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| Subject name and code | Introduction to Advanced Methods in Engineering | | |
| Field of study | Electrical and Control Engineering | | |
| Level of studies | postgraduate studies | Type of subject | Elective |
| Mode of study | Full-time studies | Mode of delivery | At the university |
| Year of study | 1 | Language of instruction | English |
| Semester of study | 2 | ECTS credits | 4.0 |
| Learning profile | General academic profile | Assessment form | Assessment |
| Conducting unit | Department of Mechatronics and High Voltage Engineering, Faculty of Electrical and Control Engineering | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | Arkadiusz Żak, MSc, PhD, DSc, Associate Professor | |
| | Teachers | Arkadiusz Żak, MSc, PhD, DSc, Associate Professor<br>Wiktor Waszkowiak, MSc, PhD | |

| Lesson type and method of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|---|
| | Number of study hours | 15.0 | 0.0 | 0.0 | 15.0 | 0.0 | 30 |
| | E-learning hours included: 0.0 | | | | | | |

| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|---|
| | Number of study hours | 30 | 3.0 | 67.0 | 100 |

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| Subject objectives | Get basic knowledge and skill on the use of advanced methods in engineering. |

Learning outcomes

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| K_W05<br>Proszę wybrać efekt kształcenia z wiedzy I umiejętności. Efekty zostaną przetłumaczone na j. angielski | | |
| K_U08 | | |
| K_U01 | | |

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| Subject contents | **Lectures**<br><br>During the course students will learn about a variety of advanced numerical techniques available and practically used for solving complex problems of various engineering branches like: civil, electrical or mechanical engineering. After a brief introduction to the problems of numerical analysis the course is going to concentrate on stationary and non-stationary phenomena analysed in current engineering, with a special attention being paid on various numerical phenomena associated with numerical investigations.<br><br>The course is planned to embrace both scientific and technical knowledge about advanced numerical techniques used in various engineering branches that will allow students to understand not only the characteristics of particular numerical techniques, but also to reveal and understand their influences on obtained numerical solutions. As a results of the course students will also gain the knowledge about the application of particular discrete modelling techniques used in engineering and learn about their drawbacks and limitations.<br><br>Students will learn about solution methods applicable to variety of stationary and non-stationary problems encountered in various fields of engineering practice, such as: eigenvalues, eigenmodes, heat transfer, transient vibrations, wave propagation, etc. Student will also learn about the most popular numerical techniques used for that purpose, starting from traditional methods of finite difference and elements and ending at most advanced methods including spectral methods in the time and frequency domains as well as utilizing splines. |
| Prerequisites and co-requisites | Basic knowledge on numerical methods, mathematics and physics of related phenomena. |
| Assessment methods and criteria | |

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Final test | 60.0% | 50.0% |
| Project | 60.0% | 50.0% |

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| Recommended reading | |
| Basic literature | O. Zienkiewicz, R. Taylor, J. Z. Zhu: The Finite Element Method: Its Basis and Fundamentals, Elsvier, 2013 |
| Supplementary literature | W. Ostachowicz, P. Kudela, M. Krawczuk, A. Żak: Guided waves in structures for SHM: the time-domain spectral element method, Wiley, 2012 |
| eResources addresses | |
| Example issues/ example questions/ tasks being completed | 1. General introduction to stationary and non-stationary problems (i.e. eigenvalues, eigenmodes, heat transfer, transient vibrations, wave propagation, etc.)<br>2. Finite Difference Method (FDM),<br>3. Finite Element Method (FEM),<br>4. Frequency and Time-domain Spectral Finite Element Methods (FD-SFEM, TD-SFEM) |
| Work placement | Not applicable |