UCLouvain

# lmeca2410

*2018*

# Mechanics of Materials

| 5 credits | 30.0 h + 30.0 h | Q2 |
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| Teacher(s) | Delannay Laurent ;Simar Aude ; |
| Language : | English |
| Place of the course | Louvain-la-Neuve |
| Main themes | The course presents different mathematical models used by engineers in order to describe the mechanical reponse of deformable materials as well as their ability to sustain crack extensions. Each model is motivated from the physics and adaptations are suggested in order to account for non-linearity under finite strains, anisotropy of composite materials as well as the influence of temperature, environment and strain rate on the mechanical response. A systematic procedure is presented in order to select materials with optimized mechanical properties. |
| Aims | At the end of the course, students will be able :<br>· to solve basic problems using models allowing to predict mechanical responses of materials involving (hyper)elasticity and (visco)plasticity under finite strains as well as crack propagations,<br>· to explain the physics underlying each model and the link between microstructure and macroscopic mechanical properties,<br>· to explain the origin of various phenomena including anisotropy of composite materials, elastic spring back and necking of plastically deformed samples, residual stresses and creep.<br>· to select a material with the best combination of mechanical properties based on the definition of performance indices,<br>1<br>According to the classification of LO in the EPL programme, this activity contributes to the development and acquisition of the following LO:<br>**LO1.1, LO1.2, LO1.3, LO2.1, LO2.2, LO2.4, LO5.3, 5.4, 5.6**<br>• LO1 Foundations of scientific and technical knowledge (LO1.1, LO1.2, LO1.3)<br>• LO2 Engineering skills (LO2.1, LO2.2, LO2.5)<br>• LO3 R & D skills (LO3.2)<br>• LO5 Efficient communication (LO5.3)<br>• LO6 Ethics and professionalism (LO6.1, LO6.3)<br>- - - -<br>*The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".* |
| Evaluation methods | The final exam will asssess both the level of understanding of theoretical concepts and the student's skills to solve practical exercices. Students will be graded while accounting also for the outcome of their project. |
| Teaching methods | The course will involve lectures, practical exercises, mechanical testing in the laboratories and as well as PBL in small groups. |
| Content | The course will cover the following topics :<br>· Materials selection procedure to achieve desired mechanical properties (material classes, performance indices)<br>· Complements of linear thermo(visco)elasticity : phase partitioning of strain and stress in composite materials (incl. eigenstrains and anisotropy)<br>· Contact stresses<br>· Plasticity and viscoplasticity (yield surface, J2 theory, elastic springback, dynamic loading, creep)<br>· Finite strains (hyperelasticity, plastic spin)<br>· Linear elastic fracture mechanics + influence of microstructure on toughness<br>- Fatigue |
| Bibliography | • Lecture notes written by the teachers<br>• Lecture notes written by the teachers |
| Faculty or entity in charge | MECA |

| Programmes containing this learning unit (UE) | | | | |
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| Program title | Acronym | Credits | Prerequisite | Aims |
| Master [120] in Electro-mechanical Engineering | ELME2M | 5 | | |
| Master [120] in Mechanical Engineering | MECA2M | 5 | | |
| Master [120] in Civil Engineering | GCE2M | 5 | | |