Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Fourth Semester B. Tech.
(Electronics and Telecommunication)

Summer Term – 2013

Course Code: ETU401

Course Name: Signals and Systems

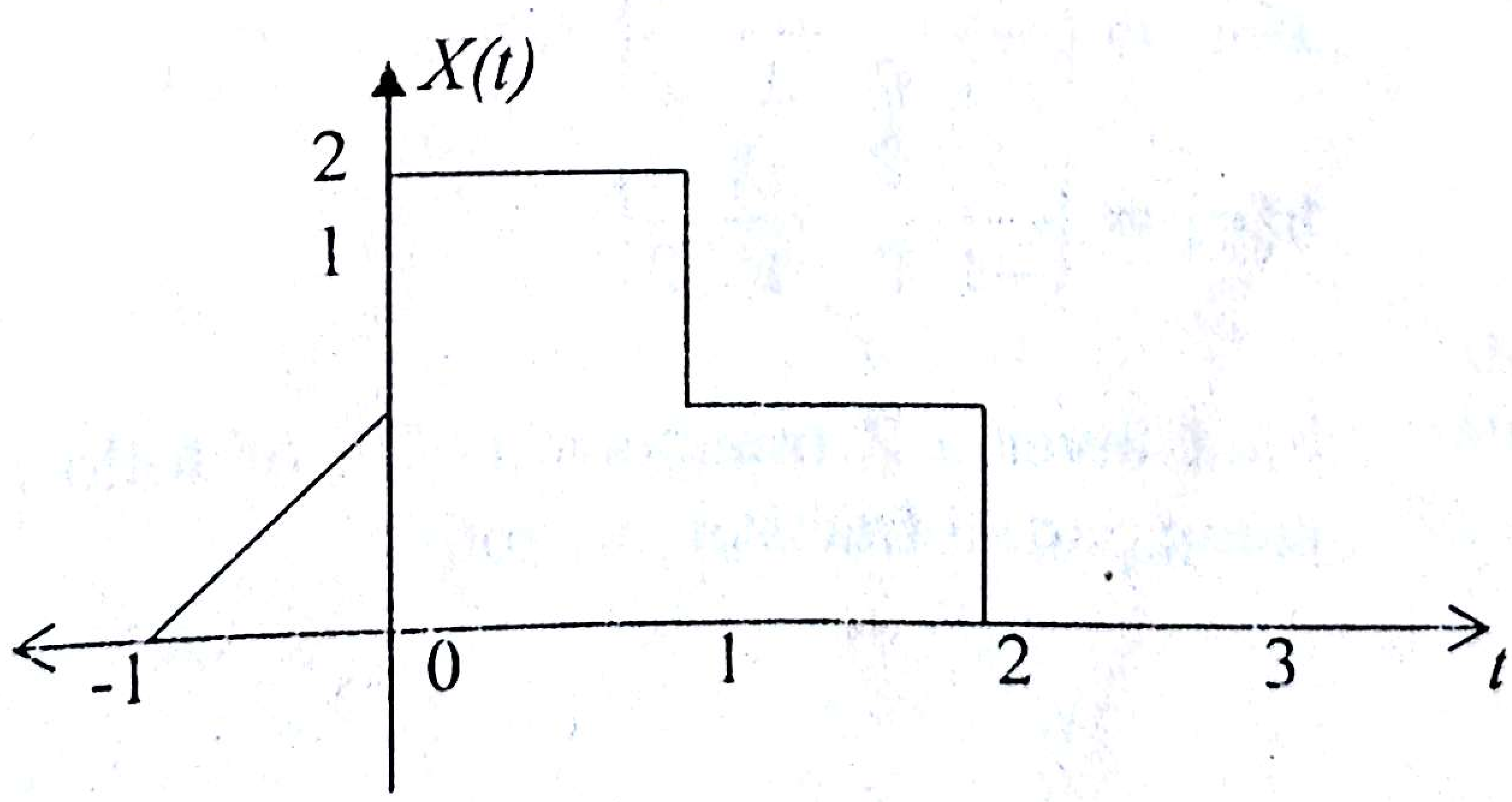
Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory; solve any two sub-questions from Q1 and Q2.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

