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Reg. No. \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2017**

**Course Code: EC202****Course Name: SIGNALS & SYSTEMS**

Max. Marks: 100

Duration: 3 Hours

**PART A***Question No. 3 is compulsory.*

1. a) Plot the signal  $x(t) = u(t + 1) + 2u(t) - u(t - 3) - 2u(t - 5)$  (4)

b) Check the periodicity of given signals. Find the fundamental period if periodic

i)  $x(t) = 10 \sin 25 \pi t + \cos 10 \pi t$

ii)  $x(n) = \cos \frac{\pi n}{2} - \sin \frac{\pi n}{8} + 3 \cos \left( \frac{\pi n}{4} + \frac{\pi}{3} \right)$  (4)

c) Determine whether the following system is time invariant, linear and causal.

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

d) Evaluate the following integral  $\int_{-10}^{10} \cos(\pi t) \delta(2t - 10) dt$  (2)

**OR**

2. a) What is the output sequence of a LTI system with impulse response  $h(n)=[3, 2]$  to the input  $x(n)=[1, 2, 3, 3]$ ? (5)

b) Compute the auto correlation of the signal  $x(n) = a^n u(n)$  for  $0 < a < 1$  (6)

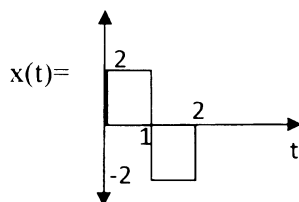
c) Check the causality and stability of the systems whose impulse responses are given

i)  $h(t) = e^{at} u(t)$  ii)  $h(n) = 2^n u(-n)$  (4)

( $a < 0$ )

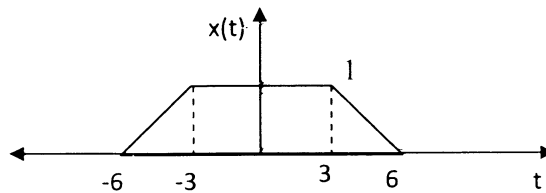
3. a) Find the output of an LTI system whose impulse response is  $h(t)$  to the input  $x(t)$ .

$h(t) = u(t) - u(t - 1)$



(8)

b) For the given signal, plot  $x(3-3t)$



(3)

c) Classify the following signals into energy, power or neither. Determine energy and power.

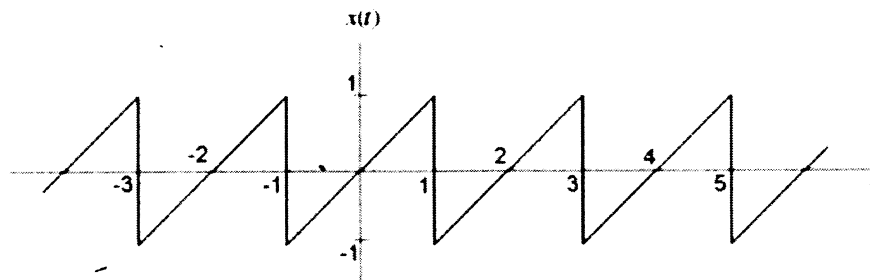
i)  $e^{2t}u(-t)$     ii)  $e^{-3|t|}$

(4)

### PART B

*Question No. 6 is compulsory.*

4. a) Determine the Fourier series representation of the signal shown in figure.



(8)

b) Compute and sketch the magnitude and phase spectrum of the signals

i)  $x(t) = Ae^{-a|t|}$  ( $a > 0$ ) (4)

ii)  $x(t) = \cos^2(2\pi t + 5) + 2\sin(5\pi t)$  (3)

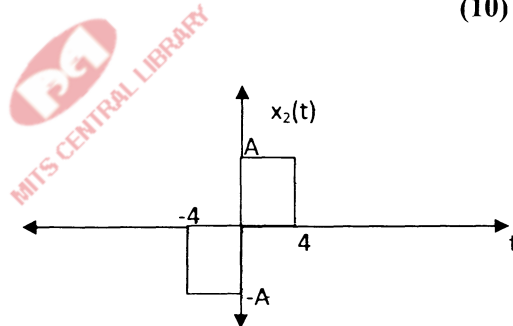
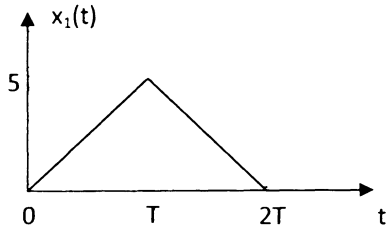
OR

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5. a) The step response of an LTI system is by  $(1 - e^{-t} - te^{-t})u(t)$ . For an input  $x(t)$ , the output is observed to be  $(2 - 3e^{-t} + e^{-3t})u(t)$ . For this observed measurement, determine the input to the system using laplace transform. (6)
- b) State the sampling theorem for low pass signals (2)
- c) Determine the Nyquist rate of sampling for the signals
- i)  $x(t) = 2\sin 250\pi t + 3\cos^2 500t$  (2)
- ii)  $x(t) = 10 \operatorname{sinc} 500t$  (3)
- d) A signal  $x(t) = 2 \cos 400\pi t + 6 \cos 600 \pi t$  is sampled with a sampling frequency 800Hz. Write the resultant discrete time signal. (2)

6. a) Find the Fourier Transform of following signals  $x_1(t)$  and  $x_2(t)$ .

(Any relevant property can be applied) (10)



- b) A continuous time LTI system is described by the differential equation

$$\frac{d}{dt}y(t) + 5y(t) = x(t)$$

Determine the response of the system to the input  $x(t) = e^{-2t}u(t)$  using Fourier Transform. (5)

**PART C***Question 9 is compulsory.*

7. a) Evaluate the inverse Z-transform of

$$X(z) = \log \frac{1}{1-az^{-1}} \quad |a| < |z| \quad (4)$$

- b) Evaluate the DTFT of following signals

i)  $x(n) = a^n \sin \Omega_0 n u(n)$  (4)

$$ii) x(n) = 0.25^n u(n+2) \quad (4)$$

c) Give the Parseval's theorem for DTFT. Prove it. (4)

d) Compute the energy of the sequence  $x(n) = \frac{\sin \Omega_c n}{\pi n}$  (4)

OR

8. a) A system is described by the difference equation

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

Determine the impulse response of the system using fourier transform. Also find the step response of the system. (8)

b) An LTI system is characterized by the system function given as

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Under what conditions the system will be obey causality and stability? (4)

Determine the impulse response of the system such that

i) The system is causal      ii) The system is stable

Justify the answers. (8)

9. a) The frequency response of a three point moving average system is given as

$$H(e^{j\Omega}) = \frac{1}{4} (1 + \cos \Omega) e^{-j\Omega}. \text{ Determine the difference equation representation of the system. (5)}$$

b) Determine the response of the system with impulse response  $h(n) = (0.5)^n u(n)$  to the input signal  $x(n) = 10 - 5 \sin \frac{\pi}{2} n$  (5)

c) Find the z-transform and specify ROC

$$i) x(n) = u(n - 2) * \left(\frac{2}{3}\right)^n u(n) \quad (* \text{ stands for convolution}) \quad (5)$$

$$ii) x(n) = -n\left(\frac{1}{3}\right)^n u(-n - 1) \quad (5)$$

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