

## Ph D - Energy

### Course – numerical methods in Matlab

#### Lecturer Professor. Josef Rak - University of Pardubice

##### Course description

Numerical analysis is a branch of mathematics that solves problems using numerical approximation. Numerical methods are techniques by which the mathematical problems involved with the engineering analysis cannot readily or possibly be solved analytically. Examples of numerical methods include solving of non-linear equation, ODE's and numerical optimization, which is finding minimal or maximal value of function of one variable or more variables. Numerical methods are implemented on computer. One possible platform for implementing numerical methods is Matlab. Many numerical methods are already implemented there. Matlab has also big advantage. Many math operations for example vectors and matrices operations are implemented there. It has also many visualization components. Comparing of exact solution and numerical solution can be done very quickly as well as displaying results graphically. In this course selected numerical problems will be explained. Also demonstration of methods in Matlab will be done. The course will have following three topics.

##### Lectures

1. Numerical methods for solving non-linear equations (Thursday 16.5. 9:30-12:30)

Basic methods for finding solution of non-linear equations (Bisection and regula-falsi method and Newton's method) and polynomial roots (Sturm sequence) will be explained and implemented in Matlab with graphical visualization.

2. Numerical methods for ODE (Thursday 16.5. 14:00-16:00)

Explicit Runge Kutta and multistep methods for solution of ODE's will be explained and demonstrated in Matlab. Also problem of explicit methods in stiff tasks will be demonstrated.

3. Numerical optimization methods (Monday 20.5. 9:30-11:30)

Numerical optimization is task to find minimal value of function of one or more variables. For function of one variable golden section method will be explained and implemented in Matlab. For functions of more variables two basic methods - steepest descent method and Newton's method will be explained and demonstrated. Finally, more sophisticated methods derived from the basic methods (Conjugate gradient method, trusted region method) will be also explained and demonstrated.

##### Location

Building 9 – Sala Direzione – 2<sup>nd</sup> floor  
Please, bring your laptop with you

##### Registration

Send an email to [gaetano.zizzo@unipa.it](mailto:gaetano.zizzo@unipa.it) by May 15, 2024 6:00 p.m.

The course will give Education Credits to all students.