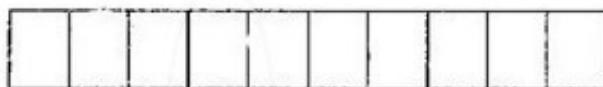


## **CBCS Scheme**

USN



15EC44

**Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018**  
**Signals and Systems**

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing ONE full question from each module.**

## Module-1

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

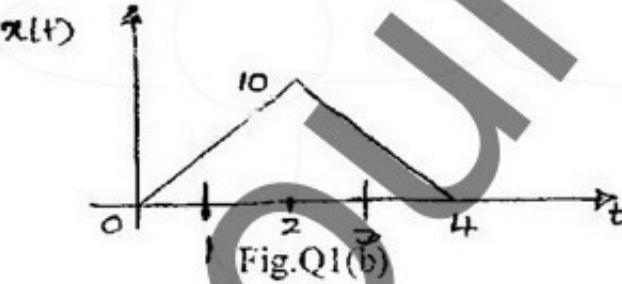
  - $x(t) = 1 + t \cos t + t^2 \sin t + t^3 \cos^2 t \sin t$
  - $x(t) = 1 + t^2 \cos^2 t + t^3 \sin^3 t + t^4 \cos t$ .

b. For the signal  $x(t)$  shown in Fig Q1(b) find and plot.

  - $x(-2t - 4)$
  - $x(-3t + 2)$
  - $x(2(-t - 1))$ .

(08 Marks)

(08 Marks)



OR

- 2 a. Determine whether the system described by the following input/output relationship is memoryless, causal, time-invariant or linear.

i)  $y(n) = e^{x(n)}$  ii)  $y(t) = \int_{-\infty}^t x(\tau) d\tau$ . (08 Marks)

b. Given the signal  $x(n) = (8 - n)[u(n) - u(n - 8)]$ . Find and sketch  
 i)  $y_1(n) = x[4 - n]$  ii)  $y_2(n) = x[2n - 3]$ . (08 Marks)

(08 Marks)

(08 Marks)

Module-2

- 3 a. Find the convolution integral of  $x_1(t) = e^{-2t} u(t)$  and  $x_2(t) = u(t + 2)$ . (08 Marks)  
 b. Find  $y(n) = \beta^n u(n) * \alpha^n u(n)$ . Given :  $|\beta| < 1$  and  $|\alpha| < 1$ . (04 Marks)  
 c. Find  $y(n) = x_1(n) * x_2(n)$ .

Where  $x_1(n) = \{1, 2, 3\}$  and

$$x_2(n) = \{1, 2, 3, 4\}.$$

(04 Marks)

OR

- 4 a. Convolute the two continuous time signals  $x_1(t)$  and  $x_2(t)$  given below :  
 $x_1(t) = \cos \pi t [u(t + 1) - u(t - 3)]$  and  $x_2(t) = u(t)$ . (08 Marks)  
 b. Evaluate  $y(n) = \beta^n u(n) * u(n - 3)$  given:  $|\beta| < 1$ . (04 Marks)  
 c. Show that : i)  $x(n) * \delta(n) = x(n)$     ii)  $x(n) * \delta(n - n_0) = x(n - n_0)$ . (04 Marks)

(08 Marks)

(04 Marks)

(04 Marks)

15EC44

**Module-3**

- 5 a. Check the following systems for memory less, causality and stability :  
 i)  $h(n) = (-0.25)^{|n|}$  ii)  $h(t) = e^{2t} u(t - 1)$ .

b. Find the step response of an LTI system whose impulse response is defined by

$$h(n) = \frac{1}{3} \sum_{k=0}^2 \delta(n-k).$$

- c. Evaluate the DTFS representation for the signal  $x(n) = \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right) + 1$ . Also draw its magnitude and phase spectra.

(06 Marks)

(04 Marks)

(06 Marks)

**OR**

- 6 a. Find the step response of an LTI system whose impulse response is given by

$$i) h(t) = e^{-|t|} \quad ii) h(t) = t^2 u(t).$$

- b. State any six properties of DTFS.

- c. Determine DTFS of the signal  $x(n) = \cos\left(\frac{\pi}{3}n\right)$ . Also draw its spectra.

(06 Marks)

(06 Marks)

(04 Marks)

**Module-4**

- 7 a. Obtain the Fourier transform of the signal  $x(t) = e^{-at} u(t)$ ;  $a > 0$ . Also draw its magnitude and phase spectra.

(06 Marks)

- b. Find the DTFT of the signal  $x(n) = \alpha^n u(n)$ ;  $|\alpha| < 1$ . Also draw its magnitude spectra.

(04 Marks)

- c. Find the FT representation for the periodic signal  $x(t) = \cos \omega_0 t$  and also draw its spectrum.

(06 Marks)

**OR**

- 8 a. Find the FT of the signum function  $x(t) = sgn(t)$ . Draw the magnitude and phase spectra.

(06 Marks)

- b. Find the DTFT of  $\delta(n)$  and draw the spectrum.

(04 Marks)

- c. Find the FT of the periodic impulse train  $\delta_{T_0}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT_0)$  and draw the spectrum.

(06 Marks)

**Module-5**

- 9 a. Find Z.T of the following sequences and also sketch their RoC :

$$i) x(n) = \sin \Omega_0 n u(n) \quad ii) x(n) = (\frac{1}{2})^n u(n) + (-2)^n u(-n-1).$$

(08 Marks)

- b. Find IZT of the following sequence  $x(z) = \frac{(\frac{1}{4})z^{-1}}{(1 - \frac{1}{2}z^{-1})(1 - \frac{1}{4}z^{-1})}$  with  $\text{RoC } \frac{1}{4} < |z| < \frac{1}{2}$ .

(08 Marks)

**OR**

- 10 a. State and prove the following properties of ZT

- i) Time reversal property    ii) differentiation property.

