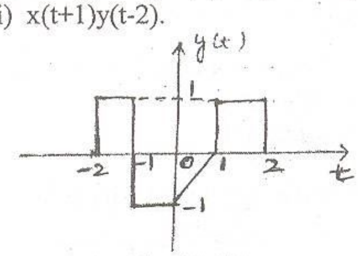


Fig. Q1 (c)

c. Sketch the waveform of the signal given below,
$y(t)=r(t+2)-r(t+1)-r(t-1)+r(t-2)$ **(05 Marks)**

d. Determine whether the following signals are periodic. If they are periodic, find the fundamental period.
i) $x(n)=\cos\left(\frac{8}{15}\pi n\right)$ ii) $x(t)=v(t)+v(-t)$ where $v(t)=\cos(t).u(t)$ **(05 Marks)**

2 a. Determine whether each of the systems given below is linear, time invariant, causal and memory.
i) $y(t)=\cos(x(t))$ ii) $y(n)=2x(n)u(n)$ iii) $y(t)=\frac{d}{dt}\left\{e^{-t}x(t)\right\}$ **(12 Marks)**

b. Sketch the trapezoidal pulse y(t) that is related to figure Q1 (a) as follows:
$y(t)=x(10t-5)$ **(08 Marks)**

3 a. Use the definition of the convolution sum to prove the following properties:
i) $x(n)*(h(n)+g(n))=x(n)*h(n)+x(n)*g(n)$
ii) $x(n)*(h(n)*g(n))=(x(n)*h(n))*g(n)$
iii) $x(n)*h(n)=h(n)*x(n)$ **(12 Marks)**

b. Evaluate continuous time convolution integral given below:
$y(t)=(t(u(t)+(10-2t)u(t-5)-(10-t)u(t-10)*u(t))$ **(08 Marks)**

4 a. Draw direct form I and direct form II implementation of the system given below:

$$\frac{d^3y(t)}{dt^3}+2\frac{dy(t)}{dt}+3y(t)=x(t)+3\frac{dx(t)}{dt}$$ **(06 Marks)**

4 b. Find the expression for the impulse response the input x(t) to the output y(t) in terms impulse response for the LTI system shown below figure Q4 (a). (06 Marl

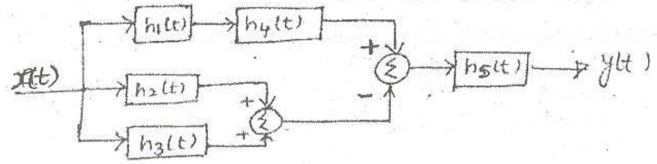


Fig. Q4 (a)

c. Determine the natural response for the system described by the following differenti equation,

$$\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+6y(t)=2x(t)+\frac{dx(t)}{dt}, \quad y(0)=2, \quad \left.\frac{dy(t)}{dt}\right/_{t=0}=1$$ (08 Mark

5 a. Prove the following properties related to DTFS:
i) Frequency shift property. ii) Convolutional property. iii) Modulation property. (14 Mark

b. Use the definition of the DTFS to determine the time signals represented by the followin DTFS coefficients:
$X(K)=\cos\left(\frac{6\pi}{17}K\right)$ (06 Marks

6 a. Determine the signal x(n) if its DTFT is as shown in figure Q6 (a) and Q6 (b). (12 Marks

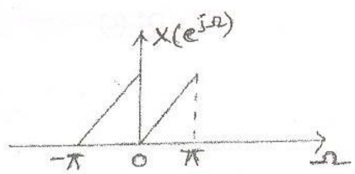


Fig. Q6 (a)

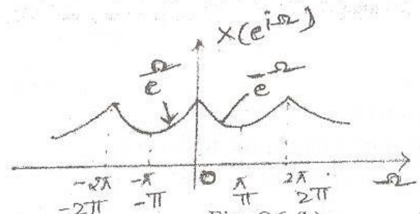


Fig. Q6 (b)

b. Prove that, $x(n)\xleftrightarrow{DTFT}x(e^{j\Omega})$ then $\sum_{n=-\infty}^{\infty}|x(n)|^2=\frac{1}{2\pi}\int_{2\pi}\left|x(e^{j\Omega})\right|^2 d\Omega$. (08 Marks)

7 a. State and prove final value theorem of Z-T. (05 Marks)
b. Prove the differential property of the Z-T. (05 Marks)
c. Find Z-T of $x(n)=\left\{\left(\frac{1}{2}\right)^n+\left(\frac{1}{3}\right)^n\right\}u(n)$. Plot the ROC units pole zero diagram. (05 Marks)
d. Determine the z-transform of the signal given using z-transform property,
$x(n)=\left(\frac{1}{2}\right)^n u(n)*\left(\frac{1}{3}\right)^n u(n)$ (05 Marks)

8 a. Find the inverse Z-T of $x(z)=\frac{z}{3z^2-4z+1}$, for the ROC as i) $|z|>1$ ii) $|z|<\frac{1}{3}$
iii) $\frac{1}{3}<|z|<1$
using partial fraction expansion method. (10 Marks)
b. Use a power series expansion to determine the time domain signal corresponding to the following z-transform $x(z)=\cos(2z)$, $|z|<\infty$. (05 Marks)
c. Determine x(n) for $x(z)=e^z+e^{1/z}$. (05 Marks)

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

Signals and Systems

Time: 3 hrs.

Max. Marks: 100

Note : ***Answer FIVE full questions choosing at least two full questions from each part.***

Part A

1 a. Determine even and odd component of following signals,

i) $x(t) = 1 + t\tan t + t^2 \tan^2 t$ ii) $x(n) = n^2\left(\frac{1}{2}\right)^{n-2}$ **(06 Marks)**

b. Determine energy in the signal $x\left(-\frac{1}{2}t+3\right)$ given the signal x(t) as below, **(08 Marks)**

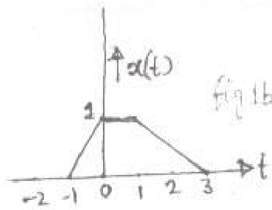

Fig. Q1 (b)

c. Verify the following system for i) Linerity ii) Time-invariance iii) Causal iv) Memory less.

$y(n) = x(n) + \sum_{K=-\infty}^{n-1} x(k)$ **(06 Marks)**

2 a. A LTI system has an impulse response $h(t) = e^{-|t-2|}$. Find the output of the system for the input $x(t) = e^{-3t}u(t)$. **(10 Marks)**

b. A discrete time system which is linear and time-invariant has impulse response $h(n) = \left(\frac{1}{2}\right)^n (u(n) - u(n-7))$. If the impulse is $x(t) = \left(\frac{1}{3}\right)^n \quad 0 \geq n \geq 9$

$= 0 \quad$ otherwise

Determine the output and obtain closed form expression in each region. **(10 Marks)**

3 a. A system is described by $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = \frac{dx(t)}{dt}$.

