

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.



5 credits

30.0 h + 30.0 h

Q2

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 response 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	<p>At the end of the course, students will be able :</p> <ul style="list-style-type: none"> <li>· 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,</li> <li>· to explain the physics underlying each model and the link between microstructure and macroscopic mechanical properties,</li> <li>· 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.</li> <li>· to select a material with the best combination of mechanical properties based on the definition of performance indices,</li> </ul> <p>1 According to the classification of LO in the EPL programme, this activity contributes to the development and acquisition of the following LO:</p> <p><b>LO1.1, LO1.2, LO1.3, LO2.1, LO2.2, LO2.4, LO5.3, 5.4, 5.6</b></p> <ul style="list-style-type: none"> <li>• LO1 Foundations of scientific and technical knowledge (LO1.1, LO1.2, LO1.3)</li> <li>• LO2 Engineering skills (LO2.1, LO2.2, LO2.5)</li> <li>• LO3 R &amp; D skills (LO3.2)</li> <li>• LO5 Efficient communication (LO5.3)</li> <li>• LO6 Ethics and professionalism (LO6.1, LO6.3)</li> </ul> <p>-----</p> <p><i>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".</i></p>
Evaluation methods	<p><b>Due to the COVID-19 crisis, the information in this section is particularly likely to change.</b></p> <p>The final exam will assess both the level of understanding of theoretical concepts and the student's skills to solve practical exercises. Students will be graded while accounting also for the outcome of their project.</p>
Teaching methods	<p><b>Due to the COVID-19 crisis, the information in this section is particularly likely to change.</b></p> <p>The course will involve lectures, practical exercises, mechanical testing in the laboratories and as well as PBL in small groups.</p>
Content	<p>The course will cover the following topics :</p> <ul style="list-style-type: none"> <li>· Materials selection procedure to achieve desired mechanical properties (material classes, performance indices)</li> <li>· Complements of linear thermo(visco)elasticity : phase partitioning of strain and stress in composite materials (incl. eigenstrains and anisotropy)</li> <li>· Contact stresses</li> <li>· Plasticity and viscoplasticity (yield surface, J2 theory, elastic springback, dynamic loading, creep)</li> <li>· Finite strains (hyperelasticity, plastic spin)</li> <li>· Linear elastic fracture mechanics + influence of microstructure on toughness</li> <li>- Fatigue</li> </ul>

Bibliography	• Lecture notes written by the teachers
Faculty or entity in charge	MECA

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