# PRINCE OF SONGKLA UNIVERSITY
## FACULTY OF ENGINEERING

Midterm Examination: Semester I          Academic Year: 2005

Date: August 1, 2005          Time: 9:00-12:00

Subject: 230-601 Advanced Engineering          Room: R300
Mathematics for Chemical Engineers

---

<u>อนุญาตให้นำเอกสารและเครื่องคำนวณทุกชนิดเข้าห้องสอบได้</u>

<u>ทุจริตในการสอบโทษขั้นต่ำคือปรับตกในรายวิชาที่ทุจริตและพักการศึกษา 1 ภาคการศึกษา</u>

Please do all 3 questions. Show all your work to receive full or partial credit.
Final score is only 100.

| Question # | Total Score | Score |
|---|---|---|
| 1.1 | 10 | |
| 1.2 | 15 | |
| 1.3 | 10 | |
| 1.4 | 15 | |
| 2 | 25 | |
| 3 | 25 | |
| **Total** | **100** | |

---

สุกฤทธิรา รัตนวิไล
ผู้ออกข้อสอบ

1

1. Solve the differential equation. (50 scores)

    1.1     $y'' + y = x \sin x$  (10 scores)

    1.2     $y'' + y' - 2y = 12e^{2x}$
         Using Inverse Operator Method. (15 scores)

    1.3     $x^2 y'' + xy' - x^2 y = 0$
         Using the Modified Bessel Function. (10 scores)

    1.4     $y'' + x^2 y = 0$ Using Power Series Method. (15 scores)

2. A thin metallic wire of thermal conductivity k, diameter D, and length 2L is annealed by passing an electrical current through the wire to induce a uniform volumetric heat generation q°. The ambient air around the wire is at a temperature $T_\infty$, while the end of the wire at $x = \pm L$ are also maintained at $T_\infty$. Heat transfer from the wire to the air is characterized by the convection coefficient h. Obtain the expression for the steady state temperature distribution T(x) along the wire. Assume one dimensional conduction along the wire. (25 scores)

3. A 5,000 lb cylinder tank is being filled with water. At initial state a tank contains 1,500 lb of water with temperature 80°F. A constant flow rate of water goes into a tank at 100 lb/hr with temperature 200°F. The flat tank bottom has constant outflow at 20 lb/hr. A reference temperature is 77°F and heat capacity of water is equal 1 Btu/lb-°F. Find the temperature of outflow water as a function of time and how much time that system needs to reach temperature of outflow water at 100°F. (25 scores)

//End