Engineering fluid mechanics

Academic Year: (2024 / 2025) **Review date: 14-01-2025**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: CALVO RIVERA, ANDRES

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

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.
COCIN1. Ability to draft, sign and develop projects in the area of industrial engineering for construction, renovation, repair, preservation, demolition, manufacture, installation, assembly or operation of: structures, mechanical equipment, energy installations, electrical and electronic installations, industrial plants and installations and automation and manufacturing processes.
COCIN3. Knowledge of basic and technological subject areas that will capacitate them to acquire new methods and theories and endow them with the versatility to adapt to new situations.
COCIN4. Ability to resolve problems with initiative, decision-making, creativity, and critical reasoning skills and to communicate and transmit knowledge, skills and abilities in the Industrial Engineering field.
COCIN5. Knowledge to perform measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar jobs.
CEP3. Ability to design and carry out experiments to analyze and interpret data obtained.
CER2. Knowledge of the basic principles of fluid mechanics and application for resolving problems in the field of engineering. Pipeline, channel and flow systems calculation.

By the end of this content area, students will be able to have:
RA1.1. Knowledge and understanding of fluid mechanics fundamentals.
RA1.2. A systematic understanding of the key aspects and concepts of fluid mechanics.
RA1.4. Awareness of the wider multidisciplinary context of engineering.
RA2.1. The ability to apply their knowledge and understanding to identify, formulate and solve problems of fluid mechanic using established methods.
RA4.2. The ability to design and conduct appropriate experiments, interpret the data and draw conclusions.
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 engineering problems of fluid mechanics.
RA5.3. An understanding of applicable techniques and methods in fluid mechanics, and of their limitations.

OBJECTIVES

By the end of this subject, students will be able to have:
1. knowledge and understanding of fluid mechanics fundamentals
2. awareness of the wider multidisciplinary context of engineering.
3. the ability to apply their knowledge and understanding to identify, formulate and solve problems of fluid mechanic using established methods;
4. the ability to design and conduct appropriate experiments, interpret the data and draw conclusions;
5. workshop and laboratory skills.
6. the ability to select and use appropriate equipment, tools and methods;
7. the ability to combine theory and practice to solve engineering problems of fluid mechanics;
8. an understanding of applicable techniques and methods in fluid mechanics, and of their limitations;

DESCRIPTION OF CONTENTS: PROGRAMME

This is a Basic course in Fluid Mechanics. Its Programme contains 7 parts:

FIRST PART: Introduction to Fluid Mechanics. The continuum hypothesis. Variables of interest.
SECOND PART: Hydrostatics: Application of Fluid Mechanics to a stagnant fluid. Pressure field in a stagnant fluid. Force and Moment acting on a solid surface. Archimedes Principle. Applications: Barometer, Manometers, Hydraulic presses ¿
THIRD PART: Basic concepts of fluid flow kinematics. Reynolds Transport theorem.
FOURTH PART: Conservation equations for fluid volumes and control volumes. Mass, Momentum and Energy conservation equations. Bernoulli equation; examples. Angular momentum equation. Applications to engineering problems.
FIFTH PART: Dimensional Analysis. The Pi theorem. Application of Dimensional Analysis to Fluid Mechanics. Relevant dimensionless numbers in Fluid Mechanics. Applications.
SIXTH PART: Flow in ducts. Flow regimes. Mechanical energy conservation applied to pipe flow with friction losses. Friction factor. Moody's chart and Colebrook equation . Localized losses in pipe systems (bends, valves, expansions, other fittings.). Illustrative examples of flow in pipes.
SEVENTH PART: External Flows

LEARNING ACTIVITIES AND METHODOLOGY

Teaching methodology will incluye:
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

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

The continuous evaluation will be based on:
- Midterms: a total of 2 midterms during the course.
- Lab sessions: 4 laboratory sessions; reports are due one week after each session.

All students who do not pass the continuous assesment must do the final exam. The final grade will be the sum of 40% continuous assessment and 60% of the grade of the final exam.

In the extraordinary examination, the final grade will be either the sum of 40% continuous assessment and 60% of the grade of the final extraordinary exam or 100% of the grade of the final extraordinary exam, whatever is higher.

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 Ingenieria Fluidomecanica, 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