Course number and name: Numerical Methods
Credits: 6 ECTS (3 US credits)
Credit categorization: Mathematics and basic science
Instructor: To be determined

Office:
Email:
Office hours:

Text book:

Required:
Chapra, Steven C. and Canale, Raymond P.; Numerical Methods for Engineers; 7th Edition (2014), McGraw-Hill Science/Engineering/Math

Recommended supporting material:
Moler, Cleve; Numerical Computing with Matlab; 2nd edition (2013); Society for Industrial & Applied Mathematics

Specific Course information:

Brief description:
The course aims at giving students the necessary tools for the use of computers and scientific software to solve engineering problems. These skills are essential both to facilitate further development of subjects in their studies and their future professional work. The course includes the description of the available methods for the numerical solution of specific problems, and furthermore, the use of state-of-the-art software for planning and problem solving.

Prerequisites or co-requisites:
Mathematics, basic programming skills

Required (Required, Elective or Selected Elective)

Course objectives and outcomes:

Course objectives:

1. Provide students with basic knowledge on numerical methods and their role in society and engineering.
2. Understand and properly plan the use of numerical methods to solve engineering problems.
3. Apply numerical methods and use software to solve problems coming from engineering practical applications.

Course outcomes:

1. Identify, formulate and solve engineering problems using numerical methods (ABET outcome 1)
2. Ability to communicate effectively in oral and written communications (ABET outcome 3)
3. Ability to function effectively on a team to complete class assignments related with the application of numerical methods (ABET outcome 5)
4. Ability to analyze and interpret data, and use engineering judgment to draw conclusions, write and present reports (ABET outcome 6)
5. Ability to acquire and apply new knowledge as needed, using appropriate learning strategies (ABET outcome 7)

List of topics to be covered:

1. Introduction and basic concepts.
   Direct and iterative algorithms. Errors.
2. Roots of equations
   Bisection, Regula-Falsi, Secant, Newton-Raphson, Brent methods. Methods for polynomial equations.Solving systems of nonlinear equations.
3. Systems of linear equations
   Gauss, Gauss Jordan, LU, Thomas, Cholesky, Jacobi and Gauss Seidel methods.
4. Eigenvalues and eigenvectors
   Power, Jacobi, Householder, QR methods.
5. Curve Fitting
   Linear and nonlinear regression. Interpolation. Fourier Transform.
6. Numerical differentiation and integration
   The trapezoidal rule, Simpson 1/3 and Simpson 3/8 rules. Gauss quadrature. Multiple integrals.
7. Ordinary Differential Equations
   Initial value problems. Runge-Kutta methods. Systems of differential equations. Boundary value problems. Shooting method. Resolution by finite differences.
8. Partial Differential Equations
   Elliptic equations. Liebmann method. Parabolic and hyperbolic equations. Explicit, implicit, Crank-Nicolson and lines methods. Introduction to the finite elements method.
9. Optimization of functions
   One-dimensional and multidimensional unrestricted optimization. Simplex method of linear programming.

Assessment structure:

Methods of Evaluation	**Weight**	**Date/freq.**	**Description**
Final exam	40%	End of semester	Grading: 70% problems, 30% theory
Following up activities	25%	Three/ course	Assessment controls lasting 1 hour. Grading: average of the 2 highest marks
Homework and presentations	10%	Every week	Assessment of report writing and oral communication skills
Projects	25%	Two/course	Assessment of programming skills and ability to apply numerical methods