MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF COMPUTER ENGINEERING

CENG 384

Spring 2019
Homework 1

Regulations:

- **Grouping:** You are allowed to work in pairs.
- **Submission:** We provide a latex template for your solutions. Use that template and create a hw1.tar.gz file that includes hw1.tex and all other related files. Tar.gz file should not contain any directories and should create a *hw1.pdf* file with the following commands, otherwise you will get zero;
  tar xvzf hw1.tar.gz
  pdflatex hw1.tex
  Submit hw1.tar.gz to the COW page of the course.
- **Deadline:** 23:55, 1 March, 2019 (Friday).
- **Late Submission:** Not allowed.

1. (20 pts) Solve the following, showing your solution in detail.
   (a) (5 pts) Given $z = x + yj$ and $3z + 4 = 2j - \bar{z}$, (i) find $|z|^2$ and (ii) plot z on the complex plane.
   (b) (5 pts) Given $z = re^{j\theta}$ and $z^3 = 64j$, find z in polar form.
   (c) (5 pts) Find the magnitude and angle of $z = \frac{(1-j)(1+\sqrt{3}j)}{1+j}$.
   (d) (5 pts) Write z in polar form where $z = -je^{j\pi/2}$.
2. (10 pts) Given the $x(t)$ signal in Figure 1, draw the signal $y(t) = x(\frac{1}{2}t + 1)$.

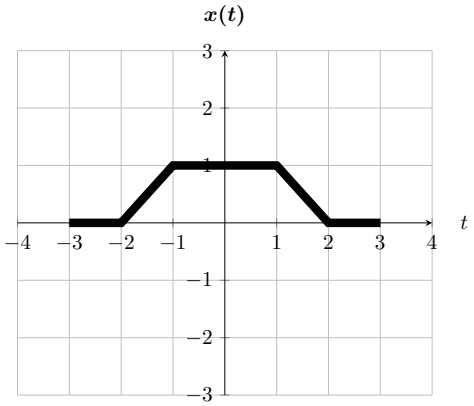

Figure 1: t vs. $x(t)$.

3. (15 pts) Given the $x[n]$ signal in Figure 2,
   (a) (10 pts) Draw $x[-n] + x[2n + 1]$.
   (b) (5 pts) Express $x[-n] + x[2n + 1]$ in terms of the unit impulse function.

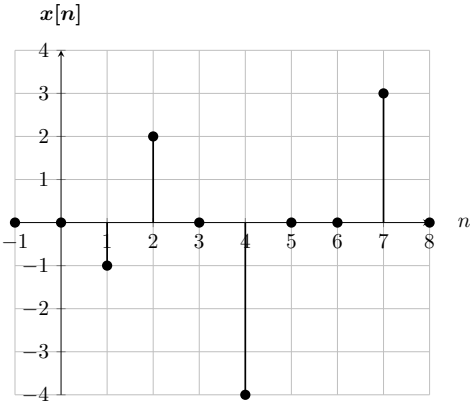

Figure 2: n vs. $x[n]$.

4. (16 pts) Determine whether the following signals are periodic and if periodic find the fundamental period.
   (a) (4 pts) $x[n] = 3\cos[\frac{13\pi}{10}n] + 5\sin[\frac{7\pi}{3}n - \frac{2\pi}{3}]$
   (b) (4 pts) $x[n] = 5\sin[3n - \frac{\pi}{4}]$
   (c) (4 pts) $x(t) = 2\cos(3\pi t - \frac{2\pi}{5})$
   (d) (4 pts) $x(t) = -je^{j5t}$
5. (15 pts) Given the signal in Figure 2, check whether the signal is even or odd. If it is neither even nor odd, then find the even (Ev{x[n]}) and odd (Odd{x[n]}) decompositions of the signal and draw these parts.
6. (24 pts) Analyze whether the following systems have these properties: *memory, stability, causality, linearity, invertibility, time-invariance*. Provide your answer in detail.
   (a) (6 pts) $y(t) = x(2t - 3)$
   (b) (6 pts) $y(t) = tx(t)$
   (c) (6 pts) $y[n] = x[2n - 3]$
   (d) (6 pts) $y[n] = \sum_{k=1}^{\infty} x[n - k]$