University of Basilicata Studies

DEPARTMENT OF MATHEMATICS, INFORMATICS AND ECONOMICS

COURSE: COMPLEMENTS IN NUMERICAL ANALYSIS			
ACADEMIC YEAR: 2019/2020			
TYPE OF EDUCATIONAL ACTIVITY: Characterizing			
TEACHER: Martina Bulai			
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phone:		mobile (optional):	
Language: Italian			
ECTS: 6	n. of total hours: 56 n. of hours of lessons: 32 n. of hours of practice: 24	Campus: Potenza Dept: DiMIE Program: Mathematics	Semester: Second

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

The knowledge and how to use of the numerical methods for approximating the derivatives of a real function, the solutions of a Cauchy problem, the eigenvalues and the eigenvectors of a matrix, the solution of a finite difference equation. To be able to choose between antagonists methods for solving a specific problem , comparing the order of convergence, stability of algorithms, computational cost. To achieve a good level in programming algorithms, for example, in MatLab in order to apply the studied numerical methods. To be able to read the numerical results provided by the machine when a numerical procedure is implemented.

PRE-REQUIREMENTS

In order to attend the course the knowledge of the arguments from the courses of Calculus I, Calculus II, Discrete Mathematics I and Numerical Analysis is required. Moreover the knowledge of MatLab is required.

SYLLABUS

Numerical differentiation (8 h)

Finite difference methods. Numerical differentiation based on Lagrange interpolation.

Numerical methods for ordinary differential equations with initial value conditions (20 h)

The Cauchy problems (IVP): conditioning and overview of the numerical methods. One-step methods: stability and convergence. Runge-Kutta methods: the choice of the step. Linear multistep methods: local truncation error and consistence, stability and convergence. Construction of the linear multistep methods. The predictor-corrector method.

Approximation of the eigenvalues and the eigenvectors of a matrix (20 h)

Eigenvalues and eigenvectors of a matrix: localization theorems and conditioning. The power iteration method: normalization with respect to the infinity norm and the 2 norm. The inverse power method for the computation of the smallest eigenvalue. The inverse power method for improving the approximation of an eigenvalue and for computing one of the corresponding eigenvectors. The QR method.

Numerical methods for finite difference equations (8 h)

First order linear difference equations with constant coefficients. Higher order linear difference equations and simultaneous difference equations with constant coefficients. Equilibrium and stability analysis. Application to population dynamics: Malthus, Verhulst and Leslie models.

Practical implementation of the studied algorithms in MatLab

TEACHING METHODS

Theoretical lessons, Laboratory tutorials.

EVALUATION METHODS

Practical test and oral examination. The aim of the examination is to test the level of achievement of the previously mentioned educational goals. The exam is divided into 2 parts:

- a practical test with the computer (resolution of three numerical exercises) on all the topics covered in the course; the test is intended to assess the understanding of the topics and the ability to choose between the different methods studied in the numerical solution of a specific problem. The student who does not show sufficient knowledge of the subjects is not admitted to the oral test; to pass the test one must acquire at least 18 points out of

30. The estimated time for the test is 2.5 hour
- an oral test which will evaluate the ability to link and compare different aspects covered during the course; to pass the test one must acquire at least 18 points out of 30.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Lecture notes and teaching material for exercises provided by the teacher, available on the online learning platform of the website of the degree courses in mathematics.

TEXTBOOKS

- G. Monegato, Fondamenti di Calcolo Numerico, CLUT (Torino)
- A. Quarteroni, R. Sacco, F. Saleri, Matematica Numerica, Springer
- D. Bini, M. Capovani, O. Menchi, Metodi Numerici per l'algebra lineare, Zanichelli

INTERACTION WITH STUDENTS

At the beginning of the course, the teacher describes the objectives, program and evaluation methods. The teacher makes available the lecture notes on the online learning platform of the website of the degree courses in mathematics.

Office hours: Monday from 15.00 to 17.00.

In addition to weekly reception, the teacher is available at all times for a contact with the students through their email.

EXAMINATION SESSIONS (FORECAST)[1]

17/06/2019, 1/07/2019, 24/07/2019, 23/09/2019, 21/10/2019, 16/12/2019

SEMINARS BY EXTERNAL EXPERTS YES □ NO X

FURTHER INFORMATION

[1] Subject to possible changes: check the web site of the Teacher or the Department/School for updates.