**Undetermined Coefficients, Part II**

For problems 1 & 2 use the method of undetermined coefficients to determine the general solution to the given differential equation.

1. \( y'' + 6y' + 10y = 8\sin(6t) + 20t \)

2. \( y'' - 4y' = 33e^{-7t} + 6t^2 \)

3. Solve the following IVP using the method of undetermined coefficients.

\[ y'' + 6y' + 9y = (7 - 3t)e^{-3t} \quad y(0) = -5, \quad y'(0) = 0 \]

For problems 4 & 5 write down the guess that we’d need to use with the method of undetermined coefficients to find the particular solution. Do not attempt to find the actual particular solution.

4. \( y'' + 16y = 12\cos(4t) + 9e^{-9t}\cos(4t) - 6t\sin(4t) \)

5. \( 3y'' - 14y' - 5y = 3e^{-3t} - 6e^{7t} - (t^2 + 9)e^{-3t} \)

**Variation of Parameters**

6. Use the method of variation of parameters to find the solution to the following differential equation.

\[ 9y'' - 6y' + 10y = -8e^{4t} \]

7. Use the method of variation of parameters to find the solution to the following IVP.

\[ y'' - 20y' + 100y = 3e^{-2t} \quad y(0) = 1, \quad y'(0) = 4 \]

**Vibrations**

For problems 8 – 11 any solutions containing both a sine and a cosine must be combined into a single cosine. Any decimal work should be to at least the 4th decimal place.

8. A 1/3 lb object will stretch a spring 16 inches by itself. The mass has no damping and is initially displaced 8 inches upwards from its equilibrium position with an initial velocity of 2 in/sec upwards. Determine the displacement at any time \( t \).

9. A 6 kg object will stretch a spring 30 cm by itself. The mass has a damper hooked up that exerts a force of 0.5 N when the velocity is 15 cm/sec. The mass is initially released from its equilibrium position and an initial velocity of 8 cm/sec downward. Determine the displacement at any time \( t \). What kinds of damping does the system experience?

10. Take the system from #8 and hook up a forcing function of the form \( g(t) = 8\sin(5t) \). Determine the displacement at any time \( t \). Does the system experience resonance?

11. Take the system from #9 and hook up a forcing function of the form \( g(t) = 3\cos(t) \). Determine the displacement at any time \( t \).