(08 Marks)

- b. Find IZT of the following sequence using partial fraction expansion method :

$$x(z) = \frac{z[2z - \frac{3}{2}]}{z^2 - \frac{3}{2}z + \frac{1}{2}}$$

Given : i)  $\text{RoC} : |z| < \frac{1}{2}$  ;   ii)  $\text{RoC} : |z| > 1$  ;   iii)  $\text{RoC} : \frac{1}{2} < |z| < 1$ .

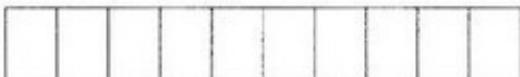
(08 Marks)

\* \* \* \* \*

2 of 2

CBCS SCHEME

USN



15EC44

**Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019**  
**Signals and Systems**

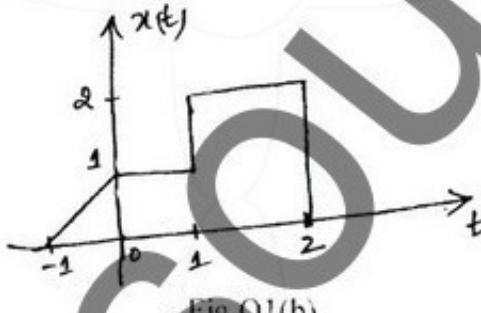
Time: 3 hrs.

Max. Marks: 80

**Note:** Answer any FIVE full questions, choosing one full question from each module.

**Module-1**

- 1 a. Define a signal and a system. Explain any two properties of a system. (06 Marks)  
b. A continuous signal  $x(t)$  is shown in Fig Q1(b). sketch and label each of the following :  
i)  $x(t) \cdot u(1-t)$   
ii)  $x(t) \cdot [u(t) - u(t-1)]$   
iii)  $x(t) \cdot \sigma(t - 3/2)$   
iv)  $x(t) \cdot [u(t+1) - u(t)]$   
v)  $x(t) \cdot u(t-1)$



(10 Marks)

OR

- 2 a. Distinguish between :  
 i) Energy and power signal  
 ii) Even and odd signal (04 Marks)

b. Determine whether the continuous – time signal  
 $x(t) = x_1(t) + x_2(t) + x_3(t)$  is periodic or not. If periodic find the fundamental period. Where  
 $x_1(t)$ ,  $x_2(t)$  and  $x_3(t)$  have periods of  $8/3$ ,  $1.26$  and  $\sqrt{2}$  respectively. (06 Marks)

c. For the following system, determine whether the system is  
 (i) Linear    (ii) Time – invariant    (iii) Memory less and    (iv) Causal.  
 $y(t) = e^{x(t)}$  (06 Marks)

## Module-2

- 3** a. Determine the convolution sum of the given sequence  
 $x(n) = \left\{ \begin{array}{l} 1, 2, 3, 1 \\ \downarrow \end{array} \right\}$  and  $h(n) = \left\{ \begin{array}{l} 1, 2, 1, -1 \\ \downarrow \end{array} \right\}$  (04 Marks)

b. Evaluate the discrete time convolution sum given and also plot the output  $y(n)$   
 $y(n) = \left(\frac{1}{2}\right)^n \cdot u(n-2) * u(n)$  (06 Marks)

c. For the system with impulse response shown, determine whether the system is stable, memory less and causal  $h(t) = e^{-2|t|}$ . (06 Marks)

15EC44

**OR**

- 4 a. Compute the o/p  $y(t)$  for an continuous time LTI system whose impulse response  $h(t)$  and its input  $x(t)$  are given by

$$h(t) = e^{-t} \cdot u(t)$$

$$x(t) = u(t) - u(t - 2)$$

- b. Prove the following convolution properties of impulse function

$$\text{i)} \quad x(t) * \sigma(t) = x(t)$$

$$\text{ii)} \quad x(t) * \sigma(t - t_0) = x(t - t_0)$$

$$\text{iii)} \quad x(t) * \sigma(t + t_0) = x(t + t_0)$$

(10 Marks)

(06 Marks)

**Module-3**

- 5 a. Find the overall impulse response of a cascade of two systems having identical impulse responses  $h(t) = 2[u(t) - u(t - 1)]$

(06 Marks)

- b. Find the unit step response of the following system given by their impulse response

$$h(n) = \left(\frac{1}{2}\right)^n \cdot u(n)$$

(04 Marks)

- c. State the condition for the Fourier series to exist. Also prove the convergence condition (Absolute Integrability)

(06 Marks)

**OR**

- 6 a. Prove the following properties of Fourier series:

- i) Convolution property  
ii) Parsevals relationship

(04 Marks)

- 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.

(06 Marks)

- c. Show that if  $x(n)$  is real and even, its Fourier coefficient are real. Hence find the DTFS coefficients for the signal

$$x[n] = \sum_{p=-\infty}^{\infty} \sigma[n - 2p]$$

(06 Marks)

**Module-4**

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

- i) Frequency shift property

- ii) Differentiation in time property

(04 Marks)

- b. Find the Fourier transform of

$$x(t) = e^{-t} \cdot u(t) . \text{ Also plot magnitude and phase spectra.}$$

(06 Marks)

- c. For the rectangular pulse shown in Fig Q7(c), Evaluate the Fourier Transform and draw its spectrum.

(06 Marks)

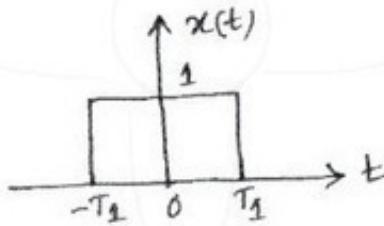


Fig Q7(c)

15EC44

## OR

- 8 a. Determine the DTFT of the following signal and draw its spectrum.

$$x(n) = \left(\frac{1}{2}\right)^n \cdot u(n-4)$$

(06 Marks)

- b. Define the DTFT of a signal. Establish the relation between DTFT and z-transform.

