



## Subject card

|   |   |  |  |            |  |  |     |
|---|---|--|--|------------|--|--|-----|
| Subject name and code                       | Mathematical methods of physics and technics I, PG_00037285   |  |  |            |  |  |     |
| Field of study                              | Technical Physics   |  |  |            |  |  |     |
| Date of commencement of studies             | October 2021  | Academic year of realisation of subject                  |  |            | 2022/2023  |  |     |
| Education level                             | first-cycle studies   | Subject group  |  |            | Obligatory subject group in the field of study<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                               | 2   | Language of instruction                                  |  |            | Polish   |  |     |
| Semester of study                           | 3   | ECTS credits   |  |            | 4.0  |  |     |
| Learning profile                            | general academic profile  | Assessment form  |  |            | assessment   |  |     |
| Conducting unit                             | Department of Theoretical Physics and Quantum Information -> Faculty of Applied Physics and Mathematics   |  |  |            |  |  |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor  |  | prof. dr hab. Anna Perelomova  |            |  |  |     |
|   | Teachers  |  | prof. dr hab. Anna Perelomova  |            |  |  |     |
| Lesson types and methods of instruction     | Lesson type   | Lecture  | Tutorial   | Laboratory | Project  | Seminar  | SUM |
|   | Number of study hours   | 30.0   | 15.0   | 0.0        | 0.0  | 0.0  | 45  |
|   | 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   | 45   | 5.0  |            | 50.0   |  | 100 |
| Subject objectives                          | The lectures are introduction into the Mathematical Physics relating to the basic problems of classic mechanics, fluid mechanics, elastic theory, theory of diffusion and the wave theory. Especial attention is paid to problems connected with dynamics of continuum medium, dynamics of material point, propagation of waves over continuous media and diffusion of mass and heat. The basis is description of dynamics of continuous media and material point by means of differential and integral equations. The aim is to form the consistent view at different areas of physics and technics. |  |  |            |  |  |     |
| Learning outcomes                           | Course outcome  |  | Subject outcome  |            |  | Method of verification   |     |
|   | K6_W03  |  | A student must understand the discrete form of conservation laws. The knowledge in the field of differentials and simple differential equations of the I and II orders is necessary. A student can study individually, find the proper literature and ask proper questions. A student makes the knowledge deeper in the course of lectures. The previous courses are repeated. |            |  | [SW1] Assessment of factual knowledge                                |     |
|   | K6_U02  |  | The student is able to solve problems using the knowledge acquired during lectures and exercises. The basic examples are discussed during lectures. The homeworks are announced at lectures and exercises.   |            |  | [SU3] Assessment of ability to use knowledge gained from the subject |     |

