Course guide
240629 - 240629 - Computational Fluid Dynamics

Last modified: 16/05/2023

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

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer: FRANCESC XAVIER ESCALER PUIGORIOL

Others: FRANCESC XAVIER ESCALER PUIGORIOL

PRIOR SKILLS

Fundamentals of Fluid Mechanics

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

TEACHING METHODOLOGY

This subject will be given in the computer room where the teacher will combine explanations with practice. The explanation lectures will serve to explain the topic contents and to comment with the students. The practice lecture will be guided sessions where the students will use actively the CFD tools available at the computer room in order to solve different problems. The simulation results obtained in small groups or individually will be discussed jointly among all the students.

LEARNING OBJECTIVES OF THE SUBJECT

The objective of the subject is to introduce to the non-initiated student the CFD philosophy and applications. It is intended that the student learns to apply the adequate procedure to perform a numerical simulation of a flow with commercial software. Through the discussion of practical cases, the student will be able to evaluate the validity of the obtained results based on his knowledge of Fluid Mechanics and on experimental results. In particular, the student has to:
- Understand the fundamental equations of Fluid Mechanics.
- Be familiar with the vocabulary of this discipline.
- Know the stages needed to simulate a standard flow problem.
- Learn how to use commercial software to simulate numerically the flow around a body or inside a duct.
- Be able to solve several practical cases and to evaluate their validity.

STUDY LOAD

Type	Hours	Percentage
Self study	67,5	60.00
Hours medium group	45,0	40.00

Total learning time: 112.5 h

CONTENTS

- INTRODUCCTION TO CFD

Full-or-part-time: 15h
Theory classes: 3h
Practical classes: 3h
Self study : 9h

- APPLICATION OF CFD. CASE STUDIES

Full-or-part-time: 37h 30m
Theory classes: 7h 30m
Practical classes: 7h 30m
Self study : 22h 30m

- TURBULENCE MODELS. BOUNDARY LAYER

Full-or-part-time: 30h
Theory classes: 3h
Practical classes: 9h
Self study : 18h

- TRANSIENT SIMULATIONS. VON KÁRMÁN VORTEX SHEDDING

Full-or-part-time: 30h
Theory classes: 3h
Practical classes: 9h
Self study : 18h

ACTIVITIES

REPORTS OF TEST CASES

Full-or-part-time: 15h
Self study: 15h

FLAT PLATE BOUNDARY LAYER SIMULATION

Full-or-part-time: 15h
Self study: 15h

VON KÁRMÁN VORTEX SHEDDING SIMULATION

Full-or-part-time: 15h
Self study: 15h

ATTENDANCE AND PARTICIPATION AT THE CLASSROOM

Related competencies :
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

Full-or-part-time: 22h 30m
Practical classes: 22h 30m

GRADING SYSTEM

Final mark = 0.25*final exam mark + 0.25*tutorial reports mark + 0.25*team work mark +0.25*classroom involvement mark

During the spring semester of the 2019-2020 academic year, and as a consequence of the health crisis due to Covid19, the scoring method will be based on:
FINAL MARK = 0.25*final exam mark + 0. 5*ATENEA tasks mark + 0.25*classroom involvement mark

EXAMINATION RULES.

To pass, it is compulsory to obtain a result above zero in at least three of the four partial marks.

BIBLIOGRAPHY

Basic:
- Anderson, Dale H. [i 4 més]. Computational fluid dynamics: the basics with applications. 4th ed. Boca Raton, FL: CRC Press, 2021. ISBN 9780815357124.
- White, F.M. Mecánica de fluidos [on line]. 6a ed. Madrid: McGraw-Hill, cop. 2008 [Consultation: 18/10/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4144. ISBN 9788448166038.
- Potter, Merle C.; Wiggert, David C. Mecánica de Fluidos. 3 ed. México: Prentice Hall, 2002. ISBN 9706862056.
- Çencel, Yunus A.; Cimbala, John M. Mecánica de fluidos : fundamentos y aplicaciones [on line]. 2a ed. México: McGraw-Hill, 2012 [Consultation: 04/07/2018]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5644. ISBN 9786071507792.

Complementary:
- Petrila, Titus; Trif, Damian. Basics of fluid mechanics and introduction to computational fluid dynamics [on line]. New York: Springer, 2005 [Consultation: 17/11/2014]. Available on: http://dx.doi.org/10.1007/b102528. ISBN 0387238387.
- Hoffman, Klaus A ; Chiang, Steve T. Computational fluid dynamics for engineers. 3rd ed. Kansas: Kansas Engineering Education System, 1998. ISBN 0962373117.
- Pozrikidis, C. Introduction to theoretical and computational fluid dynamics. New York [etc.]: Oxford University Press, 1997. ISBN 0195093208.
- Hirsch, Charles. Numerical computation of internal and external flows [on line]. 2nd ed. Oxford: Elsevier/Butterworth-Heinemann,

2007 [Consultation: 04/12/2013]. Available on: http://www.sciencedirect.com/science/book/9780750665940. ISBN 0471923850.
- Peyret, Roger, ed.. Handbook of computational fluid mechanics [on line]. San Diego: Academic Press, 2000 [Consultation: 19/04/2023]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780125530101/handbook-of-computational-fluid-mechanics. ISBN 0125322003.
- Anderson, Dale Arden; Tannehill, John C; Pletcher, Richard H,. Computational fluid mechanics and heat transfer. Washington: Hemisphere, 1984. ISBN 0070503281.