ME303: Assignment 1

Due: 22/2/23

1. Consider the rectangular domain $[0, L] \times [0, H]$.

   (a) If $Q = 0$, and if the boundary conditions are

   $$\begin{aligned} k\frac{\partial T}{\partial y}\bigg|_{y=0} &= f_b(x), \quad T|_{y=H} = f_t(x), \\ T|_{x=0} &= g_l(y), \quad T|_{x=L} = g_r(y), \end{aligned} \tag{1}$$

   with $f_t(0) = g_l(H)$, and $f_t(L) = g_r(H)$, determine the steady-state temperature $T(x, y)$.

   (b) If $Q(x, y)$ is nonzero, and if the boundary conditions are

   $$\begin{aligned} T|_{y=0} &= T|_{y=H} = 0, \\ k\frac{\partial T}{\partial x}\bigg|_{x=0} &= k\frac{\partial T}{\partial x}\bigg|_{x=L} = 0, \end{aligned} \tag{2}$$

   then find the steady-state temperature $T(x, y)$. Evaluate the constants in your solution for the case $Q = Q_0$, where Q_0 is a constant.

2. Determine the temperature field for the semicircular domain shown in Fig. 1 when $T|_{r=a} = g(\theta)$, for the cases (a) $T|_{\theta=\pm\pi/2} = 0$ with $g(\pm\pi/2) = 0$; and (b) the edges $\theta = \pm\pi/2$ are insulated (zero normal heat flux). For case (b), evaluate the constants for the case $g(\theta) = T_0$, where T_0 is a constant.

3. For a circular domain of radius a with temperature specified to be zero on the boundary $r = a$, and with a heat input $Q(r)$, find the temperature field $T(r)$. Evaluate the constants for the case $Q = Q_0$, where Q_0 is a constant.

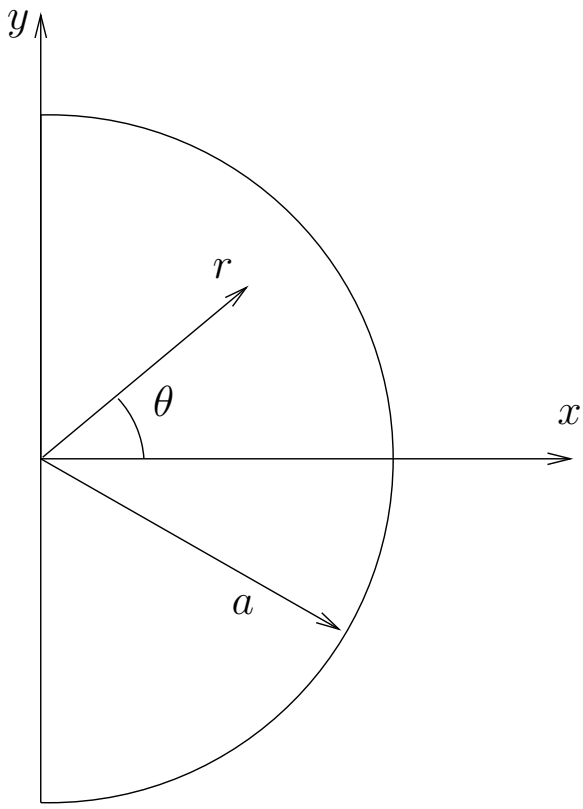

Figure 1: Semicicular domain.