

# ESTACA CFD SUMMER PROGRAM - PARIS

*Learn and practice modelling techniques for Fluid Dynamics*

*Discover Paris & Study in English for 4 weeks*



## Aims & Benefits

- ✈ Learn and operate **CFD tools** to understand and predict **aeronautical systems performances and behavior**
- ✈ Work with **industrially** relevant computation software and methods
- ✈ Study in a **multicultural** environment

## Program & Courses

- ✈ **Courses - 10 ECTS:** Fluid Mechanics | Aerodynamics | Introduction to Turbulence | Wind Tunnel | Computational Fluid Dynamics | French Language and Interculturality
- ✈ **Company visits:** ONERA, Corsair (Orly airport), Eiffel Wind Tunnel, Akkodis & more
- ✈ **Cultural visits:** Versailles Castle, Cruise on the Seine River & more

## Practical Information

- ✈ **Dates:** June, 22nd - July, 17th 2026 at ESTACA Paris Saclay Campus
- ✈ **Price:**
  - 4000€ (for free-movers)
  - 2100€ (for partner universities)*Includes housing, public transportation, all academic activities and visits (meals, visa and travel costs are not included)*
- ✈ **Requirements:** Minimum 3rd year of Bachelor degree in Engineering



✈ **Contact:** [estaca\\_incoming@estaca.fr](mailto:estaca_incoming@estaca.fr)

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## CURRICULUM 2026

### Fluid Mechanics

- **Objectives:** This course is focused on basic knowledge about fluids and flows (Newtonian fluid, laminar and turbulent flow regimes, liquid and gas...)
  - o Fluid statics: this chapter is focused on basic equation governing fluid static (pressure in a fluid at rest, static equation, hydrostatic pressure on plane and curved surfaces, pressure variation in a fluid with rigid-body (linear and rotation) motion)
  - o Kinematics of fluids: this chapter is focused on a mathematical approach of fluid mechanics to describe some basic flow properties of ideal fluids (stream function, streamlines, irrotational flow, velocity potential, potential flows...)
  - o Elementary fluid dynamics (Euler, Bernoulli and Navier Stokes equations): this chapter is focused on fundamental equations governing motions of incompressible fluids (viscosity, Euler and Navier Stokes equations, Bernoulli equation)
- **Teacher:** Baptiste Isnard (Onera)
- **Courses:** 15h
  - o Fluid statics (3h) (Lecture)
  - o Kinematics of fluids (3h) (Lecture)
  - o Elementary fluid dynamics (Euler, Bernoulli and Navier Stokes equations) (9h) (Lecture)
- **Exam:** Written exam
- **ECTS:** 2 ECTS

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## CURRICULUM 2026

### Introduction to Turbulence

- **Objectives:** Most fluid flows occurring in nature as well as in engineering applications are turbulent. The scope of this course is to introduce some of the basis of the turbulence theory and its statistical analysis. The Emphasis will be put on turbulent flow features that are of primary interest for turbulent flow prediction and modelling. The concepts will be illustrated by a fair set of representative examples issues from both the automotive and aeronautic industry.
- **Teacher:** Sébastien Deck (Onera)
- **Courses:** 15h
  - o Basic concepts (Turbulent Flows, Control Parameters, Some Practical Consequences of Turbulence)
  - o Statistical Description of turbulent Flows (Reynolds Averaged Navier Stokes equations, Kinetic energy budget)
  - o Wall-bounded Flows and Free Jets (Boundary Layer, Mixing Layer)
  - o A glimpse at simulation of turbulent flows (RANS turbulence models, LES, DNS, Hybrid RANS/LES)
- **Exam:** Written exam
- **ECTS:** 2 ECTS

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## CURRICULUM 2026

### Aerodynamics

- **Objectives:** This aerodynamics course focuses on the study of the flow of air about a wing, but many of the concepts explored are relevant to a wide variety of applications. Learners completing this aerodynamics course will gain a fundamental understanding of concepts and models used to aerodynamically analyze and design subsonic, transonic, and supersonic vehicles.
- **Teacher:** Pierre Nibourel (Onera)
- **Courses:** 21h
  - o Inviscid, Incompressible Flow: Incompressible flows over airfoils / Incompressible flows over finite wings / Three-dimensional Incompressible flows
  - o Inviscid, Compressible Flow: Compressible flows: some preliminary aspects / Normal shock waves and related topics / Oblique shock and expansion waves / Compressible flows through nozzles, diffusers and wind tunnels / Subsonic compressible flow over airfoils: Linear theory / Linearized supersonic flow / Elements of hypersonic flow
  - o Viscous Flow: Introduction to boundary layers / Laminar boundary layers / Turbulent boundary layers
- **Exam:** Written exam
- **ECTS:** 2 ECTS

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## CURRICULUM 2026

### Computational Fluid Dynamics

- **Objectives:** This course provides a comprehensive introduction to the key steps involved in producing accurate computational fluid dynamics (CFD) simulations. It offers a simplified explanation of the finite volume method and demonstrates various meshing strategies essential for obtaining reliable simulation results. Students will gain hands-on experience using ANSYS Fluent, a widely used CFD software, to set up and analyze various CFD cases, with a focus on aeronautical applications.

- **Teacher:** Ahmed BENABED (ESTACA)

- **Cours:**

o Lecture (4 hours): Introduction / Review of fundamental concepts in fluid mechanics / Principles of turbulence modeling / Finite volume method / General procedure for conducting a CFD project / Limitation and current challenges in CFD

o Laboratory sessions (8 hours): Hands-on Training with ANSYS Fluent / Application of CFD techniques to practical engineering problems

- **Exam:** Quizz and report

- **ECTS:** 2 ECTS

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## CURRICULUM 2026

### Wind Tunnel

- **Objectives:** The aim of this course is to introduce the fundamental steps required to perform two-dimensional, two-component (2D-2C) Particle Image Velocimetry (PIV) for the study of aerodynamic phenomena. The work will focus on understanding the experimental setup, seeding methods, illumination, image acquisition, and calibration processes necessary for accurate velocity field measurement. Emphasis will be placed on the main stages of post-processing, including image pre-treatment, cross-correlation, vector validation, and statistical analysis of flow fields. The course will also cover techniques to extract meaningful flow parameters such as velocity profiles, vorticity, and turbulence characteristics. By the end of the course, participants will gain practical insight into how PIV data can be processed, analyzed, and interpreted to study aerodynamic behavior under various flow conditions.

- **Teacher:** Ahmed BENABED (ESTACA)

- **Courses:** 8 hours

o Demonstration and measurement (4 hours): Experimental setup of a PIV system in a wind tunnel / Calibration and data acquisition procedures

o Post-Processing (4 hours): Processing of PIV images using MATLAB / Analysis and interpretation of velocity fields

- **Exam:** Report

- **ECTS:** 1



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## CURRICULUM 2026

### French for Beginners & Intercultural Studies

- **Objectives:** Introductory French language skills for daily life, combined with insights into French culture and intercultural communication. No prior knowledge of French required.
- **Course:** 6h of interactive class
- **Exam:** None
- **ECTS:** 1