SUBJECT DATASHEET

Subject basic Information	
Name	Thermodynamics
Code	DIM-SAP-336
Study	Sapiens
Course	
Semester	Spring
ECTS	4.5
Type	
Department	Mechanical Engineering
Area	Thermodynamics
University	Comillas
Timetable	
Teachers	Eva Arenas Pinilla
Descriptor	

Faculty information

Teacher	
Name	Eva Arenas Pinilla
Department	Mechanical Engineering
Area	
Office	
e-mail	earenas@comillas.edu
Students attention	Notice shall be given at the startup session

SPECIFIC SUBJECT DATASHEET

Subject contextualisation
Contribution to the professional profile of the Title
Engineering Thermodynamics is concerned with energy transformation and utilization. The key of the subject is the analysis of any energy process, determining the variation of the thermophysical properties of the fluids involved and applying energy and entropy balances. Special attention is paid to heat to mechanical/electric power conversion.
Pre requirements
Having passed a first year of Bachelor degree in Engineering.

Competencies - Targets
Targets
The aim of this course is to provide you with: • determination of thermophysical properties of fluids with different behaviour models: incompressible, ideal gases, real substances; • understanding the application of energy and entropy balance to energy processes; • understanding psychrometry: the basis of air conditioning and climate control systems. • the ability to interpret engineering applications of power and inverse cycles. Real-life examples and general overview of devices designed following Thermodynamic principles: combustion engines, compressors, cooling systems, etc.
General Competencies of the course / qualification
CG3. Knowledge on basic and technological matters that help the learning of new method and theories. Student will be trained to be flexible in front of new challenges.
CG4. Ability to solve new problems, make decisions, be creative, critical reasoning and to communicate knowledge and skills inside the Industrial Engineering field.

CHAPTER SEGMENT AND CONTENTS

Content – Chapter segments
Chapter 1: Introduction
1.1 Basic definitions. 1.2 Systems. 1.3 Properties. 1.4 Specific volume, pressure and temperature.
Chapter 2: The First Law of Thermodynamics
2.1 Energy. 2.2 Energy transfer by work. 2.3 Energy transfer by heat. 2.4 Energy balance for closed systems. 2.5 Energy balance for cycles.
Chapter 3: Properties of a pure substance
3.1 Thermodynamic state. 3.2 The P-v-t surface. 3.3 Tables of properties. 3.4 Incompressible substance. 3.5 Liquid approximation. 3.6 Ideal gas.
Chapter 4: First Law for control volumes
4.1 Mass balance. 4.2 Energy balance. 4.3 Steady-flow processes. 4.4 Steady-flow engineering devices. 4.5 Unsteady-flow processes.
Chapter 5: The Second Law of Thermodynamics.
5.1 Heat engines. 5.2 Refrigerators and Heat Pumps.

5.3 Energy conversion efficiencies. 5.4 Second Law formulations. 5.5 Reversible and Irreversible processes. 5.6 The Carnot cycle. 5.7 The Carnot principles.
Chapter 6: Entropy
6.1 Definition. 6.2 Entropy balance in closed systems. 6.3 Entropy balance in control volumes. 6.4 Determination of entropy. 6.5 Isentropic efficiencies. 6.6 Examples of power and refrigeration cycles.
Chapter 7: Availability
7.1 Exergy. 7.2 Exergy balance for closed systems. 7.3 Exergy balance for control volumes. 7.4 Exergy efficiency.
Chapter 8: Ideal gas mixtures and psychrometry
8.1 Composition and properties of an ideal gas mixture. 8.2 First and Second Law to ideal gas mixtures. 8.3 Psychrometric properties. 8.4 Psychrometric processes.

TRAINING METHODOLOGY

Subject methodological aspects
Both in-class and distance teaching are developed to imply the students within the learning activities. The subjects are developed to keep the student attention and following the competencies acquisition by the students. Student activities are key factors to develop this course.
In-class methodology: Activities
1. Life presentations. The teacher will explain basic concepts for every Chapter showing the more important aspects. Examples will be presented, discussed and solved to complete the understanding. 2. **In class case discussion and problem solving.** Students will discuss the cases and problems proposed by the teacher. Cases will be open challenges that can be analyzed and solved by the use of the concepts already presented in class.
Distance Methodology: Activities
1. **Self-learning** on the concepts presented in class. Material to be used are slides, personal and teacher notes and recommended material (books, articles, etc.). 2. **Case study**. To be revised and updated with the rest of information given in the subject.

STUDENT SCHEDULE SUMMARY (Hours)		
LIVE		
Teacher Lessons	Case discussion	Evaluation
15	22	8
DISTANCE		
Self study on theory	Self work on cases	Prepare for Examination
30	45	15
		ECTS: 4.5 (135 hours)

EVALUATION AND SCORING CRITERIA

Evaluation activities	Criteria	Weight
• 2 midterm exams (25% each) • Final examination (40%)	- Concepts understanding. - Use of concepts to solve real cases. - Problem solving, solution analysis and interpretation of results.	90%
• Homework	- Concepts understanding. - Use of concepts to solve real cases. - Problem solving, solution analysis and interpretation of results.	10%

Grading

Grading
The grade will be determined by two midterms (25% each), homework (10%), and a final examination (40%). The exams are all closed notebook and closed textbook. The course will not be graded on a curve, i.e., there is no bound on the numbers of As, Bs, Cs, etc.

WORKING SCHEDULE

Distance Activities	Do Date	Delivery date
• Reading about the topic of the next lesson.	Before lesson	
• Problem solving.	Before/during lesson	
• Supplementary problems.	Before/during/ after lesson	One week after lesson end.
• Midterm and final exam preparation.	Throughout the term.	

BIBLIOGRAPHY AND RESOURCES

Textbook
• Moran *et al.* Fundamentals of Engineering Thermodynamics, 8th ed. Wiley (2014)
Aditional Bibliography
• Russell & Adebiyi. Classical Thermodynamics, 1st ed. Saunders College Publishing (1993) • Borgnakke & Sonntag. Fundamentals of Thermodynamics, 6th ed. Wiley (2009) • Potter & Somerton. Engineering Thermodynamics, 1st ed. McGraw-Hill (1993)