(05 Marks)

- c. Find the Nyquist rate and Nyquist interval for the following signal.

$$x(t) = 5 \cos 1000\pi t + 2 \sin 500\pi t.$$

(05 Marks)

Module-5

- 9 a. Describe the properties of Region of convergence and sketch the ROC of two sided, right sided and left sided sequence.

(08 Marks)

- b. Determine the z-transfer of

$$(i) \quad x[n] = -u[-n-1] + \left(\frac{1}{2}\right)^n \cdot u(n)$$

$$(ii) \quad x[n] = \left(\frac{1}{2}\right)^{|n|}$$

Find the ROC and pole zero locations of  $x(z)$ .

(08 Marks)

## OR

- 10 a. Find the inverse z – transform of

$$x(z) = \frac{z(z^2 - 4z + 5)}{(z-3)(z-1)(z-2)} \text{ with : i) } |z| > 3 \quad \text{ii) } |z| < 1.$$

(08 Marks)

- b. A discrete LTI system is characterized by the difference equation

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

i) Find the system function  $H(z)$

ii) Plot poles and zeros of  $H(z)$

iii) Indicate the ROC of system is stable and causal

iv) Determine the impulse response of the stable system.

(08 Marks)

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# CBCS Scheme

USN

15EC44

**Fourth Semester B.E. Degree Examination, June/July 2017**  
**Signals and Systems**

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing one full question from each module.****Module-1**

- 1 a. Sketch the even and odd part of the signals shown in Fig. Q1(a) and (b). (08 Marks)

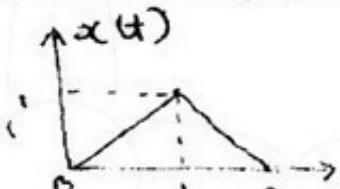


Fig. Q1(a)

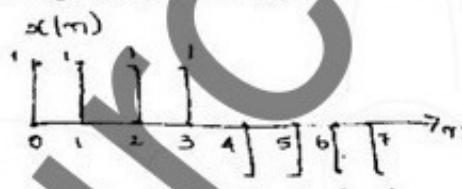


Fig. Q1(b)

- b. Determine whether the following signal is periodic or not if periodic find the fundamental period.  $x(n) = \cos\left(\frac{n\pi}{5}\right)\sin\left(\frac{n\pi}{3}\right)$  (03 Marks)

- c. Express  $x(t)$  in terms  $g(t)$  if  $x(t)$  and  $g(t)$  are shown in Fig. Q1(c). (05 Marks)



Fig. Q1(c)

**OR**

- 2 a. Determine whether the following systems are memory less, causal, time invariant, linear and stable. i)  $y(n) = n x(n)$  ii)  $y(t) = x(t/2)$ . (08 Marks)

- b. For the signal  $x(t)$  and  $y(t)$  shown in Fig. Q2(b) sketch the following signals.  
 i)  $x(t+1) \cdot y(t-2)$  ii)  $x(t) \cdot y(t-1)$  (08 Marks)

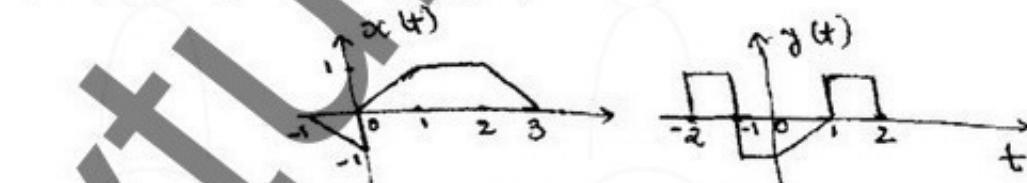


Fig. Q2(b)

**Module-2**

- 3 a. Prove the following :

$$\text{i)} \quad x(n) * [h_1(n) + h_2(n)] = x(n) * h_1(n) + x(n) * h_2(n)$$

$$\text{ii)} \quad x(n) * u(n) = \sum_{k=-\infty}^n x(k).$$

(08 Marks)

- b. Compute the convolution sum of  $x(n) = u(n) - u(n-8)$  and  $h(n) = u(n) - u(n-5)$ . (08 Marks)

15EC44

**OR**

- 4 a. State and prove the associative, integral and commutative properties of convolution. (08 Marks)  
 b. Compute the convolution integral of  $x(t) = u(t) - u(t - 2)$  and  $h(t) = e^{-t} u(t)$ . (08 Marks)

**Module-3**

- 5 a. A system consists of several subsystems connected as shown in Fig. Q5(a). Find the operator  $H$  relating  $x(t)$  to  $y(t)$  for the following sub system operators. (04 Marks)

$$H_1 : y_1(t) = x_1(t) x_1(t - 1)$$

$$H_2 : y_2(t) = |x_2(t)|$$

$$H_3 : y_3(t) = 1 + 2x_3(t)$$

$$H_4 : y_4(t) = \cos(x_4(t))$$

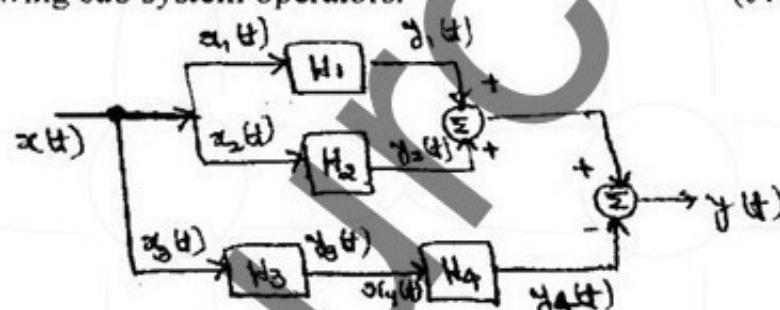


Fig. Q5(a)

