Engineering fluid mechanics

Academic Year: (2021 / 2022) **Review date: 19-01-2022**

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

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.
- Aplication of Dimensional Analysis principles to reduce the number of parameters in a generic problem.

General capabilities:
- Analysis based on scientific principles.
- Multidisciplinar 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

This is an 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

The continuous evaluation will be based on:
- 3 quizzes that will take place during the semester
- laboratory work: 4 laboratory sessions; reports are due one week after each session

All students 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.

% end-of-term-examination:	60
% of continuous assessment (assigments, 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 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