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340039 - MFLU-F3O29 - Fluid Mechanics

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering

Teaching unit: 729 - MF - Department of Fluid Mechanics

Academic year: 2019

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

ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: Carbonell Ventura, Montserrat

Others: Pons Segalà, Jordi
Nieto Reina, Iván

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, if necessary in 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 or in groups, 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.
- Hand in resolved problems by students. Submittals will consist on individual or group solution, in class or outside class, of some problems of the list or similar, the student will have in the Digital Campus. This activity will be evaluated. The student feed-back can made from the submission of the revised problems.
- 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 will give the theacher a copy of the experimental extracted data. Later, 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.
- Tutorial classes in group or individual.
- Students will make two exams of all theoretical and practical knowledge developed in the subject.

Learning objectives of the subject

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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

Total learning time: 150h	Hours large group:	52h 30m	35.00%
	Hours medium group:	0h	0.00%
	Hours small group:	7h 30m	5.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

1. INTRODUCTION TO FLUID MECHANICS. FLUID'S MECHANICAL PROPERTIES.

Learning time: 18h 30m

Theory classes: 7h
Laboratory classes: 1h 30m
Self study : 10h

Description:
1.1 Fluid's definition.
1.2 Forces acting on a fluid.
1.3 Continuum media. Non-Slip condition
1.4 Mechanical Properties of Fluids
1.5 Dimensions and systems of units.

Related activities:
A1. Applied exercises
A7. Laboratory: Determination of density and viscosity of liquids.
A12. Individual exam.

Specific objectives:
- Define the concept of a fluid.
- Interpret the continuous medium and non-slip condition hypothesis.
- Formulate the principal mechanical properties of fluids.
- Have an applied knowledge of the fluid's mechanical properties.
- Understand the influence of viscosity on friction in fluid flow.

2. FLUIDS STATICS

Learning time: 21h

Theory classes: 7h
Laboratory classes: 0h
Self study : 14h

Description:
2.1. Fundamental equation of hydrostatics. Applications.
2.2. Pressure measurement.
2.3. Pressure forces on flat and curved surfaces.
2.4. Stabilty of total or partially submmerged bodies

Related activities:
A2. Applied exercises
A12. Individual exam.

Specific objectives:
- Interpret the fundamentals for the fluid static equation.
- Interpret the equation of hydrostatic in the gravity field.
- Describe the methods and instruments for the measurement of the pressure.
- Calculate the pressure read on a gauge.
- Determine the pressure distribution in a static fluid and its effects on solid surfaces.
- Calculate the hydrostatic forces acting on a flat or curved surface.
- Interpret the Archimedes' principle.
- Calculate the buoyancy force acting on total or partially summerged bodies.

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3. PRINCIPLE OF CONSERVATION OF MASS

Learning time: 21h 30m

Theory classes: 6h 30m
Self study : 15h

Description:
3.1 Control systems and volumes.
3.2 Methods of movement description.
3.3 Viewing the speed field. Flow lines.
3.4 Material derivative.
3.5 Volumetric and mass flow rate. Average speed.
3.6 Reynolds Transportation Theorem.
3.7 Principle of Conservation of Mass.

Related activities:
A3. Applied exercises
A12. Individual exam.

Specific objectives:
- Know the Eulerian and Lagrangian descriptions of fluid flow.
- Know techniques for visualization of fluxes.
- Understand the meaning of the material derivative.
- Calculate volumetric and mass flow rates, and average velocity.
- Interpret the principle of the conservation of mass using the Reynolds transport theorem.
- Calculate mass balances in stationary and non-stationary flows.
- Apply the equation of conservation of the massa per the resolution of problems of fluids.

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4. PRINCIPLE OF CONSERVATION OF ENERGY

Learning time: 23h 30m

Theory classes: 8h
Laboratory classes: 1h 30m
Self study : 14h

Description:
4.1 Mechanical energy equation
4.2 Applications of Bernoulli's equation for an ideal fluid. Velocity and flow rate meters.
4.3 Generalized Bernoulli's equation.
4.4 Flow regimes in pipes.
4.5 Head losses in pipes: linear and secondary.
4.6 Energy grade line and the hydraulic grade line.

Related activities:
A4. Applied exercises.
A8. Laboratory: Measurement of the flow rate of a fluid flowing under pressure: Flowmeters.
A13. Individual exam.

