Printed Pages 04

Paper Code: EC-303	Roll No.										

B. TECH
(SEM. III) ODD SEMESTER EXAMINATION 2016-17
SIGNALS AND SYSTEMS

[Time: 3 Hours] **[Max. Marks: 100]**

Note: Attempt all Questions. All Questions carry equal marks:-

Q1.Attempt any **four** parts of the following:- **(5x4=20)**

(a) Determine whether the following signals are Energy signals, Power signals, or neither.

(i)

$$x(t) = e^{-at}u(t), \quad a > 0$$

(ii)

$$x(t) = tu(t)$$

(b) Show that the product of two even signals or of two odd signals is an even signal and that the product of an even and an odd signal is an odd signal.

(c) Determine and sketch the even and odd part of the signals shown in Fig. 1

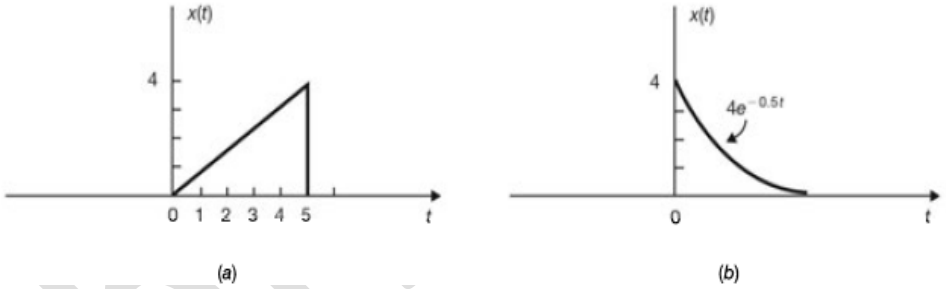

Fig. 1

(d) Express the given waveform as shown in Fig. 2 using ramp signals.

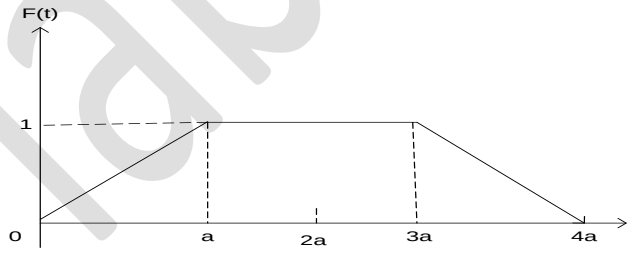

Fig. 2

(e) Establish the relationship among Unit step function, Unit ramp function and Unit impulse function.

(f) Determine whether or not each of the following signals is periodic. If a signal is periodic specify its fundamental period

(i)

$$x(t) = \cos\frac{\pi}{3}t + \sin\frac{\pi}{4}t$$

(ii)

$$x[n] = \cos\frac{1}{4}n$$

Q2. Attempt any **four** parts of the following:- **(5x4=20)**

(a) **(i)** Find the Laplace transform and the associated ROC for each of the following signal
$x(t) = \delta(at + b), a, b$ real constants

(b) **(ii)** Find the convolution integral of x (t) & h (t) and sketch the convolved signal.

$x(t) = \delta(t) + 2\delta(t-1) + \delta(t-2),\ h(t) = 3 \quad -3 < t < 2$

(c) Determine Z- transform, sketch the pole zero plot and indicate the ROC of the signal given below:

(i)

$$x[n] = \left(\frac{1}{2}\right)^n u[n] + \left(\frac{1}{3}\right)^n u[n]$$

(ii) $x[n] = a^{-n}u[-n]$

(d) Find the inverse Laplace transform of

$$X(s) = \frac{s^2 + 2s + 5}{(s+3)(s+5)^2} \qquad \mathrm{Re}(s) > -3$$

(e) For each of the following difference equations and associated input and initial conditions, determine the output y[n]:

$$y[n] - \tfrac{1}{2}y[n-1] = x[n], \text{ with } x[n] = (\tfrac{1}{3})^n, y[-1] = 1$$

(f) Let x[n] be a causal sequence and

$$x[n] \leftrightarrow X(z)$$

Show that if X(z) is a rational function with all its poles strictly inside the unit circle except possibly for a first-order pole at z= 1, then

$$\lim_{N\to\infty} x[N] = \lim_{z\to 1}(1 - z^{-1})X(z)$$

Q3.Attempt any **two** parts of the following:- (10x2=20)

(a) Find the Fourier transform X(ω) of the rectangular pulse sequence shown in Fig3.

