Computational Methods in EE

EE 4386/5301 – *University of Texas at El Paso*

Course Syllabus

COURSE INFORMATION

Meeting day and time: T/Thurs., 1:30pm – 2:50pm
Room: Health Science/School of NURS 135
Course designation: EE 4386, EE 5301
CRN: 25514, 21726
Credit hours: 3

Catalog Description

An introduction to numerical methods for Electrical and Computer Engineers; the objective of this course is to introduce the basic numerical toolset needed for ECE students to solve problems arising in different areas of ECE, including signal processing, linear system theory, Image processing, informatics, Controls and Robotics, Design Verification of Very-Large-Scale Integrated Circuits, Parallel and Distributed Computing Systems and Telecommunication/networking. The course will include the following topics: Floating-point representation; sources and propagation of errors and stability in numerical analysis; Numerical methods for systems of linear and non-linear equations; Numerical integration and approximation theory along with basic methods for differential equations; Introduction into numerical optimization; minimization for constrained and unconstrained optimization; Iterative methods for sparse systems of linear equations. These concepts and techniques are illustrated through the introduction of both classical and modern ECE based applications. Presentations of the fundamental numerical techniques used in Electrical and Computer Engineers, including solution of systems of linear and nonlinear equations, interpolation and curve-fitting, solution of ordinary and partial differential equations. And presentations for MATLAB and applications of MATLAB, MATLAB tutorial for solving the problems in EE, such as signal processing, image processing, system design/implementation, telecommunications, control system analysis and optimizations.

INSTRUCTOR INFORMATION

Dr. Wei Qian
Office: ENGR A-318
Office Hours: M/W, 9:00am – 1:00pm
Telephone: (915) 747-8090
E-Mail: wqian@utep.edu

COURSE MATERIALS

The following items are required for this course:

- Access to **MATLAB**: A manual for this tool is available at:
    http://www.mathworks.com/help/techdoc/
- Engineering graph paper
- Textbook**: Numerical Methods for Engineers** by Steven C. Chapra McGraw Hill
    ISBN: 978- 0-07-340106-5
- Reference Textbook: **An Introduction to Numerical Analysis for Electrical and Computer Engineers** by Christopher J. Zarowski

Students are required to archive their syllabus, lecture notes, MATLAB experiment notes, homework solutions, and quizzes in a well-organized notebook.

PREREQUISITES

By Course (with grade of "C" or better):
- MATH 2326 – Differential equations
- EE 2353 – Continuous Time Signals and Systems

By Topic:

- Linear system and Differential equations
- MATLAB

COREQUISITES

None.

COURSE OUTLINE

We will be using Matlab as the main programming/graphics environment, therefore, students must be familiar or learn the use of Matlab during this class. The course will focus on the solution of partial differential equations (PDEs) typical of hydraulics and transport problems, and the elementary numerical methods for Electrical and Computer Engineering.

Topics covered in this course include:

1. Introduction to MATLAB
2. Solution to equations with one variable (e.g., bisection, Newton-Raphson, secant methods).
3. Solution to systems of non-linear equations on more than one variable (e.g., generalized Newton-Raphson and secant methods)
4. Matrix algebra (e.g., transpose, inverse, addition, multiplication, etc.) -- You may want to download this [free book on Matrix Algebra by Autar K Kaw, University of South Florida](#)
5. Linear algebra and solution of systems of linear equations (Gaussian and Gauss-Jordan elimination, pivoting, LU decomposition, quadratic forms)
6. Numerical integration (trapezoidal rule, Simpson's rule, Gaussian quadrature)
7. Data fitting (least-square for linear fitting, multiple-linear fitting, polynomial fitting)
8. Numerical solution to ordinary differential equations - ODEs (Euler method, Runge-Kutta methods, stiff ODEs)
9. Optimization

COURSE OUTCOMES

By the end of the semester, the student will demonstrate the ability to:

i. Use MATLAB proficiently to solve commonly encountered ECE problems
ii. Understanding of the necessity of numerical solutions to mathematical problems arising in engineering.
iii. Understanding of, and an ability to apply basic algorithms of numerical linear algebra for ECE applications.
iv. Basic understanding of the formulation of commonly encountered ECE problems into either constrained or unconstrained optimization problems.
v. An ability to use mathematical software for the solution of optimization problems arising in ECE.
vi. Perform basic optimizations

Contribution to Professional Component

EE-4386 is a senior level core course that will give the student the ability to use a computer to solve engineering problems and analyze data.

Relationship to (ABET) Program Outcomes

- Ability to apply knowledge of mathematics, science, and engineering: *Students use concepts from physics and calculus in the analysis of engineering problems.*
- Ability to identify, formulate, and solve engineering problems: *Students solve problems numerically and observe simulations of transmission line problems.*

- Ability to communicate effectively: *Students solve problems and give oral individual presentations summarizing their work.*
- Ability to use computers to enhance problem solving: *Students will use MATLAB to solve problems and visualize solutions.*

RULES AND POLICIES

Grading

Student achievement in the course objectives will be assessed using a combination of homework and exams as well as class attendance and participation. Your course grade will be determined by your weighted performance in the following categories:

Homework .... 40%   90% – 100% ☐ **A**
Participation .... 10%   80% – 89% ☐ **B**
Midterm Exam …..................... 20%   70% – 79% ☐ **C**
Final Exam .... 30%   60% – 69% ☐ **D**   0% – 59% ☐ **F**

Student grades are protected by the Privacy Act of 1974.