Specific objectives:
- Identify and correctly evaluate the different forms of mechanical energy.
- Understand l'ús i limitacions de l'equació de Bernoulli.
- Apply the Bernoulli's equation in solving basic hydraulic problems. in velocity and flow rate meters.
- Apply the Bernoulli's equation in velocity and flow rate meters.

5. PRINCIPLE OF CONSERVATION OF MOMENTUM

Learning time: 20h

Theory classes: 6h
Laboratory classes: 0h
Self study : 14h

Description:
5.1 Principle of the conservation of the quantity of movement.
5.2 Action and reaction forces due to fluid movement.
5.3 Angular momentum equation.
5.4 Application to Turbomachines: characteristic curves.

Related activities:
A5. Applied exercises.
A13. Individual exam.

Specific objectives:
- Identify the forces and torques over a control volume.
- Determine resulting forces due to flow streams.
- Determine torques generated by flow streams.
- Apply angular momentum equation to turbomachines.

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6. FLOW SYSTEM ANALYSIS

Learning time: 25h 30m

Theory classes: 8h
Laboratory classes: 2h 30m
Self study : 15h

Description:
6.1 Installation resistant curve.
6.2 Flow in non-circular ducts. Hydraulic radius and diameter.
6.3 Operating point of a pumping installation.
6.4 Pipe systems: serial-parallel arranges.
6.5 Open-channel flow.

Related activities:
A6. Applied exercises..
A9. Laboratory: Analysis of flow in open channels. Weirs - Open Channel Flow Rate Measurement.
A10. Laboratory: Measurement of flow rates and head loss in laminar and turbulent flow.
A13. Individual exam.

Specific objectives:
- Apply mechanical energy equation in piping systems.
- Calculate main and minor head losses in piping systems.
- Calculate system-head curve of a basic installation in steady state.
- Calculate the operating point of a pumping installation.
- Interpret the opperating point of a pump.
- Calculate installations consist of pipes arranged in series, parallel, or some complicated combination.
- Calculate flow rates by flow weir.
- Calculate flow rates on a given channel geometry.
- Hydraulic jump definition.

7. FUNDAMENTAL PNEUMATIC PRINCIPLES

Learning time: 20h

Theory classes: 10h
Laboratory classes: 2h
Self study : 8h

Description:
7.1 Introduction to pneumatics.
7.2 Working pneumatic components.
7.3 Pneumatic control elements. Valves.
7.4 Basic pneumatic circuits.

Related activities:
A11: Laboratory: Elemental pneumatic circuits with double-acting cylinder. Festo panel-mounting valves and actuating attachments.
A13. Individual exam.

Specific objectives:
- Know the fundamentals of the production of compressed air.
- Know the elements of a pneumatic system.
- Know the actuators and distributors. Pneumatic symbols and design of basic circuits.

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Qualification system

The different concepts that make up the continuous assessment are:
- Written individual examinations (75%)
- Laboratory practical and reports (10%)
- Submission of resolved problems (15%)

The re-evaluation will consist of a Global Exam of the subject corresponding to the theory and problems of CP1 and CP2, independent of the grade obtained in each of the partial controls (be less than, equal to or greater than 5.0). The Global Exam will weigh 75% of the final revaluation grade.

Regulations for carrying out activities

Each of the two individual exams will consist of two parts:
Part 1: a theory test (maximum 20% of the exam).
Part 2: with a number of problems that will contemplate the score until completing the 100% of the exam.

Bibliography

Basic:

Çengel, Y.A.; Cimbala, J.M. Mecánica de fluidos : fundamentos y aplicaciones [on line]. 4a ed. México, DF: McGraw-Hill, 2018 [Consultation: 31/07/2019]. Available on: <https://discovery.upc.edu/iii/encore/record/C__Rb1520496?lang=cat>. ISBN 9781456260941.

White, Frank M. Mecánica de fluidos. 6a ed. Madrid [etc.]: McGraw-Hill, 2008. ISBN 9788448166038.

Heras, Salvador de las. Mecánica de fluidos en ingeniería [on line]. Barcelona: Iniciativa Digital Politècnica, 2012 [Consultation: 22/09/2014]. Available on: <http://hdl.handle.net/2099.3/36608>. ISBN 9788476539354.

Complementary:

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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.