

Instructor:

Dr. Robert E. Tuzun
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Office hours:

Wed 1:00-3:00 PM
Thurs 1:00-3:00 PM
and by appointment

My Web page: <http://www.cps.brockport.edu/~tuzun>
Course Web page: <http://www.cps.brockport.edu/~tuzun/courses/cps604/cps604.html>

Course materials

Michael A. Celia and William G. Gray, *Numerical Methods for Differential Equations* (Prentice-Hall, 1992).
Supplemental handouts.

Auxiliary texts:

Gene H. Golub and James M. Ortega, *Scientific Computing and Differential Equations* (Academic Press, 1992).

William E. Boyce and Richard C. DiPrima, *Elementary Differential Equations and Boundary Value Problems*.

Richard L. Burden and J. Douglas Faires, *Numerical Analysis*.

Required background

You will need the following skills to succeed in this course. I can work with you on an individual basis to bring you up to speed if you need help in these areas.

- Numerical methods/scientific programming material in CPS504/505.
- A strong working knowledge of C/C++ or Fortran 90.
- A strong working knowledge of calculus through Calculus III.

Course description

An introduction to numerical methods used to solve ordinary and partial differential equations. The course will cover some basic theory, the formulation of differential equations, initial value and boundary value problems, and several methods for numerical solutions. Since linear algebra is a tool in many of these techniques, some basic numerical linear algebra methods will be covered. Programming will also be covered throughout the course; the major aspect emphasized here will be generality.

During the course, Chapters 2 and 3 of the main text, plus additional material, will be covered. The topics, in order of presentation, are:

Linear algebra

- Matrix operations
- Solution of linear systems of equations
- Eigenvalues and eigenvectors

- Software packages for numerical linear algebra

Some basic separation of variables techniques

Numerical solutions at grid points—finite difference approximations

- Derivatives as finite differences
- Generalized formulation of difference approximations
- Solution of initial value problems in one and two dimensions

Piecewise continuous numerical solutions—finite element approximations

- Method of weighted residuals
- One-, two-, and three-dimensional problems

Discretization methods

- Spatial discretization—regular and irregular grids
- Temporal discretization
- Combined spatial-temporal discretization

Homework

Homework assignments will be given every week to week and a half. So that you can concentrate on the concepts rather than being bogged down in the details of the programming, much of the homework will require adapting software I have written rather than writing it from scratch. The homeworks will consist of short written presentations that you hand in, as well as any accompanying files on optimus. Please follow the following guidelines.

- For any question that asks for specific numerical results, please provide succinct written presentation. It is not enough to just provide numerical results or raw simulation data; you must demonstrate that you understand the results.
- You may sometimes want to show diagnostic output or raw simulation data in order to make some point. In your written presentations, please show snippets as short as possible, since the complete output may be thousands of lines.
- On each graph you generate, be sure to include axis labels with units, as well as a title.
- Maintain a separate directory for this course. Organize your directory space so that each homework assignment or project has its own directory space. You may sometimes find it advantageous to make subdirectories.
- In order for me to be able to provide the best feedback possible, I will want to be able to follow and to reproduce your work (including all numerical results). Please be sure to save all the source code, input files, shell scripts, etc., required to generate your data, as well as output files. If you have a large number of files, please provide a table of the most important input and output files, along with most important input parameters, and names of source codes, shell scripts, and other relevant files.
- Please adhere to the coding style guidelines shown later in this syllabus.
- Program in Fortran 90 (strongly preferable) or in C/C++. I will post Fortran 90 sources for all code I hand out.

Projects

Instead of tests, there will be two approximately three-week projects. The purpose of these projects will be to explore in greater detail than a homework assignment a problem related to the class material. Fully detailed handouts will be provided later.

Computing environment

If you don't have one already, you will be given an account on tesla.cps.brockport.edu, one of our department's clusters. This is a Linux machine. If you are not already proficient in the basics of working in a Linux or Unix environment, you should become so immediately.

The Web

The course Web page will be updated frequently. In addition to being passed out in the classroom, assignments, answer keys, and so on will be posted. No grades will be accessible from the Web.

Grading

Two projects: 40% (20% each)

Homework: 60% (late homework penalized 25% per day; homework due at the beginning of class).

There will be no tests or final exam.

The importance of writing/presentation skills can not be over-emphasized. Writing/presentation skills (including, when applicable, coding style) will comprise 15% of the grade for all homework assignments, and a larger percentage for projects.

I am a great believer in partial credit. I can't give credit for a one-line wrong answer, but if you show your work, you will receive partial credit for what you did correctly. (You'll also receive higher quality, more targeted feedback).

