ECE 3337 Summer-3 Hebert, Homework 5 Due Thurs 6/23

Problem 1.
Compute the sin-cos Fourier series representations for the following functions.

(a) $f(t) = 0$ for $-1 < t \le +1$; $f(t) = +5$ for $+1 < t \le +2$; $f(t) = -5$ for $+2 < t \le +3$ and $f(t + 4.0n) = f(t) \quad \forall n$

(b) $f(t) = \sin(\pi |t|)$ for $-1 < t \le +1$ and $f(t + 2.0n) = f(t) \quad \forall n$

(c) $f(t) = 5\,t$ for $-2 < t \le +2$ and $f(t) = 20 - 5\,t$ for $+2 < t \le +6$ and $f(t + 8.0n) = f(t) \quad \forall n$

Problem 2.
Compute the exponential form of the Fourier series of *f(x)* where $f(x) = \exp(x)$ for $-\pi < t \le +\pi$ and $f(x + 2.0\pi n) = f(x) \quad \forall n$. **Plot the amplitude and phase spectra versus frequency.**

Problem 3.
(a) Derive the coefficients $A_0, \{A_k, \theta_k\}_{k=1,2,..}$ for the alternate-trig form of the Fourier series as a function of the coefficients $a_0, \{a_k, b_k\}_{k=1,2,..}$ for the sin-cos form of the Fourier series.
(b) Form the coefficients $\{c_k\}_{k=0,\pm1,\pm2....}$ for the exponential form of the Fourier series as a function of the coefficients $a_0, \{a_k, b_k\}_{k=1,2,..}$ for the sin-cos form of the Fourier series.
(c) Form the coefficients $a_0, \{a_k, b_k\}_{k=1,2,..}$ for the sin-cos form of the Fourier series as a function of the coefficients $\{c_k\}_{k=0,\pm1,\pm2....}$ for the exponential form of the Fourier series.

Problem 4.
Problem 4-6(a) in your book – Ziemer.
Find the FT of $f(t) = t \exp(-\alpha t)\, u(t)$
Use the FT integral.

Problem 5.
(a) Find the FT in units of Hz (cycles/sec) for $f(t) = \exp(-t)\, u(t-3)$ using FT tables and theorems.
(factor *f*(*t*) so that all *t*'s are in the form *t*-3, apply FT property to account for the *t*-3 time-shift, then find inverse FT in table).
(b) Find the Fourier Transform (in Hz) of $f(t) = -\operatorname{sgn}(t+1)$ using FT tables and properties.

Problem 6.
Find the inverse Fourier transform of the functions $F(w)$ below.

(a) $F(w) = \dfrac{1}{(jw+2)(3+jw)}$ (apply partial fractions, then use FT table).

(a) $F(w) = \dfrac{3}{2(jw)^2 + 12(jw) + 16}$

hint: (apply partial fractions $F(w) = \dfrac{3}{2(jw)^2 + 12(jw) + 16} = \dfrac{A}{a + j\omega} + \dfrac{B}{b + j\omega}$, then Inverse FT from table)