CMPE323 Signals and Systems Fall 2016
Homework #5 Assigned 10/19/2016, **Due 10/26/2016**

Your Name Here
"CMPE323" Here
Due Date: Here

Rules for all homework:

1. $8\frac{1}{2}\times 11$ paper, no perforations. (Not torn from spiral bound notebook) Lined, unlined, or grid is OK.
2. Name, date, and CMPE323 HW## on all assignments in upper right of first page.
3. You may write on both sides of paper. Include MATLAB code listings for MATLAB exercises and plotted output. You don't need to include MATLAB code if you just use MATLAB to sketch the required outputs.
4. Single staple in upper left. STAPLE – NOT FOLD! STAPLE – NOT PAPER CLIP! STAPLE!

Failure to follow these simple rules will result in a score of 0 for that homework.

CMPE323 HW05

The problems in HW05 are taken from *Signals, Systems and Transforms*, by L. Jackson, because they use the two-sided transform. We'll get to one-sided transforms on Monday.

1) (Jackson, 5.3) Invert each of the following Laplace transforms to find the associated signal $x(t)$:

   a. $X(s)=\dfrac{3s}{s^2-s-2}, \mathrm{Re}[s]>2$

   b. $X(s)=\dfrac{3s}{s^2-s-2}, \; -1<\mathrm{Re}[s]<2$

   c. $X(s)=\dfrac{3s}{s^2-s-2}, \; \mathrm{Re}[s]<-1$

   d. $X(s)=\dfrac{2s+1}{s+2} \;\; \mathrm{Re}[s]>-2$

   e. $X(s)=\dfrac{2s^2}{s^2-1}, \; 0<\mathrm{Re}\left[s\right]<1$

2) (LaBerge) Which of the previous systems are stable?
3) (Jackson 5.5) Prove the modulation property of Laplace Transforms:
   $\mathcal{L}\left[e^{s_0 t}x(t)\right]=X(s-s_0), \;\; R'=R+\mathrm{Re}\left[s_0\right]$
4) (Jackson, 5.13) Find the step response, $s(t)$ for each of the following systems.

   a. $H(s)=\dfrac{1}{(s+1)(s+2)}, \;\; \mathrm{Re}[s]>-1$

   b. $H(s)=\dfrac{s}{s^2-1}, \; -1<\mathrm{Re}[s]<1$

5) (Jackson, 5.20) The feedback interconnection of two (causal) subsystems with system functions $F(s)$ and $G(s)$ is fundamental in control theory as well as many applictions in signal processing, communications, and electronics. Show that the feedback interconnection of two (causal) subsystems with system functions $F(s)$ and $G(s)$ is given by

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$$H(s) = \frac{Y(s)}{X(s)} = \frac{F(s)}{1 - G(s)F(s)}, \ \mathrm{Re}[s] > \sigma_{\max}$$

HINT: Express $W(s)$ in terms of $X(s)$ and $Y(s)$, and then $Y(s)$ in terms of $W(s)$. Eliminate $W(s)$ by substitution.