Course guide
340039 - MFLU-F3O29 - Fluid Mechanics

Last modified: 14/05/2024

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Garcia Gonzalez, Fernando

Others: Cantó Atienza, Gemma
Laparra Vicente, David

REQUIREMENTS

Subjects:
340023 - Physics I
340026 - Advanced calculus
340025 - Diferential equations

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE8. Knowledge of basic principals of fluid mechanic and its application to resolve problems in engineering area. Calculus of channels, canals and fluids.

Transversal:
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

TEACHING METHODOLOGY

- Lectures and participatory classes, consisting of explanation and development of the theory, and the resolution of problems. The material user will be available to the student in the Digital Campus section of the subject.
- Practical lessons in problem-solving, where it will seek the maximum involvement of students through their direct involvement in solving the problemes. Students must solve in class / outside of class, individually, problems that are assigned. In the Digital Campus section of the subject, the student can look up the list of problems before they are done in class.
- Laboratory practical classes, made directly by students, guided by the teacher, allowing them to directly observe relevant aspects of the theory. The student can look up the explanatory text of the practices to develop in the Digital Campus. The students must make a report of the practices carried out. This report will be evaluated and will be delivered before the date set by the professor.
- Students will make two exams of all theoretical and practical knowledge developed in the subject.

LEARNING OBJECTIVES OF THE SUBJECT

When the student finishes the subject, he/she has to be capable of:
· Understanding the basic principles of the behavior of fluids, when static and in movement, as well as the principles of applied thermodynamics and heat transfer.
· Knowing the principles of fluid mechanics in fluidodynamics systems.
· Solving problems of pipelines and simple fluid systems.
· Analyzing and solving problems in the area of fluid engineering.
· Interpreting, analyzing, synthesizing and extracting conclusions of results of measurements and tests.
· Writing texts with the structure adapted to the aims of communication.
· Knowing and putting into practice the dynamics teamwork.
· Carrying out assignments from basic directions given by the teacher.

STUDY LOAD

Type	Hours	Percentage
Hours large group	52,5	35.00
Hours small group	7,5	5.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. Fundamentals concepts. Fluid Properties.

Description:
Definition of fluid.Fluid as a continuous media.Fundamental properties. Viscosity.

Specific objectives:
Understanding the basic concepts of fluid mechanics. Identifying different kinds of problems in fluid mechanics. Applied knowledge of basic fluid properties and the influence of viscosity on friction in a fluid flow.

Related activities:
A1. Problems of fluid properties
A8. Laboratory: Determination of density and viscosity of liquids.
A13. Individual exam.

Full-or-part-time: 21h
Theory classes: 7h 30m
Laboratory classes: 1h 30m
Self study : 12h

2. Hydrostatics.

Description:
Pressure. Pascal's law. Pressure measurement. Hydrostatic forces over submerged surfaces. Flotation and stability. Fluids in motion as a rigid solid.

Specific objectives:
Achieving the capacity to determine the pressure distribution in a still fluid, to calculate hydrostatic forces over flat and curved submerged surfaces and to determine the pressure distribution in fluids in motion as rigid solids.

Related activities:
A2. Problems of hydrostatics
A13. Individual exam.

Full-or-part-time: 19h 30m
Theory classes: 6h 30m
Self study : 13h

3. Basic concepts for flow analysis.

Description:
Systems and control volumes. Eulerian and Lagrangian approaches. Material derivative. Flow classification. Visualization of a velocity field. Reynolds' transport theorem. Basic analysis techniques.

Specific objectives:
Understanding the use of the material derivative for connecting the Eulerian and the Lagrangian approach, identifying different flow visualization techniques, understanding the use of Reynolds' transport theorem and knowing the differential, integral, experimental and computational techniques used for flow analysis.

Related activities:
A13. Individual exam.

Full-or-part-time: 11h 30m
Theory classes: 3h 30m
Self study : 8h

4. Basic integral equations in fluid mechanics (I).

Description:
Continuity equation: massic and volumetric flow. Energy equation. Bernoulli equation. Scope and limitations. Velocity and flow rate meters.

Specific objectives:
Correctly applying the concepts of compressibility and steadiness in flow determination. Identifying and correctly estimating the different forms of mechanical energy together with the efficiency in their transformations. Correctly using Bernoulli's equation in solving basic hydraulic problems and in velocity and flow rate meters.

