MEC200
Thermodynamics

UNIVERSIDAD
NEBRIJA
Centro de Estudios Hispánicos

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Thermodynamics

Hours: 45
Credits: 6 ECTS
Prerequisites: basic calculus and algebra
Instructor name: to be determined
E-mail: @nebrija.es
Office hours: to be communicated the first day of class

1. Course Description

This course is an introduction to thermodynamics for engineering students. It concentrates upon basic principles, so that students can apply their understanding to a wide range of thermodynamics problems relevant to modern engineering. The course will provide examples of relevance to aerospace, chemical, civil, electrical and mechanical engineers. Thermodynamics is used to analyze systems in virtually every branch of engineering including applications in energy use and conservation in buildings and infrastructure systems, power generation, heating and cooling, fluid motion, behavior of chemical pollutants in soil, air and water, the hydrologic cycle, global climate change, and properties that determine the mechanical behavior of structural materials.

2. Learning Objectives

Students who successfully complete this course will:

• learn to analyze energy transfer and transformation in systems using fundamental concepts of properties of materials, work, heat, internal energy, entropy, equilibrium, and relations derived from the First and Second Laws of Thermodynamics;

• learn the methods to measure thermodynamic properties and estimate values for properties using property tables and relations;

• learn to carry out thermodynamic analysis of engineering devices and systems such as piston-cylinders, compressors, turbines, pumps, heat exchangers, heat engine cycles, and refrigeration cycles using energy, materials, and entropy relations;

• be familiar with the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.

3. Methodology

The majority of the course syllabus follows the main methodological guidelines of the Communicative Approach, based on the core principles of procedure conception and constructive acquisition of knowledge. The methodology is based on the teaching-learning procedures, focused on the learner, which encourages active participation and results in the development of general and specific competencies that prove knowledge, capacities and attitudes for their future professional careers.

4. Evaluation

The form of assessment is based on the core principles of the educational assessment, i.e., an active and participative teaching-learning process focused on the learner. The instructor uses numerous and differentiated

forms of assessment to calculate the final grade received for this course. For the record, these are listed below. The content, criteria and specific requirements for each assessment category will be explained in greater detail in class.

5.1. Grading system

In the Spanish educational system, it is required to quantitatively express the result of each student's evaluation. In order to do so, Nebrija faculty uses different strategies and instruments such as: papers, exams, tests, projects, self-evaluation activities, etc. In order to issue a final grade for the Spanish Plus programs the following scale is established:

- 30 % Attendance and active participation in class
- 30% Daily work/ Papers/ Essays
- 40% Exams/ Final papers or projects*****

Therefore, the final grade is the average between attendance and participation, daily work and exams, presentations, projects and essays.

Active participation in class is evaluated by means of different activities such as:

- Activities and exercises correction;
- Reflection upon the different contents in the course;
- Oral activities (individual, in pairs or in groups). Fluency, correction, adequacy and relevance are taken into account.

Daily work makes reference to any activity or task that is done inside or outside of the classroom, whether during the class time or at any other time.

Exams/ Final papers or projects

The course includes a midterm and a final written exam on theoretical concepts and course facts. If a student, unjustifiably, does not do or submit an exam, paper or project, it will be graded with a '0'.

*** A minimum grade of 5 must be obtained in a final exam/ final project in order to pass the course.**

5.2. Attendance, participation and grading policies

5.2.1. Attendance policy

Attendance is mandatory. In case of missing 5 or more sessions in one course, the student will receive a zero in his/her participation and attendance grade. In addition, not attending classes will not excuse the student from handing in in any homework, papers or essays previously assigned.

The following situations must be considered:

- Each session of class will count as an absence.
- Two delays of more than 15 minutes will be considered an absence. The entrance to class will not be allowed after 30 minutes once it has started.
- There are no excused absences. E.g.: Not attending class because of sickness will count as an absence. The student is responsible for catching up with any homework done while absent.
- Exams dates have been officially approved by the University, therefore, they will not be changed.*

*Except for those courses where the professor will set up specific dates and inform the students at the beginning of the program.