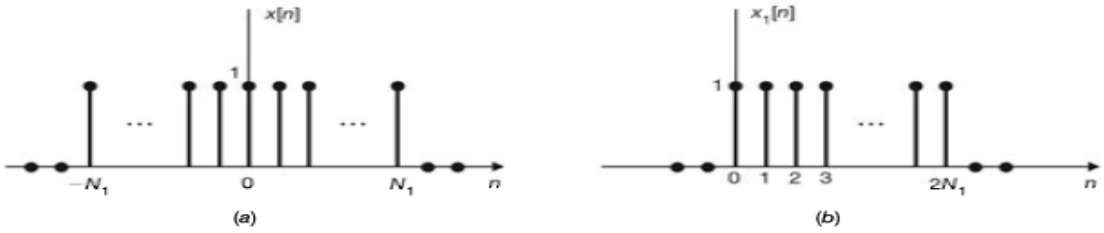

Fig.3

(b) Find the magnitude and phase spectrum of the pulse shown in Fig 4

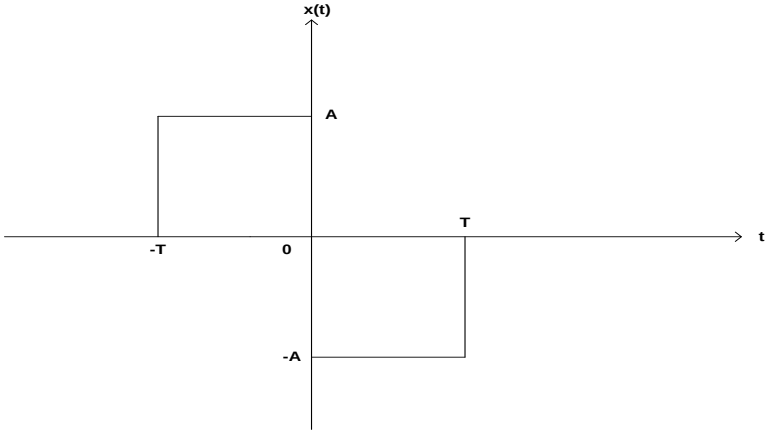

Fig 4.

(c) **(i)** State and prove the parseval's relation for DTFT. What is the significance of this relation?
(ii) State and prove the following properties of Fourier transform.
(a) Time scaling property **(b)** Duality **(c)** Frequency shifting property.

Q4. Attempt any **two** parts of the following:- **(10x2=20)**

(a) Consider the capacitor shown in Fig. 5 Let input x(t) = i(t) and output y(t) = $v_c(t)$,

(i) Find the input-output relationship.

(ii) Determine whether the system is (a) Memory less (b) Causal (c) Linear (d) time-invariant (e) Stable.

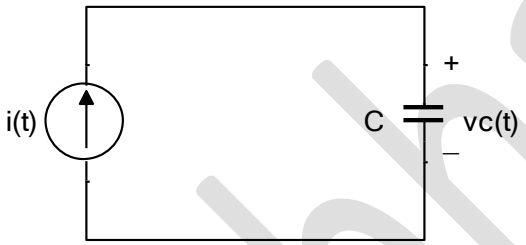

Fig. 5

(b) What is LTI System? Discuss the impulse response of LTI system and show that for LTI output Y(t)=h(t)*x(t) where x(t) is input and h(t) is the system response. If the system shown in Fig 6 (a) is formed by connecting two systems in cascade. The impulse response of the systems are given by $h_1(t)$ and $h_2(t)$, respectively, and $h_1(t)= e^{-2t} u(t)$ $h_2(t)=2 e^{-t} u(t)$
(i) Find the impulse response h (t) of the overall system shown in Fig 6 (b)
(ii) Determine if the overall system is BIBO stable.

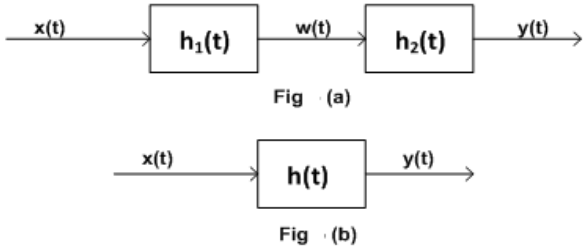

Fig.6

(c) The step response of an continuous-time LTI system is given by$(1 - e^{-t})u(t)$. For a certain unknown input x(t), the output y(t) is observed to be $(2 - 3e^{-t} + e^{-3t})$. Find the input x (t)

Q5. Attempt any **two** parts of the following:- **(10x2=20)**

(a) Use block diagram to draw the direct form, cascade form and parallel form for an LTI system with system function

$$H(s) = \frac{2s^2 + 4s - 6}{s^2 + 3s + 2}$$

(b) For the second-order differential equation for causal and stable LTI system, determine the impulse response condition of underdamped, overdamped and critical damped.

(c) Consider the RC circuit shown in Fig. 7. The switch is closed at t = 0. Assume that there is an initial voltage on the capacitor and

. $v_c(0^-) = v_0$

(i) Find the current i(t).

(ii) Find the voltage across the capacitor vc(t)

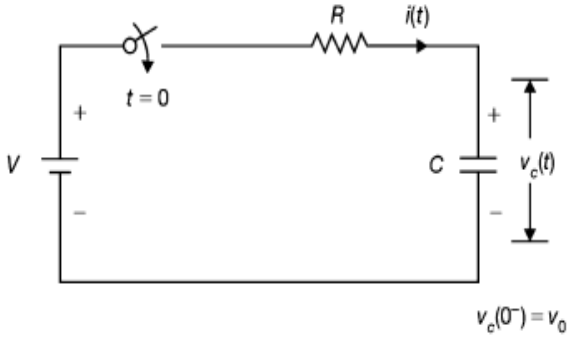

Fig. 7