BITS PILANI DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY

II yr BE(HONS) EEE/ECE/EIE **EEE/ECE/INSTR C272 CIRCUITS AND SIGNALS** 07-06-2011

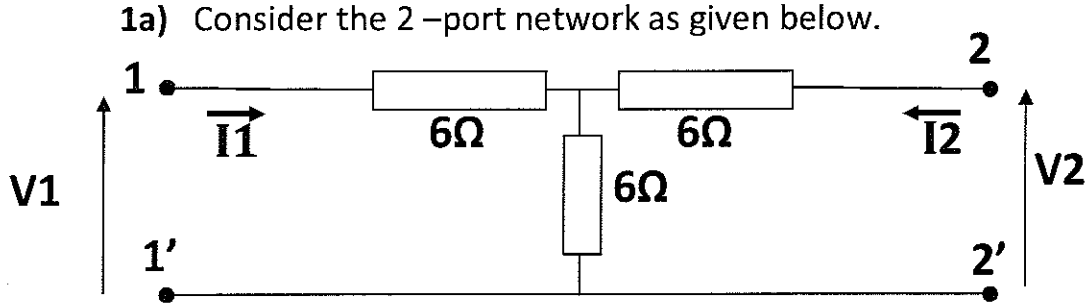
COMPREHENSIVE EXAMINATION 3 HRS Max marks : 80(40%)

Instructions:

1) Answer **ALL** questions in both **Parts A & B**
2) Make appropriate assumptions wherever necessary

PART A **(40 marks)**

1a) Consider the 2 –port network as given below.



Obtain its ABCD parameters **(6marks)**

1b Consider the signal as shown in the Fig 1. If this signal is given to be $x(2t+1)$. Sketch $x(t)$

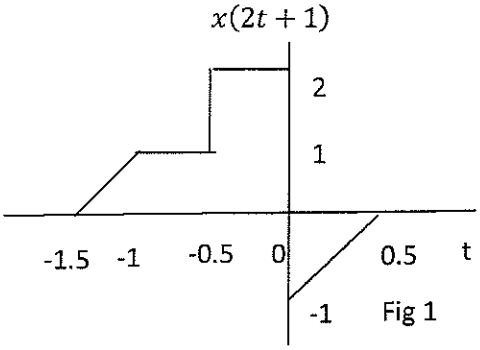


Fig 1

(6marks)

2a Consider the signal $x[n] = \cos\left[\frac{2\pi}{5}n\right]$ & $y[n] = \sin\left[\frac{2\pi}{7}n\right]$. Determine whether $x[n] - 2y[n]$ is periodic . If so, find its period **(4 marks)**

2b A Continuous System with $x(t)$ as input and $y(t)$ as output is governed by the differential equation $\frac{dy(t)}{dt} + ty(t) = x(t+1)$. Check the system for a) linearity b) Time-Invariance & c) causality **(6marks)**

3a Consider a Linear Time invariant system with the impulse response $h(t) = e^{-t}U(t)$. If the system input is $x(t) = \big(U(t) - U(t-3)\big)$, determine the system output $y(t)$. **(10 marks)**

3b Consider the interconnected Linear Time invariant subsystems S1 , S2 & S3 with impulse responses $h_1[n] = [1, 1]$; $h_2[n] = [2, 3]$ and $h_3[n] = [1, 2]$ respectively , as shown in Fig 3b. If the overall system delivers an output $[n] = [1,4,9,6]$, determine the values of **a & b** when the overall system is excited by an input $x[n] = [a, b]$

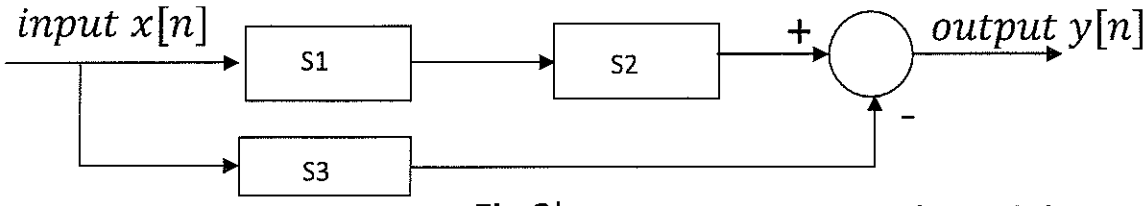


Fig 3b **(8 marks)**

PART – B **(40 marks)**

4a Consider a periodic signal (t) , with fundamental period , $T = 20msec$.When $x(t)$ is expanded using complex exponential series yielded the following Fourier coefficients, as per the table given below. Determine $x(t)$. (all other coefficients are = 0) **(6 marks)**

