CIVL 7111 - Special Modelling Project 10

Heat Transfer – Steady State Heat Conduction

Problem Statement - Consider the problem of the steady state heat conduction. The general two-dimensional boundary-value problem is

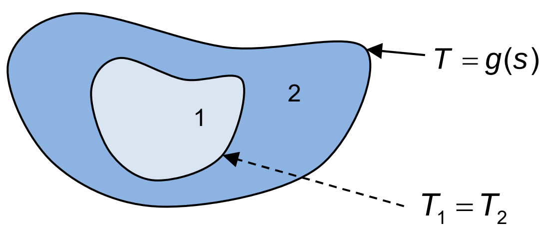
$$\frac{\partial}{\partial x}\left(k_x \frac{\partial T}{\partial x}\right)+\frac{\partial}{\partial y}\left(k_y \frac{\partial T}{\partial y}\right)=0 \qquad \text{in } \Omega$$

$$T = g(s) \quad \text{on } \Gamma$$

where the dependent variable T is the temperature and k_x and k_y are the thermal conductivites in the x and y directions.

Consider the a cross-section shown in the diagram below:

$$\frac{\partial}{\partial x}\left(k_x \frac{\partial T}{\partial x}\right)+\frac{\partial}{\partial y}\left(k_y \frac{\partial T}{\partial y}\right)=0$$



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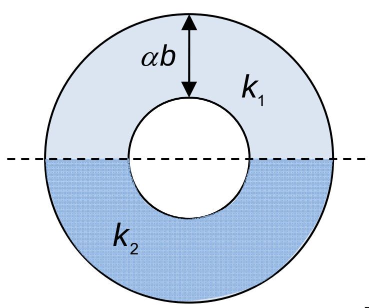

$a =$ outer diameter $= 1$

$b =$ inner diameter

$\frac{a}{b} = 2$

$k_x = k_y \qquad \frac{k_1}{k_2} = 1$, 5, and 10

$\alpha = \frac{1}{2}$ and $\frac{1}{4}$

$T = \sin(3\theta)$ on the outer boundary

$T = 0$ on the inner boundary

Use **POIS36** to the model this problem for the various cases indicated by the ratio a/b and k_1/k_2. From these results plot the temperature over the doamin.