5.2.2. Criteria to evaluate participation

Criteria to evaluate participation	Grade

The student participates very actively in the class activities. S/he successfully does the requested tasks. S/he contributes to a good development of the course, encourages his/her classmates and favor debate in class.	8.5 - 10
The student participates actively in the class activities. S/he does the requested tasks and submits them on time. Shows great interest to learn.	7 - 8.4
The student, occasionally, makes interesting remarks, but s/he basically answers when s/he is asked. S/he does not show a clear interest in the course. Misses classes occasionally.	5 - 6.9
The student does not participate unless s/he is asked. S/he has unjustified absences and delays. His/her attitude is not very participative.	0 - 4.9

5.2.3. Criteria to evaluate Daily Work

Criteria to evaluate Daily Work	Grade
The student always does all the work demanded by the professor, not only during the class but also at home. He/she always or almost always meets the deadlines established.	8.5 - 10
The student almost always does all the work demanded by the professor, not only during the class but also at home. Occasionally, he/she submits work after the established deadline.	7 - 8.4
The student occasionally does the work demanded by the professor, not only during the class but also at home. He/she does not normally meet the established deadlines and even occasionally does not submit the work.	5 - 6.9
The student never or almost never does the work demanded by the professor. He/she never or almost never meets the established deadlines.	0 - 4.9

5.2.4. Grading criteria

Number Grade	Letter Grade	Percentage
10	A+	100%
9.5 – 9.9	A	95 – 99 %
9 – 9.4	A-	90 – 94 %
8.5 – 8.9	B+	85 – 89 %
7.5 – 8.4	B	75 – 84 %
7 – 7.4	B-	70 – 74 %
6.5 – 6.9	C+	65 – 69 %
6 – 6.4	C	60 – 64 %
5 – 5.9	C-	5 – 59 %
0 – 4.9	F	0 – 49 %

5.3. Warning on plagiarism

When writing a University paper or essay and reference is made to certain authors, it is mandatory to cite them by means of a footnote or a direct reference. In no case it is acceptable that a student uses a text, no matter how brief it is, written by somebody else without putting it in inverted commas, as this means s/he is trying to make it look as his/her own. This is called plagiarism and in a university context it could be penalized with expulsion.

6. Bibliography

- Yunus A. Cengel and Michael A. Boles (2018) *Thermodynamics: An Engineering Approach* 9th McGraw-Hill Education.
- Michael J. Moran and Howard N. Shapiro (2014*). Fundamentals of Engineering Thermodynamics*. 8th ed. Wiley.

7. Office Hours

Tutorial schedule will be confirmed in the first couple of sessions, to guarantee that the time schedule suits the needs of students and instructor. However, it is always advisable to make an appointment with the lecturer beforehand in order to ensure availability.

Campus: Madrid Princesa
E-mail: to be determined

8. Course Content

TOPICS	DESCRIPTION
1. Basic Concepts	• Microscopic and macroscopic point of view • thermodynamic system and control volume • Thermodynamic equilibrium • Quasi-static process
2. First law of Thermodynamics	• First law for a closed system undergoing a cycle and change of state • first law of thermodynamics for steady flow process • steady flow energy equation applied to nozzle, diffuser, boiler, turbine, compressor, pump, heat exchanger and throttling process, filling and emptying process
3. Second law of thermodynamics	• Kelvin-Planck and Clausius statements and their equivalence • causes of irreversibility • Carnot theorem • property of entropy • entropy's change in an irreversible process • third law of thermodynamics
4. Energy	• Energy of a heat input in a cycle • exergy of finite heat capacity body • exergy of closed and steady flow system • irreversibility and Gouy-Stodola theorem and its applications
5. Vapor Power cycles	• Carnot vapor cycle, Rankine cycle, comparison of Carnot and Rankine cycle • calculation of cycle efficiencies • reheat cycle, regenerative cycle, reheat-regenerative cycle
6. Gas Power cycles	• Recapitulation of Carnot, Otto and Diesel cycle, Dual cycle • Brayton cycle, effect of reheat, regeneration, intercooling and turbine and compressor efficiency on Brayton cycle
7. Properties of gases and gas mixtures	• Avogadro's law, equation of state, ideal gas equation, Vander Waal's equation • reduced properties • law of corresponding states • compressibility chart • Gibbs-Dalton law, internal energy • enthalpy and specific heat of a gas mixtures