- b. Determine whether the following systems defined by their impulse responses are causal, memory less and stable.  
 i)  $h(t) = e^{-2t} u(t - 1)$  ii)  $h(n) = 2u[n] - 2u(n - 5)$  (06 Marks)  
 c. Evaluate the step response for the LTI systems represented by the following impulse responses. i)  $h(t) = u(t + 1) - u(t - 1)$  ii)  $h(n) = \left(\frac{1}{2}\right)^n u(n)$ . (06 Marks)

**OR**

- 6 a. State the following properties of CTFS. i) Time shift ii) Differentiation in time domain  
 iii) Linearity iv) Convolution v) Frequency shift vi) Scaling. (06 Marks)  
 b. Determine the DTFS coefficients for the signal shown in Fig.Q6 (b) and also plot  $|x(k)|$  and  $\arg\{x(k)\}$ . (10 Marks)

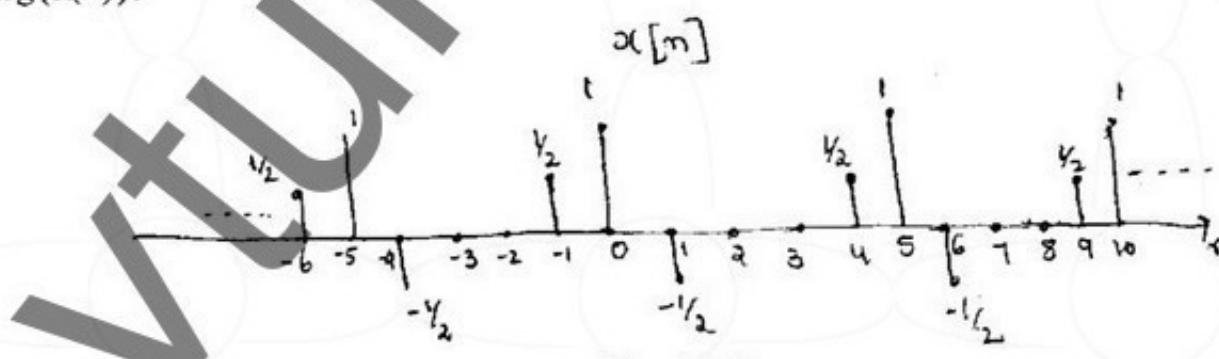


Fig. Q6(b)

**Module-4**

- 7 a. State and prove the following properties :  
 i)  $y(t) = h(t) * x(t) \xleftrightarrow{\text{FT}} y(jw) = X(jw)H(jw)$   
 ii)  $\frac{d}{dt} x(t) \xleftrightarrow{\text{FT}} jw X(jw)$  (06 Marks)

15EC44

(10 Marks)

b. Find DTFT of the following signals.

$$\text{i) } x(n) = \{1, 2, 3, 2, 1\} \quad \text{ii) } x(n) = \left(\frac{3}{4}\right)^n u[n].$$

OR

- 8 a. Specify the Nyquist rate for the following signals  
 i)  $x_1(t) = \sin(200\pi t)$     ii)  $x_2(t) = \sin(200\pi t) + \cos(400\pi t)$ .      (04 Marks)
- b. Use partial fraction expansion to determine the time domain signals corresponding to the following FTs.

$$\text{i) } X(jw) = \frac{-jw}{(jw)^2 + 3jw + 2}$$

$$\text{ii) } X(jw) = \frac{jw}{(jw + 2)^2}$$

c. Find FT of the signal  $x(t) = e^{-2t} u(t - 3)$ .

(08 Marks)

(04 Marks)

**Module-5**

- 9 a. Explain properties of ROC with example.      (06 Marks)
- b. Determine the z-transform of the following signals

$$\text{i) } x(n) = \left(\frac{1}{4}\right)^n u(n) - \left(\frac{1}{2}\right)^n u(-n-1)$$

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

(10 Marks)

OR

- 10 a. Find the time domain signals corresponding to the following z-transforms.

$$X(z) = \frac{\left(\frac{1}{4}\right)z^{-1}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)} \text{ with ROC } \frac{1}{4} < |z| < \frac{1}{2}. \quad (06 \text{ Marks})$$

- b. Determine the transfer function and the impulse response for the causal LTI system described by the difference equation

$$y(n) - \frac{1}{4}y(n-1) - \frac{3}{8}y(n-2) = -x(n) + 2x(n-1) \quad (10 \text{ Marks})$$

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# CBGS SCHEME

15EC44

USN

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**Fourth Semester B.E. Degree Examination, June/July 2018**  
**Signals and Systems**

Time: 3 hrs.

Max. Marks: 80

**Note:** Answer FIVE full questions, choosing one full question from each module.

**Module-1**

- 1 a. Sketch the even and odd part of the signals shown in Fig. Q1 (a)-(i) and Fig. Q1 (a)-(ii) (08 Marks)

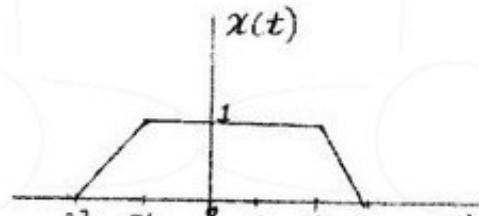


Fig. Q1 (a)-(i)



Fig. Q1 (a)-(ii)

- b. The trapezoidal pulse  $x(t)$  shown in Fig. Q1 (b) is applied to a differentiator defined by,

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

Determine the resulting output  $y(t)$  and the total energy of  $y(t)$ .