Related activities:
A3. Problems of application of mass conservation principle.
A4. Problems of application of Bernoulli equation.
A9. Laboratory: Measurement of the flow rate of a fluid flowing under pressure: Flowmeters.
A10. Laboratory: Analysis of the flow in open channels. Flow measurement with weirs.
A13. Individual exam.
A14. Individual exam.

Full-or-part-time: 45h 30m
Theory classes: 14h 30m
Laboratory classes: 4h
Self study : 27h

5. Basic integral equations in fluid mechanics (II).

Description:
Newton's laws and momentum conservation. Forces over a control volume. Angular momentum equation. Application to turbomachines: characteristic curves.

Specific objectives:
Identifying forces and torques over a control volume. Determine resulting forces due to flow streams. Estimating torques generated by flow streams.

Related activities:
A5. Problems of application of the linear momentum equation.
A6. Problems of application of the kinetic momentum equation.
A14. Individual exam.

Full-or-part-time: 24h
Theory classes: 9h
Self study : 15h

6. Pipe flow

Description:
Developed flows. Laminar and turbulent flow. Main and secondary losses. Flow in non-circular ducts. Hydraulic radius and equivalent diameter. Pipe systems: serial-parallel arranges. Steady state basic hydraulics, installation resistant curve. Operation point of a pumping installation.

Specific objectives:
Solving basic steady state hydraulic problems. Developig basic design tasks for fluid distribution instalations and determining the operating point in pumps.

Related activities:
A11. Laboratori practice: Determination of primary and secondary head losses in air flow.
A14. Individual exam.

Full-or-part-time: 28h 30m
Theory classes: 11h 30m
Laboratory classes: 2h
Self study : 15h

GRADING SYSTEM

The different concepts that make up the continuous assessment are:
- Written individual examinations (70%)
- Laboratory practical and reports (15%)
- Submission of resolved problems (15%)
The re-evaluation will consist of a Global Exam of the subject and will weigh 70% of the final revaluation grade.
The final grade of the revaluation will be obtained with the following expression:
Final Revaluation Grade = Grade (EGlobal)*0,7 + Grade delivered problems*0,15 + Grade Practice reports*0,15
Students who meet the requirements set by the EPSEVG in its Evaluation and Permanence Regulations will be able to access the re-evaluation test.

EXAMINATION RULES.

- A form may be used for each of the two individual written tests.
The two tests have the same evaluation weight of 35%, the sum of both being 70% of the final grade.
- For the problems solved individually, the teacher will indicate the date on which the delivery will be done by the students. The problems must be resolved by the students outside of class and delivered via Atenea within the time deadline set by the teacher.
The laboratory practice reports will be evaluated according to the established rubric that the students will have in advance. In order to have a note of the laboratory practices, it is essential to assist to the practices and present the reports with the group with which the practice was carried out in the laboratory.

BIBLIOGRAPHY

Basic:
- Çengel, Y.A.; Cimbala, John M. Mecánica de fluidos : fundamentos y aplicaciones [on line]. 4a ed. México, DF: McGraw-Hill, 2018 [Consultation: 20/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8102. ISBN 9781456260941.
- White, Frank M. Mecánica de fluidos [on line]. 6a ed. Madrid [etc.]: McGraw-Hill, 2008 [Consultation: 16/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4144. ISBN 9788448166038.
- Heras, Salvador de las. Mecánica de fluidos en ingeniería [on line]. Barcelona: Iniciativa Digital Politècnica, 2012 [Consultation: 05/04/2022]. Available on: https://upcommons.upc.edu/handle/2099.3/36608. ISBN 9788476539354.

Complementary:

- Bergadà Granyó, Josep M. Mecánica de fluidos : breve introducción teórica con problemas resueltos [on line]. 3a ed. Barcelona: Iniciativa Digital Politècnica, 2017 [Consultation: 05/04/2022]. Available on: https://upcommons.upc.edu/handle/2117/111266. ISBN 9788498806885.
- Potter, Merle C [et al.]. Mecánica de fluidos. 4a ed. México [etc.]: Cengage, 2012. ISBN 9786075194509.
- Franzini, Joseph B.; Finnemore, E. John. Mecánica de fluidos con aplicaciones en ingeniería. 9a ed. Madrid [etc.]: McGraw-Hill, 1999. ISBN 844812474X.