Q1 a) Sketch the following signals on given analog signal $X(t)$. **06**

1. $X(-2+t)$
2. $X(2(t+3/2))$
3. $X(3t/2)$



b) What do you mean by time variant and invariant signal? Discuss its importance and check whether the following signals are time variant or invariant. 06

a. $Y(t) = A.x(t) + B$

b. $Y(n) = 2x(n) + \frac{1}{x(n-1)}$

c) What is significance of linear time invariant (LTI) systems? Derive the output expression for discrete type of LTI system. 06

Q2 a) Find output response of discrete time LTI system 06

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

b) Find Fourier transform of following signal and draw its magnitude and phase plot 06

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

c) Describe the properties of continuous time Fourier transform and prove convolution property. 06

Q3 a) Determine Z transform and region of convergence (ROC) of function 06

$$X[n]= a^n\ u[n]- b^n\ u[-n-1]$$

b) Find the convolution of following signals and verify the result using matrix method. 06

$$x[n] = \left\{\frac{1}{-1},\frac{0}{0},\frac{-1}{1},\frac{2}{2}\right\} \text{ and}$$
$$h[n] = \left\{\frac{1}{-1},\frac{2}{0},\frac{-1}{1},\frac{2}{2}\right\}$$

Q4 a) Find inverse Z transform (IZT) of followings by using partial fraction method 06

$$X(Z) = \frac{Z(Z-1)}{(Z+2)^3(Z+1)}$$

b) A signal has Laplace transform (LT) 06

$X(s) = \frac{s+2}{s^2+4s+5}$ find LT *Y(s)* of following signals

a. $Y_1(t) = t\,x(t)$

b. $Y_2(t) = e^{-t}x(t)$

Q5 Write short notes on 12

1. Bounded input bounded output (BIBO) Stability
2. Region of Convergence
3. Role of transformation of a signal from one domain to another

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2) Assume suitable data wherever necessary and clearly state the assumptions made.
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4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
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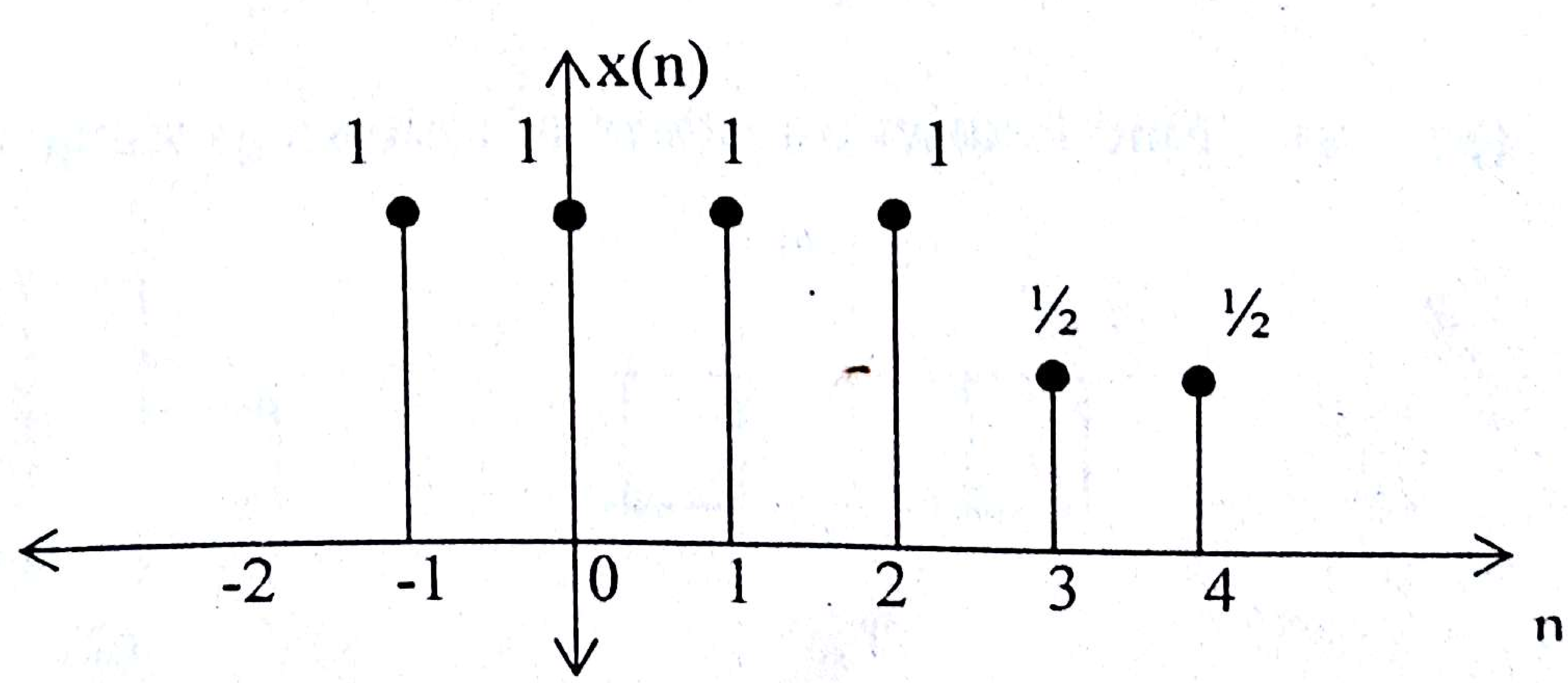
Q1 a) A discrete time signal is shown in the figure below, sketch the following signals with respect to the given signal, **06**

