1. Find the general solution of the equation $y'' + 6y' + 9y = \dfrac{e^{-3x}}{1+2x}$

2. 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.

3. 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.

4. 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.

5. 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.

6. Find the inverse Laplace transform of the given function by using the convolution theorem.
   (a) $F(s) = \dfrac{1}{s^4(s^2-1)}$.
   (b) $F(s) = \dfrac{s}{(s+1)^2(s+4)^3}$.

7. Find the Laplace transform of
   (a) $f(t) = \displaystyle\int_0^t (t-\tau)e^{3\tau}\,d\tau$
   (b) $f(t) = \displaystyle\int_0^t e^{\tau}\sin(t-\tau)\,d\tau$

8. Find the solution of the initial value problem
   (a) $y'' + 3y' + 2y = \begin{cases} 1, & 0 \le t < 10 \\ 0, & 10 \le t \end{cases}, \quad y(0) = 0, \quad y'(0) = 0.$
   (b) $y'' + 2y' + 2y = \cos t + \delta(t - \pi/2), \quad y(0) = 0, \quad y'(0) = 0.$
   (c) $y'' - y' - 6y = g(t), \quad y(0) = 1, \quad y'(0) = 8.$

9. For the equation $y'' + xy' + 2y = 0$
   (a) Seek its power series solution about $x_0 = 0$; find the recurrence relation.
   (b) Find the general term of each solution $y_1(x)$ and $y_2(x)$.
   (c) Find the first four terms in each of two solutions y_1 and y_2. Show that $W[y_1, y_2](0) \neq 0$.