Assignment 4

Use MATLAB for parts 1 and 2,

1. Given a unity feedback system with a forward loop plant transfer function of

$$G(s) = \frac{K(s+5)}{(s+2)(s+4)(s+7)(s+9)}$$

   a. Sketch the root locus.
   b. Find the coordinates of the dominant poles for which ζ = 0.7.
   c. Find the gain for which ζ = 0.7.
   d. If the system is to be cascade-compensated so that Ts 1 second and ζ 0.7, find the compensator pole if the compensator zero is at -4.5.
   e. Discuss the validity of your second-order approximation and support your argument based on appropriate plots.
   f. Simulate both uncompensated and compensated systems and compare the results to those expected.
   g. Change the compensator's zero location a few times and collect data on the compensated system to see if any other choices of compensator zero yield advantages over the original design.

2. Upon implementing the designed controller, the client asked for a reduction in the peak time by 2 times, and a reduction in the percentage overshoot by 30%. Using a MATLAB script, find the location of the zero to be added to achieve the desired performance. In the process, write a separate function for calculating the angle difference to be compensated.

3. Hypothesis: The state variables in controllable canonical representation, observable canonical representation and diagonal canonical representation are identical. Mathematically, validate or invalidate this hypothesis. (written solution).