a. $x(n+2)$

b. $x(n)u(2-n)$

c. $x(n-1)\delta(n-3)$



b) Define periodicity of a signal, find fundamental period T of following signals if possible. 06

1. $X(t) = 2\,u(t) + 2\sin(2t)$

2. $X(t) = e^{j\frac{3\pi}{5}\left(n+\frac{1}{2}\right)}$

c) State condition for linearity of system check whether following system is linear or not 06

1. $y[n]=2x[n]+3$
2. $y(t)=x^2(t)$

Q2 a) Define convolution and perform it over following signals 06

$x[n]=u[n]$, $h[n]=2^n\,u[n]$

b) What is the step response of linear time invariant (LTI) system? Derive step response in terms of impulse response for discrete case. If $h[n]=(-a)^n u[n]$, Find step response of LTI system 06

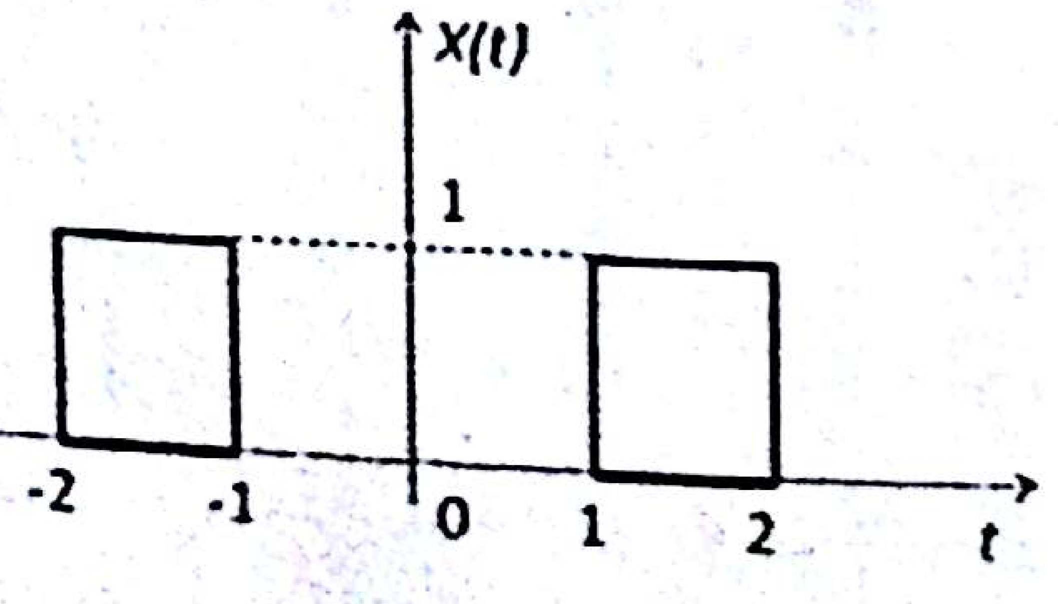
c) Describe the properties of Fourier transform and prove time shifting property. 06

