Prince of Songkla University
Faculty of Engineering

Midterm Examination: Semester II — Academic Year: 2006
Date: December 18, 2006 — Time: 9.00-12.00 AM
Subject: 230-501 Comp. Method in Chem. Eng. — Room: A201

ทุจริตในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

-There are 5 problems of the exam, Please write the answer clearly in the answer book with the problem number.
- Take the exam paper and the answer book outside the exam room is not allowed.
- Only hand written note in 1 A4 is allowed.

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1. [30 points] A mass balance for a pollutant in a well-mixed lake can be described as:

$$V\frac{dc}{dt} = W - Q * c - kV\sqrt{c}$$

Show the algorithm solving the steady-state concentration (c). (Other variables are known)

1.1 By false-position method.

1.2 By Secant method.

2. [30 points] Construct the numerical algorithm to solve n^{th} -order ODE with a step size controlled -Mid-Point integration.

3. [30 points] Compare the accuracy of multi-step method and single-step method with the same integration step size.

4. [30 points] A hot solid cylinder is immersed in a cool oil bath as part of a quenching process. This process makes the temperature of the cylinder, T_c , and the bath, T_b, change with time. If the initial temperature of the bar and the oil bath is given as 600° C and 27°C, respectively, and other dimensions and properties are:

Length of cylinder = 30 cm, Radius of cylinder = 3 cm
Density of cylinder = 2700 kg/m^3 Specific heat of cylinder = 895 J/kg-K
Specific heat of oil = 1910 J/(kg-K) Mass of oil = 2 kg
Convection heat transfer coefficient = 100 W/(m^2 K)

4.1 Give the coupled ordinary differential equations governing the heat transfer.

4.2 Show the algorithm of using Runge-Kutta 4 th order and Huen's integration methods to solve this problem and compare the accuracy of the results.

5. [30 points] Give the algorithm for the boundary value problem solving with shooting method for the example on concentration distribution problem:

$$D\frac{d^2A}{dx^2} - kA = 0$$

D and k are a diffusivity coefficient and a reaction rate constant, respectively. A is a concentration of component A with respect to the distance x. Boundary conditions are $A(x=0)= A_0$ and $A(x=l) =A_l$

Kulchanat Prasertsit