GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|---|---|---|---|
| Subject name and code | Finite Element Modeling, PG_00064902 | | | | | | |
| Field of study | Modelowanie MES | | | | | | |
| Date of commencement of studies | February 2025 | | Academic year of realisation of subject | 2025/2026 | | | |
| Education level | second-cycle studies | | Subject group | Specialty subject group<br>Subject group related to scientific research in the field of study | | | |
| Mode of study | Full-time studies | | Mode of delivery | at the university | | | |
| Year of study | 1 | | Language of instruction | Polish | | | |
| Semester of study | 2 | | ECTS credits | 5.0 | | | |
| Learning profile | general academic profile | | Assessment form | exam | | | |
| Conducting unit | Institute of Naval Architecture -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | | dr hab. inż. Beata Zima | | | | |
| | Teachers | | | | | | |
| Lesson types | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 30.0 | 0.0 | 0.0 | 45.0 | 0.0 | 75 |
| | 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 | 75 | | 12.0 | 38.0 | | 125 |
| Subject objectives | Providing students with theoretical and practical knowledge of the Finite Element Method (FEM) and developing their ability to apply this method to the analysis and solution of engineering problems in the fields of ocean engineering and structural mechanics. | | | | | | |

## Learning outcomes

| Course outcome | Subject outcome | Method of verification |
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| [K7_U13] evaluates the feasibility and potential for utilizing new technical and technological achievements in accomplishing tasks characteristic for the field of study | The student formulates a computational model, prepares input data, and performs stress, stability, and natural frequency analyses for truss, beam, and shell structures using an FEM system. | [SU5] Ocena umiejętności zaprezentowania wyników realizacji zadania<br>[SU4] Ocena umiejętności korzystania z metod i narzędzi |
| [K7_W01] explains and describes, based on general knowledge in the field of scientific disciplines forming the theoretical foundations of Naval Architecture and Ocean Engineering, the construction and principles of operation of marine systems, processes and their components, as well as methods and means of their design and operation | The student knows and understands the differences between the types of analyses performed in an FEM program. | [SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym<br>[SW1] Ocena wiedzy faktograficznej |
| [K7_W04] demonstrates knowledge encompassing selected issues in the field of advanced knowledge, particularly in the scope of methods, techniques, tools, and algorithms specific to Naval Architecture and Ocean Engineering | The student understands the concept of the Finite Element Method. | [SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym |
| [K7_U04] creatively designs or modifies, either entirely or in part, a shipborne or offshore system or process according to a given specification, considering both technical and non-technical aspects, estimating costs and adopting design techniques representative for the field | The student correctly interprets the results obtained from FEM analyses. | [SU2] Ocena umiejętności analizy informacji<br>[SU1] Ocena realizacji zadania |
| [K7_U01] applies acquired analytical, simulation, and experimental methods, as well as mathematical models for analysis and evaluation of shipborne and offshore systems and processes | The student understands the differences related to the choice of discretization method and is able to select the type of analysis appropriate to the nature of the problem. | [SU4] Ocena umiejętności korzystania z metod i narzędzi<br>[SU3] Ocena umiejętności wykorzystania wiedzy uzyskanej w ramach przedmiotu |
| [K7_U02] formulates and tests hypotheses concerning problems related to shipborne and offshore systems/processes, as well as simple research problems | The student understands the mathematical foundations of analyses performed using the Finite Element Method (FEM). | [SU2] Ocena umiejętności analizy informacji<br>[SU1] Ocena realizacji zadania |

## Subject contents

Course content – lecture

Introduction, numerical methods in structural theory. Discussion of weighted residual methods. Equilibrium equations in the context of the Finite Element Method (FEM). The RayleighRitz method. Derivation of the stiffness matrix for a finite element of arbitrary dimension. Construction of interpolation functions. Description of FEM in the case of plane strain/stress. Discretization of geometric models. Discussion of typical two-dimensional FEM elements.

Course content – project

Project: Presentation of the capabilities of FEM software using a selected program and learning its fundamentals. Application of the FEM program to solving selected engineering problems.

## Prerequisites and co-requisites

Knowledge of higher mathematics and structural mechanics consistent with the scope of the degree program.

## Assessment methods and criteria

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Exam | 60.0% | 60.0% |
| Project assignment (Project) | 60.0% | 40.0% |

## Recommended reading

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| Basic literature | KLEIBER M.: *Introduction to the Finite Element Method*. Bibl. Mech. Stosowanej IPPT PAN, PWN Warszawa 1989.<br><br>J. Reddy: An Introduction to The Finite Element Method, McGrawHill, New York, 2005 |
| Supplementary literature | ZIENKIEWICZ O.C.: Finite Element Method. Arkady 1972. |
| eResources addresses | |

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|---|---|
| Example issues/ example questions/ tasks being completed | What are approximation and interpolation?<br><br>What are shape functions?<br><br>What types and how many degrees of freedom can be distinguished at a given node?<br><br>How is the convergence of the method tested? |
| Practical activites within the subject | Not applicable |

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