Prince of Songkla University

Faculty of Engineering

Final Test
8 May 2015
215-274 Numerical Methods for Mechanical Engineering

Semester 2/2014
09:00-12:00
Room: Robot

Name _____ ID _____

Direction:

1. All types of calculator and dictionary are permitted.
2. There are totally 5 problems.
3. One sheet of hand-written A4 paper is allowed. No photocopy!!

Perapong Tekasakul
Kittinan Maliwan

Instructors

Problem No.	Full score	Your mark
1	20	
2	20	
3	10	
4	10	
5	20	
Total	**80**	

1. The following is an initial value, second-order differential equation:

$$\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 12sin(\omega t) = 0$$

where

$$\frac{dx}{dt}(0) = 3 \quad \text{and} \quad x(0) = 1$$

Note that $\omega = 2$.

Decompose the equation into two first-order differential equations. After the decomposition, solve the system from t = 0 to 3 using the fourth-order RK method with h = 0.5.

2. Use the shooting method to solve the boundary-value problem:

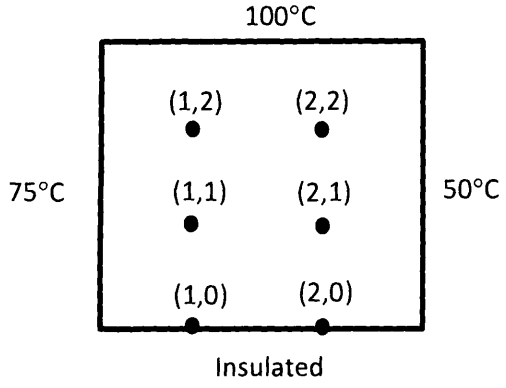
$$\frac{d^2T}{dx^2} + 0.01(20 - T) = 0$$

Obtain a solution for boundary conditions: T(0) = 40 and T(5) = 250.

Employ the Heun's method with a step size of 2. The two guesses for initial condition are 15 and 20.

3. Use the finite-difference approach to solve the problem 2. Employ four interior nodes with a segment length of $\Delta x = 2$ m.
   Employ Gauss elimination to solve for the T's. Show all steps of the computation.

4. Use the finite-difference approach to solve for the temperature of the heated plate in figure below. Write only the equations for the darkened nodes.



5. Use the simple implicit finite-difference approximation to solve for the temperature distribution of a long thin rod with a length of 10 cm and the following values: k = 0.835 cm^2/s, Δx = 2 cm, and Δt = 0.1 s.
   At t = 0, the temperature of the rod is zero and the boundary conditions are fixed for all times at T(0) = 150 °C and T(10) = 100 °C.
   Determine the temperature distribution until t = 0.2 s.
   Employ Gauss elimination to solve for the temperatures. Show all steps of the computation.