Course title: Mathematical Modelling

Course code: 63219

ECTS: 6

Professor: Žiga Virk and Aljaž Zalar

Undergraduate program

Prerequisite knowledge:

- Linear algebra (matrix analysis: basic matrix operations, eigenvalues, spectral decomposition, orthogonal similarity, linear transformation)
- Calculus (univariate and multivariate functions: basic knowledge on elementary functions, continuity, derivative and gradient, extrema, univariate integration)

Short course decription:

The course is divided into four main chapters: linear modelling, nonlinear modelling, geometric modelling and dynamical modelling.

Linear modelling examines linear systems of equations using a theory of generalized matrix inverses, in particular the Moore-Penrose inverse. Singular value decomposition and its application to principal component analysis are discussed.

Nonlinear modelling deals with methods for solving systems of nonlinear equations. The basics of vector functions are presented. The Newton and Gauss-Newton methods are used to solve such systems.

The geometric modelling chapter deals with curves and surfaces (parameterization, arc length calculation, curvature, basic plotting methods, area computation).

Finally, dynamical models using systems of differential equations are examined. Analytical methods for solving such systems are studied, while numerical methods for calculating concrete solutions are also presented, in particular (adaptive) Runge-Kutta methods.

The assessment of the students' work is based on two homework assignments, a group project and a written examination. The homeworks and the project are based on solving practical problems from different topics of the course. In the written exam, candidates have to solve theoretical problems without the use of computer equipment. The main software used at lab sessions is Matlab.