


5.00 credits

30.0 h + 30.0 h

Q2

Teacher(s)	Delannay Laurent ;Simar Aude ;
Language :	English
Place of the course	Louvain-la-Neuve
Prerequisites	This is an advanced course about the mechanics of materials which is addressed to students having prior knowledge about continuum mechanics, linear theory of thermo-elasticity in three dimensions (tensor representation) as well as some basics of materials science (mechanical properties of amorphous and crystalline materials.)
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.
Learning outcomes	<p><b>At the end of this learning unit, the student is able to :</b></p> <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>
Evaluation methods	<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 the daily work (several projects and homeworks graded individually or per group).</p> <p>The relative weight of the final exam in the total grade will depend on the number of projects organized. However, if the mark obtain at the exam is less than 8/20, only this mark will be accounted for in the total grade.</p> <p>If the exam is organized in distant mode, the professors may complete the evaluation by an individual oral exam.</p>
Teaching methods	<p>The course will involve lectures, practical exercises, mechanical testing in the laboratories and as well as PBL in small groups.</p> <p>Face-to-face teaching will be privileged but some activities may also be organized in distant mode.</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>· 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	Learning outcomes
Master [120] in Mechanical Engineering	MECA2M	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		