excelling math education...

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SUBJECT:	Numerical methods for Partial Differential Equations
ECTS CREDITS:	6 ECTS
TEACHERS, UNIVERSITY AND EMAILS:	1. Khusanov Kasim (TTPU, k.khusanov@gmail.com 2. Fayazov Kudratillo (TTPU, kudratillo52@mail.com)
RESPONSIBLE TEACHER:	Khusanov Kasim
LANGUAGE OF INSTRUCTION:	English
ACADEMIC COURSE:	2016—17.
NAME OF THE MASTER'S DEGREE:	Master in Mathematical Engineering.

COURSE AIMS:

- Introducing students to the numerical methods for PDE and its applications in process engineering
- Understanding the basic principles of finite differences and finite elements in one dimensional problems
- Understanding the basic principles and analysis of finite differences and finite elements in several dimensions: elliptical, parabolic and hyperbolic problems
- Being able to solve problems of PDE numerically
- Being able to apply various numerical mathematical methods to solve the resulting problems

LEARNING OUTCOMES (SKILLS):

Basic:

- To be able to apply the acquired knowledge and abilities to solve problems in new or unfamiliar environments within broader contexts, including the ability to integrate multidisciplinary R & D in the business environment.
- To have the ability to communicate the findings to specialist and non-specialist audiences in a clear and unambiguous way.
- To have the appropriate learning skills to enable them to continue studying
- in a way that will be largely self-directed or autonomous, and also to be able to successfully undertake doctoral studies.

Specific:

- To be able to select a set of numerical techniques, languages and tools, appropriate to solve a mathematical model.

Numerical simulation specialization:

- - To know, be able to select or use how to handle most suitable professional software tools (both commercial and free) for the simulation of processes in the industrial and business sector.

COURSE SYLLABUS:

- Introduction to the numerical methods for the resolution of Differential Equations: finite differences, finite elements, finite volumes (3h).
- Methods of finite differences and finite elements in one dimensional problems (12h).
- Methods of finite differences and finite elements in several dimensions: elliptical, parabolic and hyperbolic problems (24h).
- Interactive classes using COMSOL-MULTIPHYSICS (21h).

LITERATURE:

1. LeVeque,R.J., Finite Difference Methods for Ordinary and Partial Differential Equations: Steady State and Time Dependent Problems, SIAM,2007.
2. Samarskii, A.A., The Theory of Difference Schemes, Marcel Dekker, New York, 2001.
3. Strickwerda, J.C., Finite Difference Schemes and Partial Differential Equations, Chapman &Hall/CRC, Boca Raton, 1999.
4. Reddy, J.N., An introduction to the Finite Element Method, 2ª-3ª(1993-2006), Mc Graw Hill.
5. Johnson, C., Numerical solution for partial differential equations, 2009, Dover publications
6. Eriksson, K. Estep, D. Hansbo, P. Johnson, C.,Computational differential equations, 1996, Cambridge.
7. Class notes and COMSOL MULTIPHYSICS manuals.

TEACHING METHOD:

- Online lecture notes, tutorial solutions, peer mentoring, videoconference to all CA partners.
- Troubleshooting and / or exercises: the student has to resolve and deliver theoretical exercises of compression of the methods, practical of application to concrete problems and resolved with some software of numerical simulation: Matlab or Comsol Multiphysics.
- Practice in computer rooms: in the computer laboratory and using COMSOL Multiphysics resolve real cases simplified of diverse subjects: thermal, linear elasticity, electromagnetism, etc.
- Master sesions: these classes are devoted to explain the theoretical contents, to resolve some exercise to understand the methods and to introduce the practices of laboratory.

METHOD OF ASSESSMENT:

- Attendance and class participation (5%).
- Individual exercises (25%).
- Two lab practices (30% all the same).
- Compulsory final exam: theory (20%) and lab practices (20%).

STUDENT WORKLOAD:

On-site work at the classroom (attendance to classes and participation on them) = 60 hours.
Lecture hours: 3 hours per week
Practical/Lab hours: 3 hours per week
Mid term exam: 2 academic hours
Final exam: 2 academic hours

Self-study (autonomous study, doing exercises, programming, recommended readings) = 54 hours.