USN

10EC44

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

Time: 3 hrs. Max. Marks:100

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

PART – A

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

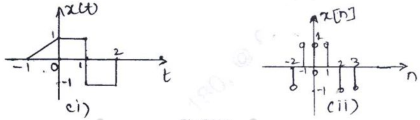

Fig.Q1(a)

b. For the signal x(t) and y(t) shown in Fig.Q1(b) sketch the signals :
 i) $x(t+1) - y(t)$
 ii) $x(t) \cdot y(t-1)$. **(06 Marks)**

Fig.Q1(b)

c. Determine whether the system described by the following input/output relationship is i) memory less ii) causal iii) time invariant iv) linear.
 i) $y(t) = x(2-t)$
 ii) $y[n] = \sum_{k=0}^{\infty} 2^k x[n-k]$. **(08 Marks)**

2 a. Compute the following convolutions :
 i) $y(t) = e^{-2t}\, u(t-2) * \{u(t-2) - u(t-12)\}$
 ii) $y[n] = \alpha^n\{u[n] - u[n-6]\} * 2\{u[n] - u[n-15]\}$. **(14 Marks)**

b. Prove the following :
 i) $x(t) * \delta(t - t_0) = x(t - t_0)$
 ii) $x[n] * u[n] = \sum_{k=-\infty}^{n} x[k]$. **(06 Marks)**

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

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

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

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

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

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

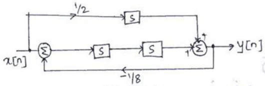

Fig. Q3(c)

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

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

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

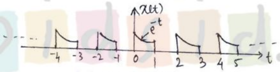

Fig. Q4(b)(ii)

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

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

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

PART – B

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

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

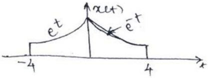

Fig. Q5(a)(ii)

b. Find inverse FT of the following x(jω) :

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

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

6 a. Determine output of the LTI system whose I/P and the impulse response is given as :

i) $x(t) = e^{-2t}u(t)$ and $h(t) - e^{-3t}u(t)$

ii) $x[n] = (⅓)^n\, u[n]$ and $h[n] = \delta[n-4]$. **(08 Marks)**

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

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

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

b. Use property of z – transforms to compute x(z) of :

i) $x[n] = n \sin(\pi n/2)\, u[-n]$

ii) $x[n] = (n-2)\,(½)^n\, u[n-2]$. **(06 Marks)**

c. Find the inverse z – transforms of

i) $x(z) = \dfrac{z^2 - 2z}{\left(z^2 + \frac{3}{2}z - 1\right)}\quad \frac{1}{2} < |z| < 2$

ii) $x(z) = \dfrac{z^3}{\left(z - \frac{1}{2}\right)}\ |z| > \frac{1}{2}$. **(08 Marks)**

8 a. Determine the impulse response of the following transfer function if :

i) The system is causal

ii) The system is stable

iii) The system is stable and causal at the same time : $H(z) = \dfrac{3z^2 - z}{(z-2)\left(z + \frac{1}{2}\right)}$. **(08 Marks)**

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

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10EC44

Fourth Semester B.E. Degree Examination, June/July 2015
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. If x(t) and y(t) are as shown Fig.Q1(a), sketch $x(1-t) \cdot y(t/2)$. **(06 Marks)**

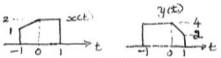


Fig.Q1(a)

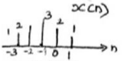


Fig.1Q(b)

b. If x(n) is as shown Fig.1(b), find the energy of the signal $x(2n-1)$. **(04 Marks)**

c. Find whether the system represented by $y(t) = x(t/2)$ is linear, TI, causal substantiate your answers. **(05 Marks)**

d. Express x(t) in terms of g(t) if x(t) and g(t) are as shown in FigQ1(d): **(05 Marks)**

Fig.Q1(d)

2 a. Perform the convolution of the two signals.

