U.S.N

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; Dec. – 2015

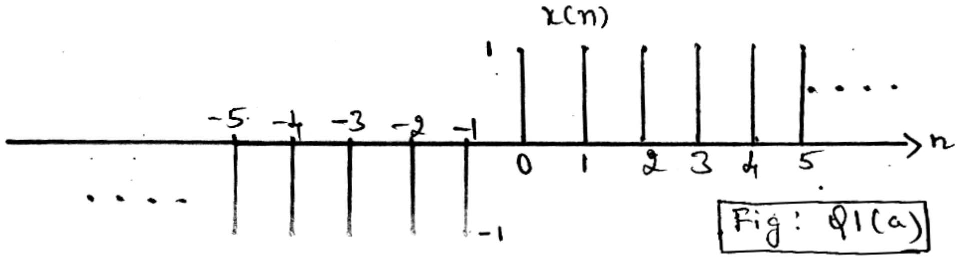
Fundamentals of Signals

Time: 3 hrs *Max. Marks: 100*

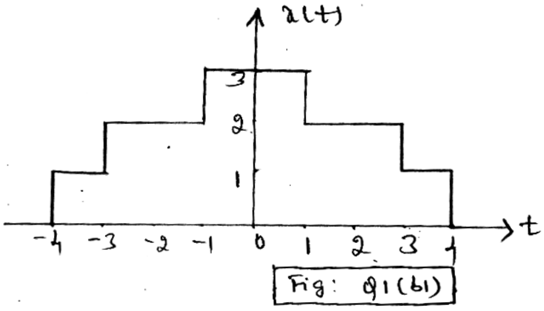
Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each **unit.
ii) Justify the assumptions made if any

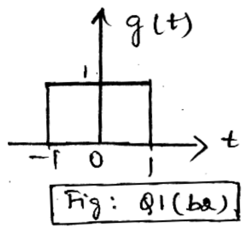
UNIT - I

1 a. Give the definition for even and odd signal. Determine and sketch the even and odd components of the discrete time signal x(n) shown in Fig. 1(a) 8



b. Two continuous time signal x(t) and g(t) are shown in Fig. Q1(b1) and Q1(b2) respectively Construct and expression x(t) in terms of g(t). 6



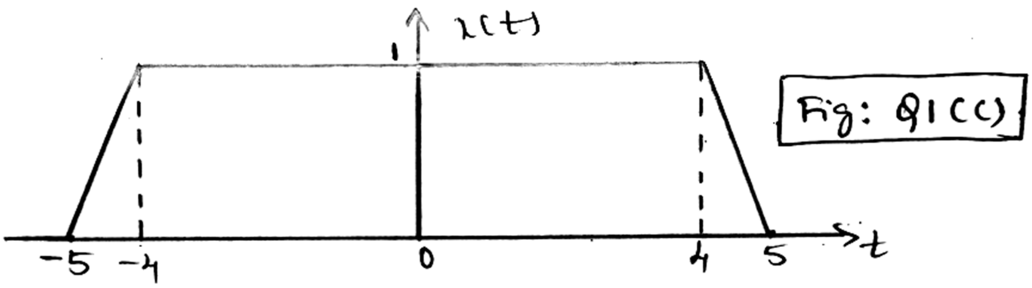


c. Define energy and Power signal. The trapezoidal pulse x(t) shown in Fig. Q 1(c) is applied to a differentiator defined by

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

i) Find the resulting output y(t) of the differentiator

ii) Find the total energy of y(t) 6



2 a. Upon applying the time scaling and time shifting operator on the signal *x* (t/2) shown in Fig. Q2 (a1) we obtain the signal y(t) as depicted in Fig. Q.2 (a2). Determine the signal y(t) 4

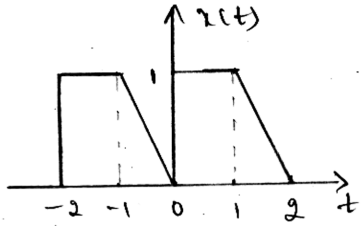


Fig Q2(a1)

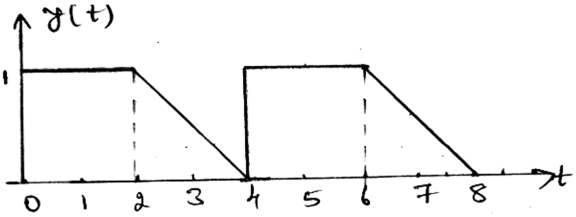


Fig: Q2(a2)

b. Determine whether the following systems are i) Linear ii) Time Invariant iii) Casual iv) Memory less v) Stable 10

