34959 - CM - Computational Mechanics

**Coordinating unit:** 200 - FME - School of Mathematics and Statistics

**Teaching unit:** 749 - MAT - Department of Mathematics

**Academic year:** 2016

**Degree:** MASTER'S DEGREE IN ADVANCED MATHEMATICS AND MATHEMATICAL ENGINEERING (Syllabus 2010). (Teaching unit Optional)

**ECTS credits:** 7,5  
**Teaching languages:** English

### Teaching staff

**Coordinator:** JOSE JAVIER MUÑOZ ROMERO

**Others:** Segon quadrimestre:  
JOSE JAVIER MUÑOZ ROMERO - A

### Prior skills

- Basic knowledge of numerical methods
- Basic knowledge of partial differential equations

### Degree competences to which the subject contributes

#### Specific:
1. **RESEARCH.** Read and understand advanced mathematical papers. Use mathematical research techniques to produce and transmit new results.
2. **MODELLING.** Formulate, analyse and validate mathematical models of practical problems by using the appropriate mathematical tools.
3. **CALCULUS.** Obtain (exact or approximate) solutions for these models with the available resources, including computational means.
4. **CRITICAL ASSESSMENT.** Discuss the validity, scope and relevance of these solutions; present results and defend conclusions.

#### Transversal:
5. **SELF-DIRECTED LEARNING.** Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
6. **EFFICIENT ORAL AND WRITTEN COMMUNICATION.** Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
7. **THIRD LANGUAGE.** Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
8. **TEAMWORK.** Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
9. **EFFECTIVE USE OF INFORMATION RESOURCES.** Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
The main objective is to provide a general perspective of the broad field of computational mechanics, covering both the modelling and the computational aspects. A broad range of problems is addressed: solids, fluids and fluid-solid interaction; linear and nonlinear models; static and dynamic problems. Some emphasis is put on applications in biomechanical problems. By the end of the course, the students should:
- Be able to choose the appropriate type of model for a specific simulation
- Be familiar with the mathematical objects (mainly tensors) used in computational mechanics
- Be aware of the different level of complexity of various problems (e.g. linear vs. nonlinear, static vs. dynamic).

Learning objectives of the subject

Teaching methodology

Four elements will be combined:
- Theory classes, where the main concepts will be presented.
- Practical classes with Matlab code in the computer room, with emphasis on the computational aspects.
- Lists of short assignments.
- Course projects, with applications in biomechanics. To be presented at the end of the course.

Students will work on the assignments and course projects individually or in groups.

| Study load | Total learning time: 187h 30m | Hours large group: 60h 32.00% | Self study: 127h 30m 68.00% |
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### Content

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<th><strong>CONTINUUM MECHANICS</strong></th>
<th><strong>Learning time:</strong> 31h 15m</th>
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<th><strong>COMPUTATIONAL ELASTICITY</strong></th>
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**Description:**
### Computational Plasticity

**Description:**

**Learning time:** 31h 15m
- Theory classes: 8h
- Practical classes: 2h
- Self study: 21h 15m

### Computational Fluid Dynamics

**Description:**

**Learning time:** 31h 15m
- Theory classes: 8h
- Practical classes: 2h
- Self study: 21h 15m

### Computational Methods for Wave Problems

**Description:**

**Learning time:** 31h 15m
- Theory classes: 8h
- Practical classes: 2h
- Self study: 21h 15m

### Qualification system

Final exam, assigned problems, and course project.
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Bibliography

Basic:


Complementary:


