UNIVERSITY OF SOUTH FLORIDA
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

EGN 4453 Numerical and Computer Tools I (Fall 2015)

Class Meetings: TR 11:00am-12:15pm in CHE 102
Help Session: F 08:00-09:50am in ENC 1002

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COURSE DESCRIPTION AND OBJECTIVES:

Course Description: An introduction to algorithmic and numerical solution of civil and environmental engineering problems.

Objectives: Upon completion of this course the student should be able to:

1) Approach technical problems using a consistent problem solving approach involving problem definition, algorithm design, algorithm implementation, solution, and testing/evaluation.
2) Design an algorithmic solution to engineering problems using flowcharts and pseudo code.
3) Apply programming logic structures for numerical algorithm development and solution.
4) Apply common numerical methods for interpolation, regression, and root finding to the solution of engineering problems.
5) Solve elementary matrix arithmetic problems analytically and numerically.
6) Solve simultaneous linear equations using matrix mathematics.
7) Use MATLAB for computational implementation, solution, and testing of algorithms.

RECOMMENDED TEXTBOOKS

- S. Attaway. MATLAB. A Practical Introduction to Programming and Problem Solving. 3rd edition. Elsevier.
- W. Y. Yang. Applied Numerical Methods Using MATLAB. 1st edition. Wiley-Interscience.

CANVAS AND E-MAIL: Course material will also be provided by instructor and posted on Canvas. Announcements regarding, for example, quizzes, exams, homework, etc. will be sent via e-mail.

MATLAB ACCESS: MATLAB is available on computers in the engineering student computer labs. Off-campus access to MATLAB® is possible via the Virtual Application website at http://www.apps.usf.edu

TOPICS COVERED AND ROUGH SCHEDULE

Week 1-2

1. Course Introduction (1st Class)
    - Course overview
    - Why numerical method?
2. Introduction to numerical methods
    - Computing concepts
    - Analytical versus algorithm solutions to engineering problems
    - Approximation: numerical error, accuracy and precision
        - Computer errors vs. human mistakes
    - A generalized process for solving engineering problems
    - Introduction to algorithm design (stepwise refinement, flowcharting, types of semantics)
3. Introduction to programming
    - Programs and programming languages
    - Syntax and semantics
    - Script files
    - Data input and output
    - Good programming practice

Week 3

4. Introduction to computer tool MATLAB
    - Command window, basic mathematical operations and built-in functions
    - Variable definition and the workspace window
    - Data representation and types
    - Basic data storage

Quiz 1

Week 4-5

5. Engineering problems
    - Linear equation and **system of linear equations**
    - **Nonlinear equation** and systems of nonlinear equations
    - **Interpolation and curve fitting**

- Numerical differentiation/integration
- Differential equations
- Optimization

Test 1

Week 6-8

6. Basic MATLAB Programming
    - Variables
    - Operators
    - Statements
    - Loops
7. Advanced programming with MATLAB
    - User-defined functions, input / output to functions and variable scope
    - Modular programming
    - Errors, debugging, and the MATLAB debugger
    - The programming process (designing, coding, debugging, testing, simulation, analysis)

Quiz 2

Week 9-10

8. Interpolation and curve fitting
    - Plot types and functions
    - Notes on better graphics
    - Interpolation and regression

Test 2

Week 11

9. Solving algebraic equations (root finding)
    - Classification of equations
    - Common methods (bisectional, Newton-Raphson) and their application
    - Numerical solutions using MATLAB

Week 12-15

10. Solving simultaneous equations
    - Basic vector and matrix algebra
    - Matrix representation of a system of algebraic equations

- Matrix manipulation
- Eigenvalues and Eigenvectors
- Introduction to solution methods (Gaussian elimination, Cramer's rule)
- Numerical solutions using MATLAB

Group Project Presentation

Take-home Final Exam

GRADING POLICY: Grades will be assigned based on test, homework and final programming projects using the following weighting:

Homework	20%
Quizzes (2)	10%
In-class tests (2)	30%
Take-home Final Exam	20%
Group Project	20%

The grading scale will be assigned based on the total weighted grade:

Grading Scale (%)	
95-100	A+
90-94	A
85-89	A-
80-84	B+
75-79	B
70-74	B-
65-69	C
60-64	D
0 - 59	F

HOMEWORK: There will be approximately 7 homework assignments through the semester. All homework assignments should be completed individually. Assignments will be distributed one or two weeks before the due date. Homework assignments submitted late, by fax, or by email will not be accepted. Collaborative work is encouraged, but each student must write up and submit their own individual solutions.

QUIZZES: There will be 2 in-class quizzes. The date for quizzes will be announced in the weeks 3 and 8.

EXAMS: Two tests will be given in class (Sept. 25, Oct. 30). There will be a final comprehensive numerical exam that will be distributed during the last week of class in lieu of an in-class final exam. The in-class tests can be re-scheduled only in the event of a legitimate reason for absence and/or prior consent of the instructor.

GROUP PROJECT: By the week 5, the project teams will be formed. Each team will give a presentation on their project and submit the project report during the last week of class. All students in the group are expected to collectively contribute to the project and will receive the grade based on their contribution to the project.

CLASS ATTENDANCE: Attendance is necessary for success in this class. If you miss a lecture, please get with a fellow student before the following lecture to review the material that you missed; otherwise the subsequent lectures may be difficult to follow.

PROFESSIONALISM AND ETHICS: Students can work together on homework; however, each person must present their own homework assignment. Everyone must do his/her own work on tests. Cheating will result in an F grade for the course. See http://www.ugs.usf.edu/catalogs/0708/adadap.htm for further information on academic dishonesty and disruption of the academic process.

Cell phones or other smart devices may not be out or visible during exams, lectures and study sessions.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES: Students in need of academic accommodations for a disability may consult with Students with Disabilities Services to arrange appropriate accommodations. Students are required to give reasonable notice prior to requesting an accommodation.

OTHER: Materials for this class may be copyrighted. You may make single copies for your personal use, consistent with U.S. copyright laws. All unauthorized recordings of class are prohibited. Recordings that accommodate individual student needs must be approved in advance and may be used for personal use during the semester only; redistribution is prohibited.