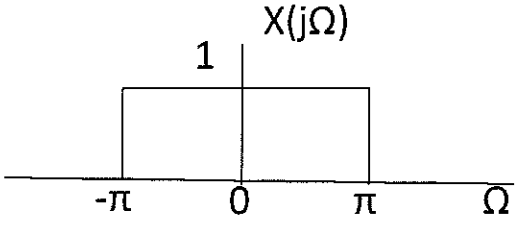
S.No	Fourier Coefficient	Magnitude	Phase (Degrees)
1	F_0	**1**	**0**
2	F_{-1}	$\frac{\sqrt{3}}{2}$	**60**
3	F_1	$\frac{\sqrt{3}}{2}$	**-60**

Useful Formula : $x(t) = \sum_{n=-\infty}^{\infty} F_n e^{j\frac{2\Pi nt}{T}}$ where $F_n = \frac{1}{T}\int_0^T f(t)e^{-j\frac{2\pi nt}{T}}dt$

4b) Consider a signal with its Fourier Transform $X(j\Omega)$ as shown below. Determine the Inverse Fourier Transform $x(t)$. **(4marks)**

Useful Formula : $X(j\Omega) = FT(x(t)) = \int_{-\infty}^{\infty} x(t)e^{-j\Omega t}dt$ and

$$x(t) = Inv.FT(X(j\Omega)) = \frac{1}{2\pi}\int_{-\infty}^{\infty} X(j\Omega)e^{j\Omega t}d\Omega$$



5a) Consider a Linear Time invariant System governed by the differential equation $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t)$; where $x(t)$ & $y(t)$ denote the input and output respectively. . Obtain the frequency response $H(j\Omega) = \frac{Y(j\Omega)}{X(j\Omega)}$. If the input $x(t) = \delta(t) - e^{-3t}U(t)$ show that the output $y(t) = \frac{1}{2}e^{-t}U(t) - \frac{1}{2}e^{-3t}U(t)$ **(6marks)**

5b) Consider the signal $x(t) = \sin^2(600\times\pi\times t) + \cos(800\times\pi\times t)$ sampled at the rate of 1000 samples/sec. prepare a table indicating the input spectral components and how they appear after undergoing sampling **(4marks)**

6a) Consider a DT signal $x[n] = (0.25)^n U[n]$ for $n \geq 0$
$= -(4)^n U[-n-1]$ for $-\infty \leq n \leq -1$.

Obtain the DTFT of this signal **(4marks)**

6b) Determine the DFT of $x[n] = [1, 0, -1, 0]$ and hence deduce the DFT of $x[n-6] \bmod 4$ **(6marks)**

7a) A DT signal is given to be such that $X(z) = \frac{z^{-1}}{(1-0.5z^{-1})(1-0.75z^{-1})}$

Determine $x[n]$ if the ROC is $|z| \geq 0.75$ ii) $|z| \leq 0.5$ **(4marks)**

7b) Consider a Linear Shift Invariant causal DT system specified by its system function $H(z) = \frac{Y(z)}{X(z)} = \frac{z}{(2z+1)(3z+1)}$ where $x[n]$ & $y[n]$ are the system input and output respectively. Obtain the following:

i) The difference equation ii) System output for an input $x[n] = u[n] - u[n-2]$ and iii) Frequency Response $H(e^{j\omega})$ **(6marks)**

