Course guide
295024 - TERM - Thermodynamics

Last modified: 13/09/2023

Unit in charge: Barcelona East School of Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: FRANCESC FONT MARTÍNEZ - JOSE LUIS TAMARIT MUR

Others: Primer quadrimestre:
MARIA DEL BARRIO CASADO - Grup: T31, Grup: T32, Grup: T33
JOSE IGNACIO ESEBERRI PIEDRA - Grup: T31, Grup: T32
ALEJANDRO MARTINEZ ALEGRE - Grup: M21, Grup: M22
JOSE LUIS TAMARIT MUR - Grup: M21, Grup: M22, Grup: M23

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEI-07. Understand applied thermodynamics and heat transfer, their basic principles and their application to engineering problems.

Transversal:
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

Theory (2 sessions per week, 3 ECTS): the teacher presents the fundamental concepts and some demonstrations, complementing key examples and discussion of some applications.
Problems and Guided activities (2 sessions per week, 3 ECTS): the teacher presents representative solving problems; students review the basic concepts and solve some problems under the supervision of the teacher. In efforts to consolidate the concepts students and their magnitudes

LEARNING OBJECTIVES OF THE SUBJECT

After completing the course the student must be able to:
- Know the basic concepts and principles explicitly and understand reasonably the thermal phenomena.
- Feeling comfortable in addressing particular problems in the field of materials engineering.
- Expressing magnitudes in SI units and conversion factors known to other systems of units

STUDY LOAD

Type	Hours	Percentage
Hours large group	52,5	35.00
Hours small group	7,5	5.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Unit 1: Fundamental Concepts

Description:
Unit 1. Fundamental concepts
Introduction to thermodynamics. thermodynamic system, thermodynamic variable, state of equilibrium thermodynamic transformation. Zero Temperature principle. Thermometers and empirical thermometric scales

Specific objectives:
To know the basic vterms of the thermodynamics

Full-or-part-time: 4h
Theory classes: 4h

Unit 2: Single and Simple Systems

Description:
Simple Systems: Definition and Properties. Simple Systems PVT: Thermal equation of state and thermal coefficients. Ideal Gas. Real gases and surface feature PVT. liquid-vapor, solid-liquid and solid steam balances. triple point and critical point. Polymorphism. thermal equations of state of real gas. Law of corresponding states. Compressibility factor

Specific objectives:
To know the fundamental behaviour of the thermodynamic systems

Related activities:
Laboratory works

Full-or-part-time: 10h
Theory classes: 10h

Unit 3. Calorimetry and Heat Propagationnglish

Description:
Heat capacity. Specific heat. Heat transfer. Thermal conductivity. Fourier law. Driving: one-dimensional and stationary. dimensional transient conduction. Heat convection. thermal black-body radiation. Stefan-Boltzmann law and Wien law.

Specific objectives:
To know the the fundamental concepts of heat and its propagation

Related activities:
Laboratory works

Full-or-part-time: 9h
Theory classes: 9h

First law of thermodynamics

Description:
Expansion work in simple PVT systems. Dissipative work. Conjugate variables and configuration work on other simple systems: surface work, work torsion work electric and magnetic polarization. First Law of thermodynamics. Internal energy. Enthalpy

Specific objectives:
To know the 1st law of thermodynamics

Related activities:
Laboratory works

Full-or-part-time: 6h
Theory classes: 6h

Unit 5: First law of thermodynamics. energy properties and applications

Description:
Joule-Gay Lussac experiment. Energy properties of ideal gas: Joule's Law. Joule-Kelvin experiment. Energetic properties of real gas: Generalized Joule's Law. Energy properties of a simple PVT system. Thermodynamic transformations of an ideal gas.

Specific objectives:
Know how to apply the 1st law of thermodynamics

Full-or-part-time: 7h
Theory classes: 7h

Unit 6: Second law of thermodynamics: Heat Engines

Description:
Heat engines. Carnot cycle. Second law of thermodynamics: Clausius and Kelvin Statements Planck. Carnot theorem. Examples of engines: Otto Cycle, Diesel Cycle

Specific objectives:
To know the basic operation of the heat engines and its relation with the 2nd law of thermodynamics

Related activities:
Laboratory works

Full-or-part-time: 7h
Theory classes: 7h

Unit 7: Second law of thermodynamics: Entropy

Description:
Clausius theorem. Entropy. Entropy of an ideal gas. Entropy an ideal gas mixture. Entropic statement of the second law of thermodynamics. Heat transfer and TS diagram. Degradation of energy. absolute temperature scale. Entropy and disorder

Specific objectives:
To know the 2nd law of thermodynamics and its entropic statement

Full-or-part-time: 8h
Theory classes: 8h

Unit 8: Thermodynamic Potentials

Description:
Thermodynamic potentials in simple PVT systems. Maxwell relations. Equilibrium conditions. TdS equations. Mayer relations in simple PVT systems. Generalization of the Maxwell relations to other simple systems. Mayer generalized equation. Joule-Kelvin coefficient. General equilibrium conditions. Fluctuations. Le Chatelier's principle.

Specific objectives:
To know the thermodynamic potentials for simple systems

Full-or-part-time: 9h
Theory classes: 9h

GRADING SYSTEM

The final grade for each student is calculated by a weighted average of the marks obtained in partial and final exams, as well as activities aimed at the laboratory. Detailed below the relative weight of each note in the final:
Half-semester exam (multiple choice questions): 20%
Laboratory works: 15%
According to the EEBE academic regulations, students that failed ordinary assessment and have obtained a mark, N, calculated as 65% of the final exam plus 35% of the half-semester exam, 3

BIBLIOGRAPHY

Basic:
- Ortega Girón, Manuel R.; Ibáñez Mengual, José A.. Lecciones de física : termología. 4a ed. Córdoba: Universidad. Departamento de Física Aplicada, 1994. ISBN 8440442912.
- Aguilar Peris, José. Curso de termodinámica. 3a ed. Madrid: Pearson Alhambra, 1989. ISBN 8420513822.
- Barrio Casado, María del ... [et al.]. Termodinámica básica : ejercicios [on line]. Barcelona: Edicions UPC, 2006 [Consultation: 17/06/2020]. Available on: http://hdl.handle.net/2099.3/36828. ISBN 9788483018712.
- Barrio Casado, María del ... [et al.]. Problemas resueltos de termodinámica. Madrid: Thomson, 2005. ISBN 8497323491.