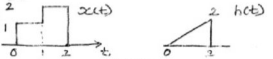


Fig.Q2(a)

Using the formula : $y(t) = \int_{-\infty}^{\infty} h(\tau)x(t-\tau)d\tau$. **(10 Marks)**

b. Perform the convolution of two finite sequences using graphical method only :

$x(n) = \left\{-1, 1, \underset{\uparrow}{0}, 1, -1\right\}$ $h(n) = \left\{1, \underset{\uparrow}{2}, 3\right\}$. **(10 Marks)**

3 a. Find natural, forced and total responses for the differential equation :
$y''(t) + 4y'(t) + 4y(t) = e^{-2t}u(t)$, assume $y(0) = 1$, $y'(0) = 0$. **(09 Marks)**

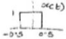
b. Find whether LTI system given by : $y(n) = 2x(n+2) + 3x(n) + x(n-1)$ is causal. Justify your answer. **(04 Marks)**

c. Draw DF – I and DF – II implementations for the differential equation :

$$\frac{d^2y(t)}{dt^2} + \frac{5dy(t)}{dt} + 4y(t) = x(t) + \frac{dx(t)}{dt}.$$ **(07 Marks)**

4 a. Consider the periodic waveform $x(t) = 4 + 2\cos 3t + 3\sin 4t$
  i) Find period 'T'
  ii) What is the total average power
  iii) Find the complex Fourier coefficients
  iv) Using Parseval's theorem, find the power spectrum
  v) Show that total average power using Parseval's theorem is same as obtained in part (2) of the question. **(12 Marks)**

b. Find FT of the following :

  i) 

  ii) $x(t) = \delta(t-2)$ iii) $x(t) = e^{-at}u(t)$. **(08 Marks)**

PART – B

5 a. Find inverse FT of $x(\omega) = \dfrac{j\omega}{(j\omega+2)^2}$ **(06 Marks)**

b. Find the DTFT of the rectangular pulse sequence shown in Fig .Q5(b).

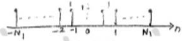


Fig.Q5(b)

Also Plot $X(\Omega)$. **(10 Marks)**

c. Find DTFT of $x(n) = \delta(4-2n)$. **(04 Marks)**

6 a. State sampling theorem. What s aliasing explain? **(04 Marks)**

b. Specify the Nyquist rate and Nyquist intervals for each of the following signals :
  i) $g(t) = \text{sinc}^2(200t)$ ii) $g(t) = \text{sinc}(200t) - \text{sinc}^2(200t)$. **(06 Marks)**

c. Find the FT of the signum function, $x(t) = \text{sgn}(t)$. Also draw the amplitude and phase spectra. **(10 Marks)**

7 a. Sate and prove the following properties of Z – transform :
  i) Multiplication by a R amp ii) Convolution in time domain. **(06 Marks)**

b. Find Z – transform of the following and specify its RoC.

$$x(n) = \sin\left(\frac{\pi}{4}n - \frac{-\pi}{2}\right)u(n-2) \quad ; \qquad x(n) = \left(\frac{2}{3}\right)^n u(n) * 2^n u(-n-3).$$ **(08 Marks)**

c. Find IZT, if $x(z) = \dfrac{\left(\frac{1}{4}\right)z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}$ for all possible RoC's. **(06 Marks)**

8 a. Solve the difference equation using Z – transform, $y(n) = y(n-1) - y(n-2) + 2$; $n \geq 0$ with initial conditions : $y(-2) = 1$, $y(-1) = 2$. **(08 Marks)**

b. Consider the system described by difference equation,

  $y(n) - 2y(n-1) + 2y(n-2) = x(n) + \frac{1}{2}x(n-1)$
  i) find system function H(z)
  ii) find the stability of the system
  iii) find h(n) of the system. **(08 Marks)**

c. Perform IZT using long division method : $x(z) = \dfrac{z}{z-a}$ RoC $|z| > |a|$. **(04 Marks)**