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ID No: _____

BITS PILANI ,DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY DUBAI

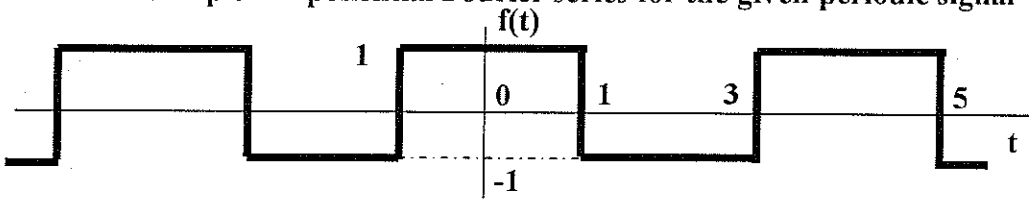
CIRCUITS AND SIGNALS

DATE: 01 – 05 - 2011 EEE C 272 /ECE C 272 / INSTR C 272 MAX MARKS: 40 (20%)

TIME: 50 MINS Test – 2[OPEN BOOK]

Note :

- *Only prescribed text books and handwritten classs notes are allowed*
- *Answer **ALL** questions .*
- *Any missing data can be suitably assumed*

1A	**Consider a discrete time signal x[n] = {1, 2, 1,-1}.Obtain and sketch its even part and odd part.**	6
1B	**Two sequences $x_1(n)$ ={1 0,1,-1} and $x_2(n)$= {1, a, -2,-3} when convolved yield $x_3(n)$ = { 1 , 1 , -1, - 3, -3, -1, 3}. Determine the value of 'a'.**	6
2A	**Obtain the Complex Exponential Fourier series for the given periodic signal** 	10
3A	**The Fourier transform $X(\omega)$ of a function is defined by** $X(\omega) = 2$ *for* $0 \le \omega \le 2$ = -2 for $-2 \le \omega \le 0$ and zero elsewhere . **Show by taking the Inverse Fourier transform that** $x(t) = \dfrac{j4Sin^2 t}{\pi t}$	6
3B	**If $x(t)$ has a Fourier transform $X(\omega)$ then , using Fourier Transform Properties Express the following in terms of $X(\omega)$ or $x(t)$ (whichever may be relevant) i) Fourier transform of** $\left(3\dfrac{d(x(t-1))}{dt}\right)$ **ii) Inverse Fourier Transform of** $\left\{\dfrac{1}{2}X\left(\dfrac{(\omega-\omega_0)}{2}\right)\right\}$	6
4	**A causal LTI system with input $x(t)$ and an output $y(t)$ is specified by the frequency response** $H(\omega) = \dfrac{Y(\omega)}{X(\omega)} = \dfrac{a - j\omega}{a + j\omega}$ **where 'a' is greater than zero. Obtain the magnitude response $\lvert H(\omega)\rvert$ and the Phase Response $\angle H(\omega)$.**	6

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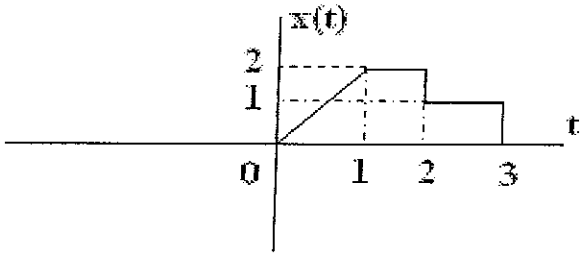
DUBAI INTERNATIONAL ACADEMIC CITY DUBAI

