PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination: Semester I | Academic Year: 2009

Date: July 26, 2009 | Time: 9:00-12:00

Subject: 230-600 Advanced Engineering Mathematics for Chemical Engineers | Room: หัวหุ่นยนต์

อนุญาตให้นำเอกสารและเครื่องคำนวณทุกชนิดเข้าห้องสอบได้
ทุจริตในการสอบโทษขั้นต่ำคือปรับตกในรายวิชาที่ทุจริต
และพักการศึกษา 1 ภาคการศึกษา

Please do all 4 questions. Show all your work to receive full or partial credit. Final score is 135. (Total page = 8, including first page)

Question #	Total Score	Score
1.1	15	
1.2	10	
1.3	15	
1.4	15	
2	20	
3	30	
4	30	
Total	135	

สุกฤทธิรา รัตนวิไล
ผู้ออกข้อสอบ

1. Solve the differential equation. (55 scores)

1.1 $y'' + 2y' - 3y = 4e^x$ (15 scores)

1.2 $y'' - y' = xe^x$ (10 scores)

Using Inverse Operator Method to solve this problem.

1.3 $x^2y' + 2xy - y^3 = 0$ (15 scores)

1.4 $x^2y' + 2xy - y^3 = 0$ (15 scores)

Using undetermined coefficient to solve this problem.

2. Please show how to solve this differential equation by Frobenius Method or Power Series. (20 scores)

$$2x^2y'' - xy' + (1+x)y = 0$$

3. Consider the consecutive second order, irreversible reactions occurring in a batch reactor

$$A + S \xrightarrow{K_1} X$$

$$X + S \xrightarrow{K_2} Y$$

$$Y + S \xrightarrow{K_3} Z$$

If one mole of A and three moles of S are initially added, determine the mole fraction of X remaining after half the A is consumed. Assume that $K_3=K_2$ and $K_2/K_1 = 2$. (30 scores)

4. Cylindrical tank is being filled from an initially empty state at a liquid rate of 10 L/min. The flat tank bottom has corroded and sustains a leak through a small hole of area which has 2 cm. in diameter. If the tank has 35 cm. and 10 m. in diameter and height, respectively. (30 scores)

   4.1 Formulate differential equation between height (h) and time (t)
   4.2 How long does it take to get a steady state liquid height in the tank?

   The dynamic relationship of tank height [h (t)] and volumetric leak rate (q) is following:

$$q = A_{leak}\sqrt{2gh(t)}$$

   A_{leak} = leak area
   g = gravitational acceleration, 9.81 m/s^2 //End