UCLouvain

lmeca2410

2024

Mechanics of Materials

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Delannay Laurent ;Simar Aude ;
Language :	English > French-friendly
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 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.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 At the end of the course, students will be able : · 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, · to explain the physics underlying each model and the link between microstructure and macroscopic mechanical properties, · 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. · to select a material with the best combination of mechanical properties based on the definition of performance indices, According to the classification of LO in the EPL programme, this activity contributes to the development and acquisition of the following LO: **LO1.1, LO1.2, LO1.3, LO2.1, LO2.2, LO2.4, LO5.3, 5.4, 5.6** • LO1 Foundations of scientific and technical knowledge (LO1.1, LO1.2, LO1.3) • LO2 Engineering skills (LO2.1, LO2.2, LO2.5) • LO3 R & D skills (LO3.2) • LO5 Efficient communication (LO5.3) • LO6 Ethics and professionalism (LO6.1, LO6.3)
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 the daily work (several projects and homeworks graded individually or per group). The relative weight of the final exam: 40% for the year work and 60% for the written exam. If the exam is organized in distant mode, the professors may complete the evaluation by an individual oral exam. The use for homework of generative AI such as ChatGPT, Consensus, Perplexity,... is forbidden.
Teaching methods	The course will involve lectures, exercises and as well as PBL (project based learning) in small groups. Face-to-face teaching will be priviledged but some activities may also be organized in distant mode if required.
Content	The course will cover the following topics : · Materials selection procedure to achieve desired mechanical properties (material classes, performance indices) · Complements of linear thermo(visco)elasticity : phase partitioning of strain and stress in composite materials (incl. eigenstrains and anisotropy) · Contact stresses · Plasticity and viscoplasticity (yield surface, J2 theory, elastic springback, dynamic loading, creep) · Finite strains (hyperelasticity, plastic spin) · Linear elastic fracture mechanics (toughness, stress intensity factor, crack opening displacement, limits of validity of LEFM, energy release rate) - Fatigue (total life and crack propagation, materials factor affecting fatigue life)

Inline resources	https://moodle.uclouvain.be/course/view.php?id=2040
Bibliography	• Lecture notes written by the teachers provided on moodle • Slides provided by the teachers provided on moodle
Faculty or entity in charge	MECA

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Mechanical Engineering	MECA2M	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		
Master [120] in Energy Engineering	NRGY2M	5		