Course description

Department/Unit /	KKE / PVM			**Academic Year**	2023/2024	
Title	Computational modelling tools			**Type of completion**	Exam	
Long Title	Computational modelling tools for mechanical and power engineering					
Accredited/Credits	Yes, 4 Cred.			**Type of completion**	Combined	
Number of hours	Lecture 2 [Hours/Week] Tutorial 2 [Hours/Week]					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	Yes	
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	YES	
Winter semester	0 / -	0 / -	1 / -	**Min. (B+C) students**	2	
Timetable	Yes			**Repeated registration**	NO	
Language of instruction	Czech			**Semester taught**	Winter semester	
Optional course	Yes			**Internship duration**	0	
Evaluation scale	1|2|3|4			**Ev. sc. – cred.**	S|N	
No. of hours of on-premise						
Auto acc. of credit	Yes in the case of a previous evaluation 4 nebo nic.					
Periodicity	every year					
Specification periodicity						
Substituted course	None					
Preclusive courses	N/A					
Prerequisite courses	N/A					
Informally recommended courses	N/A					
Courses depending on this Course	N/A					

Course objectives:

Increasing students' knowledge related to computer modelling for mechanical and energy engineering and increasing their skills and competencies in working with selected software tools (mainly ANSYS Fluent, ANSYS Mechanical, MATLAB).

Requirements on student

Active paricipation in lectures and tutorials, preparation and presentation of a seminar work, final test and oral exam (the question set is identical to the topics of the lectures).

Content

Topics of lectures
A - Introduction
1. Notes on the history of mechanics, mathematics and computational modelling. Overview of selected physical models, their mathematical formulation and basic concepts of their solution
2. Starting, user environment and concept of ANSYS Workbench and SpaceClaim, ANSYS Fluent, ANSYS Mechanical, MATLAB

B - Modelling fluid flow, heat and mass transfer using ANSYS Fluent
3. Creating/using model geometry, meshing
4. Basic fluid flow
5. Turbulence modelling
6. Heat transfer modelling
7. Multiphase flow

C - 0D and 1D models solved with MATLAB
8. Concepts and possibilities of MATLAB software (basics, matrix calculator, symbolic mathematics)
9. Visualization, graphs
10. 0D, 1D models and solutions (of systems) of ordinary differential equations
11. Graphical user interface

D - Straining modelling of machinery and power equipment and their parts
12. ANSYS Mechanical APDL user interface and options
13. Case studies (statics, modal analysis, heat transfer, ...)

Topics of practicums:
1. Examples of mathematical formulations for modelling selected problems
2. Practice - starting programs, working with graphical environment, input and output files
3. Practice importing, basic creation and modification of component geometry; meshing
4. Examples of simpler flow problems; the effect of meshing on the accuracy of the solution
5. Examples with different turbulence modelling; comparison with known experiments
6. Examples of modelling the heat transfer between the fluid and the walls of the device
7. Examples of multiphase flow modelling
8. Practice basic skills of working with MATLAB
9. Creation of function graphs, visualization of scalar and vector fields
10. Examples of 0D and 1D modelling, practice solving selected types of systems of ordinary differential equations
11. Creating and programming your own user interface
12. Groups of APDL commands, creation of geometric entities and FEA networks, entering loads and boundary conditions
13. Examples of straining and heating of a machine component (e.g. flat flanges, ...)

Fields of study

Guarantors and lecturers

- **Guarantors:** Ing. Richard Matas, Ph.D. (100%)
- **Lecturer:** Ing. Richard Matas, Ph.D. (50%), prof. RNDr. Josef Voldřich, CSc. (25%), Ing. Michal Volf (25%)
- **Tutorial lecturer:** Ing. Richard Matas, Ph.D. (50%), prof. RNDr. Josef Voldřich, CSc. (25%), Ing. Michal Volf (25%)

Literature

- **Recommended:** Ansys Fluent Theory Guide, Release 2022 R2
- **Recommended:** Ansys Fluent Tutorial Guide, Release 2022 R2
- **Recommended:** Chen X., Liu Y. *Finite Element Modeling and Simulation with ANSYS Workbench*. CRC Press, 2019.
- **Recommended:** Higham D.J., Higham N.J. *Matlab Guide*. SIAM, 2005.
- **Recommended:** Davis T.A. *Matlab Primer*. CRC Press, 2012.
- **Recommended:** Workbench User's Guide, Release 2022 R2

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Contact hours	52
E-learning (given by an e-learning course)	15
Preparation for an examination (30-60)	30
Preparation for comprehensive test (10-40)	15
Presentation preparation (report) (1-10)	3
Total:	**115**

assessment methods

Knowledge - knowledge achieved by taking this course are verified by the following means:

Test

Oral exam

Skills - skills achieved by taking this course are verified by the following means:

Seminar work

Competences - competence achieved by taking this course are verified by the following means:

Individual presentation at a seminar

Oral exam(Full-time form of study)

prerequisite

Knowledge - students are expected to possess the following knowledge before the course commences to finish it successfully:

to use basic knowledge of B.Sc. courses in thermomechanics, fluid mechanics and elasticity and strength

Skills - students are expected to possess the following skills before the course commences to finish it successfully:

to use the skills of a Bc. studies in the field of Mechanical Engineering, Technology and Materials

Competences - students are expected to possess the following competences before the course commences to finish it successfully:

N/A

N/A

N/A

N/A

teaching methods

Knowledge - the following training methods are used to achieve the required knowledge:

Lecture

Self-study of literature

One-to-One tutorial

Skills - the following training methods are used to achieve the required skills:

Practicum

Competences - the following training methods are used to achieve the required competences:

Task-based study method

Individual study

Discussion

learning outcomes

Knowledge - knowledge resulting from the course:

to know the procedures necessary for the preparation of computational models in the field of mechanical and power engineering

to describe the basic principles and rules for simulation of engineering tasks

Skills - skills resulting from the course:

to create of computational models in the field of mechanical and power engineering

to use of ANSYS Fluent, ANSYS Mechanical, ANSYS Workbench and MATLAB for basic to intermediate simulations in mechanical and power engineering

Competences - competences resulting from the course:

N/A

to access sources of information in the field, use them in his/her studies and in discussions with experts

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage St. plan v.	Year	Block	Status	R.year	R.

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Design of Power Machines and Equipment	Postgraduate Master	Full-time	Design of Power Machines and Equipment	1	2020	2023	Elective course	C	1	ZS
Design of Power Machines and Equipment	Postgraduate Master	Full-time	Nuclear Power Equipment Design	1	2020	2023	Doporučené výběrové předměty	C	1	ZS