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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)**

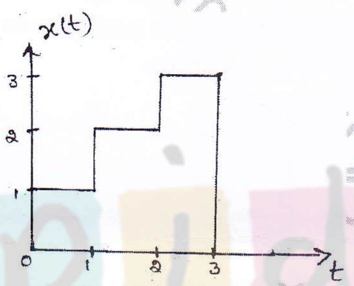

Fig. Q1 (d) – (i)

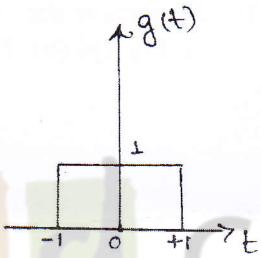

Fig. Q1 (d) – (ii)

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)**

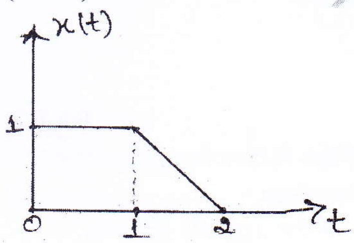

Fig. Q2 (a)

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

$$S \triangleq \sum_{K=-\infty}^{K=+\infty} |h(K)| < \infty$$ **(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)**

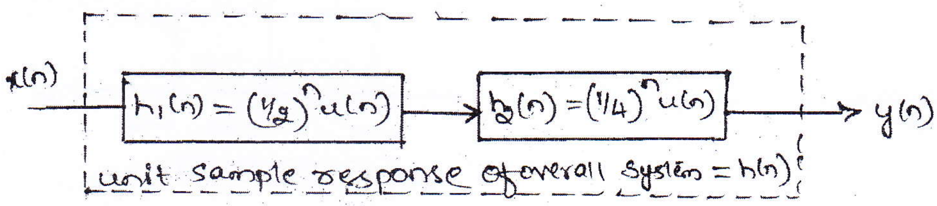

Fig. Q2 (c)

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)**

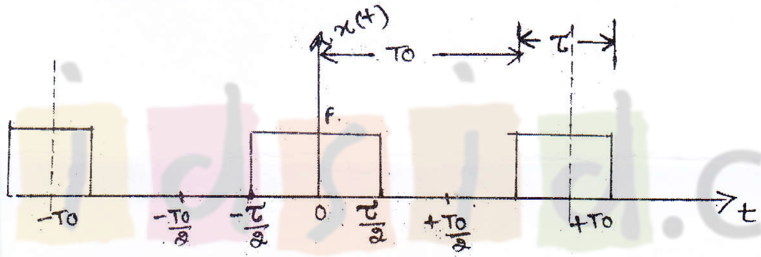

Fig. Q4 (b)

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)**

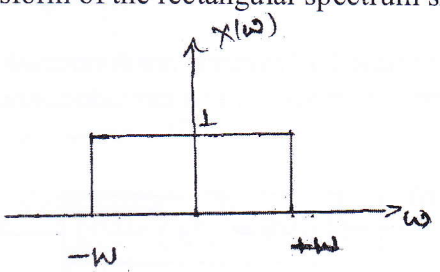

Fig. Q5 (c)

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 $x(n) = \left(\frac{1}{3}\right)^n \sin\left(\frac{\pi}{4}n\right)u(n)$ **(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 $x(n) = \delta(n) - \frac{1}{3}\delta(n-1)$ **(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)**

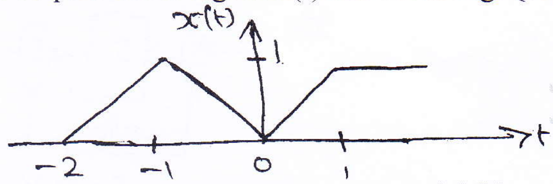

Fig.Q.1(a)