(08 Marks)

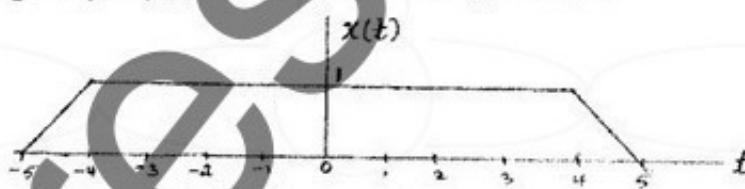


Fig. Q1 (b)

**OR**

- 2 a. Two systems are described by, (i)  $y(n) = (n+1)x(n)$  (ii)  $y(t) = x(t) + 10$ . Test the systems for (i) Memory (ii) Causality (iii) Linearity (iv) Time-invariance and (v) Stability (08 Marks)

- b. Let  $x(t)$  and  $y(t)$  be given in Fig. Q2 (b) respectively. Sketch the following signals, (i)  $x(t)y(-t-1)$  (ii)  $x(4-t)y(t)$  (05 Marks)

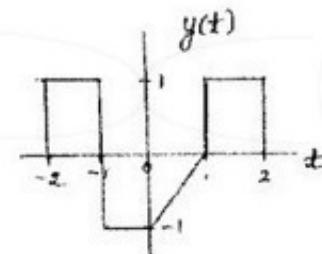
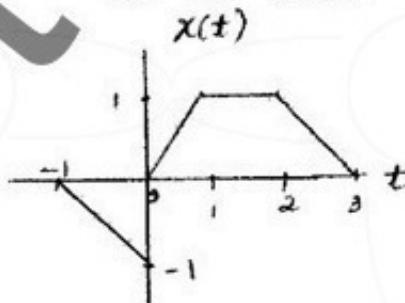


Fig. Q2 (b)

- c. Determine whether the following signal is periodic or not. If periodic find the fundamental period,  $x(n) = \cos\left(\frac{n\pi}{5}\right)\sin\left(\frac{n\pi}{3}\right)$ . (03 Marks)

15EC44

## Module-2



**OR**

- 4** a. Use the definition of the convolution sum to prove the following properties:  
 (i)  $x(n) * (h_1(n) + h_2(n)) = (x(n) * h_1(n)) + (x(n) * h_2(n))$   
 (ii)  $x(n) * h(n) = h(n) * x(n)$  (08 Marks)  
 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)

**Module-3**

- 5 a. Determine the overall impulse response  $h(t)$  in terms of impulse response of each subsystem shown in Fig. Q5 (a). (04 Marks)

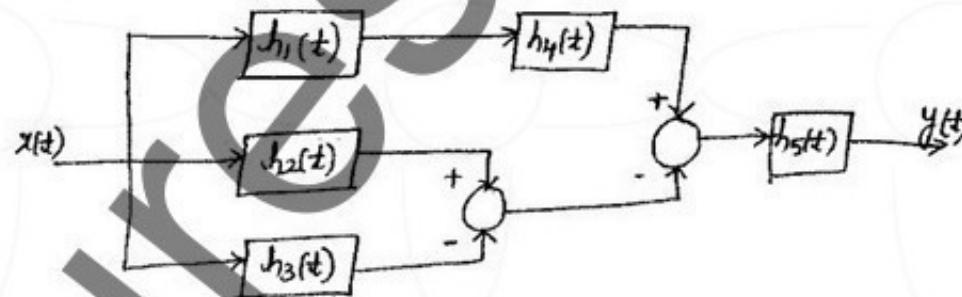


Fig. Q5 (a)

- b. Determine whether the systems described by the following impulse responses are stable, causal and memoryless:

(i)  $h(n) = \left(\frac{1}{2}\right)^n u(n)$       (ii)  $h(t) = e^t u(-1-t)$       (06 Marks)

c. Find the DTFS coefficients of the signal shown in Fig. Q5 (c).      (06 Marks)

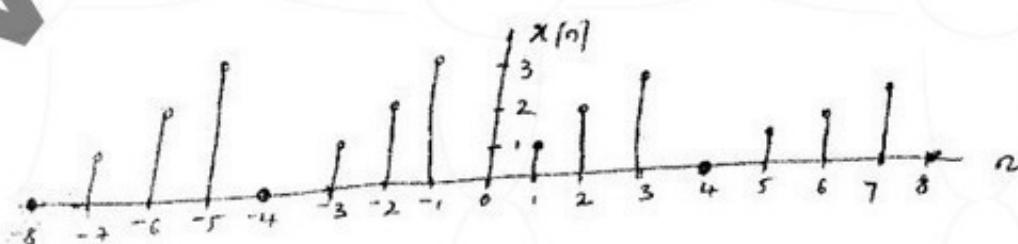


Fig. Q5 (c)

15EC44

**OR**

- 6** a. Find the unit step response for the LTI systems represented by the following responses:

$$(i) h(n) = \left(\frac{1}{2}\right)^n U(n-2) \quad (ii) h(t) = e^{-|t|}$$

- b. Find the Fourier series of the signal shown in Fig. Q6 (b),  $T = 2$

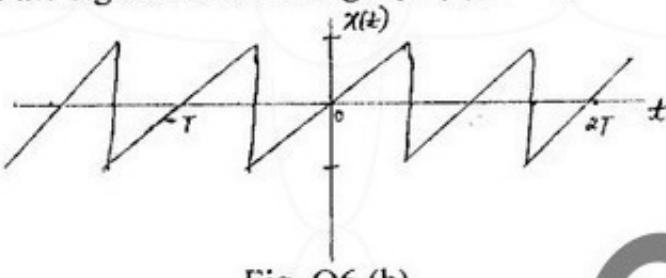


Fig. Q6 (b)

(08 Marks)

(08 Marks)

**Module-4**

- 7** a. State and prove the following properties of Discrete time Fourier transform:

(i) Frequency shift property      (ii) Time differentiation property

- b. Find the Discrete time Fourier Transform of the following signals.

$$(i) x(n) = a^{|n|} |a| < 1 \quad (ii) x(n) = 2^n U(-n)$$

(06 Marks)

(10 Marks)

**OR**

- 8** a. Determine the Nyquist sampling rate and Nyquist sampling interval for,

$$(i) x(t) = 1 + \cos 2000\pi t + \sin 4000\pi t \quad (ii) x(t) = 25e^{j500\pi t}$$

- b. Determine the Fourier transform of the following signals,

$$(i) x(t) = e^{-3t} u(t-1) \quad (ii) x(t) = e^{-at} \quad a > 0$$

c. Determine the time domain expression of  $X(j\omega) = \frac{j\omega + 1}{(j\omega + 2)^2}$ .

