

Prince of Songkla University
Faculty of Engineering

Final Examination: Semester II

Year 2006

Date: February, 28, 2007

Time 13.30-16.30

Subject: 230 – 501 Comp. Methods in Chem. Eng.

Room: A400

ทฤษฎีในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทฤษฎี และพักการเรียน 1 ภาค
การศึกษา

There are 7 pages of the examination paper including the cover page. Please check the paper and write your name or code on all pages before doing the examination.

1. A calculator and a hand written note (in A4) are allowed for the exam.
2. Please write the answers clearly and notify the problem number if writing on the back of each page.
3. Taking the exam outside the room **is not allowed**.

Problems	Full Score	
1	50	
2	60	
3	70	
Total	180	

Asst. Kulchanat Prasertsit, Ph.D

1. (50 points) Unsteady, laminar flow in a circular tube presented by Bird, Stewart and Lightfoot (BSL) (1960, 126, eq. (4.1-21)):

$$\frac{\partial \phi}{\partial \tau} = 4 + \frac{1}{\xi} \frac{\partial}{\partial \xi} \left\{ \xi \frac{\partial \phi}{\partial \xi} \right\} = 4 + \frac{\partial^2 \phi}{\partial \xi^2} + \frac{1}{\xi} \frac{\partial \phi}{\partial \xi}$$

$$\text{where } \phi = \frac{v_z}{(\rho_0 - \rho_L)R^2 / (4\mu L)} = \frac{v_z}{v_{\max}}, \xi = \frac{r}{R}, \tau = \frac{vt}{R^2}$$

Compute a numerical solution subject to the initial and boundary conditions
 $\phi(0, \xi) = 0$; $\phi(\tau, 1) = 0$; $\partial\phi(\tau, 0)/\partial\xi = 0$

Write the algorithm of this problem by using the method of line.

- 2 (60 points) The small bakery house produces 3 kinds of food; Food A, Food B and Food C. The requirement of each food is shown in the table;

Resource		A	B	C
	Flour (kg)	8	6	1
	Sugar (hr)	4	2	1.5
	Baking time (hr)	2	1.5	0.5
	Prices (Baht/ Piece)	60	30	20

At present, 48 kg of flour, 20 kg of sugar, and 8 hr of baking are available. But at most 5 piece of B can be sold. The bakery wants to maximize total revenue.

- Determine the objective function and all constraints for this problem.
- Convert the problem to a standard form. What are the basic and non basic variables?
- Show how to check whether or not the answer is optimal.
- If the answer is not optimal, show how to select the entering variable and the leaving variable. And show how to determine the new values of basic variables.

3. (70 points) In biodiesel process, the separation of glycerol from other product in settling tank is required. One student did the experiment and noticed that the change of the height of glycerol was related to time. The experimental data were shown in the table below. He also proposed the function of this change, that is

$$h = a_0 + a_1 \exp(a_2 t)$$

- a. (35 points) Show the algorithm of using univariate and pattern search method to find the constants a_0 , a_1 , and a_2 .
- b. (35 points) Show the algorithm of using the nonlinear regression to determine the constant a_0 , a_1 , and a_2 .

Time (t, min)	Height of Glycerol (h, cm)	Time (t, min)	Height of Glycerol (h, cm)
0	0	8	1.5
1	0	9	1.8
2	0.1	10	2.1
3	0.15	11	2.25
4	0.3	12	2.3
5	0.5	13	2.4
6	0.9	14	2.5
7	1.2	15	2.5