DEGREE CURRICULUM

THERMAL ENGINEERING II

Coordination: MARTORELL BOADA, INGRID

Academic year 2016-17

THERMAL ENGINEERING II 2016-17

Subject's general information

Subject name	THERMAL ENGINEERING II
Code	102301
Semester	1st Q(SEMESTER) CONTINUED EVALUATION
Typology	<table><tr><th>Degree</th><th>Course</th><th>Typology</th><th>Modality</th></tr><tr><td>Bachelor's Degree in Mechanical Engineering</td><td>3</td><td>COMPULSORY</td><td>Attendance-based</td></tr><tr><td>Master's Degree in Industrial Engineering</td><td></td><td>COMPLEMENTARY TRAINING</td><td>Only examination</td></tr></table>
ECTS credits	6
Groups	1GG,2GM,5GP
Theoretical credits	3
Practical credits	7.2
Coordination	MARTORELL BOADA, INGRID
Department	INFORMATICA I ENGINYERIA INDUSTRIAL
Teaching load distribution between lectures and independent student work	60 h lectures (40%) 90 h autonomous work (60%)
Important information on data processing	Consult this link for more information.
Language	Catalan 100%
Distribution of credits	Dr. Ingrid Martorell Boada 7,6 ECTS Dr. Marc Medrano 2,6 ECTS
Office and hour of attention	Set up with the teacher

THERMAL ENGINEERING II 2016-17

Professor/a (s/es)	Adreça electrònica professor/a (s/es)	Crèdits	Horari de tutoria/lloc
ERAS VILA, JOSEP ANTONI	jeras@diei.udl.cat	7,6	
MARTORELL BOADA, INGRID	imartore@diei.udl.cat	0	
MEDRANO MARTORELL, MARCO	mmedrano@diei.udl.cat	2,6	

Subject's extra information

Thermal Engineering II is a compulsory subject taught in third course during the first semester in the Bachelor of Mechanical Engineering.

This course requires continuous work throughout the semester in order to achieve the goals. It is recommended to visit frequently the Virtual Campus, where course information is announced. We recommend using direct mail instead of the teacher's personal email in the Messaging Virtual Campus.

The course is a journey through the different principles of thermodynamics and refrigeration and power cycles are also covered.

Learning objectives

• Obtain the necessary data of physical properties of fluids in tables and diagrams with solvency.
• Be able to numerically solve the problems of thermodynamics.
• Be able to argue the results with critical thinking
• Be able to critically analyze and synthesize concepts learned in the course
• Learn the theoretical and practical knowledge of thermal energy.
• Understand the basic principles of power and cooling cycles.

Competences

Cross-disciplinary competences

- **EPS1**. Capacity to solve problems and prepare and defence arguments inside the area of studies.
- **EPS6**. Capacity of analysis and synthesis

Specific competences

- **GEM21**. Applied knowledge of thermal engineering.
- **GEM24**. Applied knowledge of the basics of fluidomechanic machinery.

Subject contents

1. Properties of pure substances

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1.1. Pure substances

1.2. Phases of a pure substance

1.3. Change processes do a pure substance

1.4. Property diagrams for phase change processes

1.5. Property tables

1.6. Ideal gas equation of state

1.7. The compressibility factor - a measure of the deviation from ideal gas

1.8. Specific heat

1.9. Internal energy, enthalpy and specific heat of ideal gases

1.10. Internal energy, enthalpy and specific heat of solids and liquids

1.11. Problem properties pure substances

2. First law of thermodynamics

2.1. The first principle of thermodynamics

2.2. Energy balance for closed systems

2.3. Energy balance for steady state systems

2.4. Some stationary equipment engineering

2.5. Energy balance for non-steady state processes

2.6. Problems first principle of thermodynamics

3. Second law of thermodynamics

3.1. Introduction to the second law of thermodynamics

3.2. Thermal energy storage

3.3. Heat engines

3.4. Efficiencies in energy conversion

3.5. Refrigerators and heat pumps

3.6. The Carnot cycle

3.7. The Carnot heat engine

3.8. The refrigerator and heat pump Carnot

3.9. Problems of the second law of thermodynamics

4. Entropy

4.1. Entropy

4.2. The principle of entropy increase

4.3. Entropy change of pure substances

4.4. Isentropic processes

4.5. Entropy change of liquids and solids

4.6. Entropy change of ideal gases

4.7. Isentropic efficiency of steady state devices

4.8. Balance of entropy

4.9. Problems entropy

5. Gas power cycles

5.1. Cosideracions basic analysis of power cycles

5.2. Carnot cycle and its value engineering

5.3. Standard air assumptions

5.4. Reciprocal motor

5.5. The Otto cycle: the ideal cycle for spark-ignition engines

5.6. Diesel Cycle: The Ideal Cycle for Compression-ignition engines

5.7. Stirling and Ericsson cycles

5.8. Brayton cycle: the ideal cycle for gas turbines

5.9. Problems cycle gas power

6. Steam power cycles and combined cycles

6.1. Carnot cycle steam

6.2. The Rankine cycle: the ideal cycle steam power cycles

6.3. Deviations of actual vapor power cycles ideals

Methodology

The methodology of the course will be divided into:

1.-Lectures where the teacher will present the theory necessary for the acquisition of knowledge.

2.-Problems sessions where teacher will present some examples but basically students will play an active role in the learning process working in small groups or individually.

3.-Practical laboratory sessions where students work in group.

Development plan

Week	Methodology	Topic	Lecture Hours	Autonomous work hours
1-2	Lecture. Resolution of problems	Subject presentation and 1. Properties of pure substances, .	6	9
2-4	Lecture. Resolution of problems	2. First law of thermodynamics	8	12
4-6	Lecture. Resolution of problems.	3. Second law of thermodynamics	8	12
6-8	Lecture. Resolution of problems.	4. Entropy	10	15
9		Evaluation. Written test.		
10-12	Lecture. Resolution of problems.	5. Gas power cycles	12	18
13-15	Lecture. Resolution of problems. Lab practices	6. Steam power cycles and combined cycles	12	18
16-19		Evaluation. Written Test. Recovery		

Evaluation

EVALUATION ACTIVITY 1: FIRST PARTIAL

–35%

–Score ≥ 3 to average with the other scores of the course

EVALUATION ACTIVITY 2: SECOND PARTIAL

–35%

–Score ≥ 3 to average with the other scores of the course.

EVALUATION ACTIVITY 3: LAB ACTIVITIES- In group activities

–20%

–iN GROUP

–Score ≥ 4 (all practices average)

EVALUATION ACTIVITY 4: Problems and activities in class- during the course, in groups

–10%

Bibliography

Recommended references

- Yunus A. Çengel, Michael A. Boles "Thermodynamics, an engineering approach", International Edition, Fourth Edition, Mc Graw Hill, ISBN: 0-07-238332-1.
- Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Bailey. “Fundamentals of Engineering Thermodynamics”, 7th Edition, ISBN-10: 0470917687
- P. Chattopadhyay, “Engineering Thermodynamics, 2on Edition, ISBN-10: 0199456151
- Michael Horsley, M. Horsley, “Engineering Thermodynamics”,Springer, ISBN-10: 0412445204.