With initial conditions $y(0) = -1 \quad \left.\frac{dy(t)}{dt}\right|_{t=0} = 2$

If the input is $x(t) = 2e^{-2t}u(t)$, determine the output (do not use any transforms). **(10 Marks)**

b. Determine the step response of the LTI system whose impulse response is given by $h(n) = \left(-\frac{3}{4}\right)^n u(n)$. **(04 Marks)**

c. Draw the direct form – I and direct form – II implementation of the system given by,

$y(n) - \frac{1}{2}y(n-1) + \frac{1}{3}y(n-3) = x(n) + 3x(n-1)$. **(06 Marks)**

4 a. State and prove Parseval's theorem for continuous time periodic signals $x(t)$. Using the

4 b. Determine the time-domain signal given the DTFS coefficients,

$x(k) = \cos\left(\frac{10\pi}{21}k\right) + j\sin\left(\frac{4\pi}{21}k\right)$. **(04 Marks)**

c. Determine Fourier series representation of the signal x(n) shown below, and sketch its magnitude spectra. **(06 Marks)**

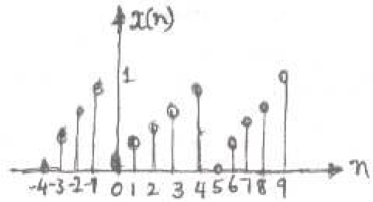

Fig Q4 (c)

Part B

5 a. Determine the DTFT of the following signals,

i) $x(n) = a^{|n-2|}, \quad |a| < 1$ ii) $x(n) = \left(\frac{1}{2}\right)^n u(n-2)$ iii) $x(n) = 2^n[u(n) - u(n-6)]$. **(10 Marks)**

b. Determine the time-domain signal given its FT as follows:

i) $x(j\omega) = \dfrac{-j\omega}{(j\omega)^2 + 3j\omega + 2}$ ii) $x(j\omega) = \begin{cases} 1 & -\pi/2 \le \omega \le \pi/2 \\ 0 & |\omega| > \pi/2 \end{cases}$

iii) $x(j\omega) = \begin{cases} 2\cos\omega & |\omega| \le \pi \\ 0 & |\omega| > \pi \end{cases}$ **(10 Marks)**

6 a. Determine the frequency response and impulse response of a system described by

$\dfrac{d^2y(t)}{dt^2} + 5\dfrac{dy(t)}{dt} + 6y(t) = -\dfrac{dx(t)}{dt}$. **(07 Marks)**

b. Explain the process of sampling and concept of aliasing as applicable to continuous time signals. **(06 Marks)**

c. Determine the frequency response $H(j\omega)$ of a system which has impulse response of $h(t) = \dfrac{\sin(\pi t)}{\pi t}\cos(3\pi t)$ using the modulation property. Plot the magnitude and phase response of $H(j\omega)$. **(07 Marks)**

7 a. Determine the z-transform of the following sequences along with their ROC. Plot the poles and zeros:

i) $x(n) = (3/4)^n u(n) + (2)^n u(-n-1)$. ii) $x(n) = (n-3)^2\left(\frac{1}{3}\right)^{n-3} u(n-3)$. **(10 Marks)**

b. Determine output of the LTI system where $h(n) = \left(\frac{1}{2}\right)^n u(n)$ and $x(n) = n\left(-\frac{1}{2}\right)^n u(n)$ using z-transform techniques. **(10 Marks)**

8 a. A stable system is described by the difference equation,

$y(n) - y(n-1) + \frac{1}{4}y(n-2) = x(n) + \frac{1}{4}x(n-1) - \frac{1}{8}x(n-2)$. Determine its impulse response.

If $x(n) = \left(\left(\frac{1}{4}\right)^n + \left(-\frac{1}{2}\right)^n\right)u(n)$ determine the output. **(10 Marks)**

b. Determine forced response, the natural response and comlete response of the system

USN

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Fourth Semester B.E. Degree Examination, June/July 08
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions choosing at least two from each part.***

Part A

1 a. Determine and sketch the even and odd components of,

i) $x(n) = e^{-n/4}u(n)$

ii) $x(t) = \begin{cases} t, & 0 \le t \le 1 \\ 2-t, & 1 \le t \le 2 \end{cases}$. **(08 Marks)**

b. Distinguish between power and energy signals. Categorise each of the following signals as power or energy signals and find the energy or power of the signal.

i) $x(n) = \left(\frac{1}{2}\right)^n u(n)$

ii) $x(t) = \cos^2 \omega_0 t$ **(08 Marks)**

c. Starting from the pulse g(t) shown in figure Q1 (c) construct the wave form x(t) and express x(t) in terms of g(t). **(04 Marks)**

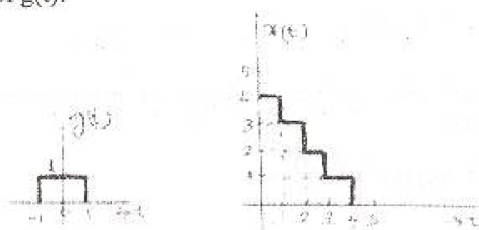

Fig. Q1 (c)

2 a. Explain the difference between the following relationships:
$x(n).\delta(n-n_0) = x(n_0)$ and $x(n) * \delta(n-n_0) = x(n-n_0)$ **(06 Marks)**

b. Given the impulse response of the system as $h(t) = e^{-t} \cdot u(t)$ and input to the system as $x(t) = e^{-3t}(u(t) - u(t-2))$ determine the output of the system. Sketch the various cases. **(14 Marks)**

3 a. Given the impulse response of a system as $h(n) = n\left(\frac{1}{2}\right)^n .u(n)$, determine if the system is causal and stable. **(04 Marks)**

b. Determine the complete response of a system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{d(t)}, \text{ with } y(0) = 0, \left.\frac{dy(t)}{dt}\right/_{t=0} = 1$$

and $x(t) = e^{-2t}.u(t)$. **(12 Marks)**

c. Draw the Form – I and Form – II structures for a system described by the following difference equation:

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{4}y(n-3) = x(n) + \frac{2}{3}x(n-2)$$ **(04 Marks)**

4 a. Determine the DTFS coefficients for the periodic signal shown in figure Q4 (a). **(08 Marks)**

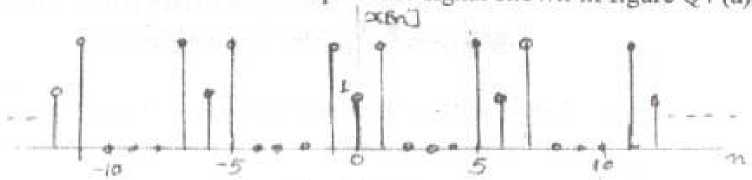

Fig. Q4 (a)

b. Determine the Fourier Series representation for the square wave shown in figure Q4 (b). Draw typical plot of X[k]. **(12 Marks)**

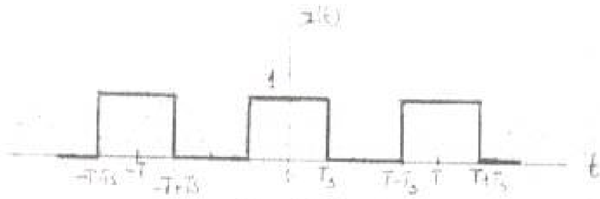

Fig. Q4 (b)

Part B

5 a. Obtain the Fourier transform of the signal $e^{-at} \cdot u(t)$ and plot its magnitude and phase spectrum. **(14 Marks)**

b. Determine the DTFT of unit step sequence $x(n) = u(n)$ **(06 Marks)**

6 a. Determine the H(w) and impulse response of the system described by the following differential equation,

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}$$ **(10 Marks)**

b. The impulse response of a continuous time system is $h(t) = \frac{1}{RC} e^{-\frac{t}{RC}}.u(t)$. Determine its frequency response and plot the magnitude and phase plots. **(10 Marks)**

7 a. Determine z-transform of $x(n) = \cos(\Omega_0 n).u(n)$. **(08 Marks)**

b. State and prove initial value theorem for z-transforms. **(04 Marks)**

c. Determine using partial fraction expansion, inverse z-transform of

$$X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}, \ ROC |z| < 0.5$$ **(08 Marks)**

8 a. A system is described by the difference equation,
$y(n) = 0.7y(n-1) - 0.12y(n-2) + x(n-1) + x(n-2)$
What will be the output when excitation is $x(n) = nu(n)$? Is the system stable? **(14 Marks)**

b. Solve the difference equation,
$y(n) - 3y(n-1) - 4y(n-2) = 0$, $n \geq 0$; given $y(-1) = 5$ and $y(-2) = 0$. **(06 Marks)**

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8 Sheets

USN | | | | | | | | | | | **EC36**

Third Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Signals & Systems

Time: 3 hrs. Max. Marks:100

Note :1. ***Answer any FIVE full questions.***
2. ***Missing parameters are to be suitably assumed.***

