Question 1. Suppose the function

\[ f(x) = \begin{cases} 
1 & 0 < x < 1 \\
2 - x & 0 \leq x < 2.
\end{cases} \]

is expanded in a cosine series, in a sine series and in a Fourier series. Sketch the periodic extension to which each series converges.
Question 2.

a) Find the eigenvalues and the eigenfunctions of the Sturm-Liouville problem

\[ x^2y'' + xy' + \lambda y = 0 \quad y(1) = 0 \quad y(5) = 0. \]

b) Put the differential equation in self-adjoint form.

c) Give an orthogonality relation.