CIRCUITS AND SIGNALS

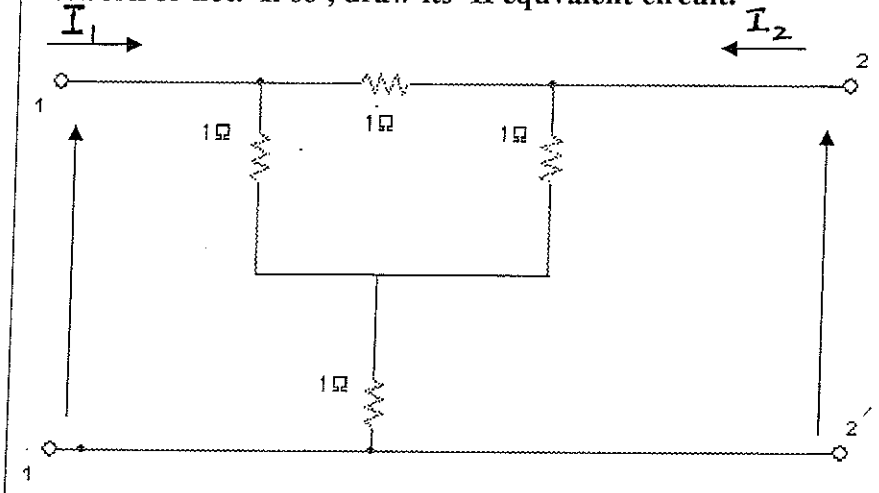
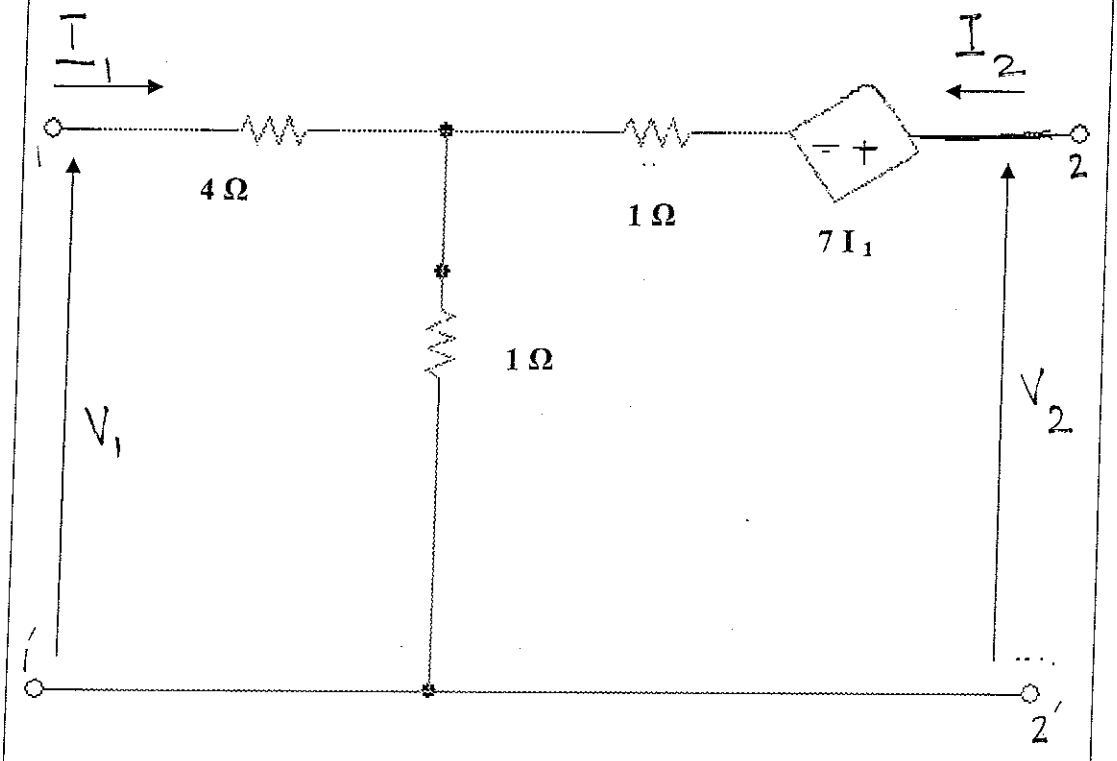
DATE: 10 – 03 - 2011 EEE C 272 /ECE C 272 / INSTR C 272 MAX MARKS: 50 (25%)

TIME: 50 MINS Test - 1

*Note : Answer **ALL** questions . Any missing data can be suitably assumed*

1A	 **Consider the signals $f_1(t)$ and $f_2(t)$ as shown in the figure above. If it is given that both the signals possess the same energy , calculate the value of 'a'**	**9**
1B	**Consider the signals $f_1(t)=\sin\left(\left(\frac{\pi}{8}\right)t\right)$ and $f_2(t)=\cos\left(\left(\frac{\pi}{6}\right)t\right)$.** **Determine whether the signal $f_3(t)=f_1(t)-f_2(t)$ is periodic. If it is so , find its period**	**6**
2A	**Evaluate the integral $\int_{-0.5}^{1}\left(\frac{t^2}{\sin\left(\frac{\pi}{2}t\right)}\left(\delta(t-0.5)-\delta(t+1)\right)\right)dt$** **using the properties of the impulse function**	**6**
2B	**For x(t) is shown below , sketch the modified signal $x\left(-\frac{t}{3}+2\right)$** 	**9**

