COURSE INFORMATION

ENGINEERING THERMODYNAMICS

Code number: 606310203
Degree: Electrical Engineering
Department: Ingeniería Eléctrica y Térmica, de Diseño y Proyectos
Academic Year: 2017-2018. First semester
Course type: Compulsory. 2nd year
Teaching hours: 1.5 hours per session; 2 sessions per week
Credit value: 6 ECTS
Link to Spanish counterpart: http://www.uhu.es/etsi/guia-de-asignatura/?codigo=606310203

TEACHING STAFF

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Office hours: On demand, or
First Semester: 11:30-13:00 on Mondays; 10:00–11:30 on Thursdays and Fridays

PROGRAMME

1. DESCRIPTION

Engineering Thermodynamics provides an introduction to the laws of Thermodynamics and their applications. This course introduces many practical and interesting subjects such as the functioning principles of Gas/Diesel Engines, Heat Pumps, Refrigerators, Power Plants, Air-Conditioning and Turbojet Engines to mention just a few. We will introduce the tools needed to analyze energy systems both closed and open, and will cover topics such as: Properties and behavior of pure substances; applications to thermodynamic systems operating at steady conditions; and Steam and Gas Power Generation cycles.

2. PREREQUISITES

It is recommended to have previous knowledge of first year of college level in Physics and Calculus.

3. LEARNING OUTCOMES

The main goal of this class is to gain a fundamental understanding of the first and second laws of thermodynamics and their application to a wide range of systems (e.g. renewable and conventional power production, car and plane engines, etc...). The desired course outcomes include:

- Understanding of the first law of thermodynamics and various forms of work and energy transfers that can occur.

- Understanding of the concept of entropy and ability to evaluate entropy changes in a wide range of processes.

- Understanding of the physical limitations implied by the second law of Thermodynamics.

- Ability to solve a wide range of practical problems involving energy, work and power.

- Familiarity with calculations of the efficiency of heat engines and other devices.

- Familiarity with different configurations in power generation cycles with steam and/or gas turbines.

4. COMPETENCES

C01, C10, CB5, G01, G04, G07, G09, G12, G14, G16, G17 AND T01

5. TEACHING METHODOLOGY

Most of the 1.5 hour sessions will include 45 minutes of lectures and 45 minutes of problem solving and discussion. Lectures will be interactive with student participation and the instructor will guide the student along the problem solving sections. Some sessions will be reserved for solving exercises in small groups. There will also be laboratory sessions where small groups of students will take measurements and perform experiments which illustrate the basic concepts explained in the classroom.

6. CONTENTS

1. INTRODUCTION.
1.1. Introduction.
1.2. System, Properties, State and Equilibrium.
1.3. Thermodynamic Processes.
1.4. Fundamental Properties.
1.5. Zeroth Law of Thermodynamics: Temperature.

2. FIRST LAW OF THERMODYNAMICS.
2.1. Introduction.
2.2. Energy Transfer by Work.
2.3. The First Law of Thermodynamics: Internal Energy.
2.4. Energy Transfer by Heat.
2.5. Energy Balance for Closed Systems.
2.6. Energy Analysis of Steady-Flow Systems.

3. PROPERTIES OF PURE SUBSTANCES.
3.1. State Postulate.
3.2. Phase-Change Processes
3.3. Thermodynamic Diagrams for Phase-Change Processes
3.4. Property Tables.
3.4. Specific Heat.
3.6. Incompressible Substance Model.
3.7. Ideal Gas Model.

4. SECOND LAW OF THERMODYNAMICS.
4.1. Introduction.
4.2. Thermal Energy Reservoirs. Heat Engines, Refrigerators and Heat Pumps.
4.3. Statements for the Second Law.
4.4. Reversible and Irreversible Processes.
4.5. Second Law Corollaries. Absolute Temperature Scale.

5. ENTROPY.
5.1. Clausius Inequality.

5.2. Entropy.
5.3. The Increase of Entropy Principle.
5.4. Entropy Balance.
5.5. Determination of the Entropy Change.
5.6. Thermodynamic Diagrams Including Entropy.
5.7. Isentropic Processes. Isentropic Efficiciency.
5.8. Reversible Steady-Flow Processes.

6. STEAM POWER CYCLES.
6.1. Introduction
6.2. The Carnot Vapor Cycle.
6.3. Rankine Cycle.
6.4. Efficiency increase of a Rankine Cycle.
6.5. Internal Reheat.
6.6. Regeneration.
6.7. Cogeneration.

7. GAS POWER CYCLES.
7.1. Introduction.
7.2. Air-Standard Assumptions.
7.3. The Otto Cycle.
7.4. The Diesel Cycle.
7.5. The Dual Cycle.
7.6. Gas Turbine Cycle: The Brayton Cycle.
7.7. The Brayton Cycle with regeneration.
7.8. Ideal Jet-Propulsion Cycles.
7.9. Modifications to Turbojet Engines.

8. REFRIGERATION AND HEAT PUMP SYSTEMS.
8.1. Introduction.
8.2. The Reversed Carnot Cycle.
8.3. Vapor-Compression Refrigeration.
8.4. Refrigerant Properties.
8.5. Heat Pumps.
8.6. Gas Refrigeration Cycles.

9. IDEAL GAS MIXTURES AND PSYCHROMETRIC APPLICATIONS.
9.1. Non-Reactive Mixtures of Ideal Gases.
9.2. Thermodynamic Properties of Humid Air.
9.3. Adiabatic Saturation. Wet-Bulb Temperatures.
9.4. Psychrometric Chart.
9.5. Air-Conditioning Processes.

7. BIBLIOGRAPHY

- Thermodynamics. K. Wark and D.E. Richards (McGraw-Hill, 6th ed., 2000).
- Fundamentals of Engineering Thermodynamics, M.J. Moran and H.N. Shapiro (John Wiley and sons, 6th ed., 2008).
- Engineering Thermodynamics, J.B. Jones and R.E. Dugan (Prentice Hall, 1997).
- Thermodynamics. An Engineering Approach. Y.A. Çengel and M.A. Boles (McGraw-Hill, 6th ed., 2008).

8. ASSESSMENT

The final qualification will be a weighted average of a written exam (60%), lab reports (15%), a 2000 words essay on a topic selected by the student from a list provided by the instructor (15%) and continuous evaluation of the student assistance, attitude and participation in the classroom (10%).