

Problem 3.3–21. Use the parameter values mass $m = 1$, spring constant $k = 2$, and damping coefficient $b = 3$.

Proceed as follows:

- a. Write the second-order differential equation for the displacement $y(t)$ and the corresponding first-order system.
- b. Calculate the eigenvalues and eigenvectors of the system matrix.
- c. Give the general solution for the displacement $y(t)$.
- d. Determine the solution $y(t)$ which satisfies the initial conditions $y(0) = -2$, $y'(0) = -1$.
- e. Sketch the graph of the solution in part d.
- f. Sketch the phase portrait of the system and highlight the solution in part d. Mark the location and indicate the nature of the equilibrium point.
- g. Describe the motion of the mass for the initial conditions in part d. In particular, how often does the mass cross the rest position $y = 0$? How quickly (that is, at what functional rate) does the mass approach equilibrium? Be specific.