ISRA UNIVERSITY

Islamabad Campus

Department of Electrical Engineering
Program: B.E. (Electrical)
Semester - Fall 2016

EL313- Signal & Systems

Quiz – 1 Solution
Marks: 10   **Handout Date: 26/10/2016**

Question # 1:

Determine whether the following signals are energy signal or power signal:
1. $x(t) = e^{-5t}u(t)$
2. $x[n] = \left[\frac{1}{4}\right]^n u[n]$
3. $x(t) = \cos(t) + j\sin(t)$

Solution:

1. $x(t) = e^{-5t}u(t)$

$$E = \int_{-\infty}^{\infty} [x(t)]^2 \, dt$$

$$= \int_0^{\infty} (e^{-5t})^2 dt = \int_0^{\infty} e^{-10t} dt = \left. -\frac{e^{-10t}}{10} \right|_0^{\infty}$$

$$= -\frac{e^{-10(\infty)}}{10} + \frac{e^{10(0)}}{10} = \frac{1}{10} < \infty$$

Hence, x (t) is an Energy Signal and its Power is P =0.

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2. $x[n] = \left[\frac{1}{4}\right]^n u[n]$

$$E = \sum_{n=-\infty}^{\infty} |x[n]|^2 = \sum_{n=0}^{\infty} \left|\left(\frac{1}{4}\right)^n\right|^2 = \sum_{n=0}^{\infty} \left|\left(\frac{1}{4}\right)^2\right|^n$$

$$= \sum_{n=0}^{\infty} \left(\frac{1}{16}\right)^n$$

Applying the geometric series formula:

$$E = \frac{1}{1 - \frac{1}{16}} = \frac{1}{\frac{16-1}{16}} \implies \frac{16}{15} < \infty$$

Since $0 < E < \infty$, signal x[n] is an energy signal and its P =0.

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3. $x(t) = \cos(t) + j\sin(t)$

$|x(t)|^2 = |\cos(t) + j\sin(t)|^2 = \cos^2(t) + \sin^2(t) \implies 1$

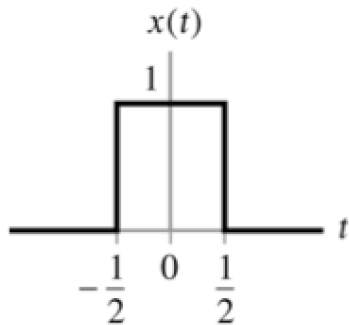$$P = \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} [x(t)]^2 \, dt$$

$$P = \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} 1 \, dt = \lim_{T \to \infty} \frac{1}{2T} [t]_{-T}^{T} = \lim_{T \to \infty} \frac{1}{2T} [T - (-T)]$$

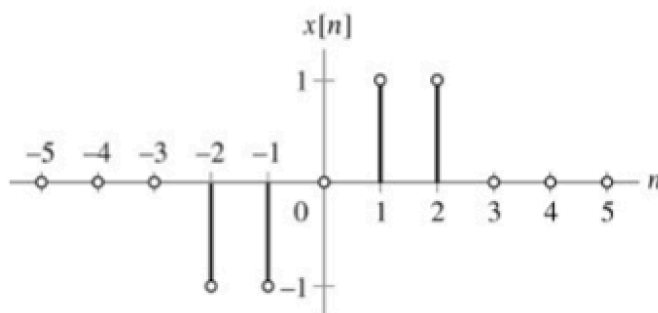$$P = \lim_{T \to \infty} \frac{1}{2T} [2T] \implies 1 < \infty$$

