



**BLG354E – HOMEWORK 1**

**1-)** Let  $x[n] = A \cos(\Omega_0 n + \phi)$ . Plot the signal according to the values given in the table below. State the main differences between signals with consecutive IDs (nth signal and (n+1)th signal).

| ID | A | $\Omega_0$      | $\phi$ |
|----|---|-----------------|--------|
| 1  | 1 | $\frac{\pi}{6}$ | 0      |
| 2  | 2 | $\frac{\pi}{6}$ | 0      |
| 3  | 2 | $\frac{\pi}{6}$ | $4\pi$ |
| 4  | 2 | $\frac{\pi}{6}$ | $\pi$  |
| 5  | 2 | $\frac{1}{6}$   | $\pi$  |

**2-)** Given  $x_1 = \cos(t)$ ,  $x_2 = \sin(\pi t)$ ,

- Determine the fundamental periods of these signals
- Show that the signal  $x_3(t) = x_1(t) + x_2(t)$  is not periodic.

**3-)** Let  $x(n) = C e^{at}$ . Plot the real and imaginary parts of the signals given below in MATLAB for the time interval  $t=0-10$ . Interpret the reason of difference between the signals.

$$C = |C|e^{j\theta}, a = r + j\omega_0$$

| ID | $ C $ | $\omega_0$ | $r$ |
|----|-------|------------|-----|
| 1  | 1     | $2\pi$     | 1   |
| 2  | 1     | $4\pi$     | 1   |
| 3  | 1     | $-2\pi$    | 1   |
| 4  | 1     | $2\pi$     | -1  |

**4-)** For an input signal  $x(t)$ , a system creates an output signal using the function  $y(t) = tu(t)x(t)$ .

- Is the system linear?
- Is the system memoryless?
- Is the system causal?
- Is the system time-invariant?

You should clearly explain your answers.

**5-)** Use the attached audio file as an discrete signal input  $x[n]$  and obtain the outputs of the following systems. Save these output in WAV format. Then, for every invertible system given below, state the inverse system and obtain the original signal and save as another WAV file.

a-)  $y[n] = \frac{e^{x[n]}}{2.5}$

b-)  $y[n] = \sum_{k=-\infty}^n x[k]$

**Note:** Artifacts of MATLAB operations may create little differences between the original  $x[n]$  and your output signal, you can ignore that. Also, use “**BitsPerSample',64**” option when saving the data with more precision.

If you have any questions, you can contact Res. Asst. Yusuf Hüseyin Şahin ([sahinyu@itu.edu.tr](mailto:sahinyu@itu.edu.tr)).