ENGR 4220/5220: Control Systems

Professor Hill
University of Detroit Mercy, Winter 2014

Homework #1
Assigned: January 7, 2014
Due: January 9, 2014

Read Chapter 1 and Section 2.2 of the book.
Recommended example problems: A-2-1

1. (20 points)

   (a) Let $z = -1 + 3j$ be a complex number. Sketch the number in the complex plane. Find the magnitude (absolute value) and the argument (angle) of z (be careful of the quadrant in the complex plane). Write z in Euler's form $z = |z|e^{j\psi}$.

   (b) Let $z = 6e^{j\frac{\pi}{3}}$. Sketch the number in the complex plane. Find Re(z) (real part of z) and Im(z) (imaginary part of z). Find the complex conjugate of z.

   (c) Let $z_1 = 2 + 3j$ and $z_2 = 5 - j$. Calculate:

      i. $z_1 z_2$

      ii. $\frac{z_2}{z_1}$

2. (20 points) Find the solution $y(t)$ of the differential equation $10\dot{y} + 5y = 2t$ if $y(0) = 3$.

3. (10 points) Which of the following could be the solution $x(t)$ of the differential equation $\ddot{x} + 2\dot{x} + 5x = \sin 3t$? Justify your choice.

   (a) $x(t) = e^{-t}(\cos 2t + 5\sin 2t) - \frac{1}{13}\sin(3t) - \frac{3}{26}\cos(3t)$

   (b) $x(t) = e^{-t}(\cos 3t + 5\sin 3t) - \frac{1}{13}\sin(2t) - \frac{3}{26}\cos(2t)$

   (c) $x(t) = e^{-2t}(\cos t + 5\sin t) - \frac{1}{13}\sin(3t) - \frac{3}{26}\cos(3t)$

   (d) $x(t) = e^{-2t}(\cos 3t + 5\sin 3t) - \frac{1}{13}\sin(2t) - \frac{3}{26}\cos(2t)$

   (e) $x(t) = e^{-t}(\cos 2t + 5\sin 2t) + 3t$