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

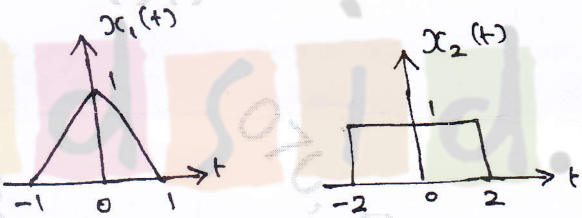

Fig.Q.1(b)

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

i) $x(n) = \cos(2n)$
ii) $x(n) = (-1)^n$
iii) $x(n) = \cos\left(\frac{\pi}{8}n^2\right)$ **(06 Marks)**

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

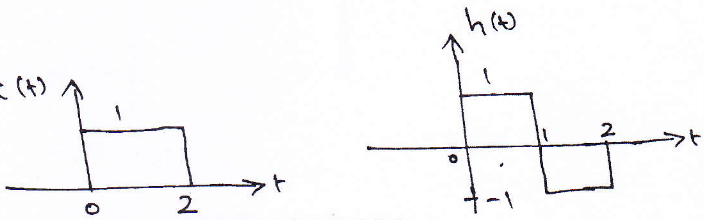

Fig.Q.2(a)

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

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

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.

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)**

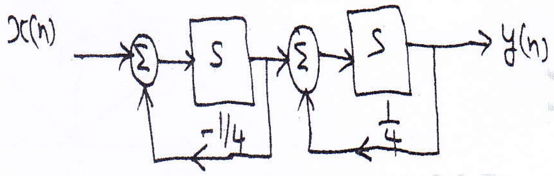

Fig.Q.3(c)

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)**

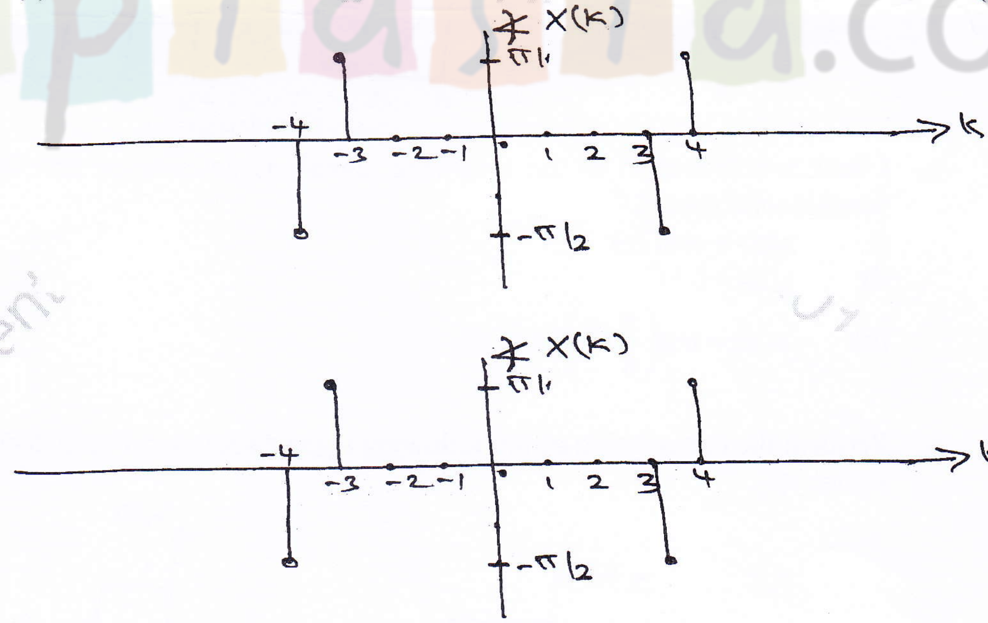

Fig.Q.4(c)