A) $y(n)=x(n)+u(n+1)$ B) $y(t)=x\left(\frac{t}{2}\right)$

c. Determine whether the following signals are periodic or not. If periodic find its fundamental period. 6

i) $y(t)=(\cos 2\pi t)u(t)$ ii) $x(n)=x(-1)^n$

UNIT - II

3 a. Consider the input signal x(n) and the impulse response h(n) given by 10

$$x(n)=1 \quad ; \quad 0\le n\le 4$$
$$=0 \quad ; \quad otherwise$$
$$h(n)=\alpha^n \quad ; \quad 0\le n\le 6 \quad ; \quad \alpha>1$$
$$=0 \quad ; \quad \text{otherwise}$$

Compute the output signal y(n)

b. Find the step response for the LTI system represented by the impulse response. 6

$h(n)=\left(\frac{1}{2}\right)^n u(n)$. Also investigate whether the system is stable and causal.

c. Find the input output relation corresponding to the system shown in Fig. Q3(c). 4

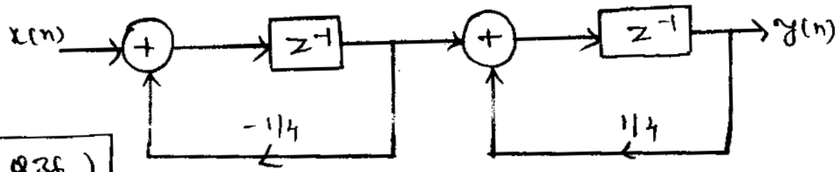


Fig: Q3(c)

4 a. Consider a LTI system with unit impulse response $h(t)=u(-t+2)$ 8

If the input applied to this system is

$x(t)=[(u(t+2)-u(t-1)]$

Find the output $y(t)$ of the system.

b. Find the output of the LTI system given by the differential equation 8

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

$$with\ y(0)=0 \quad ; \left.\frac{dy(t)}{dt}\right|_{t=0}=1 \quad and \quad x(t)=e^{-2t}u(t)$$

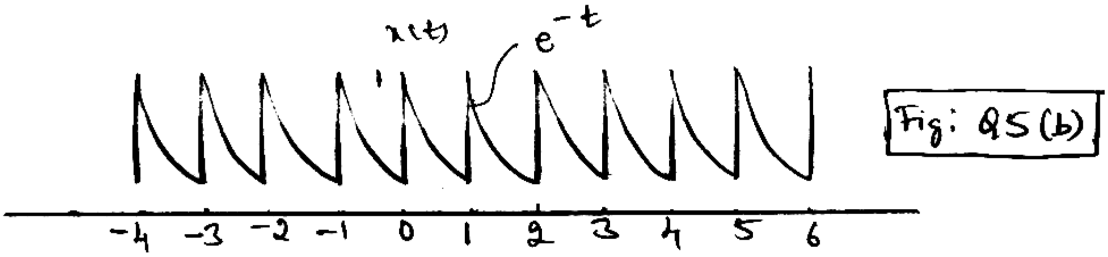
c. Sketch the direct form I and direct form II implementations for the LTI system whose difference equation is 4

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

UNIT - III

5 a. State and prove the following properties of Fourier series i) Time shift ii) Parsevel's theorem 10

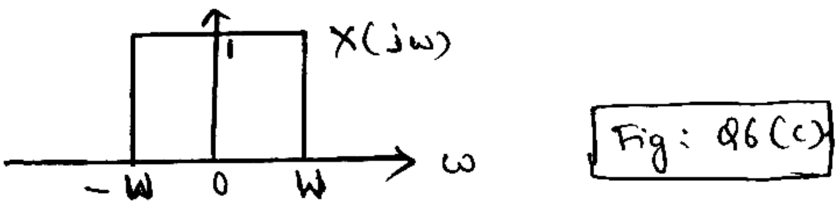
b. For the signal x(t) shown in Fig. Q 5(b), find the Fourier series representation and draw its magnitude and phase spectra 10



6 a. State and prove the following properties of Fourier Transform.
i) Frequency shift ii) Convolution. 10

