**Department of Mathematics**

# Course Profile

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| **Course Number: MATH 302** | **Course Title: Numerical Methods** |
| **Required / Elective :** Required | **Pre-requisite:** MATH 200 |
| **Catalog Description:**<br>Solution of non-linear equations, fixed point iteration; interpolation, Chebyshev polynomials, cubic spline interpolation. Numerical differentiation and integration, solution of system of linear equations: direct and iterative methods. Numerical solution of ordinary differential equations. | **Textbook / Required Material:**<br><br>K. E. Atkinson, W. Han, *Elementary Numerical Analysis*, *3*Ed. John Wiley, 2004. |
| **Course Structure / Schedule: (3+0+0) 3 / 5 ECTS** | |
| **Extended Description:**<br>Taylor polynomials; Rootfinding: the Bisection method, Newton's method, the Secant method, Fixed point iteration. Interpolation and approximation; Polynomial interpolation, Divided differences, Error in polynomial interpolation. Interpolation using spline functions. Chebyshev polynomials, a near-minimax approximation, Least squares approximation. Numerical integration, the trapezoidal and Simpson rules, error formulas. Gaussian numerical integration method. Numerical differentiation, Differentiation by interpolation, Method of undetermined coefficients.<br>Systems of linear equations, Gaussian elimination, partial pivoting, LU factorization. Tridiagonal systems, errors in solving linear systems, Iteration methods, Jacobi iteration, Gauss-Seidel iteration. Ordinary differential equations, Euler's method, convergence. Taylor and Runge-Kutta methods for initial value problems. | |
| **Design content**: None | **Computer usage:** Students use software packages to implement the numerical methods. |

**Course Outcomes:** By the end of the course the students should be able to:

1. solve numerically nonlinear equations in a single variable **[3, 5],**
2. have a basic knowledge of numerical interpolation and approximation of functions **[3, 5],**
3. have a basic knowledge of numerical integration and differentiation **[3, 5, 6],**
4. be familiar with numerical solution of ordinary differential equations **[3, 5, 6].**

**[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,**

**[6] have a basic knowledge of the main fields of mathematics, including analysis, algebra, differential equations, differential geometry.**

**Recommended reading:**

D. Kincaid and W. Cheney, *Numerical Analysis: Mathematics and Scientific Computing*, 3E,

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| Brooks/Cole, 2002. | |
| **Teaching methods:**<br>Pre-readings, lectures, small projects and individual exercises. | |
| **Assessment methods:**<br>Projects, midterm exams, final exam | |
| **Student workload:** | |
| Preparatory reading | 40 hrs |
| Lectures, workshop, discussions | 50 hrs |
| Homework | 20 hrs |
| Projects | 12 hrs |
| Final Exam | 3 hrs |
| **TOTAL ……** | **125 hrs … to match 25 x 5 ECTS** |
| Prepared by: Saadet Erbay | Revision Date: 08.02.2010 |