

Academic Year: (2023 / 2024)

Review date: 13-06-2023

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: MORENO BOZA, DANIEL

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I, II
 Physics I, II
 Linear Algebra
 Writing and Communication Skills
 Programming
 Thermal Engineering
 Machine Mechanics

SKILLS AND LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.

CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.

CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.

CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.

CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.

CG2. Apply computational and experimental tools for analysis and quantification of energy engineering problems

CG4. Being able to do design, analysis, calculation, manufacture, test, verification, diagnosis and maintenance of energetic systems and devices.

CG10. Being able to work in a multi-lingual and multidisciplinary environment

CE17 Módulo CRI. Knowledge of the basic principles of fluid mechanics and their application for solving problems in the field of energy engineering. Pipeline, channel and fluid systems calculation.

CE2 Módulo TE. Applied knowledge on the fundamentals of fluid mechanics systems and machines.

CT1. Ability to communicate knowledge orally as well as in writing to a specialized and non-specialized public.

CT2. Ability to establish good interpersonal communication and to work in multidisciplinary and international teams.

CT3. Ability to organize and plan work, making appropriate decisions based on available information, gathering and interpreting relevant data to make sound judgement within the study area.

CT4. Motivation and ability to commit to lifelong autonomous learning to enable graduates to adapt to any new situation.

By the end of this content area, students will be able to have:

RA1.1 knowledge and understanding of thermodynamics, heat transfer and fluid mechanics fundamentals.

RA1.2 a systematic understanding of the key aspects and concepts of thermal engineering and fluid mechanics.

RA2.1 the ability to apply their knowledge and understanding to identify, formulate and solve problems of thermodynamics, heat transfer and fluid mechanics using established methods;

RA4.3 workshop and laboratory skills.

RA5.1 the ability to select and use appropriate equipment, tools and methods;

RA5.2 the ability to combine theory and practice to solve problems of thermodynamics, heat transfer

and fluid mechanics.

RA5.3 an understanding of applicable techniques and methods in thermal engineering and fluid mechanics of their limitations;

OBJECTIVES

The objective of this course is to provide the student a basic understanding of Fluid Mechanics: Mass Conservation Law, Momentum Conservations Law and Energy Conservation Law.

Knowledge mastered in this course:

- Identify the fluid domain and understand the interaction with its surroundings.
- Apply properly the above mentioned conservation laws to obtain forces, moments, power and heat exchange.
- Determine the dominant terms in the conservation equations
- Determine the adequate methodology to obtain the required variables in an engineering problem (calculus, experiments, etc.)
- Present results in a rational manner, in terms of the relevant parameters.
- Comprehension of basic terminology to understand technical documentation and specific literature.

Specific capacities:

- Obtention of pressure fields in fluid statics.
- Determination of forces and moments exerted by a fluid on a surface.
- Determination of power and heat exchange between a fluid and its surroundings.
- Determination of head losses in flow in ducts.
- Application of Dimensional Analysis principles to reduce the number of parameters in a generic problem.

General capabilities:

- Analysis based on scientific principles.
- Multidisciplinary approach (use knowledge from several disciplines: Mechanics, Thermodynamics, Calculus, etc.)
- Capacity to locate and understand basic literature on the subject.

Attitudes:

- Analytical attitude
- Critical attitude
- Cooperative attitude

DESCRIPTION OF CONTENTS: PROGRAMME

Introductory course on Fluid Mechanics composed of:

1. Introduction to Fluid Mechanics: continuum hypothesis, local thermodynamic equilibrium, equations of state and definition of fluid variables.
2. Flow kinematics: Lagrangian and Eulerian description, convective flux, and Reynolds transport theorem.
3. Conservation laws: integral and differential forms of the continuity, momentum, and energy equations.
4. Dimensional analysis: Pi theorem and physical similarity.
5. 1D Flow: Couette, Poiseuille, and other flows of practical interest.
6. Flow in pipes: major and minor losses.
7. Introduction to external flows.

LEARNING ACTIVITIES AND METHODOLOGY

Teaching methodology will include:

1. Lectures: The students will be provided with lecture notes and recommended bibliography.
2. Problem solving sessions, related with the course topics
3. Homework problems aiming at student self-evaluation.
4. Development and interactive presentation of guided works, including four lab session as direct application of theory.

ASSESSMENT SYSTEM

Continuous assessment will be based on the following criteria:

Partial exams: 2 eliminatory partial exams will be conducted throughout the course, which will cover material for the final ordinary exam. The weightage of each partial exam is 45% for the first one and

40% for the second one, based on the continuous assessment.

Laboratory practices: 4 practical sessions will be conducted, and students will submit the corresponding reports one week after each practice. The weightage of the practical grade is 15% of the continuous assessment.

All students who do not pass the continuous assessment associated with the partial exams must take the final exam, which will consist of the two previously evaluated parts. In the ordinary examination period, the final grade is calculated with 40% from the continuous assessment grade and 60% from the ordinary final exam grade.

In the extraordinary examination period, the final grade is determined either by 40% of the continuous assessment grade and 60% of the extraordinary final exam grade, or by 100% of the extraordinary final exam grade if the latter is higher than the former.

% end-of-term-examination:	60
% of continuous assessment (assignments, laboratory, practicals...):	40

BASIC BIBLIOGRAPHY

- Antonio Crespo Martínez Mecánica de Fluidos, Thomson.
- Frank M. White Fluid Mechanics, McGraw Hill.
- MARCOS VERA COELLO, CARLOS MARTÍNEZ BAZÁN, ANTONIO L. SÁNCHEZ PÉREZ, IMMACULADA IGLESIAS ESTRADÉ Ingeniería Fluidomecánica, Paraninfo, 2012

ADDITIONAL BIBLIOGRAPHY

- A. L. Sánchez Apuntes de Procesos Fluidotérmicos, Publicaciones de la Universidad Carlos III de Madrid., 2005
- Amable Liñán Martínez Apuntes de Mecánica de Fluidos, Publicaciones de la ETSI Aeronáuticos de Madrid, 2006