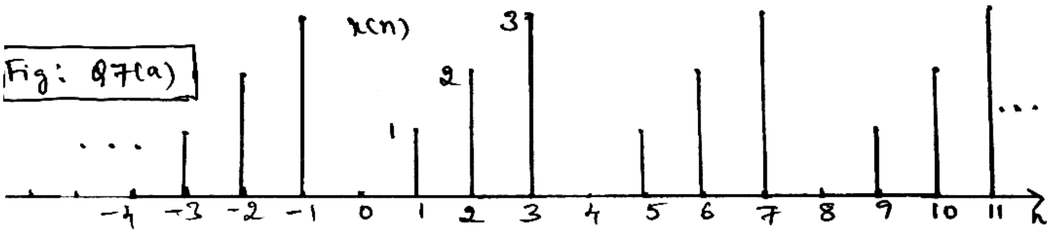
b. Determine the Fourier Transform of the unit impulse function and draw its spectrum. 6

c. Find the time domain signal corresponding to the spectrum shown in Fig. Q6(c) 4



UNIT - IV

7 a. Evaluate the discrete Time Fourier series representation for the signal x(n) shown in figure Q7(a) and sketch the spectra. Also verify Parseval's identify. 10

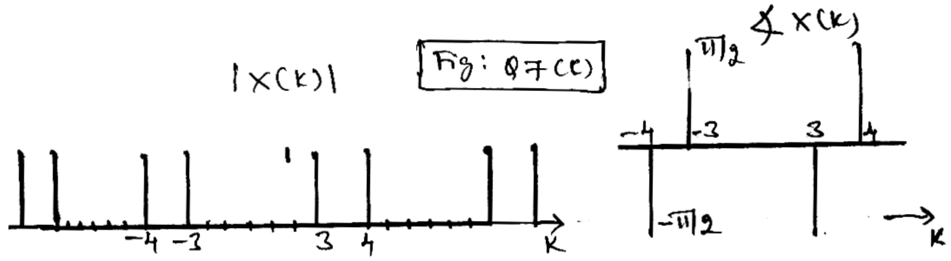


b. Determine the DTFS coefficients of the periodic sequence given by

$$x(n)=\sum_{m=-\infty}^{\infty}\delta(n-4m)$$ 5

Draw the spectrum.

c. Determine the time domain signal corresponding to the following spectra shown in Fig. Q7(c). 5



8 a. Show that the DTFT of the unit step sequence in given by $x\left(e^{i\Omega}\right)=\frac{1}{1-e^{-i\Omega}}+\pi\sum_{k=-\infty}^{\infty}\delta(\Omega)$ 6

b. Find the inverse DTFT of the following: i) $x\left(e^{j\Omega}\right)=1+2\cos\Omega+3\cos 2\Omega$ 6

ii) $x\left(e^{j\Omega}\right)=j\left(3+4\cos\Omega+2\cos 2\Omega\right)\sin\Omega$

c. Define sampling Theorem. Consider the analog signal

$x_a(t)=3\cos 50\pi t+10\sin 300\pi t-\cos 100\pi t$

i) What is the Nyquist rate for this signal

ii) What are the frequencies in radians, in the resulting discrete time signal *x(n),* if the signal is sampled at Nyquist rate. 8

iii) Suppose that we sample the signal at a rate of 200 samples/second, what is the highest frequency that can be represented uniquely at this sampling rate.

UNIT - V

9 a. State and prove the following properties of Z-transform. 7

i) Time reversal ii) convolution

b. Determine the Z-transform of the signal $x(n)=-u(-n-1)+\left(\frac{1}{2}\right)^n u(n)$ 7

Find the ROC and pole zero locations of x(2) in the Z-plane.

c. $X(Z)=\frac{\frac{1}{4}Z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}$ *with ROC:* $\frac{1}{4}<|z|<\frac{1}{2}$ 6

10 a. We want to design a casual discrete time LTI system with the property that if the input is $x(n)=\left(\frac{1}{2}\right)^n u(n)-\frac{1}{4}\left(\frac{1}{2}\right)^{n-1}u(n-1)$ then the output is $y(n)=\left(\frac{1}{3}\right)^n u(n)$. Determine the system function H(z) and the impulse response of the system that satisfies this condition. 6

b. A LTI discrete time system is given by the system function

$H(z)=\frac{3-4z^{-1}}{1-3.52^{-1}+1.5z^{-2}}$ 6

Specify the ROC of H(Z) and determine h(n) for the following conditions:

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

c. Solve the following difference equation using unilateral Z-transform

$y(n)-\frac{3}{2}y(n-1)+\frac{1}{2}y(n-2)=x(n)$ *for* $n\geq 0$ 8

With $y(-1)=4, y(-2)=10$ *and* $x(n)=\left(\frac{1}{4}\right)^n u(n)$

* * * *