1 a. Distinguish between the following with suitable example:
i) Symmetric and Non-symmetric signals.
ii) The relationship between unit-step and unit-impulse function.
iii) Power and Energy signals. **(09 Marks)**

b. Determine whether the following signals are periodic or not, if so find their period:

i) $x(t) = \cos\left(t + \pi/4\right)$ ii) $x(t) = e^{j\left(\frac{\pi}{2}t - 1\right)}$ iii) $x(t) = \cos t + \sin\sqrt{2}\,t$ **(06 Marks)**

c. Generate staircase signal $x(t)$ from signal $g(t)$. **(05 Marks)**

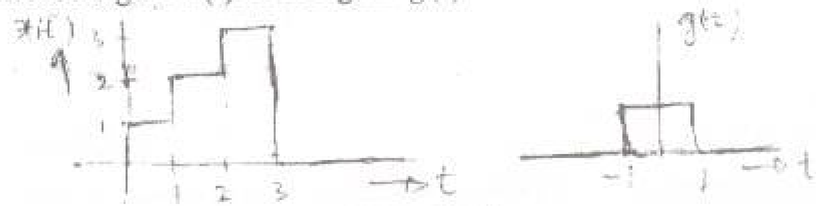


Fig. Q1 (c)

2 a. Explain the following properties of the system:
i) Stability ii) Linearity iii) Causality iv) BIBO v) Time Invariance **(08 Marks)**

b. Find $z(t) = x(2t)\cdot y(2t+1)$ where $x(t)$ and $y(t)$ are given as below: **(08 Marks)**

Fig. Q2(b)

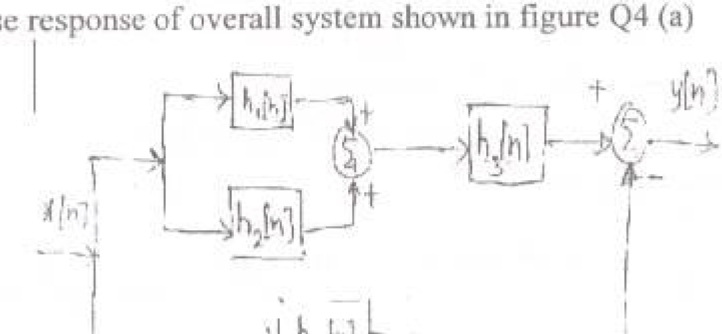
c. Find the energy of the pulse given by $x(t) = \begin{cases} A & 0 \le t \le T \\ 0 & \text{elsewhere} \end{cases}$. **(04 Marks)**

3 a. Evaluate : $y(n) = x(n) * h(n)$. Where $x(n) = \alpha^n u(n)$ and $h(n) = u(n)$, $0 < \alpha < 1$. **(08 Marks)**

b. Evaluate : $y(t) = u(t+1) * u(t-2)$. **(06 Marks)**

c. Show that i) $x(t) * \delta(t) = x(t)$ ii) $x(t) * \delta(t - t_0) = x(t - t_0)$ **(06 Marks)**

4 a. Find the impulse response of overall system shown in figure Q4 (a)



b. Draw the direct form I and direct form II implementations of the following difference equation,

$y(n)+\frac{1}{4}y(n-1)-\frac{1}{8}y(n-2)=2x(n)+3x(n-1)$. **(06 Marks)**

c. Find the forced response of the system shown in the figure Q4 (c), where $x(t)=\cos t$ **(07 Marks)**

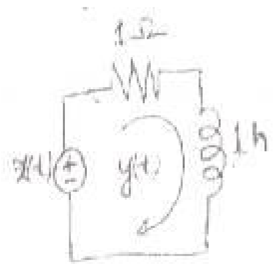


Fig. Q4 (c)

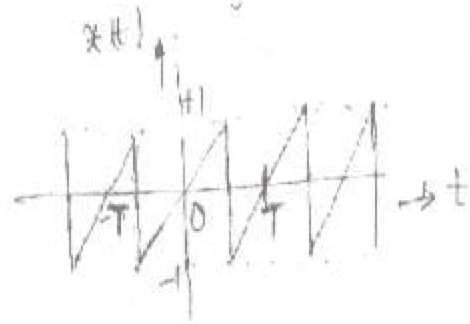


Fig. Q5 (a)

5 a. Find out the Fourier series of the following signal using trigonometric form. **(10 Marks)**

b. Evaluate the DTFS for $x(n)=\sin\left(\frac{4\pi}{21}n\right)+\cos\left(\frac{10\pi}{21}n\right)+1$. Sketch its magnitude and phase spectra. **(10 Marks)**

6 a. Prove the following properties of fourier transform

i) Time differentiation. ii) Time convolution. **(06 Marks)**

b. Find Fourier Transform of the following signal. **(08 Marks)**

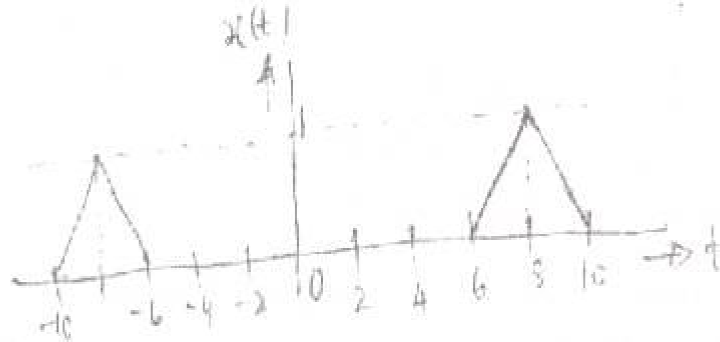


Fig. Q6 (b)

c. Find Inverse Fourier transform of $X(\omega)=\frac{j\omega+12}{(j\omega)^2+5j\omega+6}$ **(06 Marks)**

7 a. Determine Z transform and ROC of the following :

i) $x(n)=-\alpha^n u(-n-1)$ ii) $x(n)=\left(\frac{1}{3}\right)^n \sin\left(\frac{\pi}{4}n\right)u(n)$ **(10 Marks)**

b. Find the Inverse Z-transform of

i) $x(z)=\frac{z^4+z^2}{\left(z-\frac{1}{2}\right)\left(z-\frac{1}{4}\right)}$ ROC: $\frac{1}{2}<|z|<\infty$ ii) $x(z)=\frac{z^{-1}}{-2z^2-z^{-1}+1}$ ROC: $1<|z|<2$ **(10 Marks)**

8 a. State and prove sampling theorem for low pass signals. **(10 Marks)**

b. Explain the properties of ROC of Z-transform. **(10 Marks)**

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EC36

USN | | | | | | | | | |

NEW SCHEME

Third Semester B.E. Degree Examination, July 2007
EC/ EE/TE/IT/BM/ML
Signals and Systems

Time: 3 hrs.] [Max. Marks:100

Note : ***1. Answer any FIVE full questions.***
2. Make any suitable assumptions for missing data.

