## HOMEWORK 1

**Q1)** Determine whether or not each of the following signals is periodic. If the signal is periodic, find its fundamental period.

**a)** $x(t) = 4\cos(3t + \frac{\pi}{5})$          **b)** $x(t) = e^{j(\frac{\pi}{2}t-2)}$          **c)** $x(t) = e^{jt^2}$
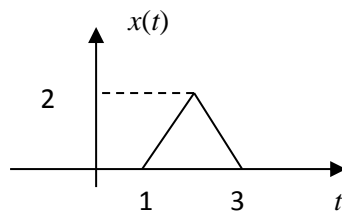
**d)** $x[n] = \cos\left(\frac{3\pi}{7}n + \frac{\pi}{4}\right)$          **e)** $x[n] = \left[\sin\left(\frac{\pi}{3}n + \frac{\pi}{2}\right)\right]^2$          **f)** $x[n] = \cos\left(\frac{\pi}{7}n^2\right)$

**Q2)** Given the following CT signal x(t),



a) Plot i) $x(3t - 4)$,  ii) $x(-2t + 1)$,  iii) $[x(t) + x(-t)]u(t)$
b) Find and plot the even and odd parts of $x(t)$.

**Q3)** Determine which of the properties hold and do not hold for the following systems and fully justify your answers:

1) Memoryless,  2)Time invariant,  3)Linear,  4) Causal,  5)Stable

**a)** $y(t) = \int_{0}^{t} x(\tau)d\tau$          **b)** $y(t) = [\sin(2t)]x(t)$          **c)** $y(t) = \frac{dx(t)}{dt}$

**d)** $y[n] = x[2n]$          **e)** $y[n] = x[-n]$          **f)** $y[n] = \sum_{k=n-5}^{n+5} x[k]$

**Q4) a)** Prove the following relations

**i)** $\sum_{n=0}^{N-1} a^n = \begin{cases} N, & a = 1 \\ \frac{1-a^N}{1-a}, & otherwise \end{cases}$          **ii)** $\sum_{n=0}^{\infty} a^n = \frac{1}{1-a}, \; |a| < 1$

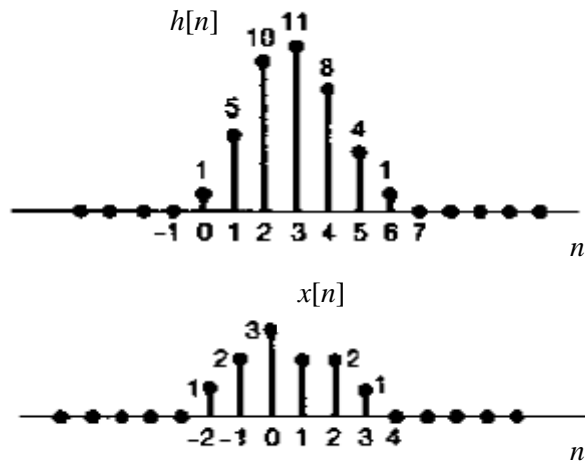**b)** Find the result of the following expressions,

**i)** $\sum_{n=-2}^{7} e^{j\frac{\pi n}{2}}$          **ii)** $\int_{0}^{8} e^{j\frac{\pi t}{2}} dt$          **iii)** $\int_{0}^{\infty} e^{-t} \sin(t)dt$

**Q5) a)** Consider two DT sequences, $x[n]$ and $h[n]$. $y[n]$ is the DT convolution of these two sequences given as,

$$y[n]= \sum_{m=-\infty}^{\infty} x[n-m]h[m]= \sum_{m=-\infty}^{\infty} x[m]h[n-m] \qquad (1)$$

$h[n]$

11
10
8
5
4
1   1
-1 0 1 2 3 4 5 6 7
$n$

$x[n]$

3
2   2
1   1
-2 -1 0 1 2 3 4
$n$

Given the above sequences, find and plot $y[n]$.

**b)** Write a MATLAB program using a for-loop to compute the convolution sum in (1) such that when two sequences $x[n]$ and $h[n]$ are given, $y[n]$ is computed and plotted. (Do not use conv command). Apply the sequences in part a) to your program and present the output plot together with your code.