EGR 265, Math Tools for Engineering Problem Solving
October 19, 2011, 50 minutes

Name: .....

TEST II

Problem 1 (20 points)

Solve the initial value problem

$$y'' + 2y' + 10y = 0, \quad y(0) = 1, \quad y'(0) = 2.$$

Problem 2 (20 points)

Find the general solution of

$$y'' - 4y' + 4y = 5x.$$

Problem 3 (20 points)

Find the general solution of

$$y'' - y' - 2y = 5e^{2x}.$$

Problem 4 (10 points)

Find the general solution of

$$y''' + 2y'' + y' = 0.$$

Problem 5 (20 points)

A 64 pound weight stretches an undamped spring by 8 feet.
(a) Working in English units, find the value of the spring constant k in lb/ft and the mass m of the weight in slugs.
(b) Find the equation of motion of the undamped spring-mass system.
(c) Find the equation of motion if the mass is released at a position of 1 feet above the equilibrium at a downward velocity of 1ft/s. Assume here that the positive x-direction is oriented downwards.

Problem 6 (10 points)

Suppose that a damping force is added to the spring-mass system in Problem 4 which is proportional to the instantaneous velocity with damping coefficient $\beta = 9$ pd-sec/ft. Does the resulting system become underdamped, critically damped, or overdamped? Justify your answer.