Course Syllabus

Course: ***CBE 606 Applied Mathematics for Chemical Engineers***

Instructor: Dr. Tomas Co, Email: tbco@mtu.edu

Main Text: T. Co, *Methods of Applied Mathematics*,
(draft copy to be distributed in class)

Course Objective: To present the various methods of applied mathematics in solving and analyzing the solutions of engineering problems.

Course Description: The course will cover three main parts: a) matrix and vector analysis, b) ordinary differential equations and c) partial differential equations. Matrix theory will focus on the solution of equations, linear algebra and linear operators. Vector analysis will focus on basic operations and differential field operations, including the transformations to curvilinear coordinates and integral theorems. For ordinary differential equations, both analytical and numerical methods for solutions will be presented, including qualitative analysis and generalized series solutions. For partial differential equations, different solution methods will be discussed, including separation of variables method, integral transform methods, similarity methods and numerical methods. Visualization and analysis of the solutions will also be emphasized through computer projects.

References:

1. V.G. Jenson and G. V. Jeffreys, Mathematical Methods in Chemical Engineering, Academic Press, 1977
2. G. Strang, Introduction to Applied Mathematics, Wellesley-Cambridge Press, 1986
3. N. Amundson and R. Aris, Mathematical Methods in Chemical Engineering, Prentice Hall, 1966
4. J. Friedly, Dynamic Behavior of Processes, Prentice Hall, 1972
5. H. Mickley, T. Sherwood and C. Reed, Applied Mathematics in Chemical Engineering, McGraw Hill, 1957
6. D. Zwillinger, Handbook of Differential Equations, Academic Press, 1998
7. C.R. Wylie and L.C. Barnett, Advanced Engineering Mathematics, McGraw Hill, 1995
8. R.L. Burden and J.D. Faires, Numerical Analysis, Prindle, Weber & Smith, 1985
9. L. Debnath, Nonlinear Partial Differential Equations for Scientists and Engineers, Birkhauser, 1997
10. P. O'Neil, Advanced Engineering Mathematics, Brooks/Cole, 2003

Requirements:

1. Assignments

   Assignment 1: 10 pts
   Assignment 2: 10 pts
   Assignment 3: 10 pts
   Assignment 4: 10 pts
   Assignment 5: 10 pts

2. Exams

   Exam 1: 10 pts
   Exam 2: 10 pts
   Exam 3: 10 pts
   Final Exam: 20 pts

Grades:

100	- 90	A
89.99	- 80	AB
79.99	- 70	B
69.99	- 65	BC
64.99	- 60	C
59.99	- 55	CD
54.99	- 50	D
49.99	- 0	F

Course Outline

		Week No.
I.	**Matrix and Vector Theory**	
	a. Review of Matrices	
	• Matrix Operations	1
	• Solution of Ax=b	
	• Least Squares Method	2
	• Eigenvalues and Eigenvectors	3
	b. Vector and Tensor Analysis	
	• Notations and Operations	4
	• Curvilinear Coordinates	5
	• Integral Theorems	
II.	**Ordinary Differential Equations**	
	a. Review of Solutions of ODEs	
	• First Order	6
	• Higher Order	
	• Symmetry (Similarity) Methods	
	b. Systems of Linear Differential Equations	
	• Stability	7
	• Diagonalization	
	c. Numerical Methods	
	• Euler and Runge-Kutta Methods	8
	• Multistep Methods	
	• Boundary Value Problems	
	d. Nonlinear Differential Equations	
	• Qualitative Analysis	9
	• Stability and Limit Cycles	
	e. Series Solutions	
	• Frobenius Methods	10
	• Bessel and Legendre Equations	
III.	**Partial Differential Equations**	
	a. Classification and Boundary Conditions	
	b. First Order and the Method of Characteristics	11
	c. Higher Order PDEs	
	• Similarity Transformations	12
	• Orthogonal Functions	
	• Separation of Variables	13
	• Laplace Transform Methods	14
	d. Numerical Methods	
	• Finitie difference methods	15
	• Finite elements methods	