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.

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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) Kolmogorov scale and some examples.

b) Some ideas on vorticity dynamics in 3D.

c) Most used statistical tools in turbulence.

d) Turbulence kinetic energy equation.

e) 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

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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

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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.

WILL YOU BE USING A VIRTUAL PLATFORM? Yes. faitic.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.