Q3 a) Find Fourier transform of signal $x(t) = \sin(\Omega_0 t)\,.\,u(t)$ 06

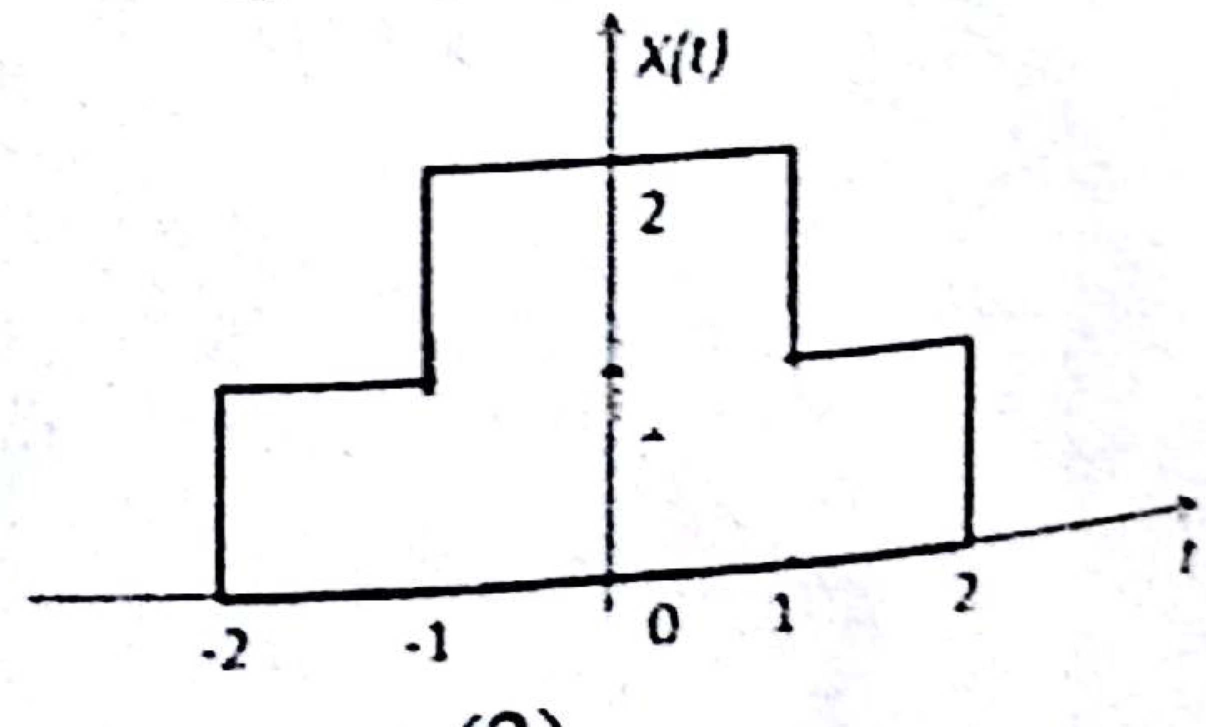
b) Find inverse Z transform by using the residue theorem and verify the result using partial fraction method. 06

$X(Z) = \dfrac{2z^{-1}}{(1-\frac{1}{4}z^{-1})^2} \qquad |z| > \frac{1}{4}$

Q4 a) Find Fourier transform of followings signals 06



(1)



(2)

b) A signal has Laplace transform (LT) 06

$X(s) = \frac{s+2}{s^2+4s+5}$ find LT $Y(s)$ of following signals

$Y_1(t) = t\,x(t)$

$Y_2(t) = x(t) * x(t)$

Q5 Write short notes on 12

1. Sampling theorem for band limited signal.
2. Region of Convergence.
3. Role of unit impulse function in finding response of a system.

