ECH3301 Process Analysis and Design   Fall 2010
HW 5   2nd Order ODEs   Due Oct 25

1. **(Homogeneous problem)**

   Find the general solution of the third-order differential equation

   $$y''' + 3y'' + 3y' + y = 0.$$

2. **(Method of undetermined coefficients)**

   Solve the given differential equation by undetermined coefficients.

   a) $\frac{1}{4}y'' + y' + y = x^2 - 2x$

   b) $y'' + y' = 2x \sin x$

3. **(Method of variation of parameters)**

   Solve the given differential equation by variation of parameters subject to the initial conditions $y(0) = 1, y'(0) = 0$.

   $$y'' + 2y' - 8y = 2e^{-2x} - e^{-x}$$

4. **(Harmonic motion)**

   A mass weighing 20 pounds stretches a spring 6 inches. The mass is initially released from rest from a point 6 inches below the equilibrium position.

   a) Find the position of the mass at the times $t = \pi/12, \pi/8, \pi/6, \pi/4$ and $9\pi/32$ s.

   b) What is the velocity of the mass when $t = 3\pi/16$ s? In which direction is the mass heading at this instant?

   c) At what times does the mass pass through the equilibrium position?