

# MATHEMATICS 602: Mathematical Principles in Science II

## Info for Winter 2012

9:30 a.m. MWF, Bolz Hall BO 0412

2:30 p.m. MWF Smith Lab SM1138

**Instructor:** Dr. Rodica D. Costin

**Office:** 436 Math Tower

**Office hours:** MF 10:30 - 11:20 or by appointment

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**web page:** [http://www.math.ohio-state.edu/~rcostin/602\\_2012/](http://www.math.ohio-state.edu/~rcostin/602_2012/)

**Prerequisites:** Math 601; linear 2nd order o.d.e.'s with constant coefficients; being able to recognize (and hence solve) Euler's differential equation.

## Reference texts

1. Linear Algebra and Its Applications (In the 3rd edition: Chapter 5, 6; Appendix A) by G. Strang
2. Linear Mathematics in Infinite Dimensions, by U.H. Gerlach, typeset lecture notes,  
only Chapters 1 and 3 in <http://www.math.ohio-state.edu/~gerlach/math/BVtypset/>
3. Lecture notes posted on the web page.

## Homework

One homework set every week, generally posted on the web page

[http://www.math.ohio-state.edu/~rcostin/602\\_2012/](http://www.math.ohio-state.edu/~rcostin/602_2012/)

each Monday and due the following Monday at the beginning of class.

*Students in the 9:30 section* – you may consult me during Monday's office hour (10:30-11:20 a.m.) regarding homework due that day; you then have a grace period until noon to submit the homework, which should be placed it in a dedicated envelope that I will have outside the door to my office.

## Exams

One take-home comprehensive final.

Team work: YES for homework, NO for the exam.

- For each homework assignment, collaboration is allowed. Every student must submit his/her own solutions.
- The FINAL EXAM IS INDIVIDUAL, and any collaboration is strictly prohibited.

## Grading policy

Each assignment paper will be graded for mathematical correctness AND PRESENTATION. Points will be DEDUCTED for sloppiness, incoherent or insufficient explanation, or for lack of supporting reasoning. The solutions should be presented so that your fellow students and your prospective client could read them and follow both the calculations and logic.

Each assignment (8 or 9 total) will consist of approximately 100 possible points, and the Final Exam will be worth about 200 points. There is a total of about 1000 points. Late papers will not be accepted except in extreme situations with documented excuse. It is the student's responsibility to be aware of all instructions that are delivered during class, including departures from general assignments.

## Use of software

You are encouraged and sometimes have to use a software package such as Maple, Mathematica, or Matlab. You are encouraged to check routine calculations this way.

When you use software, you should submit the output + explanations (what calculations you did and why). A simple solution consisting of output from, say, Maple is NOT sufficient. Use common sense here.

## Syllabus (in essence)

EIGENVALUES AND EIGENVECTORS

Adjoint of an operator

Hermitian operators

Spectral theorem

Triangularization via unitary similarity transformation

Diagonalization of normal matrices

Positive definite matrices  
Quadratic forms and the generalized eigenvalue problem  
Extremization with linear constraints  
Rayleigh quotient  
Singular value decomposition of a rectangular matrix  
Pseudo-inverse of a rectangular matrix

**INFINITE DIMENSIONAL VECTOR SPACES: EXAMPLES**  
Sturm-Liouville systems: regular, periodic, and singular Sturm-Liouville series

**INFINITE DIMENSIONAL VECTOR SPACES: PRINCIPLES**  
Inner product spaces  
Complete metric spaces  
Hilbert spaces  
Square summable series and square integrable functions  
Least squares approximation  
Projection theorem  
Generalized Fourier coefficients  
Bessel's inequality  
Parseval's identity and completeness  
Unitary transformation between Hilbert spaces