ID No: _____

3	**Find y parameters for the circuit given below. Check wether it is reciporocal network or not. If so , draw its Π equvalent circuit.** 	10
4	**For the given two port network , find the Z parameters** 	10

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SET A

BE (Hons.) EEE / ECE / EIE II Year, II Semester, 2010-2011
Quiz 2 (Closed Book)
Course No.: **EEE C272 / INSTR C 272** Course Title: **Circuits and Signals**
Date: May 17 , 2011 Time: 20 min Max. Marks: 14 Weightage: 7%

Name :	**Student Id :**	**Section :**

Note: Answer all questions. Appropriate assumptions may be made wherever necessary

1). 1). Consider the spectrum of a CT signal $x(t)$ being described as per the table. If the signal is sampled at the rate of 3000 samples per sec , find out the various frequency components present in the sampled signal spectrum in the table below (4marks)

Answer :Sampling Rate : 3000 Samples / sec

S.No	Frequency Component (in Hz)	Aliasing Error Yes/No	Sampled Signal Components In case of aliasing error indicate the aliased component
1	600		
2	1800		
3	2400		

2) Consider a sequence $x_1[n]=\{1,1,-1,0\}$. Find its DFT . Hence find the DFT of the sequence $x_2[n]=\{0,1,1,-1\}$ (3 marks)

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SET A

BE (Hons.) EEE / ECE / EIE II Year, II Semester, 2010-2011
Quiz 2 (Closed Book)
Course No.: **EEE C272 / INSTR C 272** Course Title: **Circuits and Signals**
Date:May17.05 , 2011 Time: 20 min Max. Marks: 14 Weightage: 7%

Name :	**Student Id :**	**Section :**

3. Consider $x[n]=\left\{1,\underset{\uparrow}{0},-1,-2\right\}$ and $y[n]=\{-1,-2,1,0\}$,. Obtain the 4 point circular convolution :

$x[n]\otimes_4 y[n]$ (4 marks)

Answer :

4. Consider a causal LTI Discrete Time system given by the difference equation

$y[n]=0.5x[n]+0.25y[n-1]$. Determine the frequency response $H\left(e^{j\omega}\right)=\dfrac{Y\left(e^{j\omega}\right)}{X\left(e^{j\omega}\right)}$

And hence Show that the system Impulse response $h(n)=0.5(0.25)^n U[n]$ (3 marks)

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SET B

BE (Hons.) EEE / ECE / EIE II Year, II Semester, 2010-2011
Quiz 2 (Closed Book)
Course No.: **EEE C272 / INSTR C 272** Course Title: **Circuits and Signals**
Date: May 17 , 2011 Time: 20 min Max. Marks: 14 Weightage: 7%

Name :	**Student Id :**	**Section :**

Note: Answer all questions. Appropriate assumptions may be made wherever necessary

1). Consider $x[n]=\left\{1,\underset{\uparrow}{0},-1,-2\right\}$ and $y[n]=\{-1,-2,1,0\}$,. Obtain the 4 point circular convolution :

$x[n]\otimes_4 y[n]$ (4 marks)

Answer

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2) Consider a sequence $x_1[n]=\{1,1,-1,0\}$. Find its DFT . Hence find the DFT of the sequence

$x_2[n]=\{0,1,1,-1\}$ (3 marks)

Answer:

BITS, PILANI-DUBAI **SET B**
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BE (Hons.) EEE / ECE / EIE II Year, II Semester, 2010-2011
Quiz 2 (Closed Book)
Course No.: **EEE C272 / INSTR C 272** Course Title: **Circuits and Signals**
Date:May17.05 , 2011 Time: 20 min Max. Marks: 14 Weightage: 7%

Name :	**Student Id :**	**Section :**

3.)

