1. Find a general solution for each equation below.
   
   (i) \( 2y'' + y' - 3y = 0 \)  
   (ii) \( y'' - 2y' = 0 \)  
   (iii) \( y'' - 2y = 0 \)

2. (i) Solve the initial value problem
   
   \[ y'' + 6y' - 16y = 0, \quad y(0) = a, \quad y'(0) = b. \]

   (ii) Find the relation between \( a \) and \( b \) so that the solution remains bounded as \( t \to \infty \).

3. Solve the non-homogeneous equations using the method of *undetermined coefficients*:
   
   (i) \( y'' + y' - 2y = -3e^{-t} \)  
   (ii) \( y'' + y' - 2y = -3e^t \)  
   (iii) \( y'' - y' = \sin t + 2t \).

4. (i) Use the method of *undetermined coefficients* to solve the initial value problem:
   
   \[ 2y'' - y' - 3y = 10e^{-t} - t, \quad y(0) = a, \quad y'(0) = b. \]

   (ii) Determine the relation between \( a \) and \( b \) so that the solution is bounded for \( t \geq 0 \).

5. Solve the non-homogeneous equations using the method of *variation of parameters*:
   
   (i) \( y'' + y' - 2y = -3e^t, \quad y(0) = -1, \quad y'(0) = 1. \)

   (ii) \( y'' - 2y' + y = e^t/(1 + t^2). \)

   (iii) \( y'' - 6y' + 9y = e^{3t} \ln t, \quad t > 0. \)

6. Consider the second order linear differential equation
   
   \[ (*) \quad 2t^2y'' + 3ty' - y = 0, \quad t > 0. \]

   (i) Verify that both \( y_1(t) = t^{-1} \) and \( y_2(t) = \sqrt{t} \) are solutions of system \((*)\).

   (ii) Show that \( y_1(t) \) and \( y_2(t) \) form a fundamental set of solutions for system \((*)\).

   (iii) Find a particular solution for
   
   \[ 2t^2y'' + 3ty' - y = 2t^3 + 2t^2, \quad t > 0. \]

7. An 8-lb weight stretches a spring 6 inches. Suppose that the weight is released from the equilibrium position with an upward speed of 2 ft/sec. Find the motion of the system. Is the motion periodic? If yes, find the period and the amplitude.
8. An 8-lb weight stretches a spring 6 inches. The weight is attached to a damper with a damping constant $\gamma = 5 \text{ lb-sec/ft}$. Find the motion of the system if it is released from 4 in. above the equilibrium position with a downward speed of 2 ft/sec.

9. An 8-lb weight stretches a spring 6 inches. Suppose that the weight is released from the equilibrium position with an upward speed of 2 ft/sec, and an external force $F(t) = \cos(\omega t)$-lb is applied to the system.

   (i) Find the motion for $\omega = 1$ and plot the solution; Is the motion periodic?

   (ii) Find the motion for $\omega = 8$ and plot the solution; Is the motion periodic?