

# SYLLABUS

## Course description

| Course code                                       |                            | Course  | OPTYMALIZACJA KONSTRUKCJI    |                        |        |
|---|----------------------------|---|------------------------------|------------------------|--------|
| MB/O/I/ST/C1A.14                                  |                            |   | OPTIMIZATION OF CONSTRUCTION |                        |        |
| Language of instruction                           |                            | English   |                              |                        |        |
| Academic year                                     |                            | 2023/2024   |                              |                        |        |
| <b>field of study:</b>                            |                            | Mechanical Engineering  |                              |                        |        |
| <b>field of specialisation:</b>                   |                            | CAE   |                              |                        |        |
| Educational level                                 |                            | first-cycle studies   |                              |                        |        |
| Education profile                                 |                            | General academic  |                              |                        |        |
| Mode of study                                     |                            | Full-time studies   |                              |                        |        |
| Semester(s)                                       |                            | 7   |                              |                        |        |
| Affiliation with a group of classes               |                            | Specialization module   |                              |                        |        |
| Course status                                     |                            | obligatory  |                              |                        |        |
| Types of classes, instruction hours, ECTS credits |                            | Types of classes  | Number of instruction hours  | Number of ECTS credits |        |
|   |                            | Lecture   | 15 [h]                       | 3 ECTS                 |        |
|   |                            | Classes   | -- [h]                       |                        |        |
|   |                            | Project   | 30 [h]                       |                        |        |
| Linkage of the course                             | with the education profile | related to the conducted scientific activity in the discipline to which the field of study is assigned (general academic profile) |                              |                        | 3 ECTS |
|   | with qualifications        | serves the student to acquire engineering competences   |                              |                        | 3 ECTS |
|   | with science discipline    | Mechanical Engineering  |                              |                        | 3 ECTS |
| Form of teaching                                  |                            | Traditional – classes organized at the University /classes conducted using online learning methods and techniques                 |                              |                        |        |
| Prerequisites                                     |                            | Knowledge and skills acquired in the subjects: mathematics, mechanics, strength of materials, basics of FEM                       |                              |                        |        |
| Department  |                            | Faculty of Mechanical Engineering   |                              |                        |        |
| Coordinator                                       |                            | PhD Marcin Wikło  |                              |                        |        |
| The website of the basic organizational unit      |                            | www.wm.uniwersytetradom.pl  |                              |                        |        |
| E-mail address, phone number of the coordinator   |                            | m.wiklo@uthrad.pl, phone 361- 71-16   |                              |                        |        |

# LEARNING OUTCOMES, CURRICULUM CONTENT, TEACHING CLASSES, VERIFICATION OF LEARNING OUTCOMES

|   |   |
|---|---|
| Learning Objective:   | <p>C1 – Familiarizing students with issues related to optimization and types of optimization</p> <p>C2 – Mastering the skills related to defining an optimization task</p> <p>C3 – Application of design optimization software</p>  |
| Curriculum Content:   | <p>The content of the classes is related to the conducted scientific research.</p> <p><b>Contents of lectures</b></p> <p>Introduction to optimal design. Specify optimization types. Presentation of the mathematical basis of construction optimization. Examples of the use of optimization in issues not related to construction optimization. Presentation of the method of optimal design of structures using strength criteria. Definition of an optimization task: goal function, constraints. Solving optimization tasks in numerical calculation programs. Use of software designed to optimize Matlab and optimize Ansys design and parametric optimization additionally Fusion 360 to optimize topological / generative design.</p> <p><b>Content of laboratory exercises</b></p> <p>The use of software for numerical calculations in optimization. Independent solution of one and multidimensional project. Designing a structure / frame that meets the constraints imposed in class, manual optimization of the designed structure, optimization using software to find the optimal cross-section geometry, summary of the results. Parametric optimization of structures, definition of parameters. Using the "what-if" method. Topological optimization, definition of optimization areas and areas separated from optimization. Definition of new geometry after topological optimization. Powered by Autodesk Fusion software.</p> <p>Geometry machining after topological optimization.</p> <p>An example of geometry from topological optimization that can only be produced using 3D printing techniques</p> |
| Didactic (educational) methods:   | Information lecture and calculating exercises   |
| Course assessment type, the criteria for assessing the achieved learning outcomes, and the method of calculating the final grade: | Average obtained by the student from grades for projects and from colloquia   |

