**COURSE DESCRIPTION CARD - SYLLABUS**

Course name   
Computational systems and tools in engineering  
**Course**

Field of study  
Erasmus+  
Area of study (specialization)  
–  
Level of study   
  
Form of study  
  
Year/Semester  
1/1  
Profile of study   
  
Course offered in  
English  
Requirements

**Number of hours**

Lecture  
       
Tutorials  
       
Laboratory classes  
15  
Projects/seminars  
       
Other (e.g. online)  
     

**Number of credit points**5

**Lecturers**

Responsible for the course/lecturer:  
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Faculty of Mechanical Engineering  
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Responsible for the course/lecturer:

**Prerequisites**  
1) Basic knowledge of mathematics, classical mechanics and strength of materials which corresponds to the programme for the first cycle studies.  
2) The ability to solve elementary problems of mechanics based on the already possessed knowledge; the skill to search for specific information in certain sources.  
3) Understanding the necessity to broaden own knowledge and to shape new skills;   
self-reliance and perseverance in completing tasks and problem solving.

**Course objective**  
1) To enrich students’ knowledge on scientific computing with applications to solid mechanics.  
2) To shape students' skills in computer aided modeling and analysis of physical systems.   
3) To develop more aware use of the standard models of phenomena and technical systems, resonable choice of computational tools, and to develop skills in critical analysis of the results of numerical simulations.

**Course-related learning outcomes**Knowledge  
1) The student understands the complexity of modeling of mechanical systems, including simplifying assumptions, formulating physical and mathematical models, as well as the methods of solution and verification of models.  
2) The student can explain the idea of mathematical modeling and computer simulation as well as their common and potential applications.  
3) The student has knowledge about the capabilities and limitations of specialized scientific and engineering software.

Skills  
1) The student can use a computer algebra system (CAS) and a CAD/CAE software in design and computational analysis of mechanical systems.  
2) The student can effectively conduct modeling and simulation studies, verify models, interpret results and draw conclusions.  
3) The student can prepare brief scientific works and reports of conducted simulation studies.

Social competences  
1) The student understands the need for lifelong learning, and can organize the learning process, cooperate and work in teams.  
2) The student can properly determine the priorities necessary to complete a given task.

**Methods for verifying learning outcomes and assessment criteria**Learning outcomes presented above are verified as follows:  
Final mini-project: solving a selected computational problem related to solid mechanics, and preparing a report including the obtained results, their analysis and conclusions.

Assessment rules: a grade given on the basis of the obtained scores for the report; linear grading scale;   
C grade for earning at least 50% of all points.

**Programme content**

The essence of modeling and computer simulation, and their place within the contemporary science and engineering.  
Classical models in solid mechanics.  
Computer methods and computational systems/tools in engineering.   
Symbolic computation vs. numerical computation.   
Analytical studies of beams by using a CAS system. Analysis of support reactions, internal forces and displacements for statically indeterminate beams (energy methods).  
CAD/CAE modeling and analysis of beams and frames. Solid modeling and finite element analysis (FEA).  
Capabilities of the contemporary software; parameterization and multiple variations of models; comparative analysis of several variants of the designed mechanical system.

**Teaching methods**

Problem-based method, project-based method, case study.

**Bibliography**

Basic  
1) P. Wellin, S. Kamin, R. Gaylord, An Introduction to Programming with Mathematica. Cambridge University Press, Cambridge, 2005.

2) R.J. Madachy, D. Houston, What Every Engineer Should Know About Modeling and Simulation. CRC Press, Boca Raton, 2018.

3) R.D. Cook, Finite Element Modeling for Stress Analysis. Wiley, New York, 1995.

Additional   
1) K.-H. Chang, Product Design Modeling using CAD/CAE. Elsevier, 2014.

2) G.R. Liu, S.S. Quek, The Finite Element Method: A Practical Course. Butterworth-Heinemann, Oxford, 2003.

3) D. Dubin, Numerical and Analytical Methods for Scientists and Engineers Using Mathematica. Wiley, Hoboken, 2003.

**Breakdown of average student's workload**

|  | Hours | ECTS |
| --- | --- | --- |
| Total workload | 35 | 5 |
| Classes requiring direct contact with the teacher | 20 | 3 |
| Student's own work (literature studies, preparation for laboratory classes, preparation of the mini-project) [[1]](#footnote-1) | 15 | 2 |

1. delete or add other activities as appropriate [↑](#footnote-ref-1)