CL249

Assignment 11

Q1. The problem of transient radial heat flow in a circular rod in nondimensional form is described by

$$\frac{\partial^2 u}{\partial x^2} + b\frac{\partial u}{\partial x} = \frac{\partial u}{\partial t}$$

With the following conditions:

Boundary conditions:

$$u(0,t) = 0 \qquad u(1,t) = 0$$

Initial conditions:

$$u(x,0) = 0 \quad 0 \le x \le 1$$

Use second-order accurate finite-difference analogues for the derivatives with a Crank-Nicolson formulation to integrate in time. Select values for $\Delta x \; and \; \Delta t$ for good accuracy.

i. Plot u versus x for various values of t.

Solve for the values of b: 4, 2, 0, -2, -4.

Q2. An investigator has reported the data tabulated below for an experiment to determine the growth rate of bacteria k (per d), as a function of oxygen concentration c (mg/L). It is known that such data can be modelled by the following equation:

$$k = \frac{k_{\max} c^2}{c_s + c^2}$$

Where c_s and k_{max} are parameters. Use a transformation to linearize this equation.

c	0.5	0.8	1.5	2.5	4
k	1.1	2.4	5.3	7.6	8.9

i. Use linear regression to estimate c_s and k_{max} and
ii. Predict the growth rate at c = 2mg/L.