| Learning outcomes for the course in relation to the field of study learning outcomes and the type of classes |  |   |                  | Methods of verifying learning outcomes |   |
|--|--|---|------------------|--|---|
| Learning outcome number  | Description of the learning outcomes for the course (PEU)<br>A student who has passed the course ( W ) knows and understands / ( U ) can / ( K ) is ready to:  | Field of study learning outcome (KEU)             | Types of classes | Form of verification (credits)         | Methods of testing and assessment                       |
| W1   | Student posiada wiedzę z zakresu metod numerycznych, modelowania konstrukcji oraz optymalizacji.<br>Ma wiedzę o dostępnym oprogramowaniu umożliwiającym wykonanie zadań optymalizacji zależnie od złożoności problemu.                             | K_WG01,<br>K_WG06,<br>K_WG17                      | Lecture          | Execution of projects                  | Evaluation of the correctness of project implementation |
| U1   | Student potrafi samodzielnie zdefiniować zadanie optymalizacyjne, zbudować model matematyczny funkcji celu i ograniczeń. Potrafi przeprowadzić optymalizację za pomocą dedykowanego oprogramowania, a także korzystać z oprogramowania do obliczeń | K_UW08,<br>K_UW09,<br>K_UK16,<br>K_UO19<br>K_UU21 | Lecture          | Execution of projects                  | Evaluation of the correctness of project implementation |

|    |   |   |                     |                      |                      |
|----|---|---|---------------------|----------------------|----------------------|
|    | numerycznych. Potrafi interpretować wyniki optymalizacji. Potrafi korzystać z literatury przedmiotowej, również w j. angielskim.                        |   |                     |                      |                      |
| K1 | Student potrafi współpracować i pracować w grupie oraz rozumie pozatechniczne aspekty działalności inżyniersko-mechanicznej, w tym wpływ na środowisko. | K_KK01,<br>K_KK02,<br>K_KO04,<br>K_KR07 | Lecture/<br>project | Verbal<br>assessment | Verbal<br>assessment |

| Literature and teaching aids  |  |  |  |  |  |
|---|--|--|--|--|--|
| 1. Daniel Inman, Engineering Vibrations, Pearson Education, Inc.; (2008) English<br>2. Rakowski G., Kacprzyk Z., Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 1993.<br>4. Jacek Stadnicki, Teoria i praktyka rozwiązywania zadań optymalizacji z przykładami zastosowań technicznych, Wydawnictwo WNT<br>5. Ansys manual<br>6. Fusion manual<br>7. Mathworks on-line courses <a href="https://matlabacademy.mathworks.com/?s_tid=ln_acad_learn_oc">https://matlabacademy.mathworks.com/?s_tid=ln_acad_learn_oc</a> |  |  |  |  |  |

| Student workload required to achieve the assumed learning outcomes – the balance of ECTS credits |                           |   |                 |
|--|---------------------------|---|-----------------|
| Attendance, participation  | Student workload [h].     |   |                 |
|  | Other contact hours (IGK) | Student's self-study hours<br>Classes without a teacher (ZBN) | Classes         |
| Participation in lectures  | X                         | X   | 15 [h]          |
| Participation in projects  | X                         | X   | 30[h]           |
| Meeting with teachers during their duty hours  | 2 [h]                     | X   | X               |
| Preparation for lectures/classes/.... ,<br>Preparation for ... credit / exam                     | X                         | 23[h]   | X               |
| Total student workload   | 2 [h]/ 0.1 ECTS           | 28 [h]/1.1 ECTS   | 45[h]/ 1.8 ECTS |
| ECTS credits for the course  | 75 [h]/ 3 ECTS            |   |                 |

| Additional information, comments  |
|---|
| <p>In the case of students with special needs, including disabilities, and chronic illnesses, the methods and forms of verification of learning outcomes specified above (in the syllabus) are adapted to the individual needs of these students, as appropriate.</p> <p>Detailed rules and forms of support for students with special needs, including those with disabilities and chronically ill, during classes, credits, and exams are specified in: University Regulations (Regulamin Studiów Uniwersytetu Technologiczno-Humanistycznego w Radomiu), Study Regulations (Zasady Studiowania), and Procedure for Ensuring Accessibility of the Educational Process to Students with Special Needs, Including Those with Disabilities and Chronically ill (Procedura dotycząca zapewnienia dostępności procesu kształcenia studentom ze szczególnymi potrzebami, w tym: z niepełnosprawnością, przewlekłe chorych).</p> |

