UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Course guide
820425 - EFM - Fluid Engineering

Last modified: 02/03/2026

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

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: RICARDO TORRES CAMARA - JAN MATEU ARMENGOL

Others:

Primer quadrimestre:
ANTONIO BRUNACCINI - Grup: M13, Grup: M14, Grup: T13
JOSE IGNACIO ESEBERRI PIEDRA - Grup: T11, Grup: T12
JAN MATEU ARMENGOL - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: T11, Grup: T12, Grup: T13
MARIO MIGUEL VALERO PÉREZ - Grup: M11, Grup: M12

Segon quadrimestre:
ANTONIO BRUNACCINI - Grup: M15
DAIBEL DE ARMAS ORAMAS - Grup: T15
JOSE IGNACIO ESEBERRI PIEDRA - Grup: T11, Grup: T12, Grup: T13, Grup: T14
EDUARD MARTÍN JIMÉNEZ - Grup: M12
JAN MATEU ARMENGOL - Grup: T11, Grup: T12, Grup: T13, Grup: T14, Grup: T15
PAULA OLIVERA PRIETO - Grup: M13, Grup: M14
RICARDO TORRES CAMARA - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: M15
MARIO MIGUEL VALERO PÉREZ - Grup: M11

REQUIREMENTS

TERMODINÀMICA I TRANSFERÈNCIA DE CALOR - Prerequisit
MECÀNICA DE FLUIDS - Prerequisit

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMEC-24. Understand and apply the fundamentals of fluid mechanics systems and machines.

Transversal:
1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

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STUDY LOAD

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

Total learning time: 150 h

CONTENTS

(ENG) Chapter 1: Fonamental Equacions in differential form

Description:
Kinematics of a fluid particle. Navier-Stokes equations: continuity, momentum and energy. Exact and approximate solutions of the Navier-Stokes equations. Euler equation. Bernoulli equation.

Specific objectives:
An understanding of the deduction of the equations of mass, momentum and energy in differential form including how to calculate the pressure field for a known velocity field and to obtain approximate and analytical solutions for simple flow fields.

Full-or-part-time: 8h
Theory classes: 8h

(ENG) Chapter 2: Dimensional and similarity. Modeling.

Description:
The need for dimensional analysis. Dimensional homogeneity. The PI theorem. Nondimensionalization of the basic equations. Relevant dimensionless parameters in mass transport, momentum and energy and their physical meaning. Similarity: geometric, kinematic and dynamic similarities. Partial and incomplete similarities.

Specific objectives:
A knowledge of the scope of dimensional analysis in the study of fluid flow and its limitations. To identify characteristics scales correctly and to distinguish between different types of similarity. An ability to determine dimensionless groups and to know the physical meaning of the most important in the flow of fluids and fluid machinery. An ability to obtain partial similarity from simplifications.

Full-or-part-time: 7h 30m
Theory classes: 7h 30m

Chapter 3. Compressible flow

Description:
Introduction: velocity of sound, Mach number and stagnation state. One-dimensional steady flow in nozzles and diffusers. Effects of area changes in the flow. Effects of back pressure on mass flow rate. Flow of ideal gases. Flow across a normal shock. Fanno and Rayleigh lines. Isothermal compressible flow with friction in ducts of constant cross-sectional area.

Full-or-part-time: 6h
Theory classes: 6h

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(ENG) Chapter 4: Fluid systems

Description:
Curvas resistentes y su asociación serie / paralelo. Nudos. Problemas de redes ramificadas y mallades: técnicas de resolución. Problemas de bombeox. Asociación de grupos impulsores. Diámetro económico. Punto de funcionamiento y regulación. NPSH necesario y disponible. Cavitación y golpe de ariete.

Specific objectives:
An ability to solve multiple-pipe systems and to determine fluid systems characteristics. An understanding of essential problems in stationary fluid systems. Combinations in series / paralel of pumps and fluid systems. An ability to matching pumps to system characteristics. An ability to avoid abnormal operating conditions like cavitation as well as to assess the effects of a water hammer.

