Tutorial 6

28. An autonomous robot to pick asparagus (*Dong, 2011*) capable of following planting rows has an orientation system with transfer function

$$\frac{\theta}{\theta_{ref}} = \frac{53.176}{4.6s^2 + 31.281s + 53.176}$$

Make a sketch of $\theta(t)$ in response to $\theta_{ref}(t) = 3u(t)$. Indicate in your plot C_{final}, C_{max}, T_p, and T_s. (Hint: You may use the result of Problem 27**c**).

29. Figure P4.9 shows five step responses of an automatic voltage regulation system as one of the system parameters varies (*Gozde, 2011*). Assume for all five responses that they are those of a second-order system with an overshoot of 20%. Make a sketch of the positions of the poles in the complex plane for each one of the responses. Label the curves A through E from left to right.

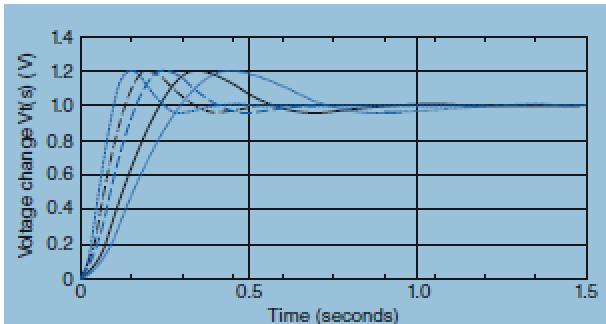
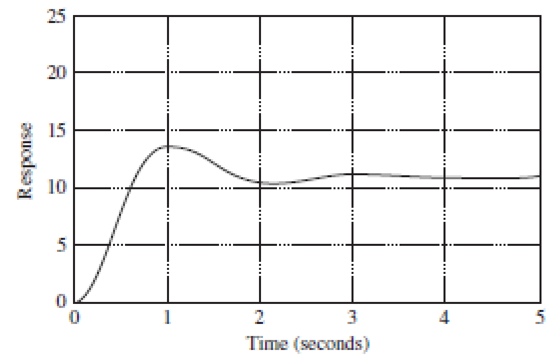


FIGURE P4.9 Time responses for an automatic voltage regulation system

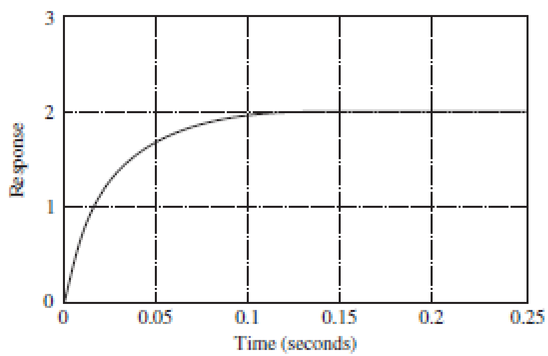
31. Find the percent overshoot, settling time, rise time, and peak time for $T(s) = \dfrac{14.65}{(s^2 + 0.842s + 2.93)(s + 5)}$ [Section: 4.7]

Tutorial 6

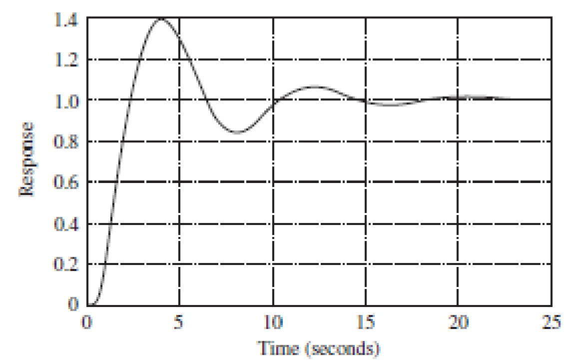
32. For each of the three unit step responses shown in Figure P4.10, find the transfer function of the system. [Sections: 4.3, 4.6]



(*b*)



(*a*)



(*c*)

56. The response of the deflection of a fluid-filled catheter to changes in pressure can be modeled using a second-order model. Knowledge of the parameters of the model is important because in cardiovascular applications the undamped natural frequency should be close to five times the heart rate. However, due to sterility and other considerations, measurement of the parameters is difficult. A method to obtain transfer functions using measurements of the amplitudes of two consecutive peaks of the response and their timing has been developed (*Glantz, 1979*). Assume that Figure P4.13 is obtained from catheter measurements. Using the information shown and assuming a second-order model excited by a unit step input, find the corresponding transfer function.

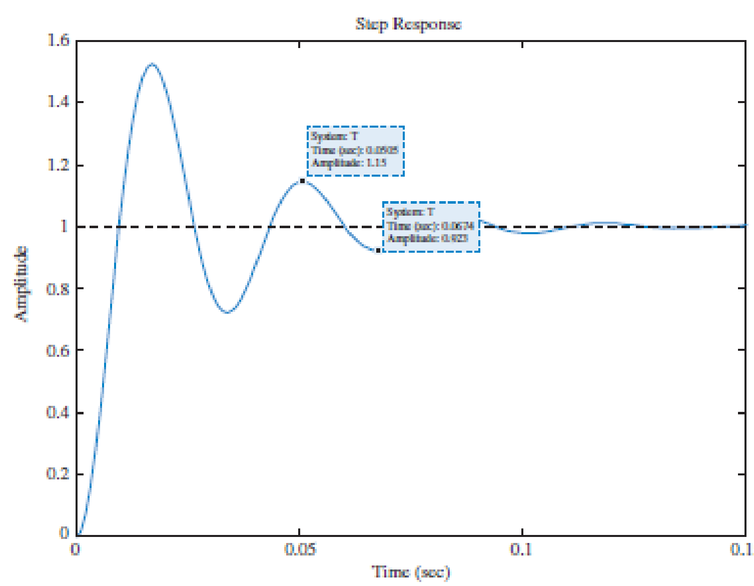


FIGURE P4.13