

Course guide 820020 - TTC - Thermodynamics and Heat Transfer

Last modified: 08/09/2023

Unit in charge: Teaching unit:	 Barcelona East School of Engineering 729 - MF - Department of Fluid Mechanics. BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject). 		
Degree:			
Academic year: 2023	ECTS Credits: 6.0 Languages: Catalan, Spanish, English		
LECTURER			
Coordinating lecturer:	FRANCESC FONT MARTÍNEZ - LLUÍS JOFRE CRUANYES		
Others:	Primer quadrimestre: JOSE ALEJANDRO CARRILLO CORTES - Grup: T11, Grup: T12 JOSE IGNACIO ESEBERRI PIEDRA - Grup: T13, Grup: T14 FRANCESC FONT MARTÍNEZ - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: T21, Grup: T22, Grup: T23, Grup: T24 LLUÍS JOFRE CRUANYES - Grup: M21, Grup: M22, Grup: M23, Grup: M24, Grup: T11, Grup: T12, Grup: T13, Grup: T14 ALEJANDRO MARTINEZ ALEGRE - Grup: M11, Grup: M12 ROGER MAYNOU GIL - Grup: M21, Grup: M22, Grup: M23, Grup: M24 RAUL OLEGARIO NAVARRETE ROMERO - Grup: T21, Grup: T22, Grup: T23, Grup: T24 MARIO MIGUEL VALERO PÉREZ - Grup: M13, Grup: M14		
	Segon quadrimestre: FRANCESCO CAPUANO - Grup: M11, Grup: M12, Grup: M13 JOSE IGNACIO ESEBERRI PIEDRA - Grup: T11, Grup: T12, Grup: T21, Grup: T22 FRANCESC FONT MARTÍNEZ - Grup: M41, Grup: M42, Grup: M43, Grup: M44, Grup: T11, Grup: T12, Grup: T13 MARCEL GARCIA COROMINAS - Grup: T13, Grup: T23 LLUÍS JOFRE CRUANYES - Grup: T21, Grup: T22, Grup: T23 ROGER MAYNOU GIL - Grup: M33, Grup: M34 PEDRO RUFES MARTINEZ - Grup: M41, Grup: M42 CARLOS RUIZ MOYA - Grup: M21, Grup: M22, Grup: M23, Grup: M24, Grup: M31, Grup: M32, Grup: M33, Grup: M34, Grup: M43, Grup: M44 TÀNIA TORM OBRADORS - Grup: M21, Grup: M22		

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:

2. 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

The contents of the subject will be developed using master classes and promoting the participation of students with active methodologies. The student must perform individual work while solving problems and preparing exams, and also teamwork to tackle complex problems and lab practices.

LEARNING OBJECTIVES OF THE SUBJECT

Give the student basic knowledge in the analysis of thermodynamical systems (both power or refrigeration systems) as well as in the basic heat transfer mechanisms.

STUDY LOAD

Туре	Hours	Percentage
Self study	90,0	60.00
Hours large group	45,0	30.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

1.- INTRODUCTION TO THERMODYNAMICS

Description:

Thermodynamical systems. Temperature and the zeroth law of thermodynamics. Thermodynamic scales. Ideal gas. Simple, compressible pure substances: gasses and steam.

Specific objectives:

Understand the basic knowledge required for the study of thermodynamics.

Full-or-part-time: 29h Theory classes: 11h 30m Laboratory classes: 2h 30m Self study : 15h

2.- FIRST LAW OF THERMODYNAMICS

Description:

Expansion work. Friction work. Internal energy. Heat. Enthalpy. Specific heats of gasses. Adiabatic, isothermal, isochoric and isobaric processes. Polytropic processes. First law of thermodynamics. Open and closed systems.

Specific objectives:

To know and to use different expressions of energy and work involved in a thermodynamical system. To study basic thermodynamical processes. To apply the first law of thermodynamics to the analysis of open and close systems.

