We would like to inform that the elective course **Turbulence Physics and Modeling** conducted by Professor Julian Andrzej Domaradzki (University of Southern California, Los Angeles, CA 90089, U.S.A.) will be offered in October 2021.

The course includes a series of eight 2-hour lectures (in English), which will be delivered remotely on the Microsoft Teams platform, in a team called **Turbulence Physics and Modeling** (the access code for participant with accounts in the pw.edu.pl domain is **y74igd8).** The schedule of the lectures is following:

- Lecture 1 - 11 October, 4.15 p.m.
- Lecture 2 - 12 October, 4.15 p.m.
- Lecture 3 - 13 October, 4.15 p.m.
- Lecture 4 - 14 October, 4.15 p.m.
- Lecture 5 - 18 October, 4.15 p.m.
- Lecture 6 - 19 October, 4.15 p.m.
- Lecture 7 - 20 October, 4.15 p.m.
- Lecture 8 - 21 October, 4.15 p.m.

Number of **ECTS credits attributed to this course is 2**.
The method of passing: homework and oral (remote) interview/test.

Characteristics of the substantive scope of the lecture:

Turbulence is a term used to characterize fluid flows disordered in space and time. Such flows are encountered in many areas of engineering, geophysics, and astrophysics. Turbulence influences variety of important physical processes: drag on moving objects, energy conversion in internal combustion engines, heat transfer and mixing in industrial applications and atmospheric, oceanic, and astrophysical flows. Because of its complexity turbulence is often considered to be the last unsolved "grand" problem of classical physics. This course will provide description of tools used in turbulence research and modeling and the necessary background in turbulence physics. The following topics will be covered: introduction to turbulence physics, equations, and terminology; numerical resolution requirements for practical turbulent flows; Reynolds Averaged Navier Stokes (RANS) equations and spatially filtered Large Eddy Simulation (LES) equations; turbulent kinetic energy (TKE) equation; two-point correlations; spectral representation of turbulent quantities; spectral energy equation, nonlinear energy transfer, viscous dissipation; Kolmogoroff theory of universal equilibrium range; RANS modeling: eddy viscosity concept; zero-, one-, two-equation models; classical LES models: Smagorinsky model, Bardina similarity model, mixed models, the dynamic procedure; spectral LES modeling: NS equations in spectral space, triad interactions, spectral theories of

turbulence; exact numerical results for subgrid scale (SGS) energy transfer and eddy viscosity; Implicit LES: uncontrolled numerical dissipation (e.g., MILES – Monotonically Implicit LES), controlled numerical dissipation (TNS – Truncated Navier Stokes), modified numerical discretizations (e.g., ALDM – Approximate Local Deconvolution Model); passive scalars (e.g., temperature or contaminants) in turbulent flows and oceanographic and atmospheric applications.

The course **Turbulence Physics and Modeling** is recommended for MSc and doctoral students whose interests and research work are related to computer modeling of thermo-flow phenomena and processes in various technical applications (aircraft aerodynamics, flow machinery, geophysics, environmental science, chemical technology).

Students, doctoral students and employees of the Warsaw University of Technology interested in participating in this lecture are asked to sign via the Excel sheet placed inside Pliki in the MS Teams team Turbulence Physics and Modeling.

Interested persons from outside the Warsaw University of Technology are asked to send a message to the address of the Lecturer jad@usc.edu, from the address to which they want to receive invitations to subsequent lectures.

Any questions, comments and suggestions should be directed to Prof. Andrzej Domaradzki jad@usc.edu.