

Faculty of Applied Sciences



MECA2855 Thermodynamics and energetics.

[45h+30h exercises] 6 credits

This course is taught in the 1st semester

Teacher(s): Michel Giot, Hervé Jeanmart, Miltiadis Papalexandris
Language: French
Level: Second cycle

Aims

Based on the appropriate scientific prerequisites in physical-chemistry and fundamental thermodynamics, this course aims at introducing the most important applications of the technical thermodynamics. It also aims at providing the student with the operational bases for the thermodynamic calculations, and for the energy systems evaluations.

Main themes

Compression and expansion of gases
 Thermodynamics of vapours and of humid air
 Fuels, heat transfer
 Brayton, Rankine and combined cycles
 Refrigeration engines.

Content and teaching methods

Basic aspects of technical thermodynamics: balance equations of the motive power, ideal gas, properties of gaseous systems, entropic diagrammes, simple transformations of state, irreversibilities, work of friction in straight pipes, singular pressure drops.

Compression and expansion: energy balances, isentropic and polytropic efficiencies, compressors, fans, turbines, axial and radial engines, characteristic curve of a turbomachine, of a circuit, compressors with intermediate cooling.

Thermodynamics of vapours: phase change, determination of the state variables, thermodynamic diagrammes and tables.

The humid air: particular characterisation formalism, Mollier diagramme, limit cooling temperature of water in contact with humid air.

Fuels: characteristic quantities, combustion products, properties of use of the main fuels, characterisation of the combustion, boilers and burners, efficiency of a boiler and of a furnace.

Heat exchangers: Fourier law, convection coefficient, overall coefficient of heat transfer through a wall, parallel or counter-current tubular heat exchanger, efficiency of a heat exchanger.

Gas turbines: calculations of the thermodynamic cycle, optimisation, static applications.

Power generation with steam: Rankine-Hirn cycle, power cycle with superheat and reheat, cycle with feedwater heaters, global efficiency, main equipment of power plants with fossile fuels, particular aspects of the cycle of nuclear power plants, main equipment of nuclear power plants. Fast breeders.

Gas-steam combined cycles.

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, lab sessions, and project work.

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.

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

The teaching is focussed on the practical sessions. A regular attendance of these practical sessions is required from all students. Evaluation methods: a significant part of the final note is related to continuous evaluation achieved during the practical sessions.

The lecture notes are available on the web site: <http://www.term.ucl.ac.be/cours/meca2855/index.htm>

Reference book: M. J. Moran and H.N. Shapiro: Fundamentals of Engineering Thermodynamics, John Wiley, 1995.

Programmes in which this activity is taught

MAP2 Ingénieur civil en mathématiques appliquées

Other credits in programs

ELME21/E	Première année du programme conduisant au grade d'ingénieur (6 credits) civil électro-mécanicien (énergie)	Mandatory
ELME21/M	Première année du programme conduisant au grade d'ingénieur (6 credits) civil électro-mécanicien (mécatronique)	Mandatory
GC21	Première année du programme conduisant au grade d'ingénieur (6 credits) civil des constructions	Mandatory
GC22	Deuxième année du programme conduisant au grade (6 credits) d'ingénieur civil des constructions	
INCH21	Première année du programme conduisant au grade d'ingénieur (6 credits) civil chimiste	Mandatory
MAP21	Première année du programme conduisant au grade d'ingénieur (6 credits) civil en mathématiques appliquées	
MAP23	Troisième année du programme conduisant au grade (6 credits) d'ingénieur civil en mathématiques appliquées	
MATR21	Première année du programme conduisant au grade d'ingénieur (6 credits) civil en science des matériaux	Mandatory
MECA21	Première année du programme conduisant au grade d'ingénieur (6 credits) civil mécanicien	Mandatory
MECA22	Deuxième année du programme conduisant au grade (6 credits) d'ingénieur civil mécanicien	