UCLouvain

lmeca2195

2019

Gasdynamics and reacting flows

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)	Papalexandris Miltiadis ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	• Governing equations of compressible flows • Steady and unsteady compressible flows in one dimension • Steady compressible flows in two and three dimensions • Supersonic combustion, detonations • Subsonic combustion - deflagrations, explosions • Introduction of multiphase compressible flows.
Aims	With respect to the reference AA of the programme of studies "Masters degree in Mechanical Engineering", this course contributes to the development and acquisition of the following skills • AA1.1, AA1.2, AA1.3 • AA2.2, AA2.4, AA2.5 • AA3.2, AA3.3 • AA4.1, AA4.2, AA4.3, AA4.4 • AA5.1, AA5.4, AA5.6 • AA6.1, AA6.4 1 More precisely, by the end of the course, the student will be capable i) to use the main concepts of gas dynamics to the analysis of propulsion systems ii) to apply the main concepts of compressible flows to the analysis of the aerodynamics of aircraft and rockets iii) to perform thermo-mechanical calculations involving nonlinear waves of gas dynamics (shock waves, rarefaction waves and contact surfaces) iv) to understand and use elements of supersonic combustion and detonation dynamics to the study of explosions and of systems for hypersonic propulsion. - - - - *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	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** • Written exam, with open books and notes. The score on the exam counts for 70% of the overall score on the course. • 3 homework assignments. The score on each assignment counts for 10% of the overall score on the course
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** • Course lectures • Session of exercices
Content	1. Steady and unsteady compressible flows in one spatial dimension. Variable-area flows, nozzle operation, rocket equation. 2. Compressible potential flow; subsonic and supersonic regime. Characteristic decomposition, applications to airfoils. 3. Simple waves, normal shock waves. Rankine-Hugoniot relations. 4. Steady compressible flows in two and three dimensions.Oblique shocks. Expansion fans and method of characteristics. Prandtle-Meyer equation. Supersonic flow around projectiles. 5. Unsteady flows. Shock formation. Piston-induced flow. Wave interactions. Shock tubes and Riemann problem. Introduction to numerical methods. 6. Detonations. Introduction. Chapman-Jouguet theory. ZND theory. Stability analysis. Multi-dimensional structure. Applications.

Inline resources	http://moodleucl.uclouvain.be/enrol/index.php?id=6803 Homework announcements.
Bibliography	• P.A. Thompson, Compressible Fluid Dynamics, 1988. **Mandatory**. • Additional notes for the course LMECA2195. **Mandatory**, available on the moodle site of the course. • Announcement of the homeworks. **Mandatory**, available on the moodle site of the course. • H.W. Liepmann & A. Roshko, Elements of Gas dynamics, Dover Edition, 1993. **Recommended**.
Faculty or entity in charge	MECA

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