Course guide
820013 - MF - Fluid Mechanics

Last modified: 08/08/2024

Unit in charge: Barcelona East School of Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics.

Degree: BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ENERGY 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).
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).

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

LECTURER

Coordinating lecturer: FRANCESCO CAPUANO - RICARDO JAVIER PRINCIPE RUBIO - JOAN CALAFELL SANDIUMENGE

Others: Primer quadrimestre:
JOAN CALAFELL SANDIUMENGE - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: M15
FRANCESCO CAPUANO - Grup: T11, Grup: T12, Grup: T13, Grup: T14
ALBERTO ANTONIO CARBO BECH - Grup: M21, Grup: M22, Grup: M53, Grup: M54
JOSE ALEJANDRO CARRILLO CORTES - Grup: M41, Grup: T13, Grup: T14
DAIBEL DE ARMAS ORAMAS - Grup: M15, Grup: M25
JOSE IGNACIO ESEBERRI PIEDRA - Grup: T21, Grup: T22
ATTILA PETER HUSAR - Grup: T21, Grup: T22, Grup: T23, Grup: T24
ALEJANDRO MARTINEZ ALEGRE - Grup: M42, Grup: M51, Grup: M52, Grup: M55
ROGER MAYNOU GIL - Grup: M11, Grup: M12
RICARDO JAVIER PRINCIPE RUBIO - Grup: M13, Grup: M14, Grup: M31, Grup: M32, Grup: M33, Grup: M34, Grup: M35, Grup: M51, Grup: M52, Grup: M53, Grup: M54, Grup: M55
PEDRO RUFES MARTINEZ - Grup: T11, Grup: T12, Grup: T23, Grup: T24
CARLOS RUIZ MOYA - Grup: M21, Grup: M22, Grup: M23, Grup: M24, Grup: M25, Grup: M33, Grup: M34, Grup: M35, Grup: M41, Grup: M42, Grup: M43, Grup: M44, Grup: M45
TÀNIA TORM OBRADORS - Grup: M43, Grup: M44

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
2. Understand the basic principles of fluid mechanics and its application to problems in the field of engineering. Calculate the parameters of ducts, channels and fluid systems.

Transversal:
1. 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

The subject will be developed using master classes to present the contents to the students. The students will have to do individual work for problem solving and test preparing, and also team work for lab experiences and complex problem solving.

LEARNING OBJECTIVES OF THE SUBJECT

Giving the students the knowledge and basic skills on this subject in order to prepare him for professional tasks related to the contents of it, and at the same time encouraging the training and learning processes in the field of fluid mechanics engineering.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Self study	90,0	60.00
Hours large group	45,0	30.00

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 fluid flow.

Full-or-part-time: 21h 30m
Theory classes: 7h 30m
Laboratory classes: 1h
Self study : 13h

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.

Full-or-part-time: 18h 30m
Theory classes: 6h 30m
Laboratory classes: 1h
Self study : 11h

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.

Full-or-part-time: 10h 30m
Theory classes: 3h 30m
Laboratory classes: 1h
Self study : 6h

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.

Full-or-part-time: 40h 30m
Theory classes: 14h 30m
Laboratory classes: 1h
Self study : 25h

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.

Full-or-part-time: 25h
Theory classes: 9h
Laboratory classes: 1h
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.

Full-or-part-time: 17h 30m
Theory classes: 6h
Laboratory classes: 1h 30m
Self study : 10h

7. Free surface flows

Description:
Flow classification. Uniform flow in canals. Specific energy, critical depth. Flow under a gate. Gradually variated flow. Flow rate control and measurement with pouring systems.

Specific objectives:
Solving slow problems in steady state open canals.Using pouring systems for flow control and measurement.

Full-or-part-time: 16h 30m
Theory classes: 5h 30m
Laboratory classes: 1h
Self study : 10h

GRADING SYSTEM

Md-term exam (30%); Homework activities (10%); Final exam (40%); Lab Pràctices (15%); Generic skills (5%). In order to pass the course it is mandatory to attend to all lab practices and deliver the correspondent lab report.
There is a re-avaluaton test for this subject.
The student will be able to access the re-assessment test that meets the requierements set by the EEBE in its Assesment and Permanence Regulations.

EXAMINATION RULES.

The evaluation will be conducted through written test both for the mid-terms and final exam.
There will be 3 homework activities due during the term. These activities will be delivered online through the course intranet.
Practices will be graded based on a pre-test to be presented bedore the lab practice start, attendance (mandatory) and lab activity developed, together with the preparation and delivery of lab reports.

BIBLIOGRAPHY

Basic:

- White, Frank M. Mecànica de fluidos [on line]. 6ª ed. Madrid: McGraw-Hill, 2008 [Consultation: 04/06/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4144. ISBN 9788448191283.
- Gerhart, Philip M.; Gross, Richard J.; Hochstein, John I. Fundamentos de mecánica de fluidos. 2ª ed. Argentina: Addison-Wesley Iberoamericana, 1995. ISBN 0201601052.
- Çengel, Yunus A.; Cimbala, John M. Mecánica de fluidos : fundamentos y aplicaciones [on line]. México, D.F: McGraw-Hill, 2018 [Consultation: 04/06/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8102. ISBN 9781456262280.

Complementary:

- Franzini, Joseph B.; Finnemore, E. John. Mecánica de fluidos con aplicaciones en ingeniería. 9ª ed. Madrid: McGraw-Hill, 1999. ISBN 844812474X.