

Fluid Mechanics

ECTS: 6 ECTS

COORDINATOR: Elena B. Martín Ortega (emortega@uvigo.es)

UNIVERSITY WHERE THE COORDINATOR IS: UVigo

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes

LECTURER 1: Marcos Meis Fernández (marcos@dma.uvigo.es)

UNIVERSITY WHERE THE LECTURER 1 IS: UVigo

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes

SUBJECT CONTENTS

1. Fundamental models of fluid dynamics

- a) Conservation laws for newtonian fluids
- b) Equations in non-dimensional form and physical interpretation of the main non-dimensional parameters: Mach, Reynolds, Froude, Prandtl, Peclet, Grashof and Nusselt numbers
- c) Derivation of the fluid mechanics main models as limit models in non-dimensional numbers

2. Incompressible inviscid flows

- a) Equations of evolution of the vorticity in a perfect fluid.
- b) Study of irrotation and potential flows. Limitations of the potential model.
- c) Examples of potential flows and applications. Some ideas of theory of support.

3. Incompressible viscous flows

- a) Some particular solutions of the Navier-Stokes equations in steady state.

- b) Elemental analysis of boundary layers: basic ideas of the techniques of analysis and study of Blasius problem.
- c) Observations on the stability of stationary laminar viscous solutions. Examples of hydrodynamic instabilities.

4. Turbulent flows

- a) Introduction
- b) Unfeasibility of the Direct Numerical Simulation (DNS) for turbulent flows
- c) The closure problem of Turbulence Modelling.
- d) Main models for turbulent flows.

5. Convective heat transfer

- a) Forced convection. Convective transport in tubes in laminar regime. Flows with high Peclet number. Thermal boundary layer. Correlations. Convective heat transport in turbulent regime. Empirical correlations.
- b) Natural convection. Correlations for heat flow in laminar and turbulent. Some examples

METHODOLOGY

Lectures: the topics covered by the course will be presented by the instructors in these sessions. 4 ECTS

Modelling sessions: some industrial problems will be presented and both its modelling and some elementary analysis will be discussed with the students. 2 ECTS.

LANGUAGE USED IN CLASS: Will depend on the audience.

IS IT COMPULSORY TO ATTEND CLASS? Students can attend via conference system

BIBLIOGRAPHY

Primary texts:

Barrero, A. y Pérez-Saborid, M.: Fundamentos y aplicaciones de la mecánica de fluidos. Mc Graw Hill, 2005.

Panton, R.L.: Incompressible Flow. Wiley, 1984.

White, F.M.: Heat and mass transfer. Addison-Wesley, 1988.

Wilcox, D.C.: Turbulence Modelling for CFD. DCW Industries, 1993.

Other useful references:

Acheson, D.J.: Elementary Fluid Dynamics. Oxford University Press, 1990.

Davidson, P. A.: Turbulence, an Introduction for Scientist and Engineers, Oxford Univ. Press, 2004.

Kundu, P.K. y Cohen, M.I.; Fluid Mechanics, 2nd ed. Academic Press, 2002.

Ockendon, H. y Ockendon, J.R.: Viscous Flow. Cambridge University Press, 1995.

Tennekes, H. y Lumley, J.L.: A first course in Turbulence. MIT Press, 1972.

White, F.M.: Viscous fluid flow, 3rd ed. McGraw-Hill, 2006.

SKILLS

Basic:

CG1: To have knowledge that provide a basis or opportunity for originality in developing and / or applying ideas, often within a research context, knowing how to translate industrial needs in terms of R & D in the field of mathematics Industrial.

CG2: To be able to apply the acquired knowledge and abilities to solve problems in new or unfamiliar environments within broader contexts, including the ability to integrate multidisciplinary R & D in the business environment.

CG4: To have the ability to communicate the findings to specialist and non-specialist audiences in a clear and unambiguous way.

CG5: To have the appropriate learning skills to enable them to continue studying in a way that will be largely self-directed or autonomous, and also to be able to successfully undertake doctoral studies.

Specific:

CE1: To acquire a basic knowledge in an area of Engineering / Applied Science, as a starting point for an adequate mathematical modelling, using well-established contexts or in new or unfamiliar environments within broader and multidisciplinary contexts.

CE2: To model specific ingredients and make appropriate simplifications in the model to facilitate their numerical treatment, maintaining the degree of accuracy, according to previous requirements.

CE5: To be able to validate and interpret the results, comparing them with visualizations, experimental measurements and functional requirements of the physical engineering system.

Modelling specialization:

CM1: To be able to extract, using different analytical techniques, both qualitative and quantitative models.

CM2: To know how to model complex systems and elements that lead to well posed/formulated problems

WILL YOU BE USING A VIRTUAL PLATFORM? Yes. fatic.uvigo.es

WILL YOU BE USING ANY SPECIFIC SOFTWARE? No.

CRITERIA FOR THE 1ST ASSESSMENT OPPORTUNITY

40% of the final mark:

- Individually carried out theoretical exercises.
- Practical exercises carried out by individuals or in groups.

60% of the final mark:

- Exam.

CRITERIA FOR THE 2ND ASSESSMENT OPPORTUNITY

The same as for the 1st assessment opportunity.

METHODOLOGIES/COMPETENCES/ASSESSMENTS

Description	Qualification(%)	Evaluated Competences
Projects. Evaluation of the works/problems proposed presented by the student	40	CE1, CE2, CM1, CM2
Long answer tests and problems.		
Written proof relative to the study of a case and his analysis	60	CE1, CE2, CM2