(05 Marks)

(06 Marks)

(05 Marks)

**Module-5**

- 9** a. Determine the z-transform  $x(z)$ , the ROC for the signals. Draw the ROC

$$(i) x(n) = -\left(\frac{1}{2}\right)^n U[-n-1] - \left(-\frac{1}{3}\right)^n U[-n-1] \quad (ii) x(n) = -\left(\frac{3}{4}\right)^n U[-n-1] + \left(-\frac{1}{3}\right)^n U[n]$$

(08 Marks)

- b. State and prove the following properties of Z-transform:

(i) Time shift      (ii) Convolution property.

(08 Marks)

**OR**

- 10** a. The Z-transform of a 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 ROCs

$$(i) 2 < |z| < 3 \quad (ii) |z| > 3$$

(08 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,  $\left(\frac{1}{2}\right)^n U(n)$ .

(08 Marks)

\* \* \* \* \*

**Fourth Semester B.E. Degree Examination, June/July 2019**  
**Signals and Systems**

Time: 3 hrs.

Max. Marks: 80

**Note:** Answer any FIVE full questions, choosing ONE full question from each module.

**Module-1**

- 1 a. Find the odd part and even part of the signal given in Fig.Q1(a).

(08 Marks)

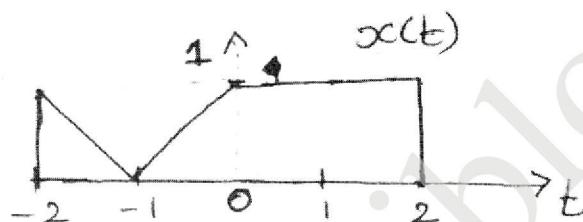


Fig.Q1(a)

- b. Find  $4x(-3n + 4)$ , if  $x(n)$  is as shown in Fig.Q1(b).

(04 Marks)

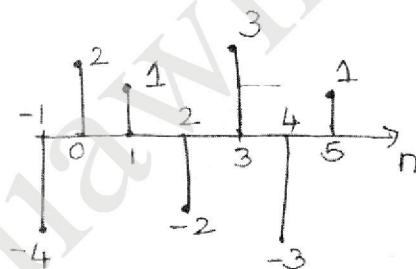


Fig.Q1(b)

- c. Find whether the signal is causal, linear, time variant and static for all values of 'n'.

$$y(n) = x(-3n).$$

(04 Marks)

**OR**

- 2 a. Find whether the given signal is periodic and if periodic, determine the period :

$$x(t) = a \cos(\sqrt{2}t) + b \sin\left(\frac{t}{4}\right). \quad (04 \text{ Marks})$$

- b. Sketch the following signal  $x(t) = r(t+1) - r(t-1) + 2r(-3)$ .

(05 Marks)

- c. Find  $y(-t-2) \cdot x\left(\frac{t}{2}+1\right)$  if  $y(t)$  and  $x(t)$  are as shown in FigQ2(c).

(07 Marks)

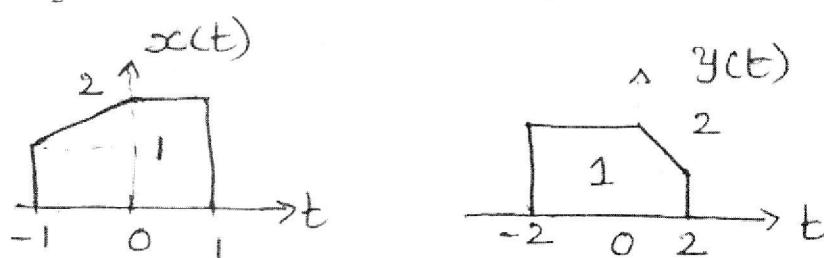


Fig.Q2(c)

**Module-2**

- 3 a. Make use of graphical method to perform the convolution of two signals  $x_1(n)$  and  $x_2(n)$

$$\begin{aligned}x_1(n) &= \left\{ 1, 2, 3, 4 \right\} \\ \text{given: } x_2(n) &= \left\{ -2, 0, 2 \right\}\end{aligned}$$

(08 Marks)

- b. Find  $x_1(t) * x_2(t)$  if

$$x_1(t) = \begin{cases} e^{-t}; & 0 \leq t \leq 1 \\ 0; & \text{otherwise} \end{cases}$$

$$x_2(t) = \begin{cases} 2; & 0 \leq t \leq 2 \\ 0; & \text{otherwise} \end{cases}$$

(08 Marks)

**OR**

- 4 a. Find  $x_1(t) * x_2(t)$  if

$$x_1(t) = \begin{cases} 1; & 0 \leq t \leq 2 \\ 0; & \text{otherwise} \end{cases}$$

$$x_2(t) = \begin{cases} t; & 0 \leq t \leq 1 \\ 0; & \text{otherwise} \end{cases}$$

(08 Marks)

- b. Find the convolution of  $x_1(n)$  and  $x_2(n)$  if  $x_1(n) = a^n u(n)$   $x_2(n) = b^n u(-n)$ .

