1. a) A mass of 5 kg stretches a spring 10 cm. What is the spring constant $K$ in Newtons/meter? (Recall $g \approx 9.8 \text{ m/s}^2$.)

b) The drag on the system in 2 Newtons when the speed is 4 cm/s. What is the damping coefficient $\gamma$ in Newtons/(m/s)?

c) The external force on the system is $5 \cos(2t)$. What is the equation for the system?

d) The initial conditions are $u(0) = u'(0) = 0$. Find the steady-state solution.

2. Let $y'' + (x - 1)y' + 3y = 0$. Use the series method, centered about $x_0 = 1$, to find the general solution. You must find a recursive formula for $a_n$.

3. Let $2y'' + y' + \sin(x)y = 0$. Let $y = \sum_{n=0}^{\infty} a_n x^n$ be the solution. Let $y(0) = 1$ and $y'(0) = 2$. Find $a_2$, $a_3$ and $a_4$.

4. Find the solution of the heat conduction problem

$$100u_{xx} = u_t, \quad 0 < x < 1, \quad t > 0$$

$$u(0, t) = 0, \quad u(1, t) = 0 \quad t > 0$$

$$u(x, 0) = \sin(2\pi x) - 2 \sin(5\pi x), \quad 0 \leq x \leq 1.$$ 

5. Let $f(x)$ be a periodic function defined by the graph below.

a. Find $a_0$.

b. Find $b_3$. 