Computational Science: Computational Methods in Engineering

Course Introduction

Outline

• What are computational methods?
• Rules and procedures for the course
• Your computer codes
What are Computational Methods?

Electromagnetic Simulation
2D FFT (1 of 2)

2D FFT (2 of 2)
Dart Throwing Analysis

Analysis of Transmission Lines

Problem definition:

Problem results:

\[ L = 554 \, \text{mm}, \quad C = 121 \, \mu\text{F/mm}, \quad \varepsilon_{\text{eff}} = 6.0, \quad Z_c = 67.78 \, \Omega \]
Spatially Variant Lattices (1 of 3)
Spatially Variant Lattices (1 of 3)

Real Science and Engineering

Few-period FSS
Rules and Procedures

Needed for This Course

1. A scientific calculator
2. Access to a computer with MATLAB 2015 or above
3. Internet access
4. Text Book

Numerical Methods for Engineers
Course Outline

- Review of MATLAB
- Numerical error
- Review of linear algebra
- Finding roots of equations
- Fitting curves to data
- Numerical differentiation and integration
- Finite-difference method for solving ODEs.
- Optimization

Homework Rules/Format

- Do your own work. Do not copy from other students.
- Due by 5:00pm on due date. No late homework accepted.
- Must have a cover sheet.
- No binding. Stapled at upper left corner.
- Provide all answers and in the order the questions were asked.
- Final answers clearly marked with a box.
- All computer codes placed at end of assignment in an Appendix.
- High level of professionalism – exceed that of the solutions.
- Must include a signed graphics checklist at the end of each assignment that includes graphics.
- Extremely good graphics – See checklists
Typical Outline of Homework

• Cover sheet
  • Name + 800#
  • Course information + Date
  • Homework #
• Answers and work to problems (no codes)
• Appendix
  • All computer codes go here
• Graphics checklist if homework contains graphics

Grading

Homework is critical in this course!
Note it is worth 40% of your grade!
No late homework accepted!

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>40%</td>
<td>90% – 100% → A</td>
</tr>
<tr>
<td>Participation</td>
<td>10%</td>
<td>80% – 89% → B</td>
</tr>
<tr>
<td>Midterm Exam #1</td>
<td>15%</td>
<td>70% – 79% → C</td>
</tr>
<tr>
<td>Midterm Exam #2</td>
<td>15%</td>
<td>60% – 69% → D</td>
</tr>
<tr>
<td>Final Exam</td>
<td>20%</td>
<td>0% – 59% → F</td>
</tr>
</tbody>
</table>
Unique Things About Rumpf

• Classes start and end exactly on time. Show up several minutes early to be ready.
• Crazy about proper graphics
• Want to encourage questions and interactions
  • Grades are never lowered from your given grade, even if a blatant grading error was made.
• Expects code that:
  • Is clean, well-organized, and well-commented.
  • Follows block diagrams exactly

Your Computer Codes
Structure of the Ideal Code

- **Initialize MATLAB**
  - close all unnecessary windows
  - clear memory
  - open a figure window
  - define units and constants

- **Dashboard**
  - Define all numbers.
  - Do not implement any part of your algorithm.

- **Rest of Code**
  - Only calculations.
  - No numbers!

- **Save/Show Results**
  - Only numbers.
  - No calculations!

Rules For Your MATLAB Codes

- You must use MATLAB for all homework and exams.
- Programs must follow the block diagrams in the class exactly.
- Codes must be neat, well organized, and well commented.
- Unless otherwise instructed, code must be a single program and NOT broken into separate functions.
- Try to use the same variable names as the notes and in the codes written by the instructor.
- No vestigial code (i.e. code that has no purpose or effect).
- Need help? If you are stuck: (1) be sure to follow ALL of the above rules, (2) e-mail me your MATLAB code.
  - rcrumpf@utep.edu
  - Cannot provide help on exams.
Advice for Computation

• Write clean code that is well organized and well commented.
• Follow block diagrams in the notes exactly.
• Do not make artificial corrections. For example, do not change an equation in the notes in order to get your code working. There must be another problem. Find the problem.

Course Website
CMEE Website

https://empossible.net/academics/emp4301_5301/

COURSE PAPERWORK
• Syllabus (PLEASE READ)

HOMEWORK
• Homework assignments
• Take home exams
• Resources for homework
• Graphics checklist

COURSE NOTES
• Some notes are provided electronically.

OTHER RESOURCES
• Information summaries
• MATLAB codes