(08 Marks)

**Module-3**

- 5 a. Define the following properties of DTFS :

i) Convolution ii) Periodicity iii) Linearity

(06 Marks)

- b. Find the complex exponential Fourier series for the periodic rectangular pulse train shown in Fig.Q5(b).

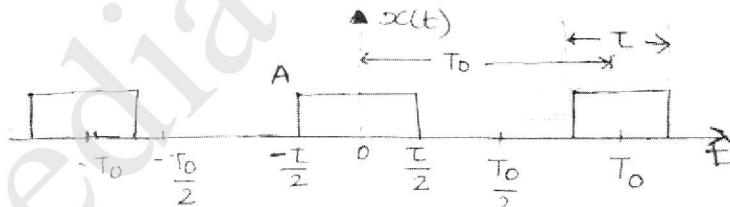


Fig.Q5(b)

**OR**

- 6 a. Find the DTFS coefficients of the signal shown in Fig.Q6(a).

(10 Marks)

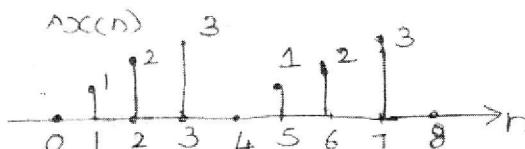


Fig.Q6(a)

- b. Find an expression for impulse response of interconnection of LTI systems shown in Fig. Q6(b).

(06 Marks)

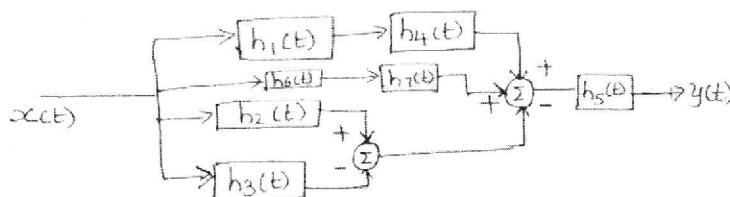


Fig.Q6(b)

**Module-4**

- 7 a. Construct the Fourier transform of rectangular pulse shown in Fig.7(a). Also obtain and plot magnitude and phase responses. (08 Marks)

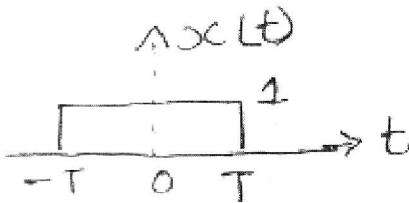


Fig.Q7(a)

- b. Define and prove the following properties of DTFT i) frequency shift ii) time reversal. (08 Marks)

**OR**

- 8 a. Explain sampling theorem and the concept of aliasing. (04 Marks)  
 b. Find DTFT of the signal,  $x(n) = -a^n u(-n - 1)$ . (04 Marks)  
 c. Find Fourier transform of the following signals.  
 i)  $x(t) = e^{-a|t|}$     ii)  $x(t) = e^{at} u(-t)$ . (08 Marks)

**Module-5**

- 9 a. Explain the properties of RoC. (06 Marks)  
 b. The system function of the LTI is given as  $H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$ . Specify the RoC of  $H(z)$  and determine the unit sample response  $h(n)$  for the following conditions :  
 i) Stable system  
 ii) Causal system  
 iii) Anticausal system. Also determine poles and zeroes of  $H(z)$ . (10 Marks)

**OR**

- 10 a. Find Z-transform of  $x(n) = nu(n-1)$ . (06 Marks)  
 b. Find inverse z-transform if  $X(z) = \frac{z}{(z^2 + z + 0.5)(z - 1)}$ . (10 Marks)

## Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020

### Signals and Systems

Time: 3 hrs.

Max. Marks: 80

**Note:** Answer any **FIVE** full questions, choosing **ONE** full question from each module.

#### Module-1

- 1 a. Sketch the even and odd parts of the signals shown in Fig.Q1(i) and (ii) (08 Marks)

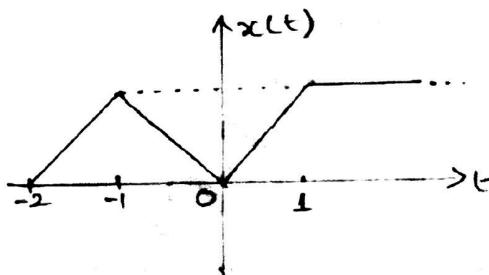


Fig.Q1(i)



Fig.Q1(ii)

- b. Determine whether the following signal is periodic or not if periodic find the fundamental period.  $x(t) = \sin^2(4t)$ . (03 Marks)

- c. The trapezoidal pulse  $x(t)$  shown in Fig.Q1(c) is applied to a differentiator is  $y(t) = \frac{dx(t)}{dt}$ .

- i) Find the resulting output  $y(t)$  of the differentiator ii) Find the energy of  $y(t)$ . (05 Marks)

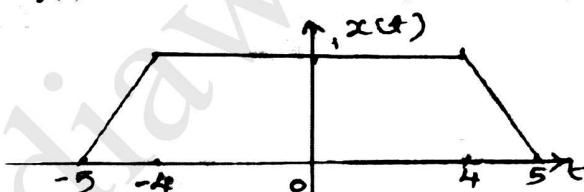


Fig.Q1(c)

#### OR

- 2 a. Determine whether the following systems are memoryless, causal, time invariant, linear and stable. i)  $y(t) = x(t^2)$  ii)  $y(n) = \log_{10}(|x(n)|)$ . (08 Marks)

- b. i) A continuous time signal  $x(t)$  is shown in Fig.Q2(b) sketch  $y(t) = [x(t) + x(2-t)] u(1-t)$ .  
ii) Sketch the signal :  $x(n) = 1; -1 \leq n \leq 3$

$$= \frac{1}{2}; n = 4$$

$$= 0; \text{ elsewhere}$$

Sketch : i)  $2x(2n)$  ii)  $\frac{1}{2}x(n) + \frac{1}{2}(-1)^n x(n)$ .

