Wrocław University of Science and Technology
Doctoral School

# COURSE CARD

## 1. Basic information

| | | |
|---|---|---|
| Course name in English: | Finite Element Analysis in Practice | |
| Course name in Polish: | Metoda Elementów Skończonych w zastosowaniu | |
| Number of hours: | 15 | |
| Type of course: | Elective course | |
| Form of course: | laboratory | |
| Code of course: | | |
| Course leader: | *dr hab. inż. Damian Pietrusiak* | |
| Faculty of the course leader: | W10 Faculty of Mechanical Engineering | |
| Email address of the course leader: | damian.pietrusiak@pwr.edu.pl | |
| Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course): | Architecture and urban planning | ☒ |
| | Automation, electronic, and electrical engineering | ☒ |
| | Information and communication technology | ☐ |
| | Biomedical engineering | ☒ |
| | Chemical engineering | ☐ |
| | Civil engineering and transport | ☒ |
| | Mechanical engineering | ☒ |
| | Environmental engineering, mining, and energy | ☒ |
| | Mathematics | ☐ |
| | Chemical sciences | ☐ |
| | Physical sciences | ☒ |
| | Management and quality studies | ☐ |

## 2. Objectives

I. Task formulation – ability to analyse the phenomena and properly classify the problem to solve with use of Finite Element Method: linear, nonlinear, buckling etc.
II. Finite Element model preparation – ability to develop proper discrete model (geometry selection, finite element type selection, interactions selection etc.) dedicated to the specified problem/solver
III. Critical evaluation – assessment of the obtained simulation results and ability to formulate practical(real structure implementation) conclusions

## 3. Content

*Detailed information about the course content, including topics and form of classes.*

| No. | Topic | Number of hours | Form of classes |
|---|---|---|---|
| 1 | Fundamental software skills - Abaqus | 2 | laboratory |
| 2 | Linear static problem – model definition | 2 | laboratory |
| 3 | Linear static problem – analysis and results interpretation | 2 | laboratory |
| 4 | Nonlinear static problem – analysis and results interpretation | 2 | laboratory |
| 5 | Explicit dynamics | 2 | laboratory |
| 6 | Linear buckling analysis | 2 | laboratory |
| 7 | Coupled temperature-displacement analysis | 2 | laboratory |
| 8 | Quiz. | 1 | Select form |
| 9 | | | Select form |
| 10 | | | Select form |
| 11 | | | Select form |
| 12 | | | Select form |
| 13 | | | Select form |
| 14 | | | Select form |
| 15 | | | Select form |

## 4. Prerequisites

*List of prerequisites relating to knowledge, skills and other competences for course participants.*

Preferably:

- fundamentals of physics, mechanics and/or structural engineering
- basic skills in 3D modelling

## 5. Learning outcomes

*List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).*

| **Symbol** | **Learning outcome** | |
|---|---|---|
| | *KNOWLEDGE. Doctoral student knows and understands:* | |
| SzD_W3 | the main trends in the development of the scientific or artistic disciplines covered in the curricula; | ☒ |
| SzD_W4 | research methodology; | ☒ |
| SzD_W5 | the rules for the dissemination of scientific results, including in open access mode; | ☐ |
| SzD_W6 | the fundamental dilemmas of modern civilization; | ☐ |
| SzD_W7 | the legal and ethical conditions of scientific activity; | ☐ |

| | | |
|---|---|---|
| SzD_W8 | the economic and other relevant conditions of scientific activity; | ☐ |
| SzD_W9 | basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results. | ☐ |
| | *SKILLS. Doctoral student is able to:* | |
| SzD_U2 | use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular:<br>- define the purpose and subject of scientific research, formulate a research hypothesis,<br>- develop research methods, techniques and tools, and use them creatively,<br>- draw conclusions on the basis of scientific research;<br>critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development;<br>transfer the results of scientific activities to the economic and social spheres; | ☒ |
| SzD_U3 | communicate on specialised topics to the extent that they enable an active participation in the international scientific community; | ☒ |
| SzD_U4 | disseminate research results, including in popular forms; | ☐ |
| SzD_U5 | initiate debates and participate in a scientific discourse; | ☒ |
| SzD_U6 | be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment; | ☐ |
| SzD_U7 | plan and implement an individual or collective research or creative activity, including in an international environment; | ☒ |
| SzD_U8 | independently plan and act for one's own development and inspire and organize the development of others; | ☒ |
| SzD_U9 | plan classes or groups of classes and implement them using modern methods and tools. | ☐ |
| | *SOCIAL COMPETENCES. Doctoral student is ready to:* | |
| SzD_K3 | fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way; | ☐ |
| SzD_K4 | maintaining and developing the ethos of research and creative environments, including:<br>- carrying out scientific activities in an independent manner,<br>- respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection. | ☒ |

## 6. Evaluation

*Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.*

:

- Presence
- Class activity
- Final quiz

## 7. Teaching methods

*Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.*

:

- Multimedia presentation
- Problem based learning
- Jigsaw
- Debate
- Socratic method
- Metacognitive questions
- Peer tutoring
- Computer Aided Engineering (CAE)

## 8. Literature

*List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.*

Primary:

1. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, *Concepts and Applications of Finite Element Analysis*, Wiley; 2001

Secondary:

1. K.J. Bathe, *Finite Element Procedures*, Klaus-Jurgen Bathe, 2006
2. Nitin S.Gokhale, *Practical Finite Element Analysis*, Finite To Infinite; 2008
3. *Abaqus Manual*

## 9. Other remarks

*Additional remarks, comments, (e.g., language of the course)*

Class language: English
Software: Abaqus