THE UNIVERSITY OF TEXAS AT AUSTIN
Dept. of Electrical and Computer Engineering

EE313 Linear Systems and Signals
Problem Set #10: Inverse Laplace Transforms and Transfer Functions

Date assigned:	November 5, 2010
Date due:	November 11, 2010

Reading: *Signals and Systems*, Sections 9.4, 9.6, 10.1–10.4, 10.7–10.8

You may use any computer program to help you solve these problems, check answers, etc.

As stated on the course descriptor, "Discussion of homework questions is encouraged. Please be absolutely sure to submit your own independent homework solution."

The office hours in ENS 433B for Prof. Evans follow. **Please note the change in Wednesday office hours.**

- Tuesday 12:15pm–1:00pm (right after lecture)
- **Wednesday 10:00am–11:00am and 1:30pm–2:00pm**
- Thursday 12:15pm–1:00pm (right after lecture)
- Friday 9:30am–11:00am

On Friday, November 12th, Prof. Evans will not be available for his afternoon coffee hour. Prof. Evans can be reached at `bevans@ece.utexas.edu`.

The teaching assistant is Mr. Jackson Massey. His office hours will be on Wednesdays 4:00pm–7:00pm in ENS 138. Mr. Massey can be reached at `jackson.massey@gmail.com`.

The ECE Department is offering tutoring sessions for all basic sequence ECE courses, including EE 313, on Sundays through Thursdays, 7:00–10:00 pm, in ENS 314. Mr. Massey will be a tutor during the Monday and Wednesday evening sessions.

Problem 10.1 Inverse Laplace Transforms
Roberts, Chapter 9, Problem 22.

Problem 10.2 Filtering
Roberts, Chapter 9, Problem 27.

Problem 10.3 Frequency Responses
Roberts, Chapter 10, Problem 46.

Plot the magnitude of the frequency response for each filter using Matlab, LabVIEW Mathscript or GNU Octave, to justify your answer. In order to plot the magnitude responses, you'll need to assign the pole and zero locations numeric values:

(a) Set the pole location to be at $p_1 = -10$ and the zero location to be at $z_1 = 0$.

(b) Set the pole locations to be at $p_1 = -10$, $p_2 = -5 + j5$ and $p_3 = -5 - j5$. There are no zeros. Please notice the p_3 is the complex conjugate of p_2.

(c) Set the pole locations to be at $p_1 = -1$, $p_2 = -3$ and the zero locations to be at $z_1 = +j5$ and $z_2 = -j5$.

(d) Set the upper three pole locations to be at $p_1 = -2 + j10$, $p_2 = -1 + j11$ and $p_3 = -1 + j9$. Set the lower three pole locations p_4, p_5 and p_6 to be complex conjugates of these pole locations. There are also three zero locations at $z = 0$.

Problem 10.4 Feedback System

Roberts, Chapter 10, Problem 35.

Also, plot the root locus over some of the values of K for which the system is BIBO unstable and BIBO stables.

For the values of K for which the system is BIBO stable, please give the range of K for different types of frequency selectivity: lowpass, bandpass, bandstop and highpass.

Note: By a computer system controlling the value K, we can obtain different system behaviors.