(08 Marks)

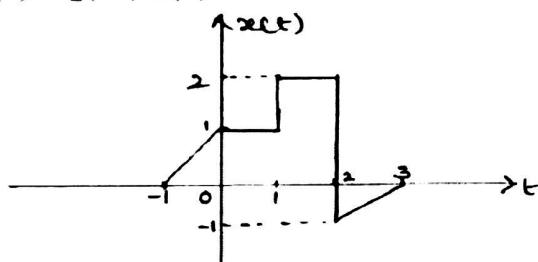


Fig.Q2(b)

**Module-2**

- 3 a. Prove the following :

i)  $x(t) * u(t) = \int_{-\infty}^t x(\tau) d\tau$

ii)  $x(n) * [h_1(n) * h_2(n)] = \{x(n) * h_1(n)\} * h_2(n)$ . (08 Marks)

- b. Compute the convolution sum of  $y(n) = \beta^n u(n) * \alpha^n u(n)$ ;  $|\beta| < 1$  and  $|\alpha| < 1$ . (08 Marks)

**OR**

- 4 a. State and prove the associative and commutative properties of convolution integral. (08 Marks)  
 b. Compute the convolution integral of  $x(t) = e^{-2t} u(t)$  and  $h(t) = u(t + 2)$ . (08 Marks)

**Module-3**

- 5 a. A system consists of several subsystems connected as shown in Fig.Q5(a). Find the operator  $T$  relating  $x(t)$  to  $y(t)$  for the subsystem operators given by

$T_1 : y_1(t) = x_1(t) x_1(t - 1)$

$T_2 : y_2(t) = |x_2(t)|$

$T_3 : y_3(t) = 1 + 2x_3(t)$

$T_4 : y_4(t) = \cos(x_4(t))$

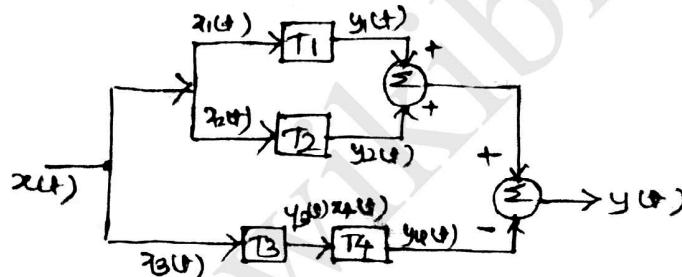


Fig.Q5(a)

(04 Marks)

- b. Determine whether the following systems defined by their impulse response are causal, memoryless and stable.

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

ii)  $h(n) = (0.99)^n u(n + 3)$ . (06 Marks)

- c. Evaluate the step response for the LTI system represented by the following impulse response

i)  $h(n) = e^n u(n) * \delta(n - 2)$

ii)  $h(n) = (-1)^n \{u(n + 2) - u(n - 3)\}$ . (06 Marks)

**OR**

- 6 a. State the following properties of CTFS :

i) Time shift

ii) Differentiation in time domain

iii) Linearity

iv) Convolution

v) Frequency shift scaling. (06 Marks)

- b. Determine the DTFS coefficients of the signal

$$x(n) = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$$

Draw : i) Magnitude spectrum

ii) Phase spectrum. (10 Marks)

**Module-4**

- 7 a. State and prove the following properties :

i)  $y(t) = x(t - t_0) \xrightarrow{\text{FT}} Y(j\omega) = e^{-j\omega t_0} X(j\omega)$

ii)  $-jtx(t) \xrightarrow{\text{FT}} \frac{d}{d\omega} X(j\omega)$ .

(06 Marks)

- b. Find the DTFT of the following signals :

i)  $x(n) = (-1)^n u(n)$

ii)  $x(n) = (\frac{1}{2})^n \{u(n+3) - u(n-2)\}$ .

(10 Marks)

**OR**

- 8 a. Find the FT of the signal :  $x(t) = te^{-2t} u(t)$ .

(06 Marks)

- b. Find the FT of unit step function.

(04 Marks)

- c. Determine the signal  $x(n)$  if its spectrum is shown in Fig.Q8(c).

(06 Marks)

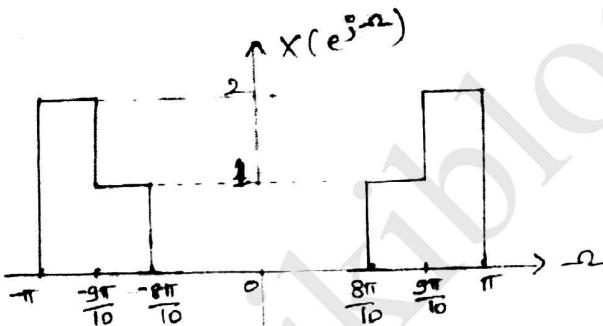


Fig.Q8(c)

**Module-5**

- 9 a. Explain properties of ROC with example.

(06 Marks)

- b. Determine the z-transform of the following signals.

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

ii)  $x(n) = \left(\frac{1}{2}\right)^n \{u(n) - u(n-10)\}$ .

(10 Marks)

**OR**

- 10 a. Find the corresponding time domain signals corresponding to the following z-transform.

$$x(z) = \frac{z^2 - 3z}{z^2 + \frac{3}{2}z - 1}; \text{ ROC } ; \frac{1}{2} < |z| < 1.$$

(06 Marks)

- b. The input and output of an LTI system is given by

$$x(n) = u(n)$$

$$y(n) = (\frac{1}{2})^{n-1} u(n+1).$$

Find :

i) Transfer function

ii) Impulse response

iii) Is the system stable?

iv) Is the system causal?

(10 Marks)