Full-or-part-time: 8h
Theory classes: 8h

(ENG) Chapter 5: Lift and drag. External flow

Description:
Drag and lift. The boundary layer equations. Boundary layer analysis and fundamental parameters. Study of the boundary layer on a flat plate. Flow around cylinders and spheres. Boundary layer with adverse pressure gradient. Experimental external flows. Basic principles of turbulence: the difficulty of the phenomena. Turbulence models.

Specific objectives:
An understanding of the effects of friction and pressure on drag and lift. An ability to know how to determine the fluid forces on common geometries and to describe the flow patterns around cylinders and spheres. An understanding of the models of the boundary layer and how to calculate their properties. An exposure to the difficulties of the turbulence: essential aspects of the turbulent phenomena and classification of the turbulence models.

Full-or-part-time: 7h 30m
Theory classes: 7h 30m

(ENG) Tema 6: Turbomàquines i màquines volumètriques

Description:
Introduction and classification of fluid machines. Turbomachinery: description and functional elements. Characteristic curves of a centrifugal pump. Similarity rules of pumps and turbines. Volumetric machines: types and description of the functional elements. Characteristic curves of volumetric pumps and motors: selection criteria. Power transmission circuits.

Specific objectives:
A knowledge of the classification of fluid machinery. An understanding of the dynamics in the impeller of the turbomachinery and its influence on the energy transfer. A knowledge of the different types of turbomàquines, of the essential functional elements and their areas of operation. An ability to use the similarity rules to re-design new turbomachinery. An understanding of the performance parameters of positive-displacement machines. A knowledge of the mechanical designs of PDM, of the selection criteria an of the use as power transmission systems.

Full-or-part-time: 8h
Theory classes: 8h

GRADING SYSTEM

To pass the course, the practical reports must have been completed and submitted. There will test reassessment. he students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations.
First assessment: 35 %
Final assessment: 35 %
Exercises/problems: 10 %
Laboratory: 15 %
Generical competence: 5%

BIBLIOGRAPHY

Basic:
- Çengel, Y. A.; Cimbala, John M.. Mecánica de fluidos : fundamentos y aplicaciones [on line]. 4a ed. México, D.F.: McGraw-Hill, 2018 [Consultation: 22/06/2022]. Available on: https://discovery.upc.edu/permalink/34CSUC_UPC/11q3oqt/alma991001586669706711. ISBN 9781456262280.
- White, Frank M. Mecánica de fluidos [on line]. 6ª ed. Madrid [etc.]: McGraw-Hill, 2013 [Consultation: 22/06/2022]. Available on: https://discovery.upc.edu/permalink/34CSUC_UPC/11q3oqt/alma991003435529706711. ISBN 9788448191283.
- Agüera Soriano, J. Mecánica de fluidos incompresibles y turbomáquinas hidráulicas. 5ª ed. act. Madrid: Ciencia 3, DL 2002. ISBN 8495391015.
- Dixon, S. L.; Hall, C.A. Fluid mechanics and thermodynamics of turbomachinery [on line]. 6th ed. Amsterdam [etc.]: Elsevier : Butterworth-Heinemann, cop. 2010 [Consultation: 30/04/2020]. Available on: https://www.sciencedirect.com/science/book/9781856177931. ISBN 9781856177931.

RESOURCES

Audiovisual material:
- Nom recurs. Resource

Hyperlink:
- How wings work Smoke streamlines around an airfoil. https://www.google.es/url?sa=t&rct=j&q=&e=s&source=video&cd=1&cad=rja&uact=8&ved=0ahUKEwi8pLys4uDNAhVFLcAKHdi8BKAQtwIIHDAA&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D6UlsArvbTeo&usg=AFQjCNHWUA5oQhKGStRYYgepZrIMlZJO5w&bvm=bv.126130881,d.ZGg- Aerodynamic Stall - Wing Profile. https://youtu.be/Ti5zUD08w5s- Mercedes-Benz E-Class Coupe Aerodynamics. https://youtu.be/jd71qpfUfEg- New BMW Aerodynamic Test Center Model, Wind Tunnel, Aerolab. https://youtu.be/eszhVxE_9-8- The Aerodynamics of Flight. https://youtu.be/5ltjFEei3AI