Questions

1) Consider the unity feedback control system where the plant transfer function is given by:

$$G(s) = \frac{K}{s(s+2.5)(s+27)}$$

a) Using the frequency domain approach, determine the gain K required to give an overshoot, in response to a step input, of no more than 10%. Explain how you achieved your result.
b) Using frequency domain approach, design a phase-lead compensator to achieve a velocity error constant no less than 25 and a step response overshoot of no greater than 10%. Describe each stage of your design.
c) Use MATLAB to plot the response of the control system, (designed in b.), to a unit ramp, showing both system output and ramp input, and evaluate the percentage steady state error to the ramp input signal.
d) Use MATLAB to evaluate the performance of your final design in the time and frequency domain. Present these in tabular form – see Table 1, and provide a written conclusion for your design.

Quantity	**Value**
Steady state error to a unit ramp	
Rise Time	
Settling Time	
Percentage Overshoot	
Phase Margin	
Gain Margin	
Bandwidth	
Peak Magnitude	
Resonant frequency	

Table 1

2) Consider the unity feedback control system where the plant transfer function is given by:

$$G(s) = \frac{K}{s^2(s+9)(s+50)}$$

a) Determine the location of the dominant poles of the closed-loop transfer function in order to achieve the following performance specification for a unit step input:
   - The settling time for a step input should be less than 2.9 s
   - The overshoot should be no more than 20%
b) Demonstrate analytically that the desired poles do not belong to the uncompensated root locus.
c) Use the root locus approach to design a cascaded phase-lead compensator with the zero placed in -1, to yield the desired specifications. Describe clearly each stage of your design. If specifications are not met, perform additional design iterations.
d) Design a phase-lag compensator in series with the phase-lead compensator in c) such that the steady state error e_{ss} for a parabolic input $0.5At^2$ is less than 2.5% of A. Describe each stage of your design.
e) Use MATLAB to evaluate the performance of your final design in the time and frequency domain. Present these in tabular form – see Table 1, and provide a written conclusion for your design.

End of Assignment Questions for Week 4