. Consider the spectrum of a CT signal $x(t)$ being described as per the table. If the signal is sampled at the rate of 3200 samples per sec , find out the various frequency components present in the sampled signal spectrum in the table below (4marks)

Answer : sampling Rate : 3200 samples/sec

S.No	Frequency Component (in Hz)	Aliasing Error Yes/No	Sampled Signal Components In case of aliasing error indicate the aliased component
1	500		
2	1500		
3	2500		

4. Consider a causal LTI Discrete Time system given by the difference equation

$y[n]=0.5x[n]+0.25y[n-1]$. Determine the frequency response $H\left(e^{j\omega}\right)=\dfrac{Y\left(e^{j\omega}\right)}{X\left(e^{j\omega}\right)}$

and hence Show that the system Impulse response $h(n)=0.5(0.25)^n U[n]$ (3 marks)

Answer :

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SET B

BE (Hons.) EEE / ECE / EIE II Year, II Semester, 2010-2011
Quiz 2 (Closed Book)
Course No.: **EEE C272 / INSTR C 272** Course Title: **Circuits and Signals**
Date:May17.05 , 2011 Time: 20 min Max. Marks: 14 Weightage: 7%

Name :	**Student Id :**	**Section :**

3.)

. Consider the spectrum of a CT signal $x(t)$ being described as per the table. If the signal is sampled at the rate of 3200 samples per sec , find out the various frequency components present in the sampled signal spectrum in the table below (4marks)

Answer : Sampling Rate : 3200 samples / sec

S.No	Frequency Component (in Hz)	Aliasing Error Yes/No	Sampled Signal Components In case of aliasing error indicate the aliased component
1	500	No	600
2	1500	Yes	$\|3200-1800\|=1400$ *lying between* -1600 *to* $+1600$
3	2500	Yes	$\|3200-2500\|=700$ *lying between* -1600 *to* $+1600$

4. Consider a causal LTI Discrete Time system given by the difference equation

$y[n]=0.5x[n]+0.25y[n-1]$. Determine the frequency response $H\left(e^{j\omega}\right)=\dfrac{Y\left(e^{j\omega}\right)}{X\left(e^{j\omega}\right)}$

and hence Show that the system Impulse response $h(n)=0.5(0.25)^n U[n]$ (3 marks)

Answer :

$$Y\left(e^{j\omega}\right) = 0.5X\left(e^{j\omega}\right)+0.25e^{-j\omega}Y\left(e^{j\omega}\right)$$

Taking DTFT $H\left(e^{j\omega}\right)=\dfrac{Y\left(e^{j\omega}\right)}{X\left(e^{j\omega}\right)} = \dfrac{0.5}{\left(1-0.25e^{-j\omega}\right)}$

$$h[n]=IDFT\left(H\left(e^{j\omega}\right)\right)=(0.5)(0.25)^n U[n]$$

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SET A

BE (Hons.) EEE / ECE / EIE II Year, II Semester, 2010-2011
Quiz I (Closed Book)
Course No.: EEE C272 / INSTR C 272 Course Title: Circuits and Signals
Date: Apr 05 , 2010 Time: 20 min Max. Marks: 16 Weightage: 8%

Name :	Student Id :	Section :

Note: Answer all questions. Appropriate assumptions may be made wherever necessary

1a). Consider a CT system with $x(t)$ as input and $y(t)$ as output given by the equation $y(t) = t^2 x(t-1)$ . . Test the above system for a) Linearity & b) Time invariance. Justify your answers with reasons (4 Marks):

Answer :

1b) A linear System " S" has the following input-output mappings as shown below . Determine the output if the input $x(t) = \cos(2t)$ (4 marks)

Input $x(t) = e^{j2t}$ → Linear System "S" → Output $y(t) = e^{j3t}$

Input $x(t) = e^{-j2t}$ → Linear System "S" → Output $y(t) = e^{-j3t}$

Answer :

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SET A

BE (Hons.) EEE / ECE / EIE II Year, II Semester, 2010-2011
Quiz I (Closed Book)
Course No.: EEE C272 / INSTR C 272 Course Title: Circuits and Signals
Date: Apr 05 , 2010 Time: 20 min Max. Marks: 16 Weightage: 8%

Name :	**Student Id :**	**Section :**

2. Consider the following functions $x(t) = (U(t+1) - U(t-1))$ &
$h(t) = (U(t-3) - U(t-5))$. Determine $y(t) = x(t) * h(t)$ (8 marks).