Course requirements

BME Faculty of Natural Sciences, Mathematician MSc Applied Numerical Methods with Matlab

Neptun code: BMETE92AM54 **Requirements:** 2/0/2/F/4 (2x45 minutes lecture, 2x45 minutes computer lab, midterm mark, credits to be earned: 4 credits)
Semester: spring 2020/21 **Language:** English
Lecturer: Róbert Horváth (A0)
Computer laboratory tutor: Róbert Horváth (A1)

Online materials: MS Teams

Prerequisites: linear algebra, one- and multivariable analysis, ordinary differential equations

Goal of the course: The goal of the course is to introduce, understand and try the basic numerical methods applied in many fields of applied sciences.

Outline of the course:

- Usage of MATLAB (all discussed numerical methods will be introduced and tested in MATLAB)

The discussed topics are:

- error calculation,
- direct and iterative solution of linear systems of equations: Gauss elimination, Gauss transform, factorizations of matrices, condition of linear systems of equations, Jacobi and Gauss-Seidel iterations, relaxation, convergence of the iteration, error estimation,
- estimation of the eigenvalue and the eigenvector, the power method, inverse power method, QR iteration,
- solution of nonlinear systems of equations,
- simple interpolation with polynomials, Hermite interpolation, interpolation with third degree splines, least squares approximations with polynomials and trigonometric polynomials,
- trigonometric interpolation, basics of fast Fourier transform,
- numerical differentiation,
- numerical integration, Newton-Cotes formulas and its usage, Gaussian quadrature,
- numerical solution of initial value problems of ordinary differential equations, basic terms of one-step methods, Runge-Kutta methods, stability, convergence and error estimation of one-step methods, multistep methods,
- numerical solution of boundary value problems of ordinary differential equations.

Attendance requirements. Because of the online teaching, there are no attendance requirements. However, it is It is highly advisable to follow the classes and solve the homework assignments regularly.

Midterm tests: Two 90 minutes tests for 50 points each. Hand-written notes, course materials, Matlab codes can be used but it is not allowed to use the help of anyone.

Test 1: 7th week, regularly scheduled lecture on 25 March, Thursday, 12-14, replacement and corrective tests will be organized in the week dedicated to replacements.
Topic: from week 1 to week 6

Test 2: 14th week, regularly scheduled computer lab on 13 May, Thursday, 14-16, replacement and corrective tests will be organized in the week dedicated to replacements
Topic: from week 7 to week 13

Grading rules:

Students will write two midterm tests (so-called recapitulative assessments of knowledge) during the semester. Both tests (90-90 minutes) are worth maximum of 36-36 points. We call a test successful if the student gains not less than 15 points (40%). Besides the tests, the lecturer will appoint some assignments for homework each week. These assignments are not for submission. Students should solve them at home to prepare for the tests.

Students who are not familiar with Matlab should go through the introductory Matlab course Matlab Onramp (ca. 2 hours, https://www.mathworks.com/learn/tutorials/matlab-onramp.html).

Students must have two successful tests to obtain a mark at least “pass” (2). Thus, if a student has an unsuccessful test then he or she must write the test again (replacement test). This will be possible in the week dedicated to replacements (15th week) at a pre-agreed date and time. Both midterm tests can be replaced at most twice, but the second retake has some special fee. With a corrective intent (corrective test), students may write the tests again also parallel with the first replacement tests. The results of the new tests (if submitted) replace that of the previous tests. It is not possible to fail with a corrective test. If the corrective test is unsuccessful then the student will get the minimum score 15.

The maximum obtainable score in the semester is 72(=36+36) points, and the final midterm mark is identified as follows:

30- pass (2)
40- average (3)
50- good (4)
60- excellent (5).

Consultations: in the office hours of the lecturer (Thursdays 16-17). Here you can ask questions regarding the lectures, computer labs and homework assignments.

Lecture notes:

- Matlab files available in MS Teams.
- Assignments for homework in MS Teams.

Other readings:

- Laurene V. Fausett, Applied Numerical Analysis Using Matlab, Pearson Prentice Hall, 2008
- W. Cheney, D. Kincaid, Numerical Mathematics and Computing, Brooks/Cole, Cangage learning, 2013
- Steven C. Chapra, Applied Numerical Methods with MATLAB - for engineers and scientists, McGraw Hill, 2008

Catch up with Matlab:

- https://www.mathworks.com/moler/chapters.html
- https://web.stanford.edu/class/ee254/software/using_ml.pdf

Budapest, 2nd February 2021

_____

Course leader