1 a. Distinguish between:
i) Continuous time and discrete time signals
ii) Even and odd signals
iii) Periodic and non-periodic signals
iv) Energy and power signals. **(08 Marks)**

b. Find the even and odd parts of the following signals:
i) $x(t) = [\mathrm{Sin}(\pi t) + \mathrm{Cos}(\pi t)]^2$
ii) $x(t) = (1 + t^3)\mathrm{Cos}^3(10t)$. **(04 Marks)**

c. Find the average power and energy of the following signals. Determine whether they are power / energy signals.

i) $x[n] = \begin{cases} \mathrm{Sin}(\pi n); & \text{for } -4 \le n \le 4 \\ 0; & \text{otherwise} \end{cases}$

ii) $x[n] = \begin{cases} \mathrm{Cos}(\pi n); & \text{for } -4 \le n \le 4 \\ 0; & \text{otherwise} \end{cases}$

iii) $x[n] = \begin{cases} \mathrm{Cos}(\pi n); & \text{for } n \ge 0 \\ 0; & \text{otherwise} \end{cases}$

iv) The raised cosine pulse (positive half cycle) x(t) which is defined as:

$$x(t) = \begin{cases} \frac{1}{2}[\mathrm{Cos}(\omega t) + 1]; & -\frac{\pi}{\omega} \le t \le \frac{\pi}{\omega} \\ 0; & \text{otherwise} \end{cases}.$$ **(08 Marks)**

2 a. Explain any four properties of continuous and / or discrete time systems. Illustrate with suitable examples. **(08 Marks)**

b. Check the given properties for the following systems:
i) Causality: (1) $y(t) = e^{x(t)}$ (2) $y[n] = x[n-2] - 2x[n-17]$.
ii) Time – invariant / variant: (1) $y(t) = t.x(t)$ (2) $y[n] = x[2n]$
iii) Linearity: (1) $y(t) = x(t/2)$ (2) $y[n] = x[n].x[n-1]$ **(12 Marks)**

3 a. Obtain the convolution of the given two signals. Also sketch the result.
Given: $h(t) = \begin{cases} 1 & \text{for } 1 < t < 3 \\ 0; & \text{elsewhere} \end{cases}$, $x(t) = \begin{cases} (1-t) & \text{for } 0 \le t \le 1 \\ 0; & \text{elsewhere} \end{cases}$ **(08 Marks)**

b. The impulse response of a LTI system is given by h[n] = {1, 2, 1, -1}. Determine the

c. Solve the difference equation of a system defined by:

$$y[n]-\frac{1}{4}y[n-1]-\frac{1}{8}y[n-2]=x[n]+x[n-1],$$

given that: $x[n] = 2^n.u[n]$; $y[-1] = 2$, $y[-2] = -1$. **(06 Marks)**

4 a. Evaluate the DTFS representation for the signal, $x[n]=\text{Sin}\left(\frac{4\pi}{21}n\right)+\text{Cos}\left(\frac{10\pi}{21}n\right)+1$

Sketch the magnitude and phase spectra. **(08 Marks)**

b. State and prove the following Fourier transform:
i) Time shifting property ii) Time differentiation property. **(06 Marks)**

c. Find the DTFT for the following signal x[n] and draw its amplitude spectrum:
Given: i) $x[n] = a^n.u[n]$; $|a| < 1$ ii) $x[n] = \delta(n)$ unit impulse (delta). **(06 Marks)**

5 a. The system produces the output of $y(t) = e^{-t}.u(t)$, for an input of $x(t) = e^{-2t}.u(t)$. Determine impulse response and frequency response of the system. **(10 Marks)**

b. The input and the output of a causal LTI system are related by differential equation

$$\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+8y(t)=2x(t)$$

i) Find the impulse response of this system
ii) What is the response of this system if $x(t) = te^{-2t}u(t)$? **(10 Marks)**

6 a. State and bring out the importance of the sampling theorem. Give the proof of the theorem for low pass signals. **(08 Marks)**

b. Explain the reconstruction of signals from its samples. What is Aliasing? How to overcome this effect? **(08 Marks)**

c. Determine the Nyquist sampling rate for the following signals:

i) $x(t) = \text{Sin}(1000t)$ ii) $x[n]=\text{Cos}(\pi n)+\left(\frac{1+\text{Sin}2\pi n}{2}\right)$. **(04 Marks)**

7 a. Explain briefly the ROC and its important properties of Z-transform. **(06 Marks)**

b. State and prove time reversal and time convolution property of Z-transform. **(06 Marks)**

c. Determine the Z-transform of the following signals:
i) $x[n] = \alpha^n u[n]$
ii) $y[n] = -\alpha^n u[-n-1]$
Depict the ROC and pole and zero locations of X(z) in the z-plane. **(08 Marks)**

8 a. A casual system has input x[n] and output y[n]. Use the transfer function to determine the impulse response of this system:

$$x[n]=\delta[n]+\frac{1}{4}\delta[n-1]-\frac{1}{8}\delta[n-2] \quad , \quad y[n]=\delta[n]-\frac{3}{4}\delta[n-1].$$ **(06 Marks)**

b. Obtain the sequence x[n] from the given transform by using convolution property.

$$X[z]=\frac{z^2}{(z-2)(z-3)}.$$ **(07 Marks)**

6

EC36

USN

NEW SCHEME

Third Semester B.E. Degree Examination, Dec.06 / Jan.07
Electronic and Communication Engineering

Signals and Systems

Time: 3 hrs.] [Max. Marks:100

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

1 a. Determine and sketch the even and odd parts of the signal shown in figure Q1 (a). **(05 Marks)**

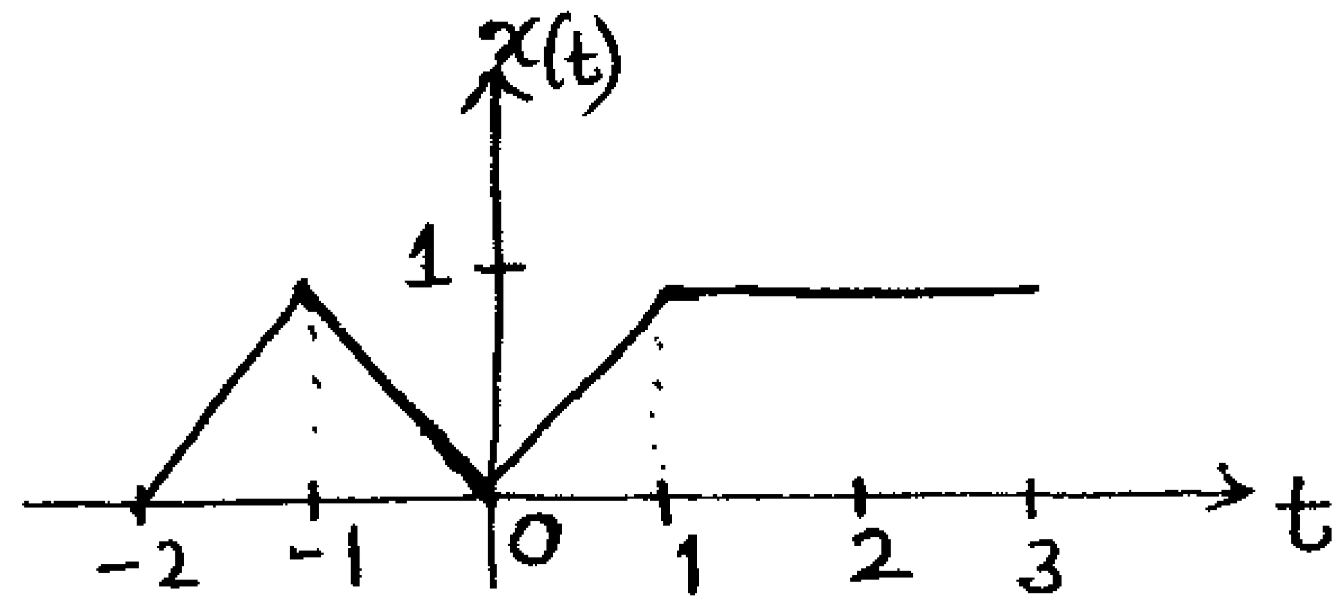

Fig. Q1 (a)

b. Determine whether the discrete-time signal $x(n) = \cos\left(\frac{\pi n}{5}\right)\sin\left(\frac{\pi n}{3}\right)$ is periodic. If periodic, find the fundamental period. **(05 Marks)**

c. Determine whether the following signals are power signals or energy signals or neither:

i) $e^{-at}; t \geq 0$

ii) $2e^{j3n}$ **(06 Marks)**

d. Determine if each of the following signals is invertible. If it is, construct the inverse system. If it is not, find the two input signals that have the same output.

i) $y(t) = \int_{-\infty}^{t} x(\tau)d\tau; y(-\infty) = 0$

ii) $y(n) = nx(n)$ **(04 Marks)**

2 a. Determine whether the system given by the following relation is,

i) Linear

ii) Time-invariant and

iii) Stable.

