King Mongkut's University of Technology Thonburi

Midterm Exam for Second Semester of Academic Year 2557

Course: INC 212 Signal and System Program: Automation Engineering, 2nd year

Date: Monday February 23, 2015 Time: 13:00-16:00

Instructor: Assoc. Prof. Dr. Benjamas Panomruttanarug

Instructions:

1. NOT Permitted: Textbooks, or notes of any kind, calculator
2. There are 6 problems in 4 pages including this instruction sheet. Total Score is 30 points.
3. Please write all your answers in an answer book.
4. Please return this examination documents with your answer book.

Assoc. Prof. Dr. Benjamas Panomruttanarug

Examiner (02.470.9092)

This exam has been approved by the department of Control and Instrumentation Engineering.

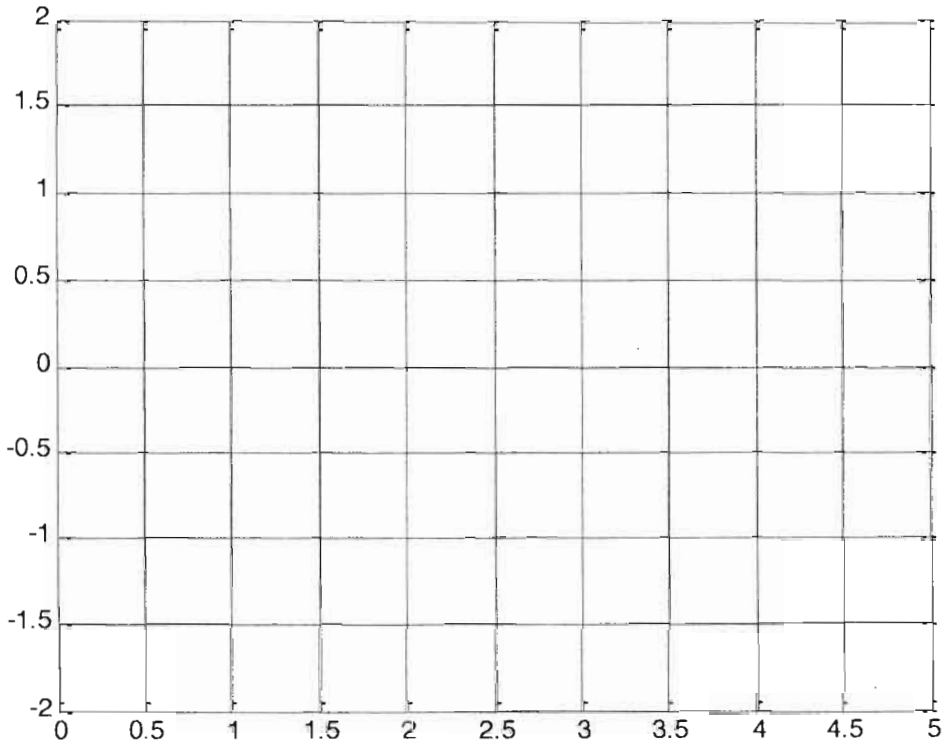
Asst. Prof. Dr. Diew Koolpiruck

Head of department of Control and Instrumentation Engineering

1. Consider the sinusoidal signals below

$$s_1 = 2\cos(\pi t)$$
$$s_2 = \cos(\pi t - 90^0)$$
$$s_3 = 0.5\cos(\pi t + 270^0)$$

1.1. Use Matlab to plot the three signals for $0 \le t \le 4.99$, giving that the sampling time is 0.01 sec. Write your Matlab code as your answer (3 points)



1.2. Compare the magnitude and phase shift of each signal in the time domain (3 points)

Signal	Magnitude	Lead or lag	Phase shift in radians
$s_1 = 2\cos(\pi t)$			
$s_2 = \cos(\pi t - 90^0)$			
$s_3 = 0.5\cos(\pi t + 270^0)$			

2. Use the definition of the four Fourier representations to **determine** the Fourier spectrum of the following signals
   2.1. **Periodic** signal $x[n]=\cos(0.1\pi n)$, $n=\ldots,-2,-1,0,1,2,\ldots$ (2 points)
   2.2. **Periodic** signal $y(t)=\cos(0.1\pi t)$ (2 points)
   2.3. **Non-periodic** signal $r[n]=\cos(0.1\pi n)$, $n=0,1,2,\ldots,19$ (2 points)
   2.4. **Non-periodic** signal $s(t)=\cos(0.1\pi t)$ (2 points)
   2.5. Compare the spectra from problem 2.1 and 2.4. Describe what frequencies have non-zero values spectra (2 points).

3. Use the definition of the four Fourier representations to
   3.1. Determine the Fourier spectrum of the **non-periodic and discrete time** square signal

$$x[n]=\begin{cases}1, & |n|\le 5\\ 0, & \text{otherwise}\end{cases}$$ (2 points)

   3.2. Evaluate the time domain signal of the **non-periodic and continuous** square spectrum

$$x(j\omega)=\begin{cases}1, & |\omega|\le 5\\ 0, & \text{otherwise}\end{cases}$$ (2 points)

4. Use the definition of the inverse FT and DTFT to **determine** the time domain signals of the following spectra
   4.1. $x(e^{j\Omega})=1$ (2 points)
   4.2. $x(j\omega)=2\pi\delta(\omega)$ (2 points)

5. Use the definition of the FT and DTFT to **determine** the frequency spectra of the following time domain signals
   5.1. $x[n]=0.3^n u[n]$ (2 points)
   5.2. $x(t)=e^{-2t}u(t)$ (2 points)

6. What have you learned from the class related to signal and system? (2 points)

Formula:

$$\cos(\theta)=\frac{e^{j\theta}+e^{-j\theta}}{2}$$

$$\sin(\theta)=\frac{e^{j\theta}-e^{-j\theta}}{2j}$$

Right sided series $\sum_{n=0}^{\infty} a^n = \frac{1}{1-a}, \ |a|<1$

Bounded series $\sum_{n=k}^{l} a^n = \begin{cases} \frac{a^k - a^{l+1}}{1-a}, & a \neq 1 \\ l-k+1, & a=1 \end{cases}$