DIM-SAP-336 Engineering Thermodynamics

SEMESTER: Fall / Spring

CREDITS: 6 ECTS (4 hrs. per week)

LANGUAGE: English

DEGREES: SAPIENS program

Course overview

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. Real-life examples and general overview of devices designed following Thermodynamic principles (power cycles, combustion engines, compressors, cooling systems, etc.) are shown. Understanding psychrometry is another goal, as the basis to air conditioning and climate control systems.

Prerequisites

Having passed a first year of Bachelor degree in Engineering

Course contents

1. Introduction: Basic definitions, Systems, Properties, Specific volume, Pressure, Temperature.
2. The First Law of Thermodynamics: Energy, Energy transfer by work, Energy transfer by heat, Energy balance for closed systems. Energy balance for cycles.
3. Properties of a pure substance: Thermodynamic state, P-v-T surface, Tables of properties, Incompressible substance, Liquids approximation, Ideal gas: equation of state and compressibility factor.
4. Control volumes analysis using energy.
5. The Second Law of Thermodynamics: Heat engines, Refrigerators and Heat pumps, Energy conversion efficiencies, Second Law formulations, Reversible and irreversible processes, The Carnot cycle, Carnot principles.
6. Entropy: Definition, Entropy balance in closed systems, Entropy balance in control volumes, Determination of entropy: pure substances and models, Isentropic efficiencies.
7. Exergy: Exergy balance for closed systems, Exergy balance for control volumes. Exergy efficiency.
8. Vapor and gas power systems: The Rankine cycle, improving performance: superheat, reheat, supercritical, regenerative cycles. Internal Combustion

Engines (Otto, Diesel, Dual cycles), Gas turbine power plants, Brayton cycle, Combined-cycle power plants.

9. Refrigeration and heat pump systems: Vapor refrigeration systems, Absorption refrigeration, Heat pump systems.
10. Ideal gas mixtures and psychometry: Composition and properties of an ideal gas mixture, First and Second Law to ideal gas mixtures, Psychrometric properties, Psychrometric processes.

Textbook

The contents of the course will be provided to the alumni in the form of weekly lectures (4h/week), supported by lecturer's slides and notes.

- M.J. Moran, H.N. Shapiro, et al., Fundamentals of Engineering Thermodynamics, 8th Edition, John Wiley and Sons, 2014

Grading

The evaluation will be determined by the combination of the results of different activities:

- Two midterm exams.
- Biweekly homework tasks.
- Final exam

The alumni grade will be defined by the maximum value to be chosen from two quantities, max (A,B):

1. **A = 0.50 * Average grade of two midterms + 0.10 * Average grade of the homework + 0.40 * Grade of the final exam.**
2. **B = 0.25 * Average grade of two midterms + 0.10 * Average grade of the homework + 0.65 * Grade of the final exam.**

The exams are all closed notebook and closed textbook. The grade will be given in the Spanish convention (0.0-10.0) with a 5.0 determining the boundary between Fail/Pass. The course will not be graded on a curve, i.e., there is no bound on the numbers of As, Bs, Cs, etc.

In case of failing, a retake exam will be offered. In this case, the final grade will be determined by the homework (10%), the midterm’s average (20%) and the retake exam grade (70%).