ENGR 3703 Computational Methods of Engineering
Fall 2005
Department of Physics and Engineering
University of Central Oklahoma

Location	Howell Hall 100
Time	MWF 12:00 - 12:50 p.m.
Instructor	Evan Lemley, Ph.D.; Assoc. Prof. of Physics and Engineering
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Office Hours	TR 9:00 a.m. - 10:00 a.m. & F 8:40 a.m – 9:40 a.m. or by appointment.
Final	W December 14, 2005 from 11:00 a.m. - 12:50 p.m.

Course Description
This course introduces general-purpose numerical methods and linear algebra concepts for solving problems in science and engineering. Students should develop an understanding of the strengths and limitations of standard numerical techniques applied to problems in engineering, such roots of nonlinear equations and systems of linear equations. The course will also cover numerical differentiation and integration, initial-value and boundary-value problems. The course will also discuss concepts and methods of scientific and engineering computing, mathematical modeling, and engineering design.

Prerequisites
ENGR 1213, PHY 2014, and MATH 3103 or concurrent enrollment.

Textbooks
Numerical Methods for Engineers, 5/E, Steven C. Chapra and Raymond P. Canale, ISBN: 0-07-310156-7, McGraw-Hill, 2006.

Students may also use the 4th Edition of the text listed above, but will have to get copies of homework problems.

Objectives
The student will be able to
- Demonstrate understanding of basic programming skills, and algorithms.
- Demonstrate understanding of the engineering software design process.
- Demonstrate understanding of significant figures, accuracy, precision, and error.
- Demonstrate understanding of bracketing and open root-finding techniques.
- Demonstrate understanding of numerical solution of linear and non-linear algebraic equations.
- Demonstrate understanding of least-squares curve-fitting techniques and interpolation schemes.
- Demonstrate understanding of numerical differentiation.
- Demonstrate understanding of numerical integration.
- Demonstrate understanding of Eulers' s methods and improvements on Euler's methods for solution of ordinary differential equations.

- Demonstrate understanding of the Runge-Kutta methods for solution of ordinary differential equations.
- Participate in a team design project that incorporates computational tools, including report preparation and a project presentation.
- Demonstrate understanding of the use of software to solve engineering problems and the necessity to use factors of safety for protection of the public.
- Demonstrate understanding that computational methods are fast-changing and that continuous education and training will be necessary in this field throughout a career.

Calculator
You must own a scientific calculator – *see the list of allowed calculators for exams in the Department of Physics and Engineering*. **Please bring your calculator to class for each meeting**.

Engineering Paper
Engineering Paper -- available from the UCO bookstore, Thompson's Bookstore, and Triangle A&E at Broadway Ext. and 63rd. Please use engineering paper for all homework assignments.

Internet & E-mail
Access to the Internet and ability to send and receive E-mail. If you do not have a computer at home you can use machines on the UCO campus: Look at
http://technology.ucok.edu/support/microcomplab.htm
for a full list of available general use computers on campus.

Portable Electronic Devices (including cell phones)
Please turn off any portable electronic devices (esp. cell phones) during class. You may not access any portable electronic device during exams except calculators that are on the approved list for Physics and Engineering courses.

Instruction Techniques
Lecture will be used predominantly although sometimes recitation periods will be employed.

Class Polices
Attendance is not required, but you will responsible for any announcements or notes from class (and quizzes).

Attendance is mandatory for all exams or other graded activities (e.g. project competitions or presentations).

Cheating or academic dishonesty of any kind will not be tolerated.

Homework
Working HW problems in a timely manner is the best way to do well on exams and in the class as a whole. Homework is due at the beginning of the class period on the due-date or due-day. Homework should be neatly written on only one side of your paper, folded length-wise with your name written on the outside of the folded pages before turning it in. Each problem should fit all of the following criteria: clearly labeled, **one problem per sheet of paper**, legible and organized. HW papers that do not fit these criteria will be penalized accordingly. See the attached HW Format section for details on the presentation of HW problems. You may also visit the following site for an electronic version of the homework format requirements:
http://engrphys.lemley.org/courses/hwk_format.php

Each HW problem you turn in is worth ten points. Some problems will be graded on detailed solutions and others will be graded on effort. I will **not** tell you ahead of time which or how many problems will be graded relative to a detailed solution, but on the returned and graded HW paper a check mark next to the problem number will indicate full effort (or ten points) and a numerical score (e.g. 8/10) next to the problem number will be used on those problems under more scrutiny.

Project
There will be Team Design Projects in this course. Projects will constitute a significant portion of your grade. More information will be given to you as project assignments are made.

