

## Subject card

|                                             |                                                                                                                                                                                                                                                              |                                                          |                                                                                                                                                                    |                                     |                                                                                                                                        |            |     |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------|-----|
| Subject name and code                       | Hydrophysics with Elements of Hydraulics - laboratory classes, PG_00201247                                                                                                                                                                                   |                                                          |                                                                                                                                                                    |                                     |                                                                                                                                        |            |     |
| Field of study                              | Aquaculture – Business And Technology                                                                                                                                                                                                                        |                                                          |                                                                                                                                                                    |                                     |                                                                                                                                        |            |     |
| Date of commencement of studies             | October 2026                                                                                                                                                                                                                                                 |                                                          | Academic year of realisation of subject                                                                                                                            |                                     | 2026/2027                                                                                                                              |            |     |
| Education level                             | Bachelor’s 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                               | 1                                                                                                                                                                                                                                                            |                                                          | Language of instruction                                                                                                                                            |                                     | Polish                                                                                                                                 |            |     |
| Semester of study                           | 2                                                                                                                                                                                                                                                            |                                                          | ECTS credits                                                                                                                                                       |                                     | 4.0                                                                                                                                    |            |     |
| Learning profile                            | practical                                                                                                                                                                                                                                                    |                                                          | Assessment form                                                                                                                                                    |                                     | credit                                                                                                                                 |            |     |
| Conducting unit                             | Laboratory of Physical Oceanography -> Department of Physical Oceanography and Climate Research -> Faculty of Oceanography and Geography -> Rector                                                                                                           |                                                          |                                                                                                                                                                    |                                     |                                                                                                                                        |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                           |                                                          | dr Jordan Badur                                                                                                                                                    |                                     |                                                                                                                                        |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                     |                                                          |                                                                                                                                                                    |                                     |                                                                                                                                        |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                  | Lecture                                                  | Tutorial                                                                                                                                                           | Laboratory                          | Project                                                                                                                                | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                        | 0.0                                                      | 0.0                                                                                                                                                                | 45.0                                | 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                                                       |                                                                                                                                                                    | 4.0                                 |                                                                                                                                        | 51.0       | 100 |
| Subject objectives                          | The transfer and consolidation of knowledge, along with the development of skills and competencies in the areas outlined below, essential for the subsequent courses in the ABIT Programme.                                                                  |                                                          |                                                                                                                                                                    |                                     |                                                                                                                                        |            |     |
| Learning outcomes                           | Course outcome                                                                                                                                                                                                                                               |                                                          | Subject outcome                                                                                                                                                    |                                     | Method of verification                                                                                                                 |            |     |
|                                             | [AKWAL3_W02] has an advanced understanding of chemical, biological, physical processes and phenomena, identifies them, analyses their mechanisms in relation to the aquatic environment, and is aware of the connections between various natural disciplines |                                                          | Students know and understand basic phenomena in Hydrophysics and Hydraulics as well as their relevance to biological and chemical processes (Topics: A1-A8, B3-B4) |                                     | [SW4] test/exam - oral or written<br>[SW1] oral statement/ conversation/discussion<br>[SW5] implementation of a problem task           |            |     |
|                                             | [AKWAL3-K04] is ready to identify and recognize dilemmas connected with the profession and understands the need to improve professional competence                                                                                                           |                                                          | Students recognize the constraints and dilemmas, as well as the necessity to improve their professional skills in Hydraulics when required.                        |                                     | [SK1] oral statement/conversation/ discussion<br>[SK4] test/exam - oral or written                                                     |            |     |
|                                             | [AKWAL3-U06] can apply basic techniques and technological processes related to the use of elements of the environment for practical purposes                                                                                                                 |                                                          | Students have the ability to perform basic hydrophysical and hydrological calculations for practical applications.                                                 |                                     | [SU4] test/exam - oral or written<br>[SU5] implementation of a problem task<br>[SU8] observation of student's independent or team work |            |     |
|                                             | [AKWAL3-U02] can make observations and perform simple physical / biological / chemical measurements that are typical in socio-economic activity based on natural sciences                                                                                    |                                                          | Students are capable of conducting and analyzing the results of basic hydrophysical and hydrological measurements (Topics: A2, A5, A6)                             |                                     | [SU5] implementation of a problem task                                                                                                 |            |     |

