

1. Find a harmonic polynomial satisfying some prescribed conditions on the boundary of a Rectangle.

2. Solve a Dirichlet problem on a rectangle using an eigenfunction expansion.

3. Given a non-homogenous 1D heat equation with homogeneous BCs.

(a) Find the **steady state solution** ψ .

(b) Find $\lim_{t \rightarrow \infty} u(x, t)$.

4. Solve a homogeneous 1D heat equation with non-homogeneous BCs in the form $u(0, t) = \gamma_0$ and $u(\ell, t) = \gamma_1$.

5. Solve a homogeneous 1D heat equation with convection and conduction terms and with homogeneous BCs

6. Solve a Heat Equation in a 2D rectangle

(a) Give the eigenvalues $\lambda_{n,m}$ and eigenvectors $\varphi_{n,m}(x, y)$.

(b) Find the eigenfunction expansion for the solution(Finite or Infinite sum).

(c) Find $\lim_{t \rightarrow \infty} u(x, t)$.

7. Solve a Dirichlet problem in a disk in polar coordinates.