$y(n) = x(n)\sum_{k=-\infty}^{\infty}\delta(n-2k)$ **(06 Marks)**

b. Figure Q2 (b)-1 shows a staircase-like signal $x(t)$ that may be viewed as a superposition of four rectangular pulses. Starting with the rectangular pulse shown in figure Q2(b)-2, construct this waveform and express $x(t)$ in terms of $g(t)$. **(06 Marks)**

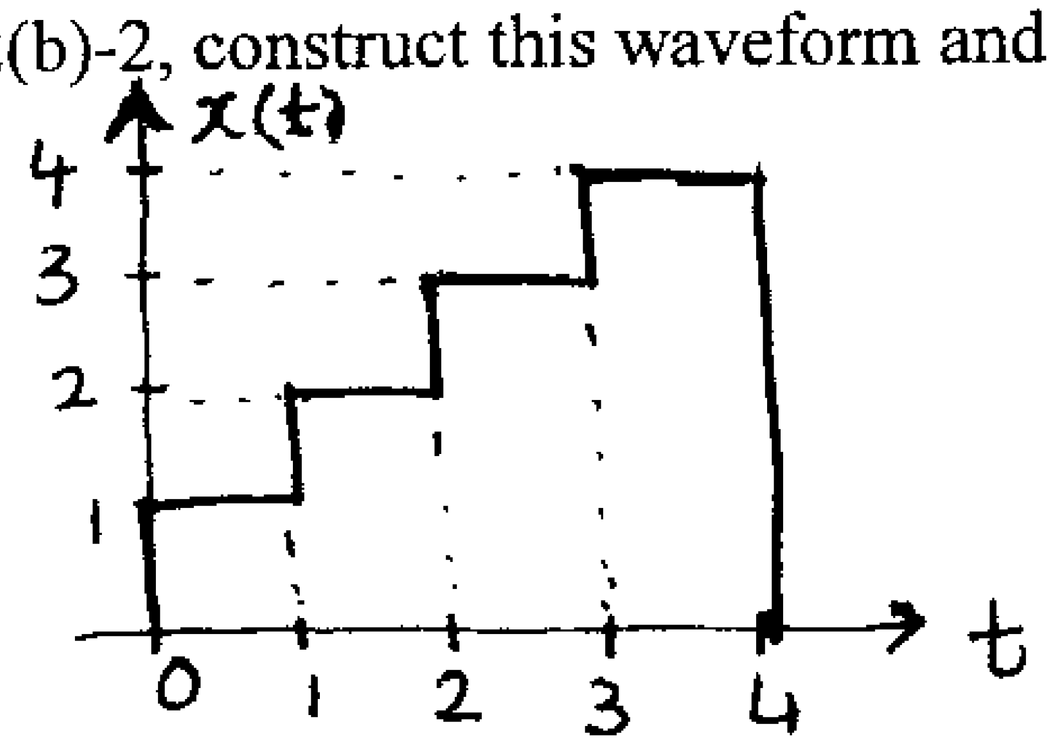

Fig Q 2(b)(i)

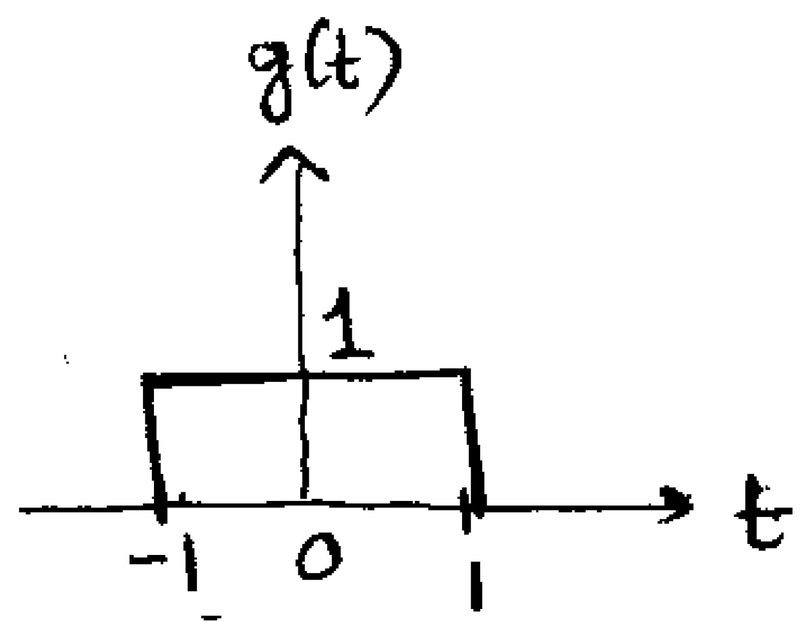

Fig Q 2(b)(ii)

Contd....2

2 c. Find the convolution of two finite duration sequences,

$h(n) = a^n u(n)$ for all n

$x(n) = b^n u(n)$ for all n

i) When $a \neq b$ ii) When $a = b$ **(08 Marks)**

3 a. Find the step response of a system whose impulse response is given by,

$h(t) = u(t+1) - u(t-1)$ **(05 Marks)**

b. Determine the output of the system described by the difference equation,

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = 2x(n).$$

with input $x(n) = 2u(n)$ and initial conditions $y(-1) = 1$, $y(-2) = -1$ **(08 Marks)**

c. Draw the direct form I and direct form II implementations of the system represented by the differential equation,

$$\frac{d^3y(t)}{dt^3} + 2\frac{dy(t)}{dt} + 3y(t) = x(t) + 3\frac{dx(t)}{dt}$$ **(07 Marks)**

4 a. Determine the complex fourier coefficients for the signal shown in figure Q4 (a). **(08 Marks)**

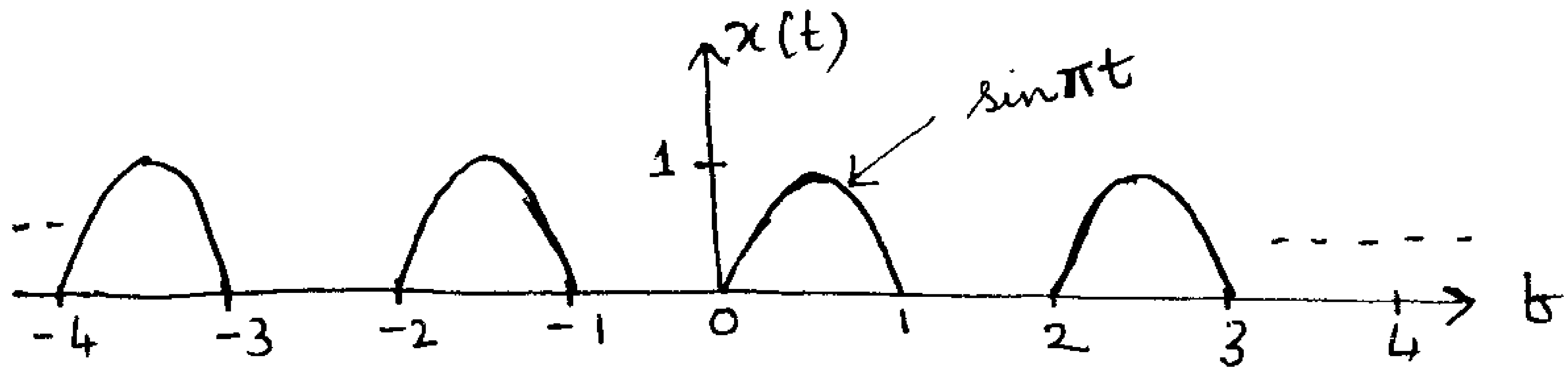

Fig. Q4 (a)

b. State and prove Parseval's theorem as applied to Fourier series. **(06 Marks)**

c. Evaluate the DTFT of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n-4)$. **(06 Marks)**