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)**

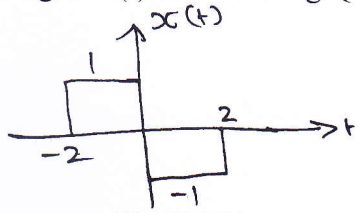

Fig.Q.5(b)

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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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)**

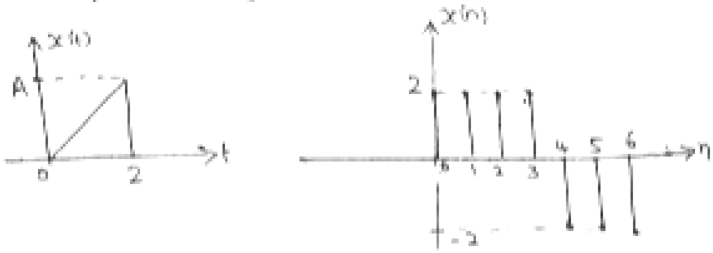

Fig.Q1(a)

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)**

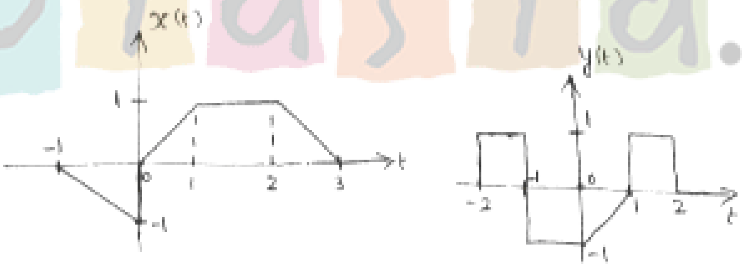

Fig.Q1(c)

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:

$x_1(t) = e^{-at}$; $0 \le t \le T$

$x_2(t) = 1$; $0 \le t \le 2T$ **(10 Marks)**

c. An LTI 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 LTI 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)**

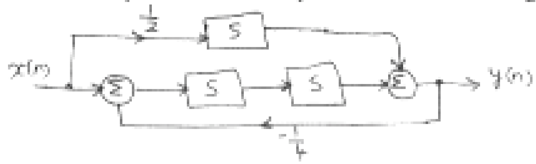

Fig.Q3(c)

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)**

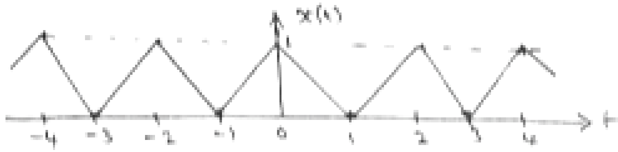

Fig.Q4(b)

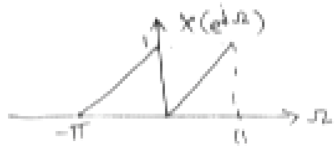

Fig.Q5(b)

