1. Find the solution to the given initial value problem.

   (a) $y'' + 4y = t^2 + 3e^t, \qquad y(0) = 0, \quad y'(0) = 2.$

   (b) $y'' + 4y = 3\sin 2t, \qquad y(0) = 2, \quad y'(0) = -1.$

   (c) $y'' + 2y' + 5y = 4e^{-t}\cos 2t \qquad y(0) = 1, y'(0) = 0.$

2. Determine a suitable form for $y(t)$ if the method of undetermined coefficients is to be used

   (a) $y'' + 3y' = 2t^4 + t^2e^{-3t} + \sin 3t.$

   (b) $y'' + 4y = t^2\sin 2t + (6t + 7)\cos 2t.$

   (c) $y'' + 2y' + 2y = 3e^{-t} + 2e^{-t}\cos t + 4t^2e^{-t}\sin t.$

3. Use the method of variation of parameters to find a particular solution to

   (a) $y'' + y = \tan x.$

   (b) $y'' + 4y' + 4y = t^{-2}e^{-2t}.$

   (c) $y'' - 2y' + y = \dfrac{e^t}{(1 + t^2)}.$

4. A mass weighing 3 lb stretches a spring 3 in. If the mass is pushed upward, contracting the spring a distance of 1 in. then set in motion with a downward velocity of 2 ft/s, and if there is no damping, find the position u of the mass at any time t. Determine the frequency, period and amplitude of the motion.

5. A series circuit has a capacitor of 10^{-5} F, a resistor of 3×10^2 Ω, and an inductor of 0.2 H. The initial charge of the capacitor is 10^{-6} C and there is no initial current. Find the charge Q on the capacitor at any time t.

6. A spring is stretch 10 cm by a force of 3 N. A mass of 2 kg is hung from the spring and is also attached to a viscous damper that exerts a force of 3 N when the velocity of the mass 5 m/s. If the mass is pulled down 5 cm below its equilibrium position and given an initial velocity of 10 cm/s, determine its position u at any time. Find the quasifrequency of the motion.

7. A mass weighing 4 lb stretches a spring 1.5 in. The mass is given a positive displacement 2 in from its equilibrium position and released with no initial velocity. Assuming that there is no damping and the mass is acted on by an external force of $2\cos 3t$ lb,

   (a) Formulate the initial value problem describing the motion of mass

   (b) Solve the initial value problem.

   (c) If the given external force is replaced by a force $4\cos \omega t$ of frequency ω, find the value of ω for which resonance occurs.

8. A spring is stretched 6 in by a mass that weighs 8 lb. The mass is attached to a dashpot mechanism that has a damping constant of 0.25 lb·s/ft and is acted by an external force of $4\cos 2t$ lb.

   (a) Find the steady-state response of this system.

   (b) if the given mass is replaced by a mass m, determine the value of m for which the amplitude of the steady-state response is maximum.