EE 235, Winter 2018
Homework 1: Math Review
Due Saturday January 6, 2018 by 11:59pm via CANVAS SUBMISSION

HW1 Topics: Complex Numbers, Functions, and Integration
HW1 References: OWN Sections 1.2, 1.2.1, HW1 Supplementary Notes
HW1 Problems (Total = 64 pts):

1. *Complex Numbers - Magnitude and Phase Components, Real and Imaginary Parts.*
   (a) (5 pts) Identify the magnitude component $|z|$ and the phase component $\angle z$ for the following complex numbers:
      i. $z = 4e^{-j}$.
      ii. $z = e^{j\frac{\pi}{6}}$.
   (b) (5 pts) Identify the real part $Re\{z\}$ and the imaginary part $Im\{z\}$ for the following complex numbers:
      i. $z = 2 - j3$.
      ii. $z = j2$.
      iii. $z = 3$.
2. *Complex Numbers - Polar Form and Rectangular Form.*
   (a) (5 pts) Using the unit circle or formulas for r and θ, convert the following complex numbers in to polar form, $z = re^{j\theta}$. Make sure $r > 0$ and $-\pi < \theta \leq \pi$:
      i. $z = \frac{\sqrt{3}}{2} + j\frac{1}{2}$.
      ii. $z = -2$
   (b) (5 pts) Using the complex plane or Euler's formula, convert the following complex numbers in to rectangular form, $z = x + jy$:
      i. $z = 3e^{-j\pi}$
      ii. $z = 2e^{j\frac{\pi}{2}}$
3. *Complex Conjugation*
   (a) Using the method of complex conjugation for dividing complex numbers, simplify the expression for each of the following complex numbers so that your answer is in rectangular form, $z = x + y$:
      i. (2 pts) $z = \frac{1}{1-j2}$. Show that $z = \frac{1}{5} + j\frac{2}{5}$.
      ii. (5 pts) $z = -\frac{1+j2}{1-j2}$.
   (b) Using the method of complex conjugation for finding magnitude, find the magnitude squared component $|z|^2$ for:
      i. (2 pts) $z = 1 + j3$.
      Show that $|z|^2 = 10$.
      ii. (2 pts) $z = 2e^{j3}$.
      Show that $|z|^2 = 4$.
4. *Function Evaluation.*
   (a) (5 pts) Let $y(t) = tx(t+3)$
      i. What is the expression for $y(t-3)$?
      ii. What is the expression for $y(2t)$?
   (b) (5 pts) Let $y(t) = \int\limits_{-\infty}^{\infty} x(\tau)h(t-\tau)d\tau$
      i. What is the expression for $y(3)$?

ii. What is the expression for $y(-t)$?

5. *Integration.*

   (a) (2 pts) Evaluate the following integral: $\int_3^\infty e^{-6t}dt + \int_{-\infty}^0 e^{6t}dt$.
   Show that the answer is $\frac{1}{6}(e^{-18}+1)$.

   (b) (2 pts) Evaluate the integral $\int_{t-2}^5 d\tau$.
   Note: τ is the variable of integration and t can be treated as a constant.
   Show that the answer is $-t+7$.

   (c) (2 pts) Suppose $\int_{-\infty}^\infty x(t)dt = 3$. Using this known integral and u-substitution, evaluate $\int_{-\infty}^\infty x(2t)dt$.
   Show that the answer is $\frac{3}{2}$.

   (d) (5 pts) Suppose $\int_{-\infty}^x x(t)dt = 2$, where $x(t)$ is a function of t, t is the variable of integration, and x can be treated as a constant. Using u-substitution, evaluate $\int_{-\infty}^{x-1} 2x(t+1)dt$.

   (e) (2 pts) Consider $\int_{-\infty}^{t+2} x(\tau - t_o)d\tau$, where τ is the variable of integration and t and t_o can be treated as constants. Using u-substitution, we can rewrite this integral as $\int_{-\infty}^a x(u)du$. What is a in terms of t and t_o?
   Show that $a = t + 2 - t_o$.

6. *Homework Self-Reflection*
   (10 pts) After completing your homework, go to the following link to rate your skill or concept understanding level for each item listed. Your self-reflection must be completed by the due date. All submissions are time-stamped, so please give yourself plenty of time to complete and submit your self-reflection.

   http://bit.ly/2qfmaEQ