1. (30 points) Find the Fourier series for the function

\[ f(t) = \begin{cases} 
1 & -1 \leq x \leq 0 \\
x & 0 < x \leq 1 
\end{cases} \]
2. (30 points) a) Use the method of separation of variables to give the general solution of

\[ u_t = \alpha^2 u_{xx}, \quad 0 < x < L, \ t > 0 \]
\[ u(0, t) = 0, \quad u(L, t) = 0 \]

b) Find a solution of

\[ u_t = 5u_{xx}, \quad 0 < x < \frac{1}{2}, \ t > 0 \]
\[ u(x, 0) = -7 \sin 12\pi x, \quad 0 < x < \frac{1}{2}, \ t > 0 \]
\[ u(0, t) = u(1, t) = 0 \]
3. (30 points) Solve the system
\begin{align*}
2x' + y' - x - y &= e^{-t} \\
x' + y' + 2x + y &= e^t
\end{align*}
4. (30 points) Find the solution using Laplace transform

\[ y' - 2y = e^{5t} \]
\[ y(0) = 3 \]