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

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

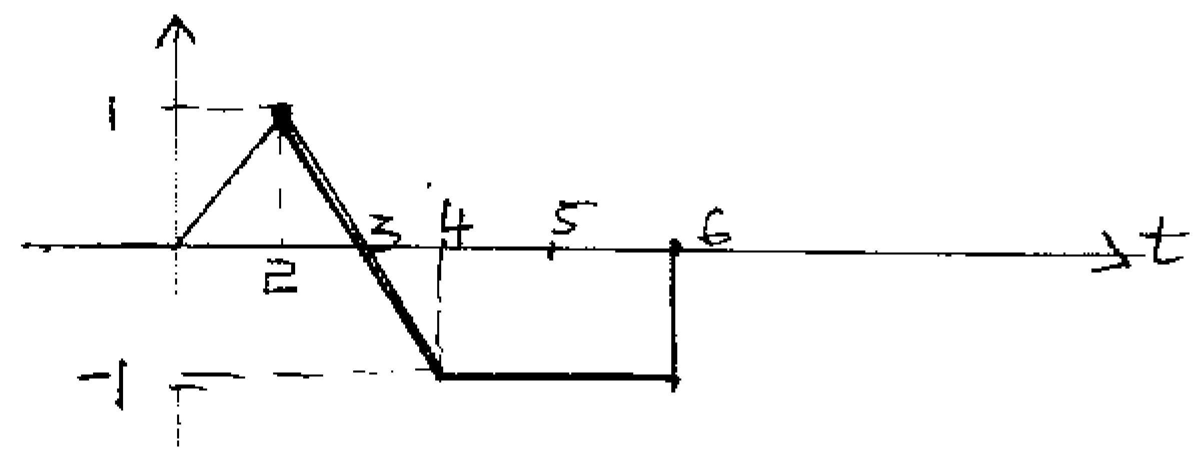

Fig. Q1 (b)

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 $x(t) = t \quad 0 < t \leq 1$ 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)**

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

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

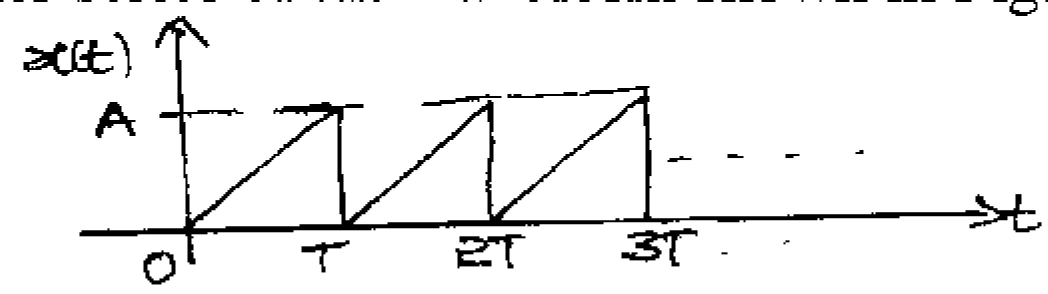

Fig. Q4 (b)

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) $x(t) = e^{-a|t|}$. **(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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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.***

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, $x(k) = (\frac{1}{2})^K$, 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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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.***

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)**

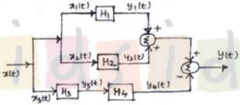

Fig.Q1(d)

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:

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

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)**

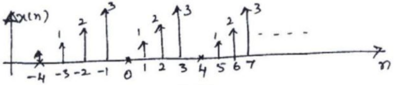

Fig.Q4(b)

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

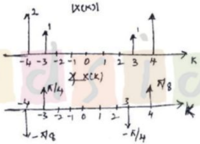

Fig.Q4(c)

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)**

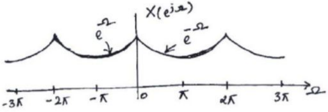

Fig.Q5(b)

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) $\int_{-\infty}^{\infty} x(w)\, e^{j2w}\, dw$.

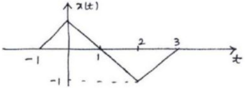

Fig.Q5(c)

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)**

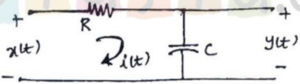

Fig.Q6(b)

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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06EC44

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.***

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. 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)**

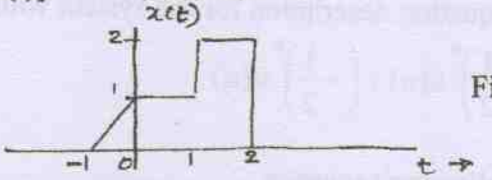

Fig.Q1(a)

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).

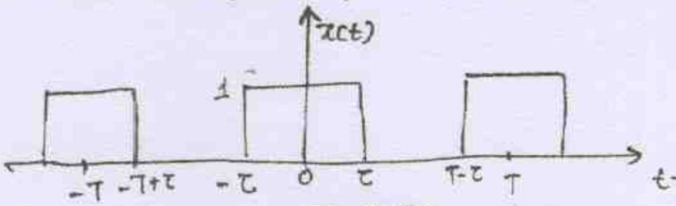

Fig.Q4(b) **(10 Marks)**

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) $x(n) = n^2 u(n)$. (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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USN 1 B I 0 7 E C 0 9 1

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.

