MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF COMPUTER ENGINEERING

CENG 384

Spring 2020
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 odtuclass page of the course.
- **Deadline:** 23:55, 24 February, 2020 (Monday).
- **Late Submission:** Not allowed.

1. (20 pts) Solve the following, showing your solution in detail.
   (a) (5 pts) Given $z = x + yj$ and $z + 1 = j - 3\bar{z}$, (i) find $|z|^2$ and (ii) plot z on the complex plane.
   (b) (5 pts) Given $z = re^{j\theta}$ and $z^2 = 25j$, 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 $y(t) = \frac{1}{2}x(2t-2)$.

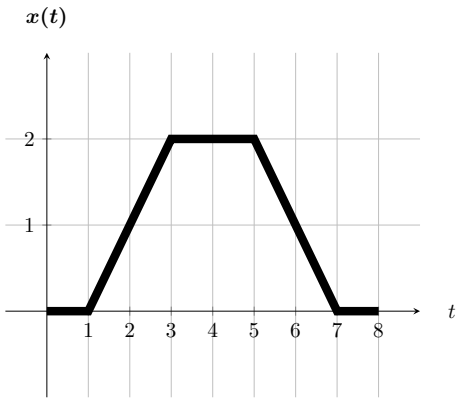

Figure 1: t vs. $x(t)$.

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.

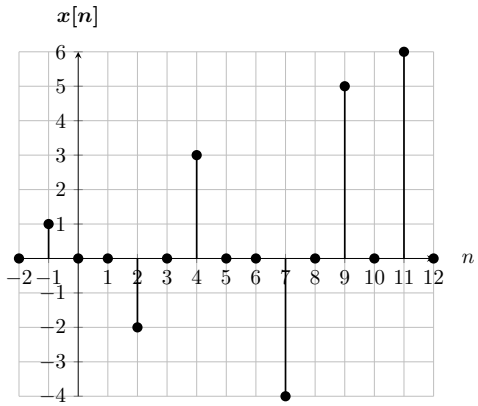

Figure 2: n vs. $x[n]$.

4. (20 pts) Determine whether the following signals are periodic and if periodic find the fundamental period.
   (a) (5 pts) $x[n] = 7\sin[\frac{5\pi}{8}n - \frac{2\pi}{3}] + 2\cos[\frac{2\pi}{3}n]$
   (b) (5 pts) $x[n] = 3\cos[5n - \frac{3\pi}{4}]$
   (c) (5 pts) $x(t) = 4\sin(5\pi t - \frac{3\pi}{5})$
   (d) (5 pts) $x(t) = je^{j2t}$
5. (20 pts) Given the signal in Figure 1, check whether the signal is even or odd. If it is neither even nor odd, then find the even (Ev{x(t)}) and odd (Odd{x(t)}) decompositions of the signal and draw these parts.
6. (15 pts) Given the $x(t)$ signal in Figure 3,
   (a) (5 pts) Express $x(t)$ in terms of the unit step function.
   (b) (10 pts) Find and draw $\frac{dx(t)}{dt}$.

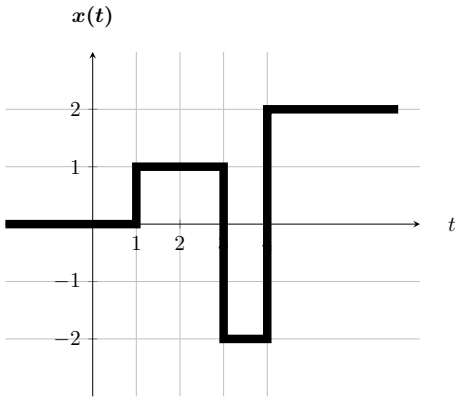

Figure 3: t vs. $x(t)$.