

ChE-626 Course Outline Fall 2009

Text: **Applied Mathematical Methods for Chemical Engineers** 2<sup>nd</sup> ED. by Norman W. Loney

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Schedule: **September 8, 2009; ChE-626 Prereq. Exam 1 1/2 hrs. (10 % of final grade)**

To do well on **this exam** you should be able to identify and solve problems of the following form:

1. a)  $y' + p(x)y = f(x)$

b)  $y' + p(x)y = q(x)y^n; n \neq 0, 1$  Hint: use the substitution  $v(x) = y^{1-n}(x)$ .

c) Give examples of Exact Differentials and be able to outline solution approaches.

2. a)  $ay'' + by' + cy = 0$ ; for the three cases of the discriminant:

$$b^2 - 4ac > 0$$

$$b^2 - 4ac = 0$$

$$b^2 - 4ac < 0$$

where a, b and c are real constants.

b) Solve:  $ay'' + by' + cy = f(x) \neq 0$ , using the method of undetermined coefficient or variation of parameters.

3. Be able to generate series solution near a **regular singular point**, for example

$$2x^2y'' - xy' + (1+x)y = 0, \text{ using the substitution: } y = \sum_{n=0}^{\infty} a_n x^{n+r}, r \text{ is a const.}$$

and be able to give or find the radius of convergence for the resulting infinite series.

4. Solve initial value problems using:

a) Laplace Transform

b) Taylor Series method.

**MATERIAL TO BE COVERED (New)**

1. **Sept. 15<sup>th</sup>**: Applications of first order equations (problem # 1, 2 - 5 & 7).

2. **Sept. 22<sup>nd</sup>**: Applications of second order equations (problem # 1, 5 - 7 & 10).

3. **Sept. 29<sup>th</sup>**: Alternative methods: Bessell functions; Inversion of Laplace transforms using the Residue theorem, Numerical Approaches.
4. **Oct. 6<sup>th</sup> – 13<sup>th</sup>**: Sturm-Liouville Problems (Regular, Periodic & Singular cases) + Eigenfunction Expansion.
5. **Oct. 20<sup>th</sup> – 27<sup>th</sup>**: Fourier series Expansion.
6. **November 3<sup>rd</sup> – 24<sup>th</sup>**: Solution of Partial Differential Equations (Heat Equation, Mass Diffusion, Momentum Equation...for reacting and nonreacting systems where appropriate) using:
  - a) Separation of variables
  - b) Numerical Methods
  - c) Laplace Transform methods.

7. **December 1<sup>st</sup> – 8<sup>th</sup>**: More Applications of Partial Differential Equations.

**There will be a 1-hour quiz every class starting 9/22/09 at 6:30PM sharp.**

**Grading: The remaining 90%: Comprehensive Final = 25%**

**Weekly Quiz (total) = 50%**

**Project Problem = 15%**

**A = 90 or better**

**B+ = 85 - 89**

**B = 80 – 84**

**C+ = 75 – 79**

**C = 70 – 74**

**F = 69 or less.**

**Office hour**

Tuesday 5:00 PM – 6:00 PM

Or by appointment