**Example.** The temperature \( u(x,t) \) in a bar of length \( L \) satisfies the heat flow problem

\[
u_t = ku_{xx} + Q(x,t), \quad 0 < x < L, \quad t > 0
\]

with initial condition \( u(x,0) = f(x) \) and Dirichlet boundary conditions \( u(0,t) = u(L,t) = 0 \). The length \( L \), diffusivity \( k \), heat source \( Q(x,t) \) and function \( f(x) \) are considered to be known. Find a solution in the form

\[
u(x,t) = \sum_{n=1}^{\infty} C_n(t)\phi_n(x)
\]

where \( C_n(t) \) are time-dependent coefficients and \( \phi_n(x) \) are suitable eigenfunctions.