Department of Mathematics

Course Profile

Course Number: MATH 428	**Course Title: Numerical Linear Algebra**
Required / Elective : Elective	**Pre-requisite :** None
Catalog Description: Numerical methods for solving linear systems of equations, linear least squares problems, matrix eigenvalue problems, nonlinear systems of equations, interpolation, integral, and initial value problems of ordinary differential equations.	**Textbook / Required Material :** "Numerical Analysis", by R. L. Burden, J. D. Faires and A. C. Reynolds, Published by PWS Publishers, 1981. "Numerical Analysis: Mathematics of Scientific Computing", by D. Kincaid and W. Cheney, Published by Brooks/Cole, 2002.

Course Structure / Schedule : (3+0+0) 3 / 7 ECTS

Extended Description :

The goal of this course is to familiarize students with computational aspects of linear and nonlinear systems of equations. The topics include: Direct and iterative methods for solving linear systems of equations, Least squares approximation theory, Matrix eigenvalue problems, Numerical solutions of nonlinear systems of equations. Most of the material to be covered can be found in chapters 6-9 of the first textbook and in chapters 4-6 of the second textbook.

The first chapter is about direct solution methods for linear systems of equations (Gaussian elimination, backward substitution, LU factorization, Cholesky factorization). The second chapter is devoted to approximation theory (least-square approximation, rational function approximation, trigonometric polynomial approximation). The third chapter is about iterative solution methods for linear systems of equations (Jacobi iterative method, Gauss-Seidel iterative method, succesive over-relaxation method). The fourth chapter is devoted to computational aspects of matrix eigenvalue problems (Schur's theorem, Gerscgorin circle theorem, power method, QL method, QR method). The fifth chapter is about numerical solution methods for nonlinear systems of equations (Newton's method, quasi-Newton methods).

Design content: None.	**Computer usage:** MATLAB assignments

Course Outcomes:

By the end of the course the students should be able to:

1. know the standard numerical methods for solving linear systems of equations **[2,3],**
2. understand the basic concepts of approximation theory **[2,3],**
3. solve numerically matrix eigenvalue problems **[2,3],**
4. write MATLAB programs for solving linear and nonlinear systems of equations **[5].**

[2] demonstrate knowledge of mathematics to construct, analyze and interpret mathematical models,

[3] demonstrate the ability to apply mathematics to the solutions of problems,

[5] have an ability to write computer programs and use algorithms for solving problems,
Recommended reading: Numerical Linear Algebra", by L. N. Trefethen and D. Bau, D. Published by SIAM, 1997.
Teaching methods: Preparatory-readings, lectures, discussions, assignments, MATLAB assignments
Assessment methods: Midterm exams, MATLAB assignments, final exam.
Student workload: Preparatory reading.....54 hrs Lectures……42 hrs Assignments…….56 hrs Discussions……..14 hrs Midterm exams……..6 hrs Final exam…….3 hrs **TOTAL …… 175 hrs … to match 25 x 7 ECTS**

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