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. 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 $y(t) = \text{Cos}(20\pi t) + \sin(50\pi t)$ 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)**

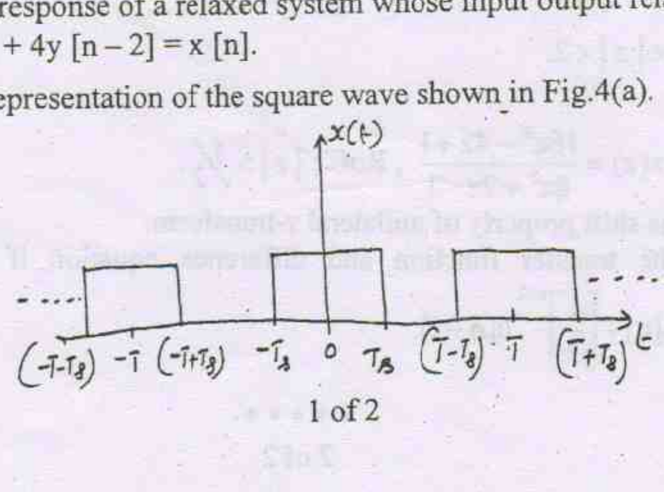
3 a. The impulse response of an LTI system is given by $h[n] = u[n]$. Determine the output if $x[n] = 3^n u[-n]$. **(08 Marks)**

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 $x[n] = \text{Cos}^2\left[\frac{\pi}{4}n\right]$. **(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)**

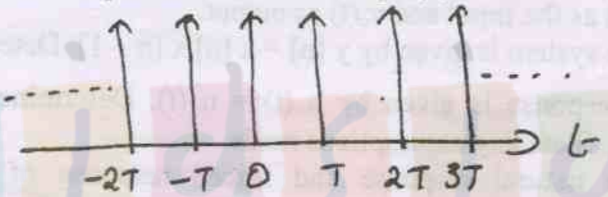
b. If $y(t) = \frac{dx(t)}{dt}$, where x (t) is a non-periodic sigal, find the Fourier Transform of y (t) in terms of x (jw). **(06 Marks)**

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: $x[n] = \text{Cos}\left[\frac{2\pi}{N}n\right]$. **(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 $x(z) = \dfrac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - z^{-1}\right)}$ for i) RoC of $|z| < \frac{1}{2}$ and ii) RoC of $1 < |z| < 2$. **(08 Marks)**

8 a. Find x [n] if $x(z) = \dfrac{16z^2 - 4z + 1}{8z^2 + 2z - 1}$; 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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4th SEM. EC/TC/IT/EE

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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.***

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. 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) $x[n] = (1/4)^n u[n]$ 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)**

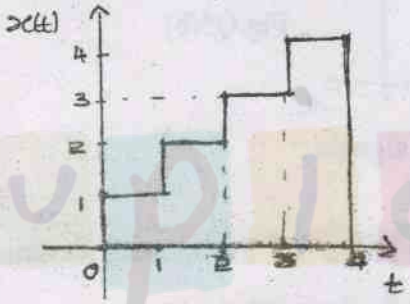

Fig.Q1(d)(i)

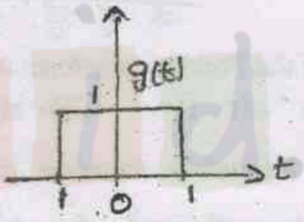

Fig.Q1(d)(ii)

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) $h[n] = (1/2)^n u[n]$ 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)**