5 a. Determine the time domain signal corresponding to $X(e^{j\Omega}) = |\sin(\Omega)|$. **(06 Marks)**

b. Use appropriate properties to determine the inverse FT of

$$x(j\omega) = \frac{j\omega}{(2+j\omega)^2}.$$ **(07 Marks)**

c. Use the duality property of Fourier representation to evaluate the following :

i) $x(t) \xleftrightarrow{FT} e^{-2\omega} u(j\omega)$

ii) $\frac{1}{1+t^2} \xleftrightarrow{FT} X(j\omega)$ **(07 Marks)**

6 a. Determine the frequency response and impulse response for the system described by the differential equation,

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}.$$ **(06 Marks)**

b. Determine the difference equation description for the system with the following impulse response:

$$h(n) = \delta(n) + 2\left(\tfrac{1}{2}\right)^n u(n) + \left(-\tfrac{1}{2}\right)^n u(n).$$ **(06 Marks)**

Contd....3

6 c. Specify the Nyquist rate and Nyquist intervals for the following signals :

i) $g_1(t) = \sin c(200t)$

ii) $g_2(t) = \sin c^2(200t)$ **(08 Marks)**

iii) $g_3(t) = \sin c(200t) + \sin c^2(200t)$

7 a. Specify the important properties of ROC of Z-transform. **(06 Marks)**

b. Find the Z-transform of the signal, **(06 Marks)**

$x(n) = n\sin\left(\frac{\pi}{2}n\right)u(-n)$.

c. Find the time domain signals corresponding to the following Z-transforms.

i) $X(Z) = \frac{1}{1-Z^{-2}}; |Z| > 1$ **(08 Marks)**

ii) $X(Z) = \cos(2Z); |Z| < \infty$

8 a. The output of a discrete-time LTI system is $y(n) = 2\left(\frac{1}{3}\right)^n$ when the input $x(n)$ is $u(n)$.

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

ii) Determine the output when the input is $\left(\frac{1}{2}\right)^n u(n)$. **(13 Marks)**

b. Use unilateral Z-transform to determine the forced response, the natural response and the complete response of the system described by the difference equation,

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

with the input $x(n) = 2\left(-\frac{1}{2}\right)^n u(n)$ and initial condition $y(-1) = 3$. **(07 Marks)**

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USN

NEW SCHEME

Third Semester B.E. Degree Examination, July 2006

EE / EC /IT /TC / BM /ML

Signals & Systems

Time: 3 hrs.] [Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***

1 a. Write the formal definition of a signal and a system. With neat sketches for illustration, briefly describe the five commonly used methods of classifying signals based on different features. **(12 Marks)**

b. Determine if the following systems are time-invariant or time variant :

i) $y(n) = x(n) + x(n-1)$, ii) $y(n) = x(-n)$ **(04 Marks)**

c. Determine if the system described by the following equations are causal or non-causal :

i) $y(n) = x(n) + \frac{1}{x(n-1)}$, ii) $y(n) = x(n^2)$ **(04 Marks)**

2 a. What do you mean by impulse response of an LTI system? How can the above be interpreted? Starting from fundamentals, deduce the equation for the response of an LTI system, if the input sequence $x(n)$ and the impulse response are given. **(06 Marks)**

b. Determine $y(n)$ if $x(n) = n+2$ for $0 \le n \le 3$ and

$h(n) = a^n u(n)$ for all n. **(07 Marks)**

c. Determine the convolution sum of the two sequences,

$x(n) = \{\underset{\uparrow}{3}, 2, 1, 2\}$ and $h(n) = \{1, \underset{\uparrow}{2}, 1, 2\}$ **(07 Marks)**

3 a. Discuss briefly the block diagram description for LTI systems by difference equations. **(06 Marks)**

b. What do you mean by natural response of a system? Determine the natural response for the system described by the following difference equations:

i) $y(n) - \frac{9}{16} y(n-2) = x(n-1)$, $y(-1) = 1$, $y(-2) = -1$.

ii) $y(n) + \frac{9}{16} y(n-2) = x(n-1)$, $y(-1) = 1$, $y(-2) = -1$. **(09 Marks)**

c. Find difference-equation descriptions for the two systems depicted in figure Q3 (c). **(05 Marks)**

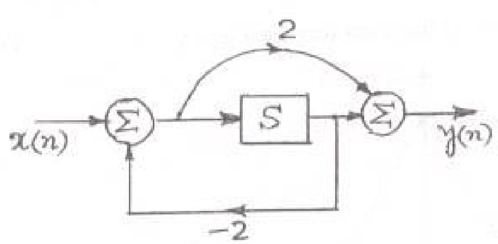

Fig. Q3 (c)-1

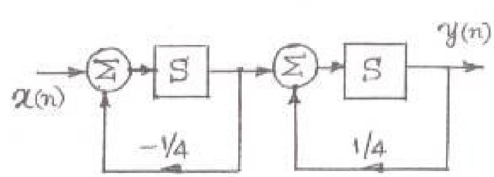

Fig. Q3 (c)-2

c. An analog signal is given below as,

$$m(t) = 4\cos 100\pi t .$$

Calculate – i) the minimum sampling rate to avoid aliasing.

ii) if the signal is sampled at the rate of 200 Hz, what is the discrete-time signal after sampling?

(05 Marks)

7 a. Write the definition of the Z-transform of a discrete-time signal $x(t)$. What do you mean by region of convergence? Write the important properties of the ROC of the Z- transform.

(09 Marks)

b. Find the Z-transform of –

i) $x(n) = n^2 u(n)$, ii) $x(n) = \cos n\theta . u(n)$

(06 Marks)

c. Find x(n) by using the convolution for

$$X(Z) = \frac{1}{\left(1-\frac{1}{2}Z^{-1}\right)\left(1+\frac{1}{4}Z^{-1}\right)}$$

(05 Marks)

8 a. Using long division, determine the inverse Z-transform of

$$X(Z) = \frac{1}{\left[1-\left(\frac{3}{2}\right)Z^{-1}+\left(\frac{1}{2}\right)Z^{-2}\right]}$$

when the region of convergence is $|Z| > 1$.

(04 Marks)

b. By using partial fraction expansion method, find the inverse Z-transform of

$$H(Z) = \left[\frac{-4+8Z^{-1}}{1+6Z^{-1}+8Z^{-2}}\right]$$

(04 Marks)

c. i) Find the impulse response for the causal system,

$$y(n) - y(n-1) = x(n) + x(n-1)$$

ii) Find the response of the system to inputs $x(n) = u(n)$ and $x(n) = 2^{-n}.u(n)$. Test its stability.

(12 Marks)

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5

c. An analog signal is given below as,

$$m(t) = 4\cos 100\pi t.$$

Calculate – i) the minimum sampling rate to avoid aliasing.
ii) if the signal is sampled at the rate of 200 Hz, what is the discrete-time signal after sampling?

(05 Marks)

7 a. Write the definition of the Z-transform of a discrete-time signal $x(t)$. What do you mean by region of convergence? Write the important properties of the ROC of the Z- transform.

(09 Marks)

b. Find the Z-transform of –

i) $x(n) = n^2 u(n)$, ii) $x(n) = \cos n\theta . u(n)$

(06 Marks)

c. Find x(n) by using the convolution for

$$X(Z) = \frac{1}{\left(1-\frac{1}{2}Z^{-1}\right)\left(1+\frac{1}{4}Z^{-1}\right)}$$

(05 Marks)

8 a. Using long division, determine the inverse Z-transform of

$$X(Z) = \frac{1}{\left[1-\left(\frac{3}{2}\right)Z^{-1}+\left(\frac{1}{2}\right)Z^{-2}\right]}$$

when the region of convergence is $|Z| > 1$.

(04 Marks)

b. By using partial fraction expansion method, find the inverse Z-transform of

$$H(Z) = \left[\frac{-4+8Z^{-1}}{1+6Z^{-1}+8Z^{-2}}\right]$$

(04 Marks)

c. i) Find the impulse response for the causal system,

$$y(n) - y(n-1) = x(n) + x(n-1)$$

ii) Find the response of the system to inputs $x(n) = u(n)$ and $x(n) = 2^{-n}.u(n)$.
Test its stability.

