Assignment 1 (Unit 1)

1. A continuous-time signal $x(t)$ is shown in fig.1. Sketch and label carefully each of the following signals:
    a. $x(t-1)$
    b. $x(2-t)$
    c. $x(2t+1)$
    d. $x(4-\frac{t}{2})$
    e. $[x(t)+x(-t)]u(t)$
    f. $x(t)[\delta\left(t+\frac{3}{2}\right)-\delta\left(t-\frac{3}{2}\right)]$
2. A discrete-time signal is shown in fig.2. Sketch and label carefully each of the following signals:
    a. $x[n-4]$
    b. $x[3-n]$
    c. $x[3n]$
    d. $x[3n+1]$
    e. $x[n]u[3-n]$
    f. $x[n-2]\delta[n-2]$
    g. $\frac{1}{2}x[n]+\frac{1}{2}(-1)^2x[n]$
3. Determine whether or not each of the following signals is periodic. If a signal is periodic, specify its fundamental period.
    a. $x_1(t)=je^{j10t}$
    b. $x_2(t)=e^{(-1+j)t}$
    c. $x_3[n]=e^{j7\pi n}$
    d. $x_4[n]=3e^{j3\pi(n+1/2)/5}$
    e. $x_5[n]=3e^{j3/5(n+1/2)}$
4. Determine the fundamental period of the signal $x(t)=2\cos(10t+1)-\sin(4t-1)$
5. Determine the values of P_∞ and E_∞ for each of the following signals:
    a. $x_1(t)= e^{-2t}u(t)$
    b. $x_2(t)= e^{j\left(2t+\frac{\pi}{4}\right)}$
    c. $x_3(t)= \cos t$
    d. $x_1[n]= (\frac{1}{2})^n u[n]$
    e. $x_2[n]= e^{j(\frac{\pi}{2n}+\pi/8)}$
    f. $x_3[n]= \cos(\frac{\pi}{4}n)$
6. For each of the systems given below, determine which of the systems are linear and which are non-linear.
    a. $y(t)=tx(t)$
    b. $y(t)=x^2(t)$
    c. $\frac{dy(t)}{dt}+3y(t)=x(t)$
    d. $y[n]=2x[n]+1$
    e. $y[n]=n^2x[n-2]$
    f. $y[n-1]+n^2y[n]=(2n+3)x[n]$
7. For each of the systems given below, check whether systems are time-variant or not.
    a. $y(t)=tx(t)$
    b. $y(t)=x(t)\cos\omega_c t$

c. $y[n] = x[n+1] - x[n-1]$
d. $y[n] = x[kn]$

8. Check whether given systems are instantaneous or not.
   a. $5x^3(t) + 2x(t)$
   b. $y(t) = 2x(t) - x(t-1)$
   c. $y(t) = 2x(t-1)$
   d. $y[n] = 4x[n+1]$
   e. $y[n] = 4x^2[n]$
   f. $y[n] = x[n] + x[n-1]$
9. Check whether given systems are causal or not.
   a. $y(t) = 2x(t) - x(t-1)$
   b. $y(t) = x^3(t) - x(t-1)$
   c. $y(t) = x(t) - x(t+1)$
   d. $y[n] = \sum_{k=-\infty}^{n} x[k]$
   e. $y[n] = x[n]\cos\omega_c n$
   f. $y[n] = nx[n]$
10. Check whether given systems are invertible or not.
   a. $y(t) = \int_{-\infty}^{t} x(\tau)d\tau$
   b. $y(t) = x(t)x(t-1)$
   c. $y(t) = x\left(\frac{t}{2}\right)$
   d. $y[n] = 2x^2[n]$
   e. $y[n] = x[n] + 3$
   f. $y[n] = nx[n]$
11. Check whether given systems are stable or not.
   a. $y(t) = \frac{dx(t)}{dt}$
   b. $y(t) = \int_{-\infty}^{t} x(\tau)d\tau; x(t) = u(t)$
   c. $y(t) = Kx\left(\frac{t}{2}\right)$
   d. $y[n] = x[n]\cos\omega_c n$
   e. $y[n] = x[2n]$
   f. $y[n] = x^2[n]$

