1. Solve the IVP

\[ y'' - 2y' + y = 1 + e^x \]
\[ y(0) = 0 \]
\[ y'(0) = 2 \]
2. A system is modelled by the differential equation

\[ 2x'' + 16x' + 50x = 400 \cos t + 1040 \sin t \]

(a) What does the differential equation tell you about the system being modelled (include a description of all constants)

(b) Find the general equation of the system.
(c) If the system satisfies the initial conditions

\[ x(0) = 0; x'(0) = -20 \]

find both the transient and steady periodic solutions, where each is given as a single oscillation.

(d) What is the longterm behavior of the solution? Does it depend on the initial conditions?
3. Find the eigenvalues and eigenfunctions for

\[ y'' + 2y' + \lambda y = 0 \]

\[ y(0) = y(1) = 0 \]
4. Solve

\[ y'' + y = 1 + \tan(x). \]
5. (a) Find the Fourier series for $f$ on the interval $[-3, 3]$.

$$f(t) = 3 + |2t|$$

(b) Sketch the function to which $f$ converges on the interval $[-9, 9]$. 