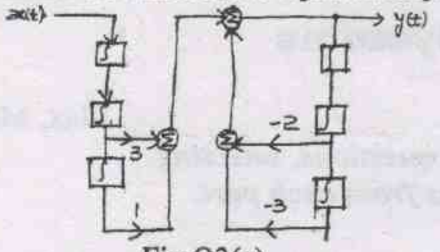

Fig.Q3(c)

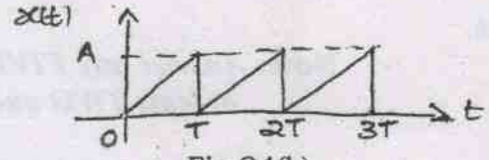

Fig.Q4(b)

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 $x[n]=n\left(\frac{1}{2}\right)^{|n|}$. **(07 Marks)**

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

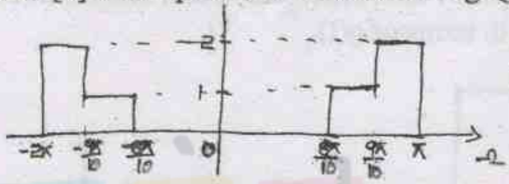

Fig.Q5(b)

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

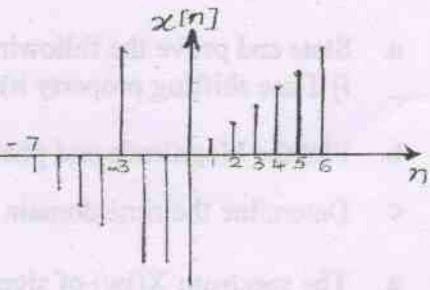
Time: 3 hrs. Max. Marks:100

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
$x(n) = \{3, 5, \underset{\uparrow}{-2}, 4\}$ 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)**

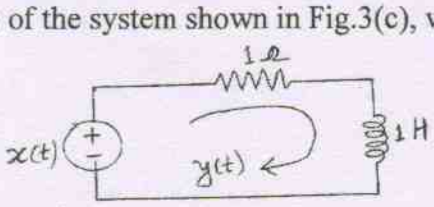


Fig.3(c)

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

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

c. Find the DTFS harmonic function of $x(n) = A\cos(2\pi n/N_o)$. Plot the magnitude and phase 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)**

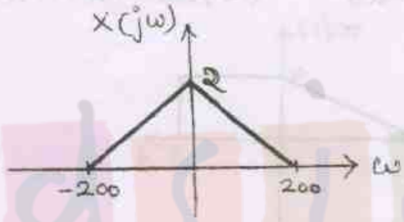


Fig.6(a)

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)**

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USN

06EC44

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)**

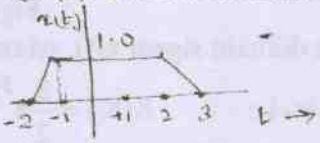

Fig. Q1 (b)

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)**

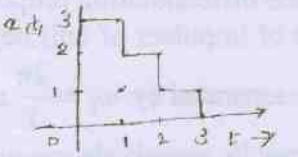

Fig. Q1 (c) – (i)

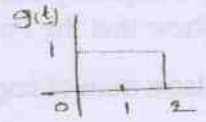

Fig. Q1 (c) – (ii)

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)**

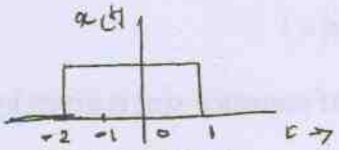

Fig. Q2 (c)

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)**

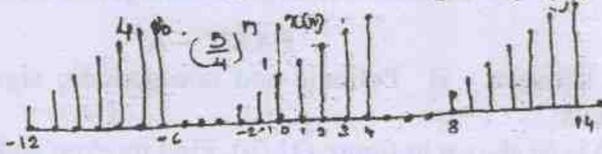

Fig. Q4 (b)

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) $x(n)=a^n U(n)$; $|a|<1$ 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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