Full-or-part-time: 29h Theory classes: 11h 30m Laboratory classes: 2h 30m Self study : 15h



3.- SECOND LAW OF THERMODYNAMICS

Description:

Enthropy and irreversibilities. Second law of thermodynamics. Thermal engine. Carnot's efficiency. Isenthropical processes and isentrhropical efficiencies for thermal engines. Gas turbine: Brayton's cycle. Steam turbine: Rankine cycle. Steam compression refrigeration systems.

Specific objectives:

To understand the concept of enthropy and the second law of thermodynamics, and its application to thermal engines. To know the ideal power cycles for producing mechanical work. To know the ideal steam compression cycle for refrigeration and heat pumpling applications.

Full-or-part-time: 26h 30m

Theory classes: 11h 30m Self study : 15h

4.- CONDUCTIVE HEAT TRANSFER

Description:

General differential equation for conduction heat transfer. Conduction in a flat wall. Conduction in a cylindric wall. Thermal resistance. Overall heat transfer coefficient.

Specific objectives:

To present the general differential equation for conduction heat transfer and its application in simple geometries. To show the concept of thermal resistance and its application to flat and cylindrical walls.

Full-or-part-time: 23h 30m

Theory classes: 6h Laboratory classes: 2h 30m Self study : 15h

5.- CONVECTIVE HEAT TRANSFER

Description:

Free and forced convection mechanism. Interior and exterior convection. Convection over flat surfaces. Convection over cylinders. Convections in pipe flow. Empirical correlations.

Specific objectives:

To describe the convective heat transfer mechanism and its classification acroding to the nature of the flow. To use different empirical correlations that allow to estimate the convection heat trasfer.

Full-or-part-time: 21h

Theory classes: 6h Self study : 15h

6.- RADIATIVE HEAT TRANSFER

Description:

Electromagnetic spectrum and radiation physics. Kirchoff's law. Black-body radiation. Grey and real bodies. Radiation functions.

Specific objectives:

To understand the physical nature of electromagnetic radiation and its modelling and interaction studies.

Full-or-part-time: 21h Theory classes: 6h Self study : 15h



GRADING SYSTEM

Mid-term exams (30%); Homework activities (10%); Final exam (40%); Lab practices (15%); Generic skills (5%). In order to pass the course it is mandatory to attend to all lab practices and deliver the correspondent lab reports. There is a re-evaluation test for this subject. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-20 18-06-13.pdf)

EXAMINATION RULES.

The evaluation will be conducted through written tests both for the mid-terms and final exam.

There will be 2 homework activities due during the term. These activities will be delivered online through the course's intranet. Practices will be graded based on a pre-test to be presented before the lab practice start, attendance (mandatory) and lab activity developed, together with the preparation and delivery of lab reports.

BIBLIOGRAPHY

Basic:

- Çengel, Yunus A; Boles, Michael A. Thermodynamics : an engineering approach. 8th ed. in SI Units. New York: McGraw-Hill, cop. 2015. ISBN 9789814595292.

- Çengel, Yunus A; Boles, Michael A; Apraiz Buesa, Ignacio. Termodinámica. 7a ed. México [etc.]: McGraw-Hill, cop. 2012. ISBN 9786071507433.

- Çengel, Yunus A; Ghajar, Afshin J. Heat and mass transfer : fundamentals & applications. 4th ed. New York: McGraw-Hill, cop. 2011. ISBN 9780073398129.

- Çengel, Yunus A; Muñoz Díaz, Enrique; Ochoa López, Alvaro; Robledo Rella, Víctor Francisco; Cordero Pedraza, Carlos R; Ghajar, Afshin J. Transferencia de calor y masa : fundamentos y aplicaciones [on line]. Sexta edición. México: McGraw-Hill, [2020] [Consultation: 27/02/2023]. Available on:

https://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=10213. ISBN 9786071505408.