

Course guide

240245 - 240AU112 - Aerodynamics

Last modified: 16/05/2023

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

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2019). (Optional subject).

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

LECTURER

Coordinating lecturer: Jou Santacreu, Esteban

Others: Jou Santacreu, Esteban

TEACHING METHODOLOGY

Theory classes are held once a week in two-hour sessions. Three practical classes in two-hour sessions are held along course

LEARNING OBJECTIVES OF THE SUBJECT

The aim of the course is to introduce students to the world of aerodynamics applied to road vehicles.
Aerodynamic effects of the features of actual vehicles is studied from a numerically and a qualitative point of view.
Description of the operation of different elements both in the world of competition, as in cars and commercial vehicles.
The contribution of the vehicle's internal flow on aerodynamic forces is also studied. The course ends with an introduction to the flow simulation around vehicles.

STUDY LOAD

Type	Hours	Percentage
Hours small group	13,5	12.00
Hours medium group	27,0	24.00
Self study	72,0	64.00

Total learning time: 112.5 h

CONTENTS

1. Introduction to automobile aerodynamics

Description:

Historic review of the vehicle aerodynamics, present and future trends. Basic principles and special features of vehicle aerodynamics

Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h



2. Fundamentals of fluid mechanics

Description:

Plan of the basic equations of the Flow Mechanics and the phenomenon of the fluids related to the vehicles.
External incompressible flow. Effects of the viscosity. Study of laminar and turbulent boundary layer.

Full-or-part-time: 10h

Theory classes: 2h

Self study : 8h

3. Experimentation vs. Simulation

Description:

Experimental aerodynamic tests in track and wind tunnel. Comparison with CFD simulation. Knowledge of advantages and disadvantages of each technique, as well as their limitations.

Full-or-part-time: 11h

Theory classes: 3h

Practical classes: 2h

Self study : 6h

4. Car aerodynamics.

Description:

Specific study of forces on tourism and strategies for optimizing forms. Flow around a passenger car. Analysis of drag force. Flow patterns. Strategies for development of vehicle components.

Full-or-part-time: 9h

Theory classes: 3h

Self study : 6h

5. Competition cars

Description:

Study of the aerodynamic peculiarities of the different racing vehicles. Historical review Basic forms depending on competition type. Components description.

Full-or-part-time: 6h 30m

Theory classes: 2h

Self study : 4h 30m

6. Commercial vehicles

Description:

Study of the reduction of Drag forces in commercial vehicles. Aerodynamic forces in trucks and coaches.

Full-or-part-time: 8h

Theory classes: 2h

Self study : 6h



7. Interior Flow

Description:

Procedure description for the correct performance of aerodynamic simulations. Guidelines and recommendations on geometry, mesh, setup and solver configuration.

Full-or-part-time: 6h

Theory classes: 2h

Self study : 4h

8. CFD introduction

Description:

Procedure description for the correct performance of aerodynamic simulations. Guidelines and recommendations on geometry, mesh, setup and solver configuration.

Full-or-part-time: 5h 30m

Theory classes: 1h 30m

Practical classes: 4h

GRADING SYSTEM

Final Grade = $0.2 \cdot \text{labs} + 0.35 \cdot \text{partial exam} + 0.45 \cdot \text{final exam}$

EXAMINATION RULES.

The realization of the labs is mandatory

BIBLIOGRAPHY

Basic:

- Barnard, R. H. Road vehicle aerodynamic design : an introduction. 3rd ed. Mechaero, 2010. ISBN 9780954073473.
- Hucho, Wolf-Heinrich. Aerodynamics of road vehicles : from fluid mechanics to vehicle engineering. 4th ed. Warrendale, PA: Society of Automotive Engineers, cop. 1998. ISBN 0768000297.