SYLLABUS

Title:	**Fluid-Structure Interactions in Nature and Engineering**		
Degree of study:	II (Master), III (PhD)		
Field of study, specialty:	Any engineering specialty		
Code:		**Semester:**	**Number of ECTS: 3**
Level of the subject: intermediate		**Type of the subject:** elective	
Hours: 70 h	Lectures: 25 h Practice: 0 h Labs: 15 h Consultations: 10 h	Individual work: 20 h	
Responsible for the subject:	dr hab. Natalia Kizilova		

Objectives of the course

C1. Teaching the basics of fluid interactions with a deformable solid.
C2. Getting to know the flows over the walls (external flows).
C3. Getting to know the flows in deformable pipes and channels (internal flows).

Prerequisites for knowledge, skills and other competences

1. Basic knowledge of theoretical mechanics, mechanics of deformable solids, fluid mechanics.
2. Basic knowledge: thermomechanics, composite materials, resistance and control.

Learning outcomes (knowledge)

EW1 - The student understands the basics and equations of mechanics of deformable solids.
EW2- The student understands the basics and equations of fluid mechanics.
EW3 - The student understands the basics and equations of tribology and acoustics.
EW4- Student distinguishes the rules of flow stability over walls.
EW5- The student knows the basic concepts of fluid-structure interaction in any flow regime.

Learning outcomes (skills)

EU1 - The student is able to solve the problems of flow over flexible walls in aerospace engineering.
EU2- The student is able to solve the problems of fluid mechanics in deformable pipes and channels.
EU3- The student is able to solve stability problems in the fluid-structure interaction.
EU4- The student is able to solve problems of flow stability for aviation engineering.
EU5- The student is able to construct biomimetic surfaces for flow stabilization.

Course content

Lectures	**Number of hours**
Solid structures and fluid rheology: from macro to nano scale	4
Convective and absolute flow instabilities over flexible walls	2
Flows in deformable pipes and channels: experimental data and theoretical models	2
Wave excitation on flexible walls, coherent structures and Reynolds number effects	2
Passive, active and reactive flow methods for controlling transitional and turbulent flows confined by walls	2
Coatings compatible: walkway control; separation control	2
Micro and nano-structured surfaces for flow stabilization	1
Laboratories	
Solve the problems of fluid mechanics over flexible walls	2
Solve fluid mechanics problems in deformable pipes and channels	4
Solve problems with flow instability over flexible walls	4

Solve problems of flow instability in deformable pipes and channels	1
Constructing a biomimetic surface for flow stabilization	1
Modeling and simulations of PSI using FEM	3

Basic and supplementary literature

1. Publicly accessible teaching materials.
2. Materials on the website of the faculty prepared by the teacher.
3. Handbooks:
   - Rajeev Kumar Jaiman, Vaibhav Joshi, Computational Mechanics of Fluid-Structure Interaction. Computational Methods for Coupled Fluid-Structure Analysis. Springer Nature, 2022
   - Thomas Richter, Fluid-structure interactions: models, analysis and finite elements. Lecture notes in computational science and engineering. Springer, 2017.

Student's workload

Form of activity	**Average numer of hours**
Contact hours with the teacher (classes)	30
Contact hours with the teacher (consultations)	10
Homework – projects	10
SUM	**50**

Teaching tools

1. Lectures in the form of presentations in PDF format.
2. The content of the lectures and laboratory tasks in the form of files (PDF).
3. Individualized calculation projects for independent solution.
4. Access to the website of the subject, the repository of the subject on the GitHub portal and laboratory instructions.

Assessment methods (F - forming, P - summative)

Fd1-Fd2 - grades from homework,

Fl1-Fl5 - grades from laboratory exercises,

Fl - evaluation from the laboratory test,

Work during laboratory classes and individual or group project presented during classes are assessed.

Details of the grading system published on the course website.

Realization of learning outcomes

Learning outcome	**Effects defined for the whole program**	**Objectives of the course**	**Teaching tools**	**Estimation method**
EW1		C1,C2	Lecture, independent work in laboratories and project preparation	Mark 2-5 or a descriptive estimation
EW2		C3		As above

EW3		C2,C3		As above
EW4		C1,C2,C3		As above
EU1		C1,C3		As above
EU2		C1,C2		As above
EU3		C2,C3		As above
EU4		C1,C2		As above