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| Subject contents                                               | A. Elements of Fluid Mechanics and Hydraulics (30 hours):<br><br>Analytical problems, quizzes and discussions to reinforce lecture topics:<br><br><ol style="list-style-type: none"><li>1. Properties of fluids.</li><li>2. Hydrostatics: pressure and manometers, hydrostatic forces on submerged flat walls, buoyancy and static equilibrium.</li><li>3. Hydrodynamics: Eulers and Lagranges frameworks, conservation of mass, momentum and energy; Euler and Bernoulli equations</li><li>4. Potential flows, applications of momentum and Bernoullis equations. Sub- and Supercritical flows. Laminar and turbulent flows. Flows in pipes and open channels.</li><li>5. Forces on submerged bodies, measurement techniques in channels, tanks and pipes.</li><li>6. Fluid flow through inlets, outlets and overflows, retention time in artificial and natural reservoirs.</li><li>7. Fluid flow in porous media, Darcys law, basic filtration equation, wells, ditches and drainage.</li><li>8. Elements of hydrology: hydrological cycle ,precipitation and evaporation, water balance for the catchment area, groundwater flow</li><li>9. Elements of coastal dynamics (waves, tides, storm surges, coastal currents) river and lake hydrology,</li></ol><br>B. Physical properties of water and elements of biooptics<br><br>B.3. Analytical problems demonstrating the significance of water's physical properties on environmental processes.<br><br>B.4. Measurements of specific optical properties of natural waters and variables utilized in remote sensing techniques. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                               |
| Prerequisites and co-requisites                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                               |
| Assessment methods and criteria                                | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Percentage of the final grade |
|                                                                | mid-terms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 51.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 80.0%                         |
|                                                                | problem solving in class                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 51.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 20.0%                         |
| Recommended reading                                            | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <ol style="list-style-type: none"><li>1. Mitosek M., Fluid mechanics in environmental protection and engineering (in Polish), Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2014</li><li>2. Baran-Gurgul K., Problems in hydraulics with solutions (in Polish), Politechnika Krakowska, Kraków, 2005</li><li>3. Czetwertyński E., Utrysko B., Hydraulics and hydromechanics (in Polish), PWN, Warszawa, 1975</li><li>4. Dera J., Marine physics (in Polish), PWN, Warszawa, 2003</li></ol>                                                                                                   |                               |
|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <ol style="list-style-type: none"><li>1. Bajkiewicz-Grabowska E., 2020, General Hydrology (in Polish), PWN, Warszawa, 2020</li><li>2. Kubrak J., Technical Hydraulics (in Polish), Wyd. SGGW, Warszawa, 1998</li><li>3. Kubrak E. J., Technical Hydraulics. Calculations. SGGW, Warszawa, 2004</li><li>4. Mobley C., Light and water, Academic Press, San Diego, 1994</li><li>5. Radlicz-Ruhlowska H., Szuster A., Hydrogeology and hydraulics with elements of hydrogeology (in Polish), WSIP, 1997</li><li>6. Woźniak B., Dera J., Light Absorption in Sea Water, Springer, New York, 2007</li></ol> |                               |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                               |
| Example issues/<br>example questions/<br>tasks being completed | <ol style="list-style-type: none"><li>1. Use the mass conservation equation and Euler equation to derive flow properties in simple cases.</li><li>2. Calculate hydrostatic forces on submerged walls</li><li>3. In-depth analysis of Bernoulli equation (ie. calculation of total head loss in pipe flow due to friction, flow constriction and variation in pipe height)</li><li>4. Calculate the time to empty a water tank,</li><li>5. Calculate fluid velocity in an open channel, for steady and uniform flow</li><li>6. Calculate wave properties in shallow and deep water</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                               |
| Work placement                                                 | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                               |

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