COURSE DESCRIPTION CARD - SYLLABUS

Course name
Data visualization and processing [S2MiBM2-IWP>WiPD]

Course

Field of study
Mechanical Engineering

Year/Semester
1/2

Area of study (specialization)
Virtual Engineering Design

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

KNOWLEDGE: student has knowledge of information technology and knowledge of mechanical engineering, including numerical simulations and CAD SKILLS: student knows how to use CAx software, including performing simple FEM simulations; can integrate the information obtained and interpret it SOCIAL COMPETENCES: the student is aware of the responsibility for the tasks performed, understands the need to acquire new knowledge.

Course objective

Students acquire knowledge of systems and techniques related to data visualizaton, processing and analysis. They will learn about selected issues in the field of computational geometry (3D modeling, curves and parametric surfaces, triangulation) and the basics of rendering.

Course-related learning outcomes

Knowledge:
Has knowledge of modeling, including the creation of a physical model, CAE (Computer Aided Engineering) systems, analysis of the results of simulations of complex mechanical systems using numerical methods; knows the basic concepts of modern methods of optimal design and their practical

engineering applications.
Has knowledge in the field of CAD / CAM (Computer Aided Design / Computer Aided Manufacturing) systems, 3D geometric modeling methods, model visualization methods and procedures for using models for virtual product testing. Has knowledge in the field of integration of information flows, the use of IT tools supporting design; has the basics of knowledge to optimize construction solutions.
Has extended and in-depth knowledge enabling to link technical mechanics and strength of materials with computer techniques.
Has structured, theoretically based knowledge of the use of information systems in the design of machines and technological processes.

Skills:
Can interpret natural and technical phenomena; can perform a simple calculation related to data processing, write a simple computer program to perform more complex calculations.
Is able to describe and basically use engineering software systems to support design, describe 3D geometric modeling methods, model and data visualization methods, and procedures for using models for virtual product testing.
Can integrate obtained information, interpret it and critically assess, as well as draw conclusions and formulate and comprehensively justify opinions.
Is able to determine the directions of further learning and implement the process of self-education, as well as direct others in this field.
Is able to take into account social, economic, legal, ecological and other non-technical conditions in solving engineering problems.
Is able to obtain information from literature, databases and other properly selected sources in the field of mechanics and machine construction; is able to integrate the information obtained, interpret and critically evaluate it, as well as draw conclusions and formulate and fully justify opinions.

Social competences:
Understands the need for lifelong learning; can inspire and organize the learning process of others.
Can adequately set priorities for implementation of the tasks specified by him or others.
Is able to determine the importance of knowledge in solving cognitive and practical problems and to seek the opinion of experts in case of difficulties in solving the problem independently.
Is aware of the social role of a technical university graduate, and especially understands the need to formulate and convey to society, in particular through the mass media, information and opinions regarding technological achievements and other aspects of engineering activities; makes every effort to convey such information and opinions in a universally understandable manner, with justification for different points of view.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Oral and written tests. Assessment of individually made projects. Grades: very good - if the ratio of sums of achieved and total points is bigger than 90,1%; good plus - if the ratio of sums of achieved and total points is between 80,1-90%; good - if the ratio of sums of achieved and total points is between 70,1-80%; satisfactory plus - if the ratio of sums of achieved and total points is between 60,1-70%; satisfactory - if the ratio of sums of achieved and total points is between 50,1-60%; if the sum is smaller than 50% - unsatisfactory.

Programme content

3D models. Visualisation. Overview of the possibilities of visualization systems on the example of the selected software. Techniques for data precessing. Data processing pipeline and filters (including those created in Python). Segmentation and registration. Modal analysis and basics of data mining.

Course topics

3D models. Parametric curves and surfaces. Data sources (numerical calculations, experiment, medical diagnostics). Visualisation. Techniques for data presentation - scalar and vector fields, sections, isosurfaces, streamlines / web glyphs / vectors, volumetric visualization. Selection / determination of variables for visualization. Vorticity, linear integral convolution. Overview of the possibilities of visualization systems on the example of the selected software (e.g. ParaView, Python/Matplotlib). Data processing

pipeline and filters (including those created in Python). Segmentation and registration. Modal analysis, data processing and basics of data mining.

Teaching methods

Information / problem lecture, Case study, laboratory with elements of project.

Bibliography

Basic:
U. Ayachit. The ParaView Guide. Community Edition. http://paraview.org/paraview-guide/
http://www.bu.edu/tech/support/research/training-consulting/online-tutorials/introduction-to-scientific-visualization-tutorial/
M. Gągolewski, M. Bartoszuk, A. Cena. Przetwarzanie i analiza danych w języku Python. PWN, Warszawa, 2016. ISBN: 9788301189402

Additional:
https://en.wikipedia.org/wiki/Scientific_visualization
https://en.wikipedia.org/wiki/Line_integral_convolution
http://www.bu.edu/tech/support/research/training-consulting/online-tutorials/paraview/

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00