Guía docente
205245 - ELF - Laboratorios Experimentales en Fluidos

Última modificación: 19/04/2023

Unidad responsable: Escuela Superior de Ingenierías Industrial, Aeroespacial y Audiovisual de Terrassa
Unidad que imparte: 729 - MF - Departamento de Mecánica de Fluidos.

Titulación: GRADO EN INGENIERÍA EN TECNOLOGÍAS AEROESPACIALES (Plan 2010). (Asignatura optativa).
GRADO EN INGENIERÍA EN TECNOLOGÍAS INDUSTRIALES (Plan 2010). (Asignatura optativa).
GRADO EN INGENIERÍA EN VEHÍCULOS AEROESPACIALES (Plan 2010). (Asignatura optativa).

Curso: 2023 **Créditos ECTS:** 3.0 **Idiomas:** Inglés

PROFESORADO

Profesorado responsable: Raush Alviach, Gustavo Adolfo

Otros: Quintana Vallmitjana, Marc

METODOLOGÍAS DOCENTES

The teaching methodology is divided into three parts:
- In the exposition sessions, the faculty will introduce the theoretical bases of the syllabus, basic concepts of the methods and results examples to illustrate the interpretations of the same. The presentation will make interactive use of tools such as the use of Matlab and Python-based programs. Mostly, the general concepts and calculation procedure will be presented in the Jupyter-notebook Python environment. Nevertheless, students are allowed to be open-minded and proactive to use any other tools that will be considered helpful in the course to get the final results.
- In the laboratory work sessions, the faculty will guide the students in applying the theoretical concepts for the resolution of experimental setups, basing at all times the critical reasoning. Activities will be proposed to the students to solve in the classroom and out of the classroom to favor the contact and use of the basic tools necessary for the realization of an instrumentation system.
- Autonomously, the students have to work on the material provided by the teachers and the result of the laboratory work sessions to assimilate and fix the concepts. The faculty will provide a study plan and follow-up activities (ATENEA).

OBJETIVOS DE APRENDIZAJE DE LA ASIGNATURA

1. To have obtained the knowledge, understanding, application capacity, and analysis of the measurement processes applied in fluid mechanics.
2. To have the knowledge and understanding of the analysis of random series applied to the measurement of turbulent flow.
3. Knowledge, understanding, application and analysis of experimental techniques to measure pressure, temperature and velocity in open and closed flows.
4. To have the ability to choose, among different experimental tools, the most appropriate ones to obtain relevant information on a Fluid Mechanics problem.
5. Identify the limitations of the chosen techniques, the errors made and reported the results obtained, in a critical and self-sufficient way.

HORAS TOTALES DE DEDICACIÓN DEL ESTUDIANTADO

Tipo	Horas	Porcentaje
Horas grupo grande	30,0	40.00
Horas aprendizaje autónomo	45,0	60.00

Dedicación total: 75 h

CONTENIDOS

Module 1: Pressures and Errors and Uncertainties

Descripción:
Errors Theory and uncertainty in measurement in fluid mechanics. Navier-Stokes equations: dimensionless parameters.
Pressure measurements in open flows. Column, multicolumn and transducer pressure gauges.
Static pressure measurements in models. Orifice dimensions and their configurations. Piezometric rings.

Actividades vinculadas:
Individual deliverable work assigned to the content of the module.
Ad-hoc laboratory session. Preparation of laboratory activity report.
Examples of Activities in laboratory: Pressure measurements on dynamic probes. Density measurements of manometric fluids

Dedicación: 12h 30m
Grupo grande/Teoría: 5h
Aprendizaje autónomo: 7h 30m

Module 2: Velocity and Flow rate

Descripción:
Dynamic probes, Pitot tubes
Hot-wire anemometry: Principles and applications
Other thermal velocity probes: thermistors and vane probes.
Flow rate measurements. Principle of orifices and contractions
Flow measurements of free discharges and fan's flows

Actividades vinculadas:
Individual deliverable work assigned to the content of the module.
Ad-hoc laboratory session. Preparation of laboratory activity report.
Examples of Activities in laboratory: Speed measurements with dynamic, thermal and turbine probes. Developing of calibration curves and their error analysis. Measurement of the flow rate of a rotodynamic pump and obtaining the characteristic curve. Flow measurements on the weir.