Homework Policy

Homework will be assigned on a weekly basis and graded on a 100 point scale. Homework is due at the beginning of lecture on the assigned due date. Late assignments will not be accepted and will be given a grade of zero. Students must show all work to get full credit on problems. Unless otherwise directed, all calculations should be complete. Students must do their own work on assignments. Copied assignments will receive a zero grade and disciplinary action will be pursued.

Format – Unless otherwise indicated, all homework assignments will be submitted as a single paper document stapled in the upper left corner with no additional binding. The first page must be a cover sheet with the student's name, date of the assignment, course information, and assignment number. No problems or work should appear on the cover sheet. Homework shall be neat, well organized, and the writing clear. Answers to questions should be clearly marked or boxed. All computer codes shall be provided in an appendix. Assignments should be single-sided.

Exam Policy

Midterm Exams – Two midterm exams will be given and graded on a 100 point scale. Duration of the exams will be around 1 hour and will be strictly enforced. Work on the Exams must be neat and well organized. Unless otherwise directed, all calculations should be complete and not contain constants like ☐, ☐, ☐, c, ☐, etc. The final answer must be boxed and clearly marked. The Exams will be closed book, but calculators and writing utensils are allowed.

Final Exam – The final exam will last the entire duration of the time allotted by the University, but no longer. Work must be neat and well organized. The final answer must be boxed and clearly marked. Unless otherwise directed, all calculations should be complete. The final exam will be closed book, but calculators and writing utensils are allowed.

Missed Exams – A missed exam can be made-up ONLY IF: (1) the reason for missing the exam is beyond the student's control, e.g. such as a medical excuse, jury duty, death in the family or automobile accident, or (2) prior consent is obtained from the instructor for missing the exam based on a non-frivolous excuse, e.g. such as a job interview or out-of-town job related travel. In either case, the student must submit a written and signed statement describing the reasons for missing the exam, with appropriate documentation, and petition for a makeup exam. **A missed exam will carry zero grade if these conditions are not met**.

Attendance Policy

Students are required to attend class and to show up to lectures on time. The course instructor reserves the right to turn away late comers and to withdraw students from the course that are repeatedly absent. Students missing more than two lectures should seriously reflect on their commitment to this course, as missing classes is highly correlated with poor performance. Students absent from lecture are still held responsible for all information discussed, homework assigned, and exams administered during that missed lecture. In some cases, absence can be forgiven if coordinated with the course instructor well before the lecture is missed.

Participation Policy

The following items are expected from students as part of their participation grade:
• Attendance: Attendance is required.
• Ask questions. Despite how silly or "dumb" you may think your question is, it is very likely that other students have the same question. Confusion on even small details in course material can cause bigger problems and hold you back. If you are truly embarrassed by your question, send an anonymous e-mail to the course instructor. I promise I will respond!
• Respond honestly to poles and provide real-time feedback to instructor about the course. This will contribute greatly to the quality of the course and your success in it.
• Visit instructor during office hours if needed.
• Treat e-mail correspondence as a professional exchange of information.
• Turn off cell phones, pagers, or anything else that may distract the class.
• Purchase the text book.
• Read assigned sections of the book.
• Bring all of your course materials (text book, notes, pens/pencils, paper, Smith charts, calculator, ruler, compass, etc.) to every class.

- Show proper etiquette during class. Do not talk, make excessive noise, or otherwise distract the class. You will be asked to leave and it will affect your grade.
- Keep the course materials well organized.

ACADEMIC DISHONESTY

As an entity of The University of Texas at El Paso, the Department of Electrical and Computer Engineering is committed to the development of its students and to the promotion of personal integrity and self-responsibility. The assumption that a student's work is a fair representation of the student's ability to perform forms the basis for departmental and institutional quality. All students within the Department are expected to observe appropriate standards of conduct. Acts of scholastic dishonesty such as cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in the whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student, or the attempt to commit such acts will not be tolerated. Any case involving academic dishonesty will be referred to the Office of the Dean of Students. The Dean will assign a Student Judicial Affairs Coordinator who will investigate the charge and alert the student as to its disposition. Consequences of academic dishonesty may be as severe as dismissal from the University. See the Office of the Dean of Students' homepage (Office of Student Life) at http://studentaffairs.utep.edu/dos for more information.
You can also refer to the IEEE website for information on our code of ethics:
http://www.ieee.org/about/corporate/governance/p7-8.html

AMERICAN DISABILITIES ACT

The UTEP Disabled Student Services Office was established for the purpose of providing appropriate and reasonable accommodations as mandated in Section 504 of the Rehabilitation Act of 1973 (http://www.dol.gov/oasam/regs/statutes/sec504.htm) and the Americans with Disabilities Act (http://www.ada.gov/). If you have needs regarding learning disabilities, please help by reporting your special needs to the course instructor the first week of classes.
For addition help, contact the Center for Accommodations and Support Services (CASS):
(915) 747-5148
cass@utep.edu
http://sa.utep.edu/cass/

DISCRIMINATION

I do not discriminate, nor will I allow discrimination, on the basis of age, gender, color, ethnicity, national origin, religion, disability, sexual orientation, or favorite sports team. Members of the UTEP community are protected from discrimination and harassment by the State and Federal Laws.