

ECE-320 Linear Control Systems
Homework 1

Due Date: Tuesday September 7

Problems:

1 a) Using the definition of the Laplace transform, show that if $x(t) \leftrightarrow X(s)$ then $x(t)e^{-at} \leftrightarrow X(s+a)$

b) Using the result from part a and by completing the square in the denominator show that

$$\frac{As + B}{s^2 + 2as + c} \leftrightarrow e^{-at} \left[A \cos(bt) + \frac{B - Aa}{b} \sin(bt) \right] u(t)$$

where $b^2 = c - a^2$

2 For the following transfer functions, determine the impulse responses, $h(t)$, by doing partial fractions:

$$\begin{aligned} a) H(s) &= \frac{s + 3}{(s + 1)(s + 2)} \\ b) H(s) &= \frac{s}{(s + 1)^2(s + 3)} \\ c) H(s) &= \frac{1}{(s + 1)(s + 2)(s + 3)(s + 4)} \\ d) H(s) &= \frac{s}{(s^2 + 2)(s + 1)} \\ e) H(s) &= \frac{1}{s^2 + s + 1} \\ f) H(s) &= \frac{s}{2s^2 + s + 3} \end{aligned}$$

Note: You are expected to be able to do all of this using only the table of Laplace transforms given on the web site. You may check your answers with Maple.