Grading Policies
The following table shows the breakdown of credit for the course.

HW and Misc.	10%
Exams (x3)	10%
Projects	30%
Final Exam	30%
Total	**100%**

Tentative Grading Scale
90-100% -- A, 80-90% -- B, 70-80% -- C, 60-70% -- D, <60% -- F

STUDENT INFORMATION SHEET / SYLLABUS ATTACHMENT
See separate handout or go to:
http://engrphys.lemley.org/courses/fall_2005_syllabus_attachment.pdf

Tentative ENGR 3703 Computational Methods Schedule					
Week #	**Day**	**Date**	**Topics and Activities**	**Text Sections**	**Covered**
1	M	22Aug2005	Syllabus Intro & Modeling and Problem Solving	1.1-1.2	
	W	24Aug2005	Programming Review – flowcharts, algorithms, pseudocode	2.1 – 2.3	
	F	26Aug2005	Excel & MATLAB review – basic control structures	2.4-2.6	
2	M	29Aug2005	Sig. Figs., Accuracy and Precision, and Error Defs.	3.1-3.3	
	W	31Aug2005	General Error discussion and round-off error	3.3-3.4	
	F	02Sep2005	Taylor Series and the remainder term & Error Propagation	4.1-4.2	
3	M	05Sep2005	**LABOR DAY – NO CLASS**		
	W	07Sep2005	Total Error & other error topics	4.3-4.4	
	F	09Sep2005	Graphical Root finding & Bisection	5.1-5.2	
4	M	12Sep2005	False-Position & Incremental Searching	5.3-5.4	
	W	14Sep2005	Fixed-Point Iteration & Newton-Raphson	6.1-6.2	
	F	16Sep2005	Newton-Raphson & Secant Method & other techniques	6.2-6.5	
5	M	19Sep2005	Root-Finding with Software	7.7	
	W	21Sep2005	Gauss Elimination	9.1-9.3	
	F	23Sep2005	**EXAM 1**		
6	M	26Sep2005	Gauss Elimination & Improvements	9.3-9.4	
	W	28Sep2005	Complex and Non-linear systems	9.5-9.6	
	F	30Sep2005	Gauss-Jordan	9.6-9.7	
7	M	03Oct2005	LU Decomposition	10.1	
	W	05Oct2005	Matrix Inversion	10.2	
	F	07Oct2005	Ill-conditioned systems & Iterative refinement	10.3	
8	M	10Oct2005	Special Matrices	11.1	
	W	12Oct2005	Gauss-Seidel	11.2	
	F	14Oct2005	Using Software to solve linear algebraic equations	11.3	
9	M	17Oct2005	Least-Squares Regression	17.1-17.2	
	W	19Oct2005	Least-Squares Regression	17.3-17.5	
	F	21Oct2005	**FALL BREAK – NO CLASS**		
10	M	24Oct2005	Newtons and LaGrange Interpolation	18.1-18.2	
	W	26Oct2005	**EXAM 2**		
	F	28Oct2005	Newtons and LaGrange Interpolation	18.3-18.5	
11	M	31Oct2005	Spline Interpolation	18.6	
	W	02Nov2005	Spline Interpolation	18.6	
	F	04Nov2005	Trapezoidal Rule	21.1	
12	M	07Nov2005	Simpson's Rules	21.2	
	W	09Nov2005	Other Newton-Cotes Integration Considerations	21.3-21.5	
	F	11Nov2005	Romberg Integration	22.1-22.2	
13	M	14Nov2005	Gauss Quadrature	22.3	
	W	16Nov2005	Improper Integrals	22.4	
	F	18Nov2005	Numerical Differentiation	23.1-23.2	
14	M	21Nov2005	Numerical Differentiation	23.3-23.5	
	W	23Nov2005	**THANKSGIVING BREAK – NO CLASS**		
	F	25Nov2005	**THANKSGIVING BREAK – NO CLASS**		
15	M	28Nov2005	Euler's Method and Improvements	25.1-25.2	
	W	30Nov2005	Runge-Kutta Methods	25.3	
	F	02Dec2005	**EXAM 3**		
16	M	05Dec2005	Runge-Kutta Methods	25.4	
	W	07Dec2005	Runge-Kutta Methods	25.5	
	F	09Dec2005	Boundary Value Problems and Eigenvalue Probs.	27.1-27.2	
17	F	17Dec2004	**FINAL EXAM -- W December 14, 2005 from 11:00 a.m. - 12:50 p.m.**		