# COURSE DESCRIPTION CARD - SYLLABUS

Course name

Modelling aiding machine design

## Course

| Field of study | Year/Semester |
|---|---|
| Mechanical engineering | 2/2 |
| Area of study (specialization) | Profile of study |
| – | general academic |
| Level of study | Course offered in |
| Second-cycle studies | polish |
| Form of study | Requirements |
| full-time | compulsory |

## Number of hours

| Lecture | Laboratory classes | Other (e.g. online) |
|---|---|---|
| 15 | 15 | 0 |
| Tutorials | Projects/seminars | |
| 0 | 0 | |

## Number of credit points

2

## Lecturers

Responsible for the course/lecturer:

dr inż. Paweł FRITZKOWSKI

e-mail: pawel.fritzkowski@put.poznan.pl

tel. 61 665 2387

Faculty of Mechanical Engineering

ul. Jana Pawła II 24, 60-965 Poznań

Responsible for the course/lecturer:

## Prerequisites

1) Basic knowledge of mathematics, technical 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 the student’s knowledge on mechanics with some elements of analytical and numerical approach to modelling and computer simulation in mechanics.

2) To shape skills in computer aided modelling and analysis in the area of statics and dynamics of the basic structural members and complex 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 has well-structured and theoretically-based knowledge on the methods of analytical mechanics and computational methods, including the rigid finite element method (RFEM) - [K2_W02, K2_W06]
2) The student understands the complexity of modelling of mechanical systems including simplifying assumptions, formulating physical and mathematical models, as well as the methods of solution and verification of models - [K2_W07]
3) The student has knowledge about computer aided design, including modelling and analysis of structures - [K2_W07]

Skills

1) The student can use a symbolic-numeric computation software in design and analysis of mechanical constructions [K2_U10, K2_U14]
2) The student can conduct modelling and simulation studies, verify the used model, interpret the results and draw conclusions - [K2_U10, K2_U11, K2_U13]
3) The student can prepare brief scientific works and reports of conducted simulation studies - [K2_U03]

Social competences

1) The student understands the need for lifelong learning, and can organize the learning process, cooperate and work in teams - [K2_K01, K2_K03]
2) Can properly determine the priorities necessary to complete a given task - [K2_K04]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: a written exam consisting of 5 equally scored, theoretical open-response questions.

Computer laboratory classes: final test of knowledge and skills, i.e. solving a problem related to statics and dynamics of beam structures.

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

## Programme content

The essence of modelling and computer simulation, and their place within the contemporary science and engineering.
Physical, mathematical and numerical models. The improvement cycle for models.
Classification of models and problems in mechanics.

Classical models in solid mechanics and fluid mechanics (the model of linear oscillator,
the Euler-Bernoulli beam, the thin plate vibration model, the heat equation, the displacement equations of the elasticity theory, the Navier-Stokes equations).
Computer methods in mechanics. Quality criteria for simulation studies.
Sources of errors in approximate solutions.
Introduction to the rigid finite element method (RFEM).
RFEM in statics and dynamics of beam structures.
Stiffness, inertia and damping coefficients. Types of vibration damping and its modelling.
Modelling of supports. Mathematical description of motion and the structure of computational models.
RFEM vs. other computational methods in structural mechanics.

## Teaching methods

informational lecture, multimedia presentation, problem-based method, project-based method

## Bibliography

Basic

1. Kruszewski J., Sawiak S., Wittbrodt E., Metoda sztywnych elementów skończonych w dynamice konstrukcji. WNT, Warszawa, 1999.

2. Arczewski K., Pietrucha J., Szuster J.T., Drgania układów fizycznych. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2008.

3. Cichoń C., Cecot W., Krok J., Pluciński P., Metody komputerowe w liniowej mechanice konstrukcji. Wydawnictwo Politechniki Krakowskiej, Kraków, 2010.

Additional

1. Wittbrodt E., Adamiec-Wójcik I., Wojciech S., Dynamics of Flexible Multibody Systems: Rigid Finite Element Method. Springer, Berlin, 2006.

2. Beards C.F., Structural Vibration: Analysis and Damping. Arnold, London, 1996.

3. Rosłoniec S., Wybrane metody numeryczne z przykładami zastosowań w zadaniach inżynierskich. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2008.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 54 | 2,0 |
| Classes requiring direct contact with the teacher | 30 | 1,0 |
| Student's own work (literature studies, preparation for laboratory classes, preparation for the final test) [1] | 20 | 1,0 |

[1] delete or add other activities as appropriate