MATHEMATICS 602
Mathematical Principles in Science II
Info for the section of Winter 2010, 9:30 a.m. MWF, University Hall 0151

Instructor: Dr. Rodica D. Costin,
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web page: http://www.math.ohio-state.edu/~rcostin/602/

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

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, Chapters 1 and 3 in http://www.math.ohio-state.edu/~gerlach/math/BVtypset/

Syllabus (in essence):
I. 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

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

III. 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 equality and completeness  
Unitary transformation between Hilbert spaces

**Homework:** One homework set every week, generally posted on the web page (http://www.math.ohio-state.edu/~rcostin/602/) each Friday and due the following Friday AT THE START OF CLASS.  

**Exams:** One take-home comprehensive final.  

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

- For each homework assignment, TEAMS are allowed and even encouraged, with a limit of 3 persons per team (but NOT for the final exam!!). Each team submits ONE SET OF SOLUTIONS, signed by each member, and every team member receives the same grade.  
  It is preferably that the teams change their their composition from week to week.  
- The FINAL EXAM IS INDIVIDUAL, and any collaboration is strictly prohibited.

**Homework 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 rationale. The solutions should be presented so that your fellow students and your prospective client could read them and follow both the calculations and logic.  

**Grading policy:** 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 obligated to use a software package such as Maple or Matlab. So, practice with some linear algebra software soon, and get used to working with it. All routine calculations should be checked this way. If we want you to do hand calculations, we will make it explicit. Even then, check yourself. Moreover, when you use software, you must acknowledge that you did, and support the output with some form of explanation: why it was used, and an interpretation of any answer that is not just a routine calculation. A simple solution consisting of output from, say, Maple is NOT sufficient. Common sense should rule here.