lmeca1855

2024

Thermodynamics and energetics.

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Bartosiewicz Yann ;Papalexandris Miltiadis ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	• Thermodynamics of ideal gases • Introduction to heat transfer and to heat exchangers • Phase equilibria, change of phase. • Gas turbines • Refrigeration engines • Compression and expansion of gases • Pressure losses • Humid air • Introduction to Rankine cycles
Learning outcomes	**At the end of this learning unit, the student is able to :** In consideration of the reference table AA of the program "Masters degree in Mechanical Engineering", this course contributes to the development, to the acquisition and to the evaluation of the following experiences of learning: 1 • AA1.1, AA1.2, AA1.3 • AA2.1, AA2.2, AA2.5 • AA3.2, AA3.3 • AA5.1, AA5.5, AA5.6 • AA6.1, AA6.4
Evaluation methods	The final exam will consist of theoretical questions and exercises/problems to solve. The exam is written, without access to books and notes, i.e. books and notes closed. The same exercise question could possibly bring together/ mix concepts from different chapters, including different parts of the course. An mid-term written examination will be organized with closed books. The grade will count for 20% of the global grade. In the case of a second session, the grade obtained during the examination will be carried over. The global grade will therefore be calculated as follows: Global grade = 80% grade of the final exam + 20% grade of mid-term exam. Continuous assessment includes work/assignments, which will result in a single overall grade, communicated at the end of the last work/assignment. Failure to comply with the methodological instructions defined on moodle, particularly in terms of the use of online resources or collaboration between students, for any work/assignment will result in an overall score of 0 for the continuous assessment.
Teaching methods	• Course lectures • Session of exercises
Content	• Basic aspects of technical thermodynamics: balance equations of the motive power, ideal gas, properties of gaseous systems, entropic diagrams, simple transformations of state, irreversibilities, work of friction in straight pipes, regular/singular pressure drops. • Compression and expansion: energy balances, isentropic and polytropic models/efficiencies, compressors, fans, turbines, axial and radial engines, kinematic analysis, characteristics curve of a turbomachinery, of a circuit, working point stability, compressors with intermediate cooling. • Thermodynamics of vapors: phase change, determination of the state variables, thermodynamic diagrams and tables. • The humid air: formalism, absolute/relative humidity, dry/wet bulb temperature, Mollier chart, air-water mixtures, humid air mixing • Introduction to combustion : phenomenology of combustion, balance equation and stoichiometry, coefficients of the quality of combustion, heat of combustion, heating value of fuels, adiabatic combustion temperature, main pollutants produced by the combustion of fuels. • Gas turbines: calculations of the thermodynamic cycle, optimisation, static applications. • Power generation with steam: Rankine-Hirn cycle, main components, energy analysis, energy balance over each component, efficiency, physical/thermodynamic constraints, complex cycles including bleeding and reheating, introduction to combined cycles (CCGT) • Refrigeration engines: simple cycle, selection criteria of the thermodynamic fluid, cycle with double compression and double expansion, cascade cycles. The heat pump. • Practical sessions: they include exercises.

	• The pedagogical methods used aim at developing a sound understanding of the physics of the physical phenomena involved and knowledge of the systems which enable to achieve the thermodynamic processes
Inline resources	https://moodle.uclouvain.be/course/view.php?id=718
Bibliography	• Notes du cours LMECA1855, disponibles sur le site Moodle du cours et au SICI • Transparent du cours magistral, disponibles sur le site Moddle du cours • Ennoncés d'exercices, disponibles sur le site Moddle du cours • Eléments de thermodynamique technique, J. Martin, P. Wauters, Presses universitaires de Louvain, 2014. • M. J. Moran, H.N. Shapiro : Fundamentals of Engineering Thermodynamics, John Wiley, 1995. • Notes du cours LMECA1855, disponibles sur le site Moddledu cours et au SICI. **Obligatoire.** • Transparent du cours magistral, disponibles sur le site Moodle du cours. **Obligatoire.** • Ennoncés d'exercices, disponibles sur le site Moodle du cours. **Obligatoire**. • Eléments de thermodynamique technique, J. Martin, P. Wauters, Presses universitaires de Louvain, 2014. **Conseillé** • M. J. Moran, H.N. Shapiro : Fundamentals of Engineering Thermodynamics, John Wiley, 1995. **Conseillé**
Other infos	Lecture notes of the course LMECA1855, available on the Moodle site of the course and ay SICI.
Faculty or entity in charge	MECA

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Specialization track in Mechanics	FILMECA	5		
Minor in Mechanics	LMINOMECA	5		
Mineure Polytechnique	MINPOLY	5		