Homework D.14 - Solution

0.14

The char eq ⁿ

$$1 + P(s)C(s) = 1 + \left(\frac{k_D s^2 + k_p s + k_I}{s}\right)\left(\frac{1/m}{s^2 + b/m\, s + k/m}\right) = 0$$

$$\Rightarrow \quad s^3 + \left(\frac{b}{m} + \frac{k_D}{m}\right)s^2 + \left(\frac{k}{m} + \frac{k_p}{m}\right)s + \frac{k_I}{m} = 0$$

$$\Rightarrow \quad 1 + k_I\left(\frac{1/m}{s^3 + \left(\frac{b}{m} + \frac{k_D}{m}\right)s^2 + \left(\frac{k}{m} + \frac{k_p}{m}\right)}\right) = 0$$

∴ The matlab command is

$$\text{rlocus}\left(\left[\tfrac{1}{m}\right], \left[1, \tfrac{b+k_D}{m}, \tfrac{k+k_p}{m}, 0\right]\right)$$