(12 Marks)

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NEW SCHEME

EC36

USN 1 S B P 2 L E 0 1 0

~~Third~~ TV Semester B.E. Degree Examination, July/August 2004

EC / TE / ML / IT / BM / EE

Signals and Systems

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) A continuous, causal Linear Time Invariant System is shown in Fig 1.a.

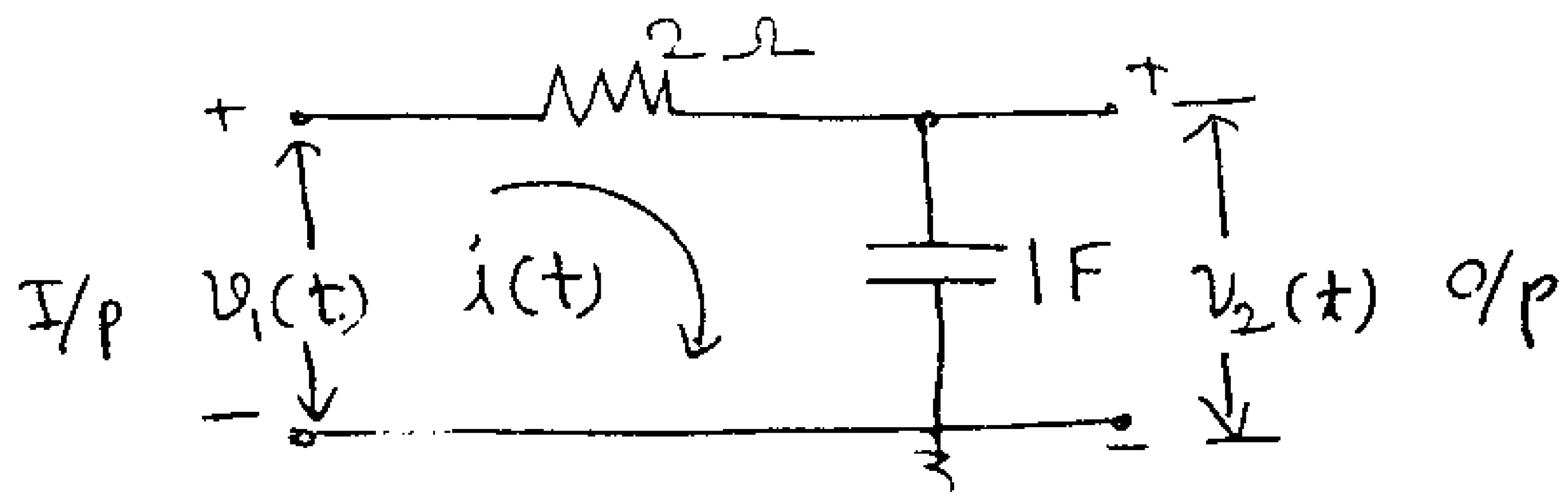


Fig 1.a.

Determine the unit impulse and step response of this system. Plot the response. Also verify whether the system is causal and stable. **(10 Marks)**

(b) Find $x(t) * y(t)$ for the signals shown and also sketch the convolved signal

i) $x(t) = \delta(t) - 2\delta(t-1) + 8\delta(t-2)$
$y(t) = 2, \quad -1 \leq t \leq 1$

ii) $x(t) = 2, \quad for\ -1 \leq t \leq 1$
$y(t) = t, \quad -2 \leq t \leq 2$ **(10 Marks)**

2. (a) A discrete LTI system is characterized by the following difference equation

$y(n) - y(n-1) - 2y(n-2) = x(n)$
with $x(n) = 6u(n)$ and initial conditions
$y(-1) = -1, \ y(-2) = 4$

i) Find the zero-input response, zero-state response, and total response.

ii) How does the total response change if $y(-1) = -1, y(-2) = 4$ as given, but $x(n) = 12u(n)$

iii) How does the total response change if $x(n) = 6u(n)$ as given, but $y(-1) = -2$ and $y(-2) = 8$. **(10 Marks)**

(b) State and prove frequency convolution and modulation property of Fourier transform of a CT signal. **(10 Marks)**

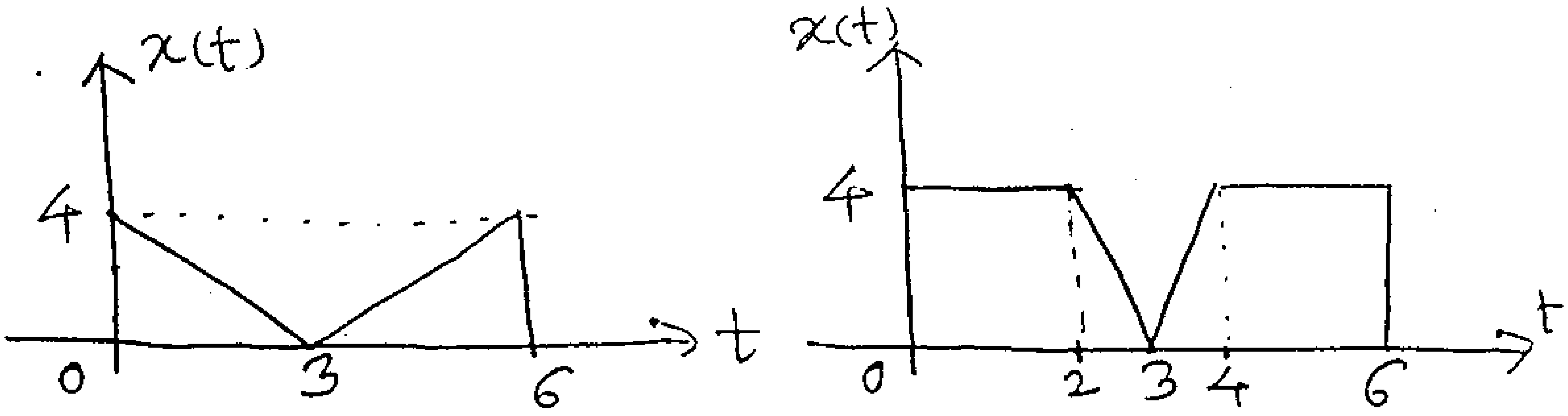
3. (a) i) Consider a linear shift - invariant system with unit - sample response $h(n) = \alpha^n u(n)$, where α is real and $0 < \alpha < 1$. If the input is $x(n) = \beta^n u(n)$ for $0 < |\beta| < 1$, determine the output $y(n)$ in the form $y(n) = (K_1\alpha^n + K_2\beta^n)u(n)$ by explicitly evaluating the convolution sum.

ii) By explicitly evaluating the transforms $x(e^{jw})$, $H(e^{jw})$ and $y(e^{jw})$ corresponding to $x(n), h(n)$ and $y(n)$ specified in part (i), show that

$y(e^{jw}) = H(e^{jw}).X(e^{jw})$ **(10 Marks)**

Contd.... 2

(b) Find the Fourier transform of the following signals shown in fig (3b) ~~showing~~ Using properties of the Fourier transform.



(10 Marks)

4. (a) An LTI system is described by

$$H(f) = \frac{4}{2+j2\pi f}$$

Find its response $y(t)$ if the input is $x(t) = u(t)$. (10 Marks)

(b) State and prove Parseval's theorem for CT signals. Using this theorem determine the range of frequencies $(-f_1, f_1)$ where 50% of the signals energy lies. The spectrum of the signal is shown in fig.4.b.