| Subject contents                      | <p>-Introduction to the course. The physical field. Fluid model for gases and liquids. Material point and fluid's element (2)</p> <p>-Description of continuum mechanics in variables of Euler and Lagrange (2)</p> <p>- Kinematics of continuum medium. Trajectories and streamlines. (4)</p> <p>-Continuity equation (conservation of charge and other integral quantities) in integral and differential forms. Mass flux. (2)</p> <p>-Kinematics of material point. (2)</p> <p>-Conservation equation for energy in the field of potential force. Potencial. (2)</p> <p>-Trajektories in the phase plane. (2)</p> <p>-Mathematical and physical oscillators and the dynamics of a material point in the field of non-potential force. (2)</p> <p>-Mass diffusion. Probabilistic description. (2)</p> <p>-Diffusion of heat. Moments of the diffusion equation. Heat flux, (2)</p> <p>-General and particular integrals of the diffusion equation in 1D at the axis and half-axis . Metoda Fouriera. (2)</p> <p>-Transverse and longitudinal elastic waves . Wave equation at the infinite axis. The solution of D'Alembert. (2)</p> <p>- Some solutions of the wave equation at the axis, half-axis and sector. (2)</p> <p>-Acoustic waves. Nonlinearity. Shock waves in fluids. (2)</p> |                               |  |                          |                   |                               |                                     |       |       |                                       |       |       |                                      |       |       |
|---------------------------------------|---|-------------------------------|--|--------------------------|-------------------|-------------------------------|-------------------------------------|-------|-------|---------------------------------------|-------|-------|--------------------------------------|-------|-------|
| Prerequisites and co-requisites       | A student must know the foundations of Mechanics, Mathematical Analysis and Differential Equations.   |                               |  |                          |                   |                               |                                     |       |       |                                       |       |       |                                      |       |       |
| Assessment methods and criteria       | <table border="1"> <thead> <tr> <th data-bbox="453 1382 796 1413">Subject passing criteria</th> <th data-bbox="801 1382 1141 1413">Passing threshold</th> <th data-bbox="1145 1382 1485 1413">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="453 1420 796 1473">A student solves the basic problems</td> <td data-bbox="801 1420 1141 1473">60.0%</td> <td data-bbox="1145 1420 1485 1473">30.0%</td> </tr> <tr> <td data-bbox="453 1480 796 1534">A student derives the basic equations</td> <td data-bbox="801 1480 1141 1534">60.0%</td> <td data-bbox="1145 1480 1485 1534">60.0%</td> </tr> <tr> <td data-bbox="453 1541 796 1588">A student is active during exercises</td> <td data-bbox="801 1541 1141 1588">10.0%</td> <td data-bbox="1145 1541 1485 1588">10.0%</td> </tr> </tbody> </table>   |                               |  | Subject passing criteria | Passing threshold | Percentage of the final grade | A student solves the basic problems | 60.0% | 30.0% | A student derives the basic equations | 60.0% | 60.0% | A student is active during exercises | 10.0% | 10.0% |
| Subject passing criteria              | Passing threshold   | Percentage of the final grade |  |                          |                   |                               |                                     |       |       |                                       |       |       |                                      |       |       |
| A student solves the basic problems   | 60.0%   | 30.0%                         |  |                          |                   |                               |                                     |       |       |                                       |       |       |                                      |       |       |
| A student derives the basic equations | 60.0%   | 60.0%                         |  |                          |                   |                               |                                     |       |       |                                       |       |       |                                      |       |       |
| A student is active during exercises  | 10.0%   | 10.0%                         |  |                          |                   |                               |                                     |       |       |                                       |       |       |                                      |       |       |

|  |   |   |
|--|---|---|
| Recommended reading  | Basic literature  | <ol style="list-style-type: none"> <li>1. L. Schwartz: Mathematical Methods in Physics, McGraw-Hill 1984</li> <li>2. A. Tikhonov, A. Samarsky: The equations of mathematical physics, McGraw-Hill 19633.</li> <li>3. R. Puzyrewski, J. Sawicki: Foundations of fluid mechanics and hydraulics, PWN, Warsaw 2000</li> <li>4. B. Budak, A. Samarsky A. Tikhonov: Tasks and problems of mathematical physics, PWN, Warsaw 1965</li> <li>5. A. Zagorski: Methods of Mathematical Physics, Warsaw University of Technology Publishing House, Warsaw 2001</li> <li>6. V. Vladimirov:, Equations of mathematical physics, Mir Publishers Moscow 1984</li> <li>7. Ladau L., Lifszitz E. Mechanics of Continuum Media,, PWN, Warsaw 1958</li> <li>8. Burka E., Nałęcz T. Fluid Mechanics in Examples, PWN, Warsaw 1999.</li> </ol> |
|  | Supplementary literature  | <ol style="list-style-type: none"> <li>1. Grybos R. Fundamentals of fluid mechanics, PWN, Warsaw, 1998.</li> <li>2. Golebiewski C., Luczywek E., Walicki E. Collected problems of Fluid Mechanics, PWN, Warsaw 1975.</li> <li>3. Grybos R. Collected problems of Fluid Mechanics, Gliwice 1979.</li> <li>4. Ilijuszyn A.A., Lomakin W.A., Szmakow A.P., Fluid Mechanics of Continuum Media in Exercises, PWN, Warsaw 1987.</li> </ol>   |
|  | eResources addresses  | Adresy na platformie eNauczenie:  |
| Example issues/<br>example questions/<br>tasks being completed | <p>To derive the continuity equation.</p> <p>To calculate the rate of mass flow over the given surface.</p> <p>To determine the period of mathematical oscillator, using the integral of the II Newton law.</p> <p>To determine the particular solution of the wave equation at the interval <math>[0, l]</math>.</p> |   |
| Work placement   | Not applicable  |   |