



UNIVERSITÀ DI PISA

CHEMICAL ENGINEERING THERMODYNAMICS

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Anno accademico	2017/18
CdS	CHEMICAL ENGINEERING
Codice	537II
CFU	9

Moduli	Settore/i	Tipo	Ore	Docente/i
TERMODINAMICA DELL'INGEGNERIA CHIMICA	ING-IND/24	LEZIONI	90	ANDREA LAMORGESE ROBERTO MAURI

Learning outcomes

Knowledge

Students are expected to learn how to apply the principles of mass and energy conservation, together with the second law of thermodynamics, to describe the equilibrium states that are currently encountered in chemical engineering. The fundamental principles of thermodynamics are studied in depth, both starting from a classical, historical-oriented perspective, and also showing how they are connected to the basic laws of mechanics. Then, students are expected to apply these abstract principles to problems that are typical of the chemical engineering industry, determining in particular the properties of mixtures and alloys, phase equilibria, surface effects and chemical reactions.

Assessment criteria of knowledge

- The student must demonstrate her/his ability to put into practice and to execute, with critical awareness, the activities illustrated or carried out under the guidance of the teacher during the course.

Methods:

- Final oral exam
- Final written exam
- Final laboratory practical demonstration

Passing the written exam is a prerequisite for the oral exam.

Skills

The student will be able to apply the principles and laws of thermodynamics to solve problems encountered in chemical engineering practice.

Assessment criteria of skills

The student must pass a written exam, solving within two hours of time, two problems of obvious relevance for chemical engineering applications.

Behaviors

The student will be able to set up and resolve correctly practical problems of chemical engineering by applying the principles and the laws of thermodynamics.

Assessment criteria of behaviors

During the oral exam the instructor will assess the student's ability to set up and resolve problems of the chemical engineering practice.

Prerequisites

The student must possess notions of differential calculus.

Co-requisites

It would be advisable for the student to follow an advance course on multi-variable differential calculus.

Teaching methods



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Delivery is face to face. The attendance is strongly advised.

Learning activities:

- Attending lectures.
- Solving homework problems.
- Participation in discussions in class.

All the teaching material and teacher-student communications of general interest are available on the elearning site. Individual teacher-student interactions are dealt with through the use of emails or by individual meetings.

Syllabus

- First law - Equilibrium, internal energy, phase rule, ideal gas.
- Volumetric properties - Cubic equations of state, law of corresponding states.
- Heat effects - Temperature, specific heats, sensible and latent heat.
- Second law - The heat engine, Carnot cycle, entropy, principle of entropy increase.
- Connection between thermodynamics and statistical mechanics.
- Thermodynamic potentials - Enthalpy, free energies, Maxwell relations.
- Thermodynamic cycles - Two-phase systems, thermodynamic diagrams, steam engines, refrigeration cycles.
- Ideal mixtures - Chemical potential, ideal gas mixtures and ideal solutions.
- Non ideal mixtures - Partial molar properties, excess properties, fugacities.
- Phase equilibria - Stability, coexistence and spinodal curves, vapor-liquid equilibrium.
- Surface effects - Surface tension, Young-Laplace equation.
- Chemical reaction equilibrium - Reaction coordinate, equilibrium constants.

Bibliography

- Textbook: C. Rizzo, R. Mauri, Termodinamica per l'Ingegneria Chimica, in press.
- Recommended reading: J.M. Smith, H.C. Van Ness, M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, McGraw Hill (2005). S.I. Sandler, Chemical, Biochemical, and Engineering Thermodynamics, Wiley (2006).

Non-attending students info

Non-attending students are asked to contact the teacher and select the subjects that will be studied together with the practical skills that must be acquired.

Assessment methods

The exam consists of a written part followed, within one week, by an oral part. In the written exam the student is asked to solve two problems within two hours; examples of recent exams are available in the elearning site. The oral exam consists of a question-answer 30 minute session, where the teacher assess how deeply the student understand principles and laws of thermodynamic. Examples of typical oral questions are available in the elearning site.

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