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Fourth Semester B. Tech. (Electronics and Telecommunication)

Summer – 2014

Course Code: ETU401

Course Name: Signals and Systems

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory; solve any two sub-questions from Q1, Q2 and Q3.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

Q1. A Explain the classification of signals, Sketch the following signals **06**

1. u(n+3)-u(n-2)
2. u(5-n).u(n)
3. r(t-2)-2 r(t-1)+ r(t)

B State condition for linearity of system check whether following system is linear or not **06**

i. y(n)= nx(n)
ii. $y(t) = x(t)\cos(50\pi t)$

C What is significance of LTI system? Derive the output expression for continuous and discrete type of LTI system in terms of impulse response? **06**

Q2. A Obtain convolution of following signals using any two methods. **06**
$x(n)= 2\delta(n+1)- \delta(n)+ \delta(n-1)+3\ \delta(n-2)$,
$h(n)= 3\delta(n-1)+ 4\delta(n-2)+ 2\delta(n-3)$

B State and prove time shifting property of Fourier transform, If $x(t)= e^{-|t|}$, find Fourier transform of $x(t-3)$ **06**

C State and prove convolution property of continuous time Fourier transform. **06**

Q3. A Find discrete time Fourier transform (DTFT) of **06**
1. $x(n)=a^{n}\ u(n)\ |a|<1$
2. $x(n) = a^{|n|}\ \ |a|<1$

B Prove that discrete time Fourier transforms is always periodic function of ω with period of 2π **06**
i.e. $X(e^{j(w+2\pi)})= X(e^{jw})$

C What is aliasing? How it is responsible for signal distortion? What are protective measures to avoid aliasing? **06**

Q4. A Signal $x(t)= Sinc(150\pi t)$, is sampled at rate of a) 100Hz, b)200Hz, c)300Hz for each of these three cases is it possible to recover signal x(t) from its sampled version. **06**

B Prove the following **06**
If $Z.T.\{x(n)\}=X(z)$
1. $Z.T.\{x(n-m)\}=z^{-m}\ X(z)$
2. $Z.T.\{a^{n}\ x(n))\}= X(a^{-1}z)$

A Find inverse L.T. of the following. **06**

1. $X(s) = \frac{1}{S+5+6S^{-1}}$ 2. $X(s) = \frac{S^2+8S+6}{(S+1)(S^2+3S+2)}$

B Explain the following **06**

1.Sampling theorem for band limited signal
2. Circular convolution
3. Nyquist rate

Government College of Engineering, Amravati

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Fourth Semester B. Tech.

(Electronics and Telecommunication)

Winter – 2014

Course Code: ETU401

Course Name: Signals and Systems

Time: 2 hr. 30min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1 Solve the following questions

(a) Given the continuous time signal specified by 4

$$x(t) = \begin{cases} 1 - |t|, & -1 \leq t \leq 1 \\ 0, & otherwise \end{cases}$$

Determine the resultant discrete time sequence obtained by uniform sampling of x(t) with a sampling interval of (i) 0.25 s,(ii) 0.5 s, (iii) 1.0 s.

(b) Show that the product of two even signals or of two odd signals is an even signals and that the product of an even and an odd signal is an odd signal. 4

Cont.

(c) Show that the complex exponential signal 4

$x(t) = e^{j\omega_0 t}$, is periodic and that its fundamental period is $2\pi/\omega_0$.

2 (a) Explain the properties of continuous time linear time invariant system. 6

(b) Show that

(i) (i) $x(t) * \delta(t-t_0) = x(t-t_0)$ 6

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

(iii) $x(t) * u(t - t_0) = \int_{-\infty}^{(t-t_0)} x(\tau)\, d\tau$

3 Solve any two 12

(a) Describe the properties of fourier transform and prove time shifting property.

