ACHARYA INSTITUTE OF TECHNOLOGY
Bangalore - 560090

USN | | | | | | | | | | | **10EE52**

Fifth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain about power and energy signal with example. Determine whether signal given in Fig Q1(a) is power or energy signal, find corresponding value. **(06 Marks)**

b. Find out the even and odd component of the following signals. **(06 Marks)**

i) $x(t) = \cos t + \sin t + \sin t \cos t$ ii) $x(t) = 1 + t + 3t^2 + 6t^3 + 9t^4$

iii) $x(t) = 1 + t \cos t + t^2 \sin t + t^3 \sin t \cos t$

c. For the given signal x(t) shown in Fig Q1(c) sketch and label

(i) x(0.5t) (ii) x(t+3) (iii) x(3t+2) (vi) x(-3(t-1)) **(08 Marks)**

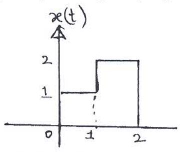


Fig Q1(a)

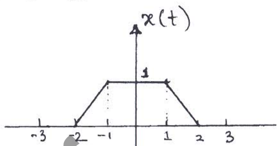


Fig Q1(c)

2 a. Impulse response of a system is given by $h[n] = \begin{cases} 1 & n = 0 \\ 1/2 & n = 1 \\ 0 & \text{otherwise} \end{cases}$

Input for the given system is $x[n] = \begin{cases} 2 & n = 0 \\ 4 & n = 1 \\ -2 & n = 2 \\ 0 & \text{otherwise} \end{cases}$

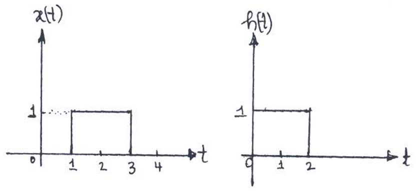
Find out the output y[n] of the system. **(06 Marks)**

b. Given impulse response of the system $h[n] = \left[\frac{1}{2}\right]^n u[n-2]$. Find out step response of the system. **(08 Marks)**

c. Draw direct form – I and direct form – II implementation for the following difference equation. $y[n] + \frac{1}{4}y[n-1] - \frac{1}{8}y[n-2] = 2x[n] + 3x[n-1]$ **(06 Marks)**

3 a. Obtain the convolution integral for a system with input x(t) and impulse response h(t), as shown in Fig Q3(a). **(08 Marks)**

Fig Q3(a)



b. For the given impulse response determine whether system is memory less, stable and causal, justify your answer. $h[n] = [2]^n u[-n]$. **(04 Marks)**

c. Find out the complete solution for the system described by the following differential equation.

$$\frac{d^2y(t)}{dt^2} + 5\frac{d}{dt}y(t) + 6y(t) = x(t), \text{ Where } x(t) = e^{-t}u(t)$$

With initial conditions $y(0) = -\frac{1}{2}, \frac{d}{dt}y(t)\Big|_{t=0} = \frac{1}{2}$ **(08 Marks)**

4 a. Determine the Fourier series representation of the square wave shown in Fig Q4(a)

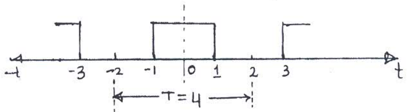


Fig Q4(a) **(08 Marks)**

b. Determine the discrete Fourier series representation for the following signal.

$x[n] = \cos \frac{\pi}{3} n + \sin \frac{\pi}{4} n$ **(06 Marks)**

c. State and prove the time shift and frequency shift property of Fourier series. **(06 Marks)**

PART – B

5 a. Using the properties of Fourier Transform find out Fourier transform of the following signals.

i) $x(t) = \sin(\pi t)e^{-2t}u(t)$ ii) $x(t) = e^{-3(t-2)}$ **(12 Marks)**

b. Obtain the Fourier Transform of the following signals.

i) $x(t) = u(t)$ ii) $x(t) = e^{-\alpha t}u(t)$

iii) $x(t) = 1 \quad -0.5 \le t \le 0.5$

$= 0$ elsewhere. **(08 Marks)**

6 a. Find DTFT of the following signal

i) $x[n] = \left[\frac{1}{2}\right]^{n+2} u[n]$ ii) $x[n] = n\left[\frac{1}{2}\right]^{2n} u[n]$ iii) $x[n] = -\left[\frac{1}{2}\right]^{n} u(-n-1)$ **(12 Marks)**

b. An LTI causal system is having a frequency response as $H(e^{j\Omega}) = \frac{e^{j\Omega}}{1+\cos\Omega}$. Obtain linear constant difference equation of the system. **(08 Marks)**

7 a. Obtain z transform and the ROC and location of poles and zero's of x(z), for the following x[n].

i) $x[n] = \left[\frac{1}{2}\right]^{n} u[n] + \left(-\frac{1}{3}\right)^{n} u[n]$ ii) $x[n] = -\left(\frac{3}{4}\right)^{n} u(-n-1) + \left(-\frac{1}{3}\right)^{n} u[n]$ **(10 Marks)**

b. Obtain inverse 'z' transform of the given x(z) using partial fraction expansion

$x(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - z^{-1}\right)}$ i) with ROC $1 < |z| < 2$ ii) with ROC $|z| < \frac{1}{2}$ **(10 Marks)**

8 a. Use convolution property of 'z' transform to obtain x(z) for the given x(n)

$x(n) = u(n-2) * \left(\frac{2}{3}\right)^{n} u(n)$ **(06 Marks)**

b. Obtain inverse z transform of $x(z) = \frac{2 + z^{-1}}{1 - \frac{1}{2}z^{-1}}$ with ROC $|z| > \frac{1}{2}$ **(06 Marks)**

c. Solve the following linear constant coefficient difference equation using z transform method

$y[n] - \frac{1}{2}y[n-1] = x[n]$ with given input $x[n] = \left(\frac{1}{3}\right)^{n}$ and initial condition $y[-1] = 1$ **(08 Marks)**