

## 3450:439/539:001 Homework 14 Spring 2008

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Recommended due date: Wednesday, May 1, 2008

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**THIS HOMEWORK IS NOT FOR COURSE CREDIT.** However, you need to do problems to learn the material. Also, about 1/3 of your exam will consist of recommended homework problems.

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1. Solve for the steady-state temperature distribution in a flat plate covering  $0 \leq x \leq a$ ,  $0 \leq y \leq b$  if the temperature on the left side is a constant  $T_1$  and that on the right side a constant  $T_2$ , while the top and bottom sides are kept at temperature zero.
2. Solve the boundary-value problem

$$\begin{aligned}\frac{\partial^2 u}{\partial t^2} &= c^2 \left[ \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right], \\ u(0, y, t) = u(a, y, t) &= u(x, 0, t) = u(x, b, t) = 0, \\ u(x, y, 0) &= f(x, y), \quad \frac{\partial u}{\partial t}(x, y, 0) = 0,\end{aligned}$$

in which  $0 < x < a$ ,  $0 < y < b$  and  $t > 0$ . This problem models sound waves in a 2-dimensional rectangle, assuming a given initial disturbance and zero initial velocity. This is a simplification of the problem in a rectangular room.

3. Find the steady-state temperature distribution in a disk of radius 5 with edge maintained at  $f(\theta) = \cos(\theta)$  degrees.
4. Find the temperature distribution in a solid infinitely long cylinder of radius 1. Let the axis of the cylinder be along the  $z$ -axis in  $xyz$ -space. For this problem, assume that the temperature depends only on time  $t$  and the horizontal distance  $r$  from the  $z$ -axis. Assume the outer surface of the cylinder is held at zero degrees for all time and that the initial temperature distribution in the cylinder is given by  $f(r) = r$ . (Note the solution must remain bounded as  $r \rightarrow 0^+$ .)