(b) Find the fourier transform of a Guassian pulse signal

$x(t) = e^{-at^2}$ for $a > 0$.

(c) Find the fourier transform of

i. $e^{-a|t|}$ $(a > 0)$

ii. Signum function

$$sgn(t) = \begin{cases} 1, & t > 0 \\ -1, & t < 0 \end{cases}$$

4 Solve any two 12

(a) The analog signal $x(t)$ is given as

$x(t) = 2\cos 2000\pi t + 3\sin 6000\pi t + 8\cos 120000\pi t$

.Calculate

i) Nyquist sampling rate

ii) If the given x(t) is sampled at the rate $f_s = 5000$ Hz. What is the discrete time signal obtained after sampling?

(b) Write short note on

i) Sampling theorem for band limited signals

ii) Aliasing effect

(c) Find the inverse Laplace transform of

$$X(s) = \frac{5s+13}{s(s^2+4s+13)} \qquad R_e(s) > 0$$

5 (a) Prove the initial and final value theorem for unilateral Laplace transform. 6

(b) Find the Z-transform of the following discrete time signals, and find ROC for each 6

$$i)\ x(n) = (-\frac{1}{5})^n u(n) + 5(\frac{1}{2})^{-n} u(-n-1)$$

$$ii)\ x(n) = \frac{1}{2}\,\delta(n) + \delta(n-1) - \frac{1}{3}\,\delta(n-2)$$

Government College of Engineering, Amravati

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Fourth Semester B. Tech.
(Electronics and Telecommunication)

Summer – 2017

April 21

Course Code: ETU401

Course Name: Signals and Systems

Time: 2 hrs. 30min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1. (a) For the signal $x(t)$ shown in Fig.1(a) below find the signals. **6**

