November 5, 2007

Midterm Exam II

EE 3302: Signals and Systems

NOTE: **Please, complete the following table and keep record of your assignment number.**

First Name	
Last Name	
Student ID	
Assignment #	0

Exercise 1. Consider the periodic signal $x(t) = \cos(\pi t) - 2 - \sin(2\pi t)$. Let $y(t)$ be the first derivative of $x(t)$.

A) Determine the fundamental period of $y(t)$ and the value of the coefficients of the Fourier series of $y(t)$ [pt. 15].

B) Indicate how much power is carried by the first harmonic component, i.e., P_1, and how much power is carried by the second harmonic component, i.e., P_2 of signal $y(t)$ [pt. 10].

Exercise 2. Consider the continuous-time signal $x(t) = \frac{\sin(6t)\cos(10t)}{t}$.

A) Derive, sketch and label carefully the Fourier transform of $x(t)$, i.e., $X(j\omega)$ [pt. 15].

B) Compute the energy of $x(t)$ [pt. 5].

Exercise 3. A continuous-time signal $x(t)$ has the following spectrum

$$X(j\omega) = \frac{\mathrm{e}^{-j\omega t_0}}{j(\omega + \omega_0)} + \pi\ \delta(\omega + \omega_0)\ \mathrm{e}^{-j\omega_0 t_0}$$

where ω_0 and t_0 are constant positive real values.

A) Evaluate $x(t)$ [pt. 15].

Exercise 4. Consider the ideal pass band filter with frequency response

$$H(j\omega) = \begin{cases} 1 & A < |\omega| < B \\ 0 & \text{otherwise} \end{cases}$$

where A and B are positive real values. The continuous-time signal $x(t) = u(t)$ is sent to the input of the pass band filter, where $u(t)$ is the causal unit step function. Let $y(t)$ be the signal at the output of the pass band filter.

A) Calculate the energy of $x(t)$ [pt. 10].

B) Calculate the energy of $y(t)$ [pt. 15].

Exercise 5. Consider the continuous-time square wave signal $x(t) = u(t+2) - u(t-2)$. Signal $x(t)$ is sent to the input of a LTI system with frequency response $H(j\omega) = j\omega\ \mathrm{e}^{j\omega 5}$.

A) Derive, sketch and label carefully the output of the LTI system, i.e., $y(t)$ [pt. 15].