



## Subject card

|   |  |  |  |                                     |  |            |     |
|---|--|--|--|-------------------------------------|--|------------|-----|
| Subject name and code                       | Fundamentals of Finite Element Method (CAE), PG_00055402   |  |  |                                     |  |            |     |
| Field of study                              | Mechanical Engineering   |  |  |                                     |  |            |     |
| Date of commencement of studies             | October 2022   |  | Academic year of realisation of subject  |                                     | 2024/2025  |            |     |
| Education level                             | first-cycle studies  |  | Subject group  |                                     | Obligatory subject group in the field of study   |            |     |
| Mode of study                               | Full-time studies  |  | Mode of delivery   |                                     | at the university  |            |     |
| Year of study                               | 3  |  | Language of instruction  |                                     | Polish   |            |     |
| Semester of study                           | 6  |  | ECTS credits   |                                     | 4.0  |            |     |
| Learning profile                            | general academic profile   |  | Assessment form  |                                     | exam   |            |     |
| Conducting unit                             | Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology   |  |  |                                     |  |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor   |  | dr hab. inż. Wiktoria Wojnicz  |                                     |  |            |     |
|   | Teachers   |  |  |                                     |  |            |     |
| Lesson types and methods of instruction     | Lesson type  | Lecture  | Tutorial   | Laboratory                          | Project  | Seminar    | SUM |
|   | Number of study hours  | 30.0   | 0.0  | 0.0                                 | 30.0   | 0.0        | 60  |
|   | 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  | 60   |  | 4.0                                 |  | 36.0       | 100 |
| Subject objectives                          | The aim of the study is to acquire knowledge of fundamentals of finite element method  |  |  |                                     |  |            |     |
| Learning outcomes                           | Course outcome   |  | Subject outcome  |                                     | Method of verification   |            |     |
|   | [K6_U11] is able to analyse the operation of devices and compare the construction solutions applying usage, safety, environmental, economic and legal criteria   |  | The student understands the basics mathematical FEM.   |                                     | [SU1] Assessment of task fulfilment  |            |     |
|   | [K6_W11] possesses knowledge on design, technology and manufacturing of machine parts, metrology, and quality control; knows and understands methods of measuring and calculating basic values describing the operation of mechanical systems, knows basic calculating methods applied to analyse the results of experiments |  | The student is able to build appropriate analysis models layout including nonlinearities encountered in mechanics. |                                     | [SW1] Assessment of factual knowledge  |            |     |
|   | [K6_U07] is able to design a typical construction of a mechanical device, component or a testing station using appropriate methods and tools, adhering to the set usage criteria   |  | The student is able to apply the right tools numeric required for the analyzed solution works.                     |                                     | [SU4] Assessment of ability to use methods and tools   |            |     |
|   | [K6_W08] possesses basic knowledge including the methodology of designing machine parts, mechanical devices, selection of construction materials, manufacturing and operation, with the lifetime cycle   |  | The student is able to assess the usefulness various MES environments to specific solving problems.                |                                     | [SW2] Assessment of knowledge contained in presentation<br>[SW1] Assessment of factual knowledge |            |     |

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| Subject contents   | Basic information on modeling methods, structure discretization. The concept of shape function and methods of creating shape functions using different type of polynomials like: algebraic, Lagrange, Hermit, trigonometric polynomials and natural coordinates. The concept of characteristic matrices of a finite element and the method of their construction for the problems of elastic fields and heat transfer. Matrix aggregation and creation of global matrices of the finite element model. Equations of motion in FEM and methods of solving them for linear and nonlinear problems. FEM spectral formulation in the time domain. MES software.<br><br>Design task 1 - development in Matlab FEM program for statics and dynamics analysis of isotropic beams and frames with any load patterns and boundary conditions.<br><br>Design task 2 - development in Matlab FEM program for statics and dynamics analysis of isotropic / composite plates of any shape, boundary conditions and loads |  |                               |
| Prerequisites and co-requisites                          | Algebra, Strength of Materials, Dynamics, Heat transfer   |  |                               |
| Assessment methods and criteria                          | Subject passing criteria  | Passing threshold  | Percentage of the final grade |
|  | Test of theoretical knowledge   | 60.0%  | 50.0%                         |
|  | FEM code in Matlab  | 60.0%  | 50.0%                         |
|  |   |  |                               |
| Recommended reading                                      | Basic literature  | Rakowski G., Kacprzyk Z., Metoda elementów skończonych w mechanice konstrukcji. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005<br><br>Łodygowski T., Kąkol W., Metoda elementów skończonych w wybranych zagadnieniach mechaniki konstrukcji inżynierskich. Politechnika Poznańska, Poznań 1994 (dostępny on-line) |                               |
|  | Supplementary literature  | Kleiber M., ed., Komputerowe metody mechaniki ciał stałych. Seria: Mechanika Techniczna, PWN, Warszawa-Poznań 1995<br><br>Zienkiewicz O.C., Taylor R.L., The Finite Element Method. Vol. I-III, Butterworth-Heinemann 2000   |                               |
|  |   |  |                               |
|  | eResources addresses  | Adresy na platformie eNauczanie:   |                               |
| Example issues/ example questions/ tasks being completed | Define stiffness matrix of the planar system composed of the bars   |  |                               |
| Work placement   | Not applicable  |  |                               |