Since, signal x (t) is a Power signal and its $E = \infty$

Question # 2:
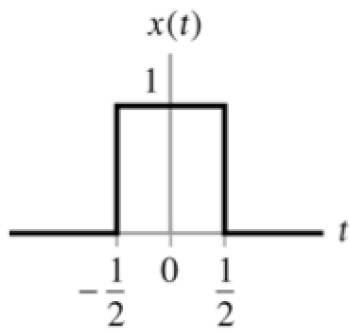
Sketch the following signals:
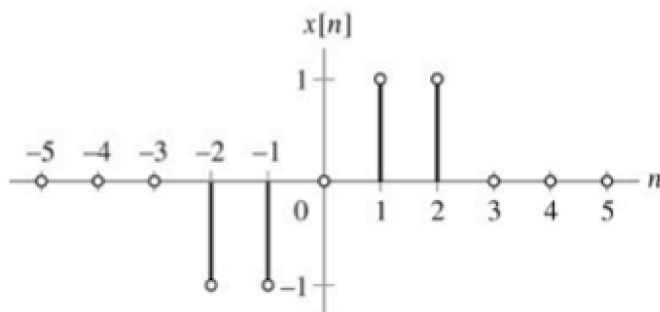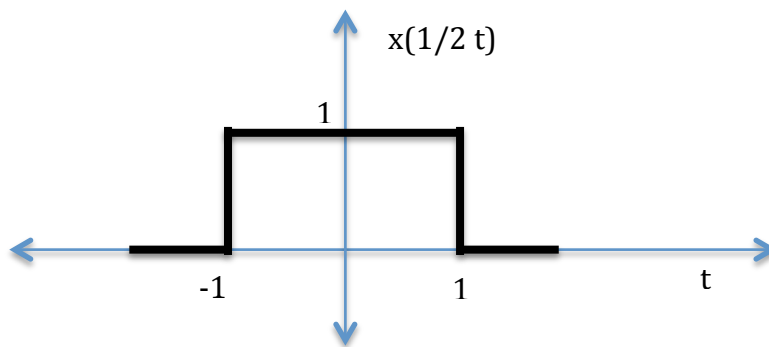

$x(t)$

1.

Sketch $y(t) = x\left(\frac{1}{2}t\right)$.
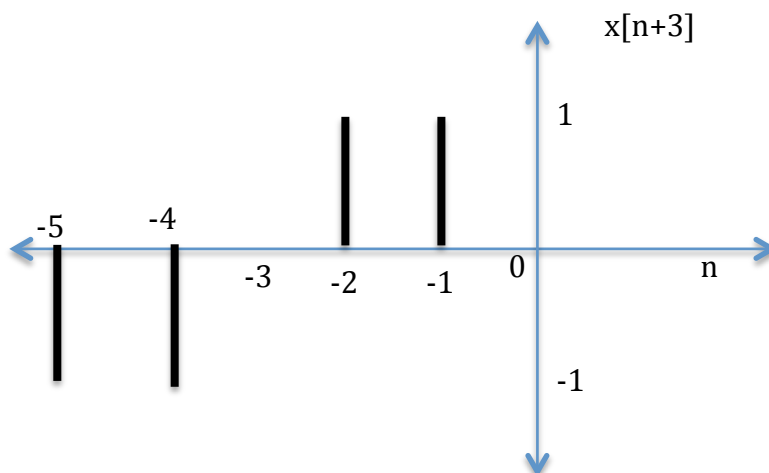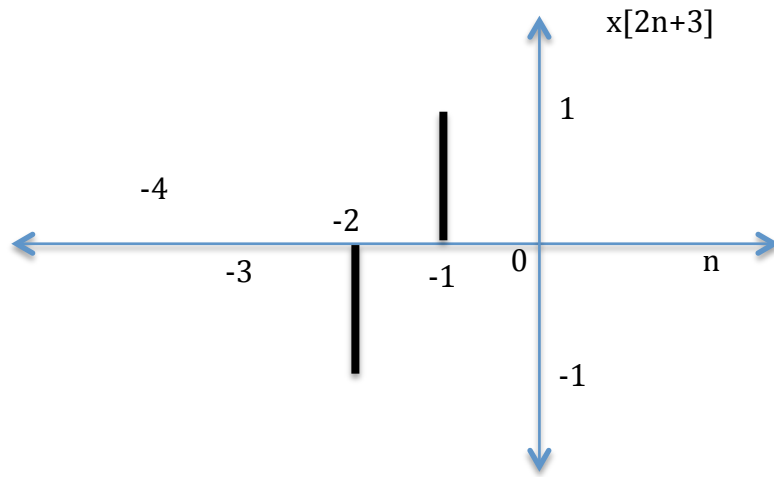

$x[n]$

2.

Sketch $y[n] = x[2n + 3]$

Solution:

$x(t)$

1

$-\dfrac{1}{2}$ 0 $\dfrac{1}{2}$

1.   Sketch $y(t) = x\left(\dfrac{1}{2}t\right)$.

x(1/2 t)

1

-1   1   t

$x[n]$

1

-5 -4 -3 -2 -1

0   1   2   3   4   5   n

-1

2.   Sketch $y[n] = x[2n + 3]$

x[n+3]

1

-5   -4

-3   -2   -1   0   n

-1

x[2n+3]

-4

-3   -2

-1   0   n

1

-1

Good Luck