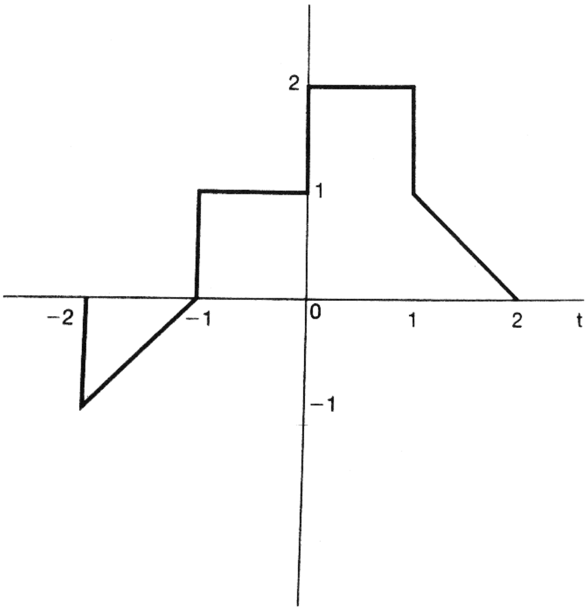

Fig.1

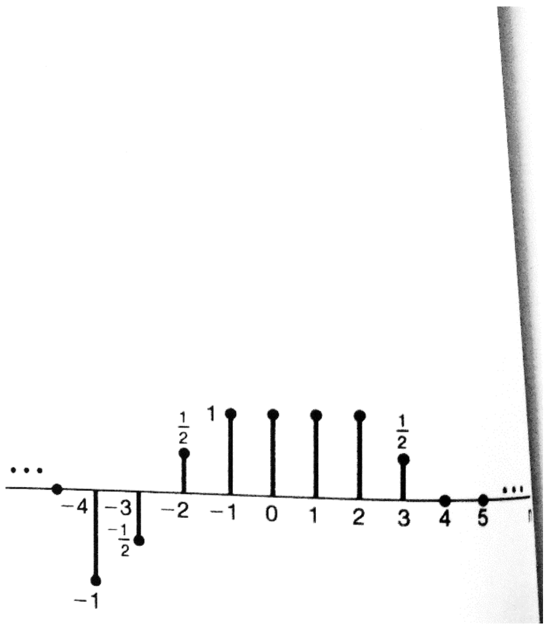

Fig.2

Answers

1. Do yourself.
2. Do yourself.
3. .
    a. $T = \pi/5$
    b. Not periodic
    c. N=2.
    d. N=10.
    e. Not periodic
4. π
5. .
    a. $P_\infty = 0 \quad E_\infty = $ ¼
    b. $P_\infty = 1 \quad E_\infty = \infty$
    c. $P_\infty = 1/2 \quad E_\infty = \infty$
    d. $P_\infty = 0 \quad E_\infty = 4/3$
    e. $P_\infty = 1 \quad E_\infty = \infty$
    f. $P_\infty = 1/2 \quad E_\infty = \infty$
6. .
    a. Linear
    b. Non-linear
    c. Linear
    d. Non-Linear
    e. Linear
    f. Linear
7. .
    a. Time varying
    b. Time varying
    c. Time invarint
    d. Time varying
8. .
    a. Instantaneous
    b. Not-Instantaneous
    c. Not-Instantaneous
    d. Not-Instantaneous
    e. Instantaneous
    f. Not-Instantaneous
9. .
    a. Causal
    b. Causal
    c. Non-causal
    d. Causal
    e. Causal
    f. Causal
10. .
    a. Invertible
    b. Non-invertible
    c. Invertible

d. Non-invertible
e. Invertible
f. Non-invertible

11. .

a. Stable
b. Unstable
c. Stable
d. Stable
e. Stable
f. Stable