

Faculty of Applied Sciences



MECA1855 Thermodynamics and energetics.

[30h+30h exercises] 5 credits

This course is taught in the 1st semester

Teacher(s): Hervé Jeanmart, Miltiadis Papalexandris
Language: French
Level: First 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.

Other credits in programs

ELME22/M	Deuxième année du programme conduisant au grade d'ingénieur civil électro-mécanicien (mécatronique)	(5 credits)
FSA12BA	Deuxième année de bachelier en sciences de l'ingénieur, orientation ingénieur civil	(5 credits)
FSA13BA	Troisième année de bachelier en sciences de l'ingénieur, orientation ingénieur civil	(5 credits)
GC22	Deuxième année du programme conduisant au grade d'ingénieur civil des constructions	(5 credits)
GC23	Troisième année du programme conduisant au grade d'ingénieur civil des constructions	(5 credits)
INCH22	Deuxième année du programme conduisant au grade d'ingénieur civil chimiste	(5 credits)
MECA22	Deuxième année du programme conduisant au grade d'ingénieur civil mécanicien	(5 credits)