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

3. $x\left(\frac{3}{2}t\right)$ 4. $x(-t+1)$

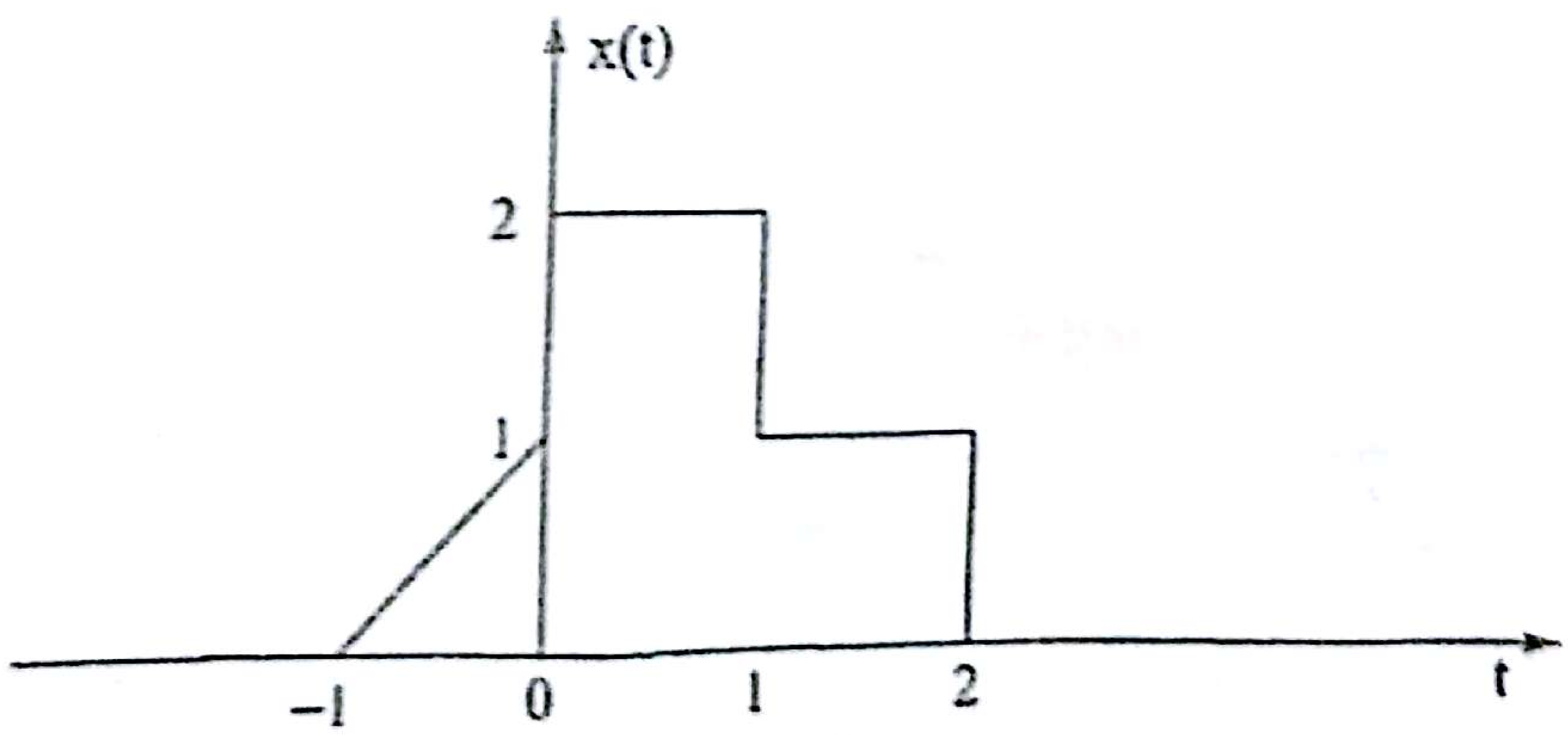

Fig. 1(a)

(b) Check whether or not the given systems are linear, time invariant, causal, memory less and stable. 6

1. $y(t) = x(t-2) + x(2-t)$

2. $\frac{d^3 y(t)}{dt^3} + 4\frac{d^2 y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 2y^2(t) = x(t+5)$

2. Solve any two from the following.

(a) Represent the sequence $x(n) = \{3,\underset{\uparrow}{2},-1,2,4,1\}$ as sum of shifted unit impulses with x (0) = 2. 6

(b) Find the convolution of the following sequence. 6

$$x(n) = 2\delta(n+1) - \delta(n) + \delta(n-1) + 3\delta(n-2)$$
$$h(n) = 3\delta(n-1) + 4\delta(n-2) + 2\delta(n-3)$$

6,5,3,11,14,6

$x(n)=\{2,\underset{\uparrow}{-1},1,3\}$, $h(n)=\{3,4,2\}$

(c) Find whether the following systems with impulse response $h(t)$ are stable or not. 6

1. $h(t) = \frac{1}{RC}e^{-t/RC}u(t)$

2. $h(t) = e^{-2t}u(t-1)$

3. Solve any two from the following.

(a) Prove that convolution in time domain is multiplication in frequency domain. 6

(b) Find the Fourier transform of $x(n) = sin\left(\frac{\pi n}{2}\right)u(n)$ 6

(c) A Signal $x(t) = sinc(150\pi t)$ is sampled at a rate of 6

1) 100Hz 2) 200Hz 3) 300Hz

For each of these three cases, Explain if you can recover the signal $x(t)$ from the sampled signal.

4. **Solve any two from the following.**

(a) Find the Laplace transform of the signal $x(t) = e^{-b|t|}$ 6

(b) Using the Laplace transform find the impulse response of an LTI system described by differential equation 6

$$\frac{d^2y(t)}{dt^2} - \frac{dy(t)}{dt} - 2y(t) = x(t)$$

(c) Determine the initial value and final values for the Laplace Transforms 6

i) $X(s) = \frac{s+5}{s^2+3s+2}$ ii) $X(s) = \frac{s^2+5s+7}{(s^2+3s+2)}$

5. (a) Determine the Z transform, ROC and pole zero locations of X(z) for 6

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

(b) Realize Direct Form-I and Direct Form-II for the Z-transform using an example. 6