# Ten Lectures on Turbulence

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| **Course Nr.:** | 2189904 |
| **Course Title:** | Ten lectures on turbulence |
| **Course Credits:** | 4 |
| **Semester Start Date:** | October 17 2019 |
| **Class Schedule:** | Th. 15:45-17:15 |
| **Classroom :** | Building 10.81; Room 219.1 |

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| **Instructor:** | Dr. Ivan Otic |
| **Email:** | ivan.otic@kit.edu |
| **Website:** | http://www.iatf.kit.edu/english/21_54.php |
| **Office Location:** | Geb. 07.08; Vincenz-Prießnitz-Straße 3, Room 327 |
| **Office Hours:** | Fr 14:00-15:00 and by appointment |

**Course Description:**

The course is aimed of giving the fundamentals of turbelence theory, modelling and simulation. Governing equations and statistical description of turbulence are introduced. Reynolds equations, Kolmogorov's theory and scales of turbulent flows are discussed. Homogeneous and isotropic turbulence. Turbulent free-shear flows and wall-bounded turbulent flows are discussed. Turbulence modelling approaches and simulation methods are introduced.

**Prerequisites:**

Undergraduate statistics and probability theory. Graduate-level fluid mechanics.

## Course Objectives:

At the completion of this course, students

- are able to understand fundamentals of statistical fluid mechanics, turbulence theory and turbulence modelling.
- are able to derive RANS and LES transport equations
- get working knowledge of modelling techniques that can be used for solving engineering heat and mass transfer problems

## Reference texts:

- Lecture Notes

- Presentation slides

   Lecture material is available at: www.iatf.kit.edu/english/21_629.php

## Grading:

The final grade is based on performance in:
- Homework Problems
- Final Exam

## Recommended Books:

- *Pope, S. B.: Turbulent Flows. Cambridge University Press, 2003.*

- *Hinze J. O.: Turbulence. McGraw-Hill, 1975.*

**Tentative Course Outline**:
The weekly coverage might change as it depends on the progress of the class.

| | Content |
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| 1 | • Introduction |
| 2 | • Turbulent transport of momentum and heat |
| 3 | • Statistical description of turbulence |
| 4 | • Scales of turbulent flows |
| 5 | • Homogeneous turbulent shear flows |
| 6 | • Free turbulent shear flows |
| 7 | • Wall-Bounded turbulent flows |
| 8 | • Turbulence Modelling |
| 9 | • Reynolds Averaged Navier-Stokes (RANS) Simulation Approach |
| 10 | • Large Eddy Simulation (LES) Approach |