www.m2i.es
info@m2i.es

Turbulence

ECTS: 6 ECTS

COORDINATOR: Manuel García-Villalba (manuel.garcia-villalba@uc3m.es)

UNIVERSITY WHERE THE COORDINATOR IS: UC3M

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? No

LECTURER 1: Óscar Flores Arias (oflores@ing.uc3m.es)

UNIVERSITY WHERE THE LECTURER 1 IS: UC3M

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? No

SUBJECT CONTENTS

1 Introduction

2 Statistical description

2.1 Statistical tools

2.2 Reynolds-averaged Navier Stokes equations

2.3 Closure Problem

3 Free shear flows

3.1 Mixing layers, jets, wakes.

4 The scales of turbulent flows

4.1 Energy cascade

5 Wall-bounded shear flows

5.1 Channel flow, pipe flow, boundary layers.

6 Modelling turbulence: DNS, LES, RANS

7 Introduction to RANS modelling

7.1 Eddy-viscosity models

7.2 Reynolds-stress models

8 Introduction to LES modelling

METHODOLOGY

In the theory lectures the students will be introduced to the physics and turbulent flows modelling contents. The students will need to solve simple problems with analytical solution. In addition they will need to solve numerical problems using Matlab or any other programming environment of their choice.

LANGUAGE USED IN CLASS: Will depend on the audience

IS IT COMPULSORY TO ATTEND CLASS? Students can attend via conference system, in the university where the teacher is

---

BIBLIOGRAPHY

- Pope, S. B. (2000). Turbulent flows. Cambridge university press.

- Davidson, P. A. (2004). Turbulence: An Introduction for Scientists and Engineers: An Introduction for Scientists and Engineers. Oxford University Press.

- Tennekes, H., & Lumley, J. L. (1972). A first course in turbulence. MIT press.

- Durbin, P. A., & Reif, B. P. (2011). Statistical theory and modeling for turbulent flows. John Wiley & Sons.

- Wilcox, D. C. (1998). Turbulence modeling for CFD (Vol. 2, pp. 103-217). La Canada, CA: DCW industries.

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:

CM2: To know how to model elements and complex systems leading to well-posed formulated problems.

WILL YOU BE USING A VIRTUAL PLATFORM? No.

WILL YOU BE USING ANY SPECIFIC SOFTWARE? Yes. Matlab.

CRITERIA FOR THE 1ST ASSESSMENT OPPORTUNITY

50% of the final mark: essays and participation in class.

50% of the final mark: exam.

CRITERIA FOR THE 2ND ASSESSMENT OPPORTUNITY

Written exam
