

ECE 414 Homework #1

1. For each of the following Laplace transforms, find $f(t)$ by performing partial fraction expansions. Show your work.

(a) $F(s) = \frac{20}{s(s+1)(s+10)}$ (b) $F(s) = \frac{8}{s(s+4)}$ (c) $F(s) = \frac{40}{s^2+4}$ (d) $F(s) = \frac{3s^2+9s+12}{(s+2)(s^2+5s+11)}$

2. Use the final value theorem of the Laplace transform to find $\lim_{t \rightarrow \infty} f(t)$ for each of the above $F(s)$. Compare these results to the actual $\lim_{t \rightarrow \infty} f(t)$ found by evaluating your results from #1 above. Why do some results agree and others don't?

3. The output of a system in response to a unit step input is $y(t) = (2 + 10e^{-4t} - 12e^{-6t})u_s(t)$ where $u_s(t)$ is the unit step function.

(a) Find the transfer function $H(s) = \frac{Y(s)}{U(s)}$ where $y(t)$ is the output and $u(t)$ is the input.

(b) Find the output $y(t)$ of this system to the input $u(t) = 10\cos(2t) \quad -\infty \leq t \leq \infty$. Why is it that the Laplace transform cannot be used to find $y(t)$ in this case?

(c) If the output of this system is $y(t) = \frac{32}{6}(1 - e^{-6t})u_s(t)$ what is the input $u(t)$ that produces this output?

4. To confirm your answers to #1 above, use the function `invlaplace.m` (that is not in the Control Toolbox) make plots of the time functions $f(t)$ from the given Laplace transforms $F(s)$. In addition, make plots of the time functions $f(t)$ that resulted from your work in #1 above. These should be identical. Be an employable engineer and make sure your plots demonstrate the responses appropriately.