UCLouvain

lmeca2195

2020

Gasdynamics and reacting flows

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

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 • We maintain the right to ask a student for an oral exam in case of technical problems or suspicion of fraude.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** • Course lectures • Session of exercices • Lectures in the classroom or mixed (classrooms with simultaneous broadcasting on Teams) depending on the pandemic conditions
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**. • H.W. Lipmann and A. Roshko, *Elements of Gasdynamics*, 2001, Dover. **Recommended**
Faculty or entity in charge	MECA

Force majeure

Teaching methods	Due to the pandemic, the class lectures and exercise sessions in 2020-21 will take place on line, via Teams.
Evaluation methods	If the exam cannot take place in an auditorium for sanitary reasons, the exam will take place on line, via Teams. It will be of duration of 3 hours, open notes and books and monitoring via webcam.

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		