1) For the problem below, find a feedforward gain, $K_{ff}$, such that the system will have zero steady-state error for a unit step input. Prepare a Simulink simulation that verifies your results.

$$\frac{100}{(S+1)(S+5)(S+30)}$$

2) Change the 100 in the open-loop transfer function above to 110 and perform a Simulink simulation with the same values of $K_{ff}$ and $K_p$ from problem #1. What do you conclude about feed-forward controllers?

3) The system shown below is a Type 0 system without the PI controller. The addition of a non-zero term for $K_2$ guarantees the steady-state error will eventually be zero, but it does not guarantee satisfactory system performance.

   a) With $K_2 = 0$, select the proportional gain ($K_1$) such that the closed loop roots have a damping ratio of 0.707.
   
   b) Select the integral gain term, $K_2$, according to the procedure given in the text.
   
   c) Prepare a Simulink simulations and plot the unit step response of the system under the following three conditions:

   i) your $K_1$, $K_2 = 0$
   
   ii) your $K_1$ and your $K_2$, and
   
   iii) your $K_1$ and $K_2 = 5*(your ~K_2$ from part b)

What conclusion can you draw about the effectiveness of the PI controller? How could you improve the performance of the system?