

ME 318 – PROGRAMMING & ENGINEERING COMPUTATIONAL METHODS Spring 2014

Class Web Site: UT's Canvas web portal
Classroom: ETC 2.108
Class Time: Tue-Thur 8-9am

Faculty: Prof. Dragan Djurdjanovic
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Office Hours: Wed 2-4pm

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Lab: ETC 3.112
Unique 18240: Monday 1:00-2:30 pm
Unique 18245: Monday 3:00-4:30 pm
Unique 18250: Tuesday 3:30-5:00 pm
Unique 18255: Monday 5:00-6:30 pm
Unique 18260: Tuesday 5:00-6:30 pm
Unique 18265: Monday 6:30-8:00 pm

BOOKS AND SUGGESTED MATERIALS:

- Required Book: None
- Chapra, S.C., and Canale, R.P., Numerical Methods for Engineers, 4th Edition, ©2001 McGraw-Hill.
- Austin, M., and Chancone, D. *Engineering Programming in C, Matlab, and Java*, ©1999 John Wiley & Sons.

COURSE DESCRIPTION:

Coursework includes applied numerical analysis, programming algorithms, and applications of computational methods to the solution of mechanical engineering problems. In first third of the course formal programming methods will be taught in the class and students will implement those in the lab. In the rest of the class analytical methods are taught in lectures and then applied in computer lab using MATLAB.

PREREQUISITES:

M 427k with a grade of at least C-.

COURSE EVALUATIONS:

UT standard course/instructor evaluations will be distributed to the students to obtain feedback on the course content and the quality of teaching.

GRADING:

The course will have three exams (2 mid-terms and a final take home exam). The final grade will be determined as follows:

- 15% - the lowest score of the three exams
- 40% - the other two exams (20% each)
- 20% - Homework Assignments
- 20% - Matlab Programming Lab Assignments
- 5% - Attendance (it will be checked randomly)

GENERAL INSTRUCTIONS:

All assignments should be submitted at the beginning of class or lab on the due date. If assignments are submitted with less than 12 hours delay, the delay will incur a 10% penalty. Further delays will mean 0% for that assignment.

Though primarily graded on technical correctness, homework should be tidy, clear, and professionally presented. Serious infractions in this area may merit a 10% penalty.

Students are responsible for regularly checking the web site for posted assignments and updates.

COURSE POLICIES:

Collaboration: Discussion with other students is encouraged. All work submitted for credit, however, must be your own. **Any evidence of plagiarism or other forms of scholastic dishonesty may be grounds for a failing grade in the course.**

Attendance: Class and lab attendance is highly recommended and will be occasionally checked (it carries 5% of the course grade). **Missing an exam constitutes failing the entire course** (write to Prof. Djurdjanovic in advance if conflicts are foreseen)!

Disabilities:

The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4241 TDD or the College of Engineering Director of Students with Disabilities at 471-4382.

SYLLABUS AND SCHEDULE

Week 1

- Lectures – Introduction to MATLAB
 - Computer architecture
 - Working in MATLAB workspace
- *Homework 1 out 8/28*
- **No lab this week**

Week 2

- Lectures – Writing scripts in MATLAB
 - Variables, Operators, and Operations
 - Programming Structures
 - Arrays
 - Simple Programming Examples
- *Homework 2 out & Homework 1 due 9/4*
- **No lab this week**

Week 3

- Lectures – Functions and Subroutines
 - Concepts and Syntax of Functions and Subroutines
 - Examples
 - Recursions
 - Built in Functions, Graphing Functions
- *Homework 3 out & Homework 2 due 9/11*
- **Lab 1** - Introduction to Matlab

Week 4

- Lectures - Introduction to numerical methods
 - Sources of Errors
 - Intro to Root finding, $f(x) = 0$
 - Visualization in MATLAB
- *Homework 4 out & Homework 3 due 9/18*
- **Lab 2** – Programming in MATLAB

Week 5

- Lectures – Root finding, $f(x) = 0$
 - False Position Method
 - Newton's Method
 - Bisection Method
 - Secant Method
- *Homework 5 out & Homework 4 due 9/25*
- **Lab 3** – Visualizing Data

Week 6

- Lectures – Solving $Ax=b$ & Matrix methods
 - Matrix Review
 - Gauss-Jordan
 - Determinants and Singularities
 - Matrix Inverse
- *Homework 5 due 10/2*
- **Lab 4** – Finding Roots Functions of 1 Variable

Week 7

- Lecture – Vectorial NR, ***EXAM 1 on 10/9***
- *Homework 6 out 10/9*
- **Lab 5** – Solving Systems of Linear Equations

Week 8

- Lectures – Curve Fitting
 - Least Squares Method
 - Linear, Quadratic, Cubic
 - Exponential curves
- *Homework 7 out & Homework 6 due 10/16*
- **Lab 6** – Roots of functions of multiple variables

Week 9

- Lectures - Numerical Calculus
 - Differentiation: Backward, forward, central, 2nd order/generalized
 - Integration: Trapezoidal rule
- *Homework 8 out & Homework 7 due 10/23*
- **Lab 7** – Interpolation and Curve Fitting

Week 10

- Lectures – ODEs
 - Introduction
 - 1st order ODE
 - Euler's, Modified Euler Method (Heun)
- *Homework 8 due 10/30*
- **Lab 8** – Numerical Calculus

Week 11

- Lecture – ODEs continued, ***EXAM 2 on 11/6***
 - Runge-Kutta Methods
 - Sets of 1st order ODEs (Euler & RK)
- ◇ *Homework 9 out*
- **Lab 9** – Solving 1st order ODEs

Week 12

- Lectures – ODEs III
 - Higher Order ODEs
 - Initial value problems
 - Boundary Value Problems
- *Homework 10 out & Homework 9 due 11/13*
- **Lab 10** – Using the Runge-Kutta Method to solve higher order ODEs

Week 13

- Lectures – PDEs
- *Homework 11 out & Homework 10 due 11/20*
- **Lab 11** – Solving ODEs using ODE45 and BVP

Week 14

- Lecture – Exam review (no lecture on 11/27)
- **Lab 12** – Solving PDEs

Week 15

- Lecture – Advanced numerical analysis topics;
 - What after ME318?
 - Course evaluations
- *Homework 11 due 12/2 (Tuesday)*
- Lab – Additional office hours, if applicable
- **Take home exam: out 12/1, due 12/5 at 5pm**