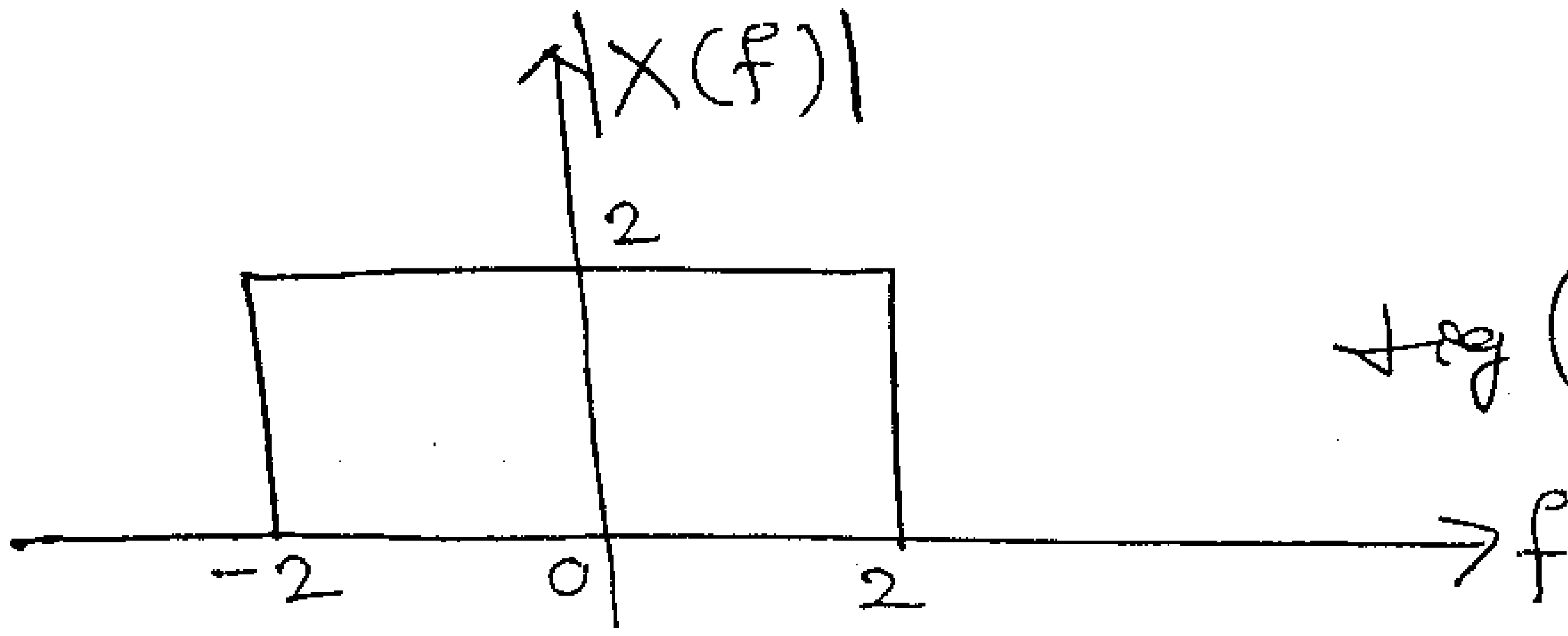


fig (4b)

(10 Marks)

5. (a) Determine the exponential Fourier series representation for the full rectified sinewave shown in Fig 5. (a). Also plot the line spectrum.

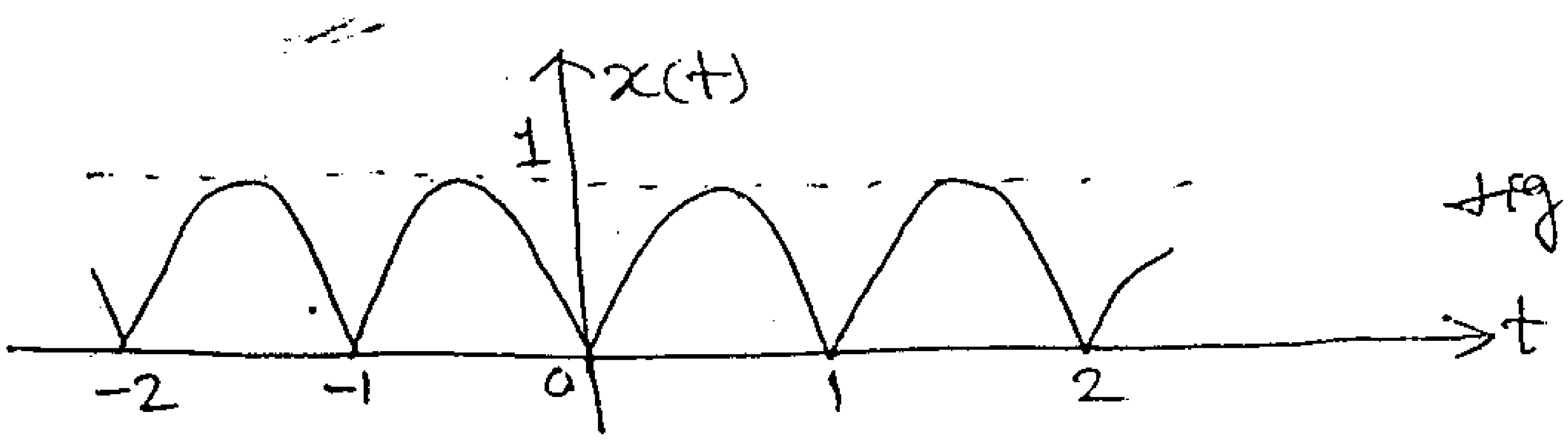


fig (5a)

(10 Marks)

(b) Show that the Fourier transform of a train of impulses of unit height, separated by T secs, is also a train of impulses of height $\omega_0 = \frac{2\pi}{T}$, separated by $\omega_0 = \frac{2\pi}{T}$. (10 Marks)

6. (a) State and prove the sampling theorem for low pass signals. Give the significance of this theorem. (10 Marks)

Contd.... 3

(b) A 100Hz sinusoid x(t) is sampled at 240 Hz. Has aliasing occurred? How many full periods of x(t) are required to obtain one period of the sampled signal? (4 Marks)

(c) A 100Hz sinusoid is sampled at rates of 140Hz, 90Hz and 35Hz. In each case, has aliasing occurred, and if so, what is the aliased frequency. If the original signal has the form $x(t) = cos(200\pi t + \theta)$, write the expressions for the aliased signal $x_a(t)$. (6 Marks)

7. (a) State and prove time reversal and time convolution property of Z-transform. (8 Marks)

(b) Find the Z-transform of the following including R.O.C.

i) $x(n) = -(\frac{1}{2})^n u(-n-1)$

ii) $x(n) = \alpha^{|n|}$, $0 < |\alpha| < 1$

iii) $x(n) = Ar^n cos(\omega_0 n + \phi)u(n)$, $0 < r < 1$. (12 Marks)

8. (a) Suppose $X(z)$ is given by $X(z) = \frac{z(z^2-4z+5)}{(z-3)(z-2)(z-1)}$

Find $x(n)$ for the following ROCs

i) $2 < |z| < 3$ ii) $|z| > 3$ iii) $|z| < 1$. (12 Marks)

(b) Solve the following linear constant coefficient difference equation using Z-transform method

$y(n) - \frac{3}{2}y(n-1) + \frac{1}{2}y(n-2) = (\frac{1}{4})^n u(n)$

with initial conditions $y(-1) = 4 \& y(-2) = 10$. (8 Marks)

** * **

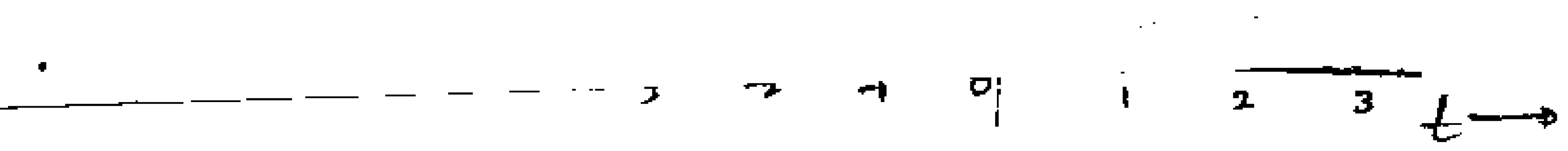


Fig. Q4 (a)