Dedicación: 12h 30m
Grupo grande/Teoría: 5h
Aprendizaje autónomo: 7h 30m

Module 3: Boundary Layer

Descripción:
Boundary Layer Concepts. Measurement techniques. Boundary layer smooth and rough plate. Transition zone. Types of dynamic probes.

Actividades vinculadas:
Individual deliverable work assigned to the content of the module.
Ad-hoc laboratory session. Preparation of laboratory activity report.
Examples of Activities in laboratory: Measurement of the boundary layer profile. Analysis of conventional dynamic probes and Stanton probe

Dedicación: 12h 30m
Grupo grande/Teoría: 5h
Aprendizaje autónomo: 7h 30m

Module 4: Aerodynamic Forces and Moments

Descripción:
Measurements of forces and moments by direct measurements through aerodynamic balances: internal and external. Principles of operation. Coordinate systems and load cells as force sensing elements.
Aerodynamic coefficients: drag, lift/downforce, moment. Betz's method: wake's momentum.

Actividades vinculadas:
Individual deliverable work assigned to the content of the module.
Ad-hoc laboratory session. Preparation of laboratory activity report.
Examples of Activities in laboratory: Aerodynamic force measurements at wind tunnels using the methods of: momentum (Betz method) and aerodynamic balance.

Dedicación: 12h 30m
Grupo grande/Teoría: 5h
Aprendizaje autónomo: 7h 30m

Module 5: Flow Visualization

Descripción:
Definitions and their measurements. Wake method.
Visualization by direct injection tracer techniques. Visualization by smoke.
Particle imaging techniques, PIV/PTV, TPIV, SPIV. Principles, image processing tools. Pressure measurements by PIV techniques.

Actividades vinculadas:
Individual deliverable work assigned to the content of the module.
Ad-hoc laboratory session. Preparation of laboratory activity report.
Examples of Activities in laboratory: Visualization of the flow detachment in aerodynamic bodies like: cylinder, airfoil, scale model of a passenger car, etc.

Dedicación: 12h 30m
Grupo grande/Teoría: 5h
Aprendizaje autónomo: 7h 30m

Module 6: Recap

Descripción:
Complementation of masterclasses aimed at solving doubts and concepts.

Actividades vinculadas:
Oral presentations an recap old sessions.

Dedicación: 12h 30m
Grupo grande/Teoría: 5h
Aprendizaje autónomo: 7h 30m

SISTEMA DE CALIFICACIÓN

The teaching methodology is divided into three parts:
- In the exposition sessions, the faculty will introduce the theoretical bases of the syllabus, basic concepts of the methods and results examples to illustrate the interpretations of the same. The presentation will make interactive use of tools such as the use of Matlab and Python-based programs. Mostly, the general concepts and calculation procedure will be presented in the Jupyter-notebook Python environment. Nevertheless, students are allowed to be open-minded and proactive to use any other tools that will be considered helpful in the course to get the final results.
- In the laboratory work sessions, the faculty will guide the students in applying the theoretical concepts for the resolution of experimental setups, basing at all times the critical reasoning. Activities will be proposed to the students to solve in the classroom and out of the classroom to favor the contact and use of the basic tools necessary for the realization of an instrumentation system.
- Autonomously, the students have to work on the material provided by the teachers and the result of the laboratory work sessions to assimilate and fix the concepts. The faculty will provide a study plan and follow-up activities (ATENEA).
Penalties:
- The use of wrong dimensional and conceptual errors from previous subjects such as: fluid mechanics, fluid engineering, or similar. The students must to be careful and precise with concepts and principles used in the report writing and descriptions.
- the mistakes on reporting of results without units and wrong units of the measurement systems will be severely penalized.
The final score will be calculated as the following algorithm: - 25% of the grade will be assigned to the 5 individual deliverables that the teaching staff will publish in order to consolidate concepts and techniques necessary in the preparation of future reports. Each activity has a weight of 5% in the final grade. - 75% will be assigned to laboratory activities. Your contributions will be divided as follows: o Four activities will have a contribution of 15% on the final grade o The remainder has its composition in 5% in the report and 10% in the oral presentation of the group. The group note is common to its members.