(1) Use separation of variable method to solve the boundary-value problem

\[ k \frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}, \quad 0 < x < L, \quad t > 0 \]

\[ u(0, t) = 0, \quad u(L, t) = 0, \quad t > 0 \]

\[ u(x, 0) = x^2 L, \quad 0 < x < L. \]