Final grades will be assigned according to the following cutoffs. The cutoffs may be lowered under some circumstances, but they will never be raised.

Grade	Average	Grade	Average
A	93.0 & above	B-	80.0-82.9
A-	90.0-92.9	C+	77.0-79.9
B+	87.0-89.9	C	73.0-76.9
B	83.0-86.9	E	< 73.0

Coding style guidelines

In order to make it as easy as possible to understand and grade your work, I am gradually introducing a set of coding guidelines to be used in all of my upper level courses. At a minimum, please adhere to the following guidelines:

1. Begin your program with a comment block that includes your name, the homework problem or project number, and any other relevant identifying information, as well as any other comments you wish to include.
2. Separate your code into paragraphs interspersed with comment blocks. Paragraphs and/or comment blocks should be separated from one another by one empty line.
3. Indent in a way that enhances readability:
 - a. Indent each for, do, while, or do-while statement block by some number of spaces (at least two).
 - b. Indent each if block by some number of spaces (at least two).
 - c. Do not use TAB characters to indent.
 - d. In C/C++ programs, it does not matter to me whether or not braces off-setting statement blocks are on their own separate lines. However you choose, be consistent throughout the program.
4. In Fortran programs, use implicit none in all main programs, functions, and subroutines. Never rely on the Fortran naming convention.
5. Name variables, and other identifiers such as function names, in a manner that makes it as easy as possible to determine their scope and purpose. Here is a sampling of common practices, meant to inspire you to develop your own style:
 - a. Variables and other identifiers such as subroutine and function names consist of short capitalized words strung together (e.g., SumX for sum of X, SumXX for sum of squares of X, NumIterMax for maximum number of iterations). An alternative is to use lower case and to separate words with underscores (e.g., sum_x, sum_xx).
 - b. Parameters (in Fortran) or defined constants (in C/C++) have all upper case letters, with words separated by underscores (e.g., MAX_SIZE).
 - c. More complicated naming conventions may apply to module identifiers (e.g., MODNAME_VarName) or to identifiers in complicated or large programs.
 - d. Variable names are no longer than 15 characters.

An excellent book on all aspects of software construction is Mike McConnell's *Code Complete* (Microsoft Press). Although the book is aimed at business programmers, it is full of advice useful to all programmers.

General policies

Course policies are in accordance with “*SUNY Brockport 2007-2008: Your Right to Know & Academic Policies Handbook*”.

Students are expected to attend all classes. Absences will be excused for (a) documented illness, (b) official representation of the college, (c) death of a close relative, (d) religious holidays, and (e) other circumstances beyond the control of the student. The student is responsible for obtaining class notes and handouts for classes missed. Missing classes does not absolve the student of responsibility for any course work. In accordance with suggested College policy, any student whose unexcused absences exceed 15% of classes may receive a lowered grade or failure at the instructor’s discretion.

No incompletes or withdrawals will be given for this course except in cases of illness, personal tragedy, or extraordinary circumstances beyond the student’s control, and then only if documented to the instructor’s satisfaction.

While you are encouraged to work together, any assignments handed in must be your own work. Submitting material as your own work that is not entirely your authorship or knowingly providing an answer to another person constitutes cheating. If I am convinced beyond a reasonable doubt that cheating has occurred, the person(s) submitting the illicitly obtained answer, and any person(s) knowingly providing the same, will receive a grade of zero for that assignment. Further disciplinary procedures may also be considered.

SUNY Brockport is committed to maintaining a workplace and learning environment free of sexual harassment and intimidation. Sexual harassment is unacceptable behavior, unlawful, and intolerable.

I do not have the authority to cancel classes, no matter how severe the weather. Only the President of the College makes that decision. On days of severe weather, please listen to WBSU (89.9 FM) or WHAM (1180 AM) for class cancellations. You may also call 395-COLD. If I have any information, I will do my best to send email or post a message on my Web page.

Disability statement

Students with documented disabilities may be entitled to specific accommodations. SUNY Brockport's Office for Students with Disabilities makes this determination. Please contact the Office for Students with Disabilities at 395-5409 or osdoffic@brockport.edu to inquire about obtaining an official letter to the course instructor detailing approved accommodations. The student is responsible for providing the course instructor with the official letter. Faculty and staff work as a team with the Office for Students with Disabilities to meet the needs of students with disabilities.

Disclaimer

Announcements given in class or on the Web are considered official addenda to course policies. All policies described are subject to change as the situation warrants. Should changes be necessary, all students will be notified in a timely fashion.