GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Selected problems of heat and mass transfer, PG_00059161 | | |
| Field of study | Power Engineering | | |
| Date of commencement of studies | February 2024 | Academic year of realisation of subject | 2024/2025 |
| Education level | second-cycle studies | Subject group | |
| 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 | 3.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Zakład Ekoinżynierii i Silników Spalinowych -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | prof. dr hab. inż. Janusz Cieśliński | |
| | 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 | 15.0 | 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 | 8.0 | 22.0 | 75 |

**Subject objectives**

The main objectives of the course are:

1. presentation of practical aspects of the use of heat transfer theory as applied to the design of heat exchangers;

2. presentation of fabrication methods, thermophysical properties and application possibilities of new working media, especially ionic liquids and nanofluids;

3. introduction to the theory of mass transfer with particular emphasis on the similarity of heat and mass transfer.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K7_W07] knows the environmental effects of energy technologies used; is familiar with the issues of effective energy management and use of renewable energy sources, has a broad and well-established knowledge of the processes of energy production and use | Student is able to propose a number of solutions increasing the intensity of heat and mass exchange, limiting the impact of the construction and operation of heat and mass exchangers on the environment | [SW1] Assessment of factual knowledge |
| [K7_W06] knows the extended issues of reliability of power equipment and diagnostics of defects in this equipment | The student is familiar with TEMA regulations and knows the ranges of the relevant restrictions: corrosive environment, high temperature, maximum velocities, high pressure for heat exchangers. | [SW3] Assessment of knowledge contained in written work and projects |
| [K7_U05] is able to integrate technical and economic analysis of the use of various energy technologies, including technologies using renewable energy sources and conventional and nuclear energy | Student is able to choose the right one type of heat and mass exchanger for the respective application from a technical and economic point of view | [SU3] Assessment of ability to use knowledge gained from the subject |

**Subject contents**

Part A. High-efficiency heat exchangers 1. Design of heat exchangers 2. Organization of the flow 3. Thermal efficiency of the heat exchanger 4. Intensification of heat transfer 5. Operation of heat exchangers

Part B. New working fluids 1. Ionic liquids 2. Nanofluids: a) Base liquids, nanoparticles, manufacturing methods; b) Thermophysical properties of nanofluids c) Convective heat transfer using nanofluids d) Application of nanofluids in thermal engineering 3. Selection of the working liquid

Part C. Introduction to mass transfer 1. Basic concepts 2. Diffusive mass transport 3. Convective mass transport 4. The law of conservation of substances for a stationary medium 5. The analogy between heat and mass transfer 5. Simultaneous transport of heat and mass

**Prerequisites and co-requisites**

Applied thermodynamics, heat and mass transport, energy conversion

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Lecture | 56.0% | 50.0% |
| Design | 56.0% | 50.0% |

<table>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>Cz. A<br><br>1. Gupta J.P.: Fundamentals of Heat Exchanger and Pressure Vessel Technology, Hemisphere, Washington, DC, 1986.<br><br>2. Zohuri B.: Compact Heat Exchangers, Springer International Publishing Switzerland 2017, DOI 10.1007/978-3-319-29835-1_3<br><br>3. Pudlik W.: Wymiana i wymienniki ciepła. Wyd. 5 cyfrowe, Wyd. PG, 2012.<br><br>4. Pioro L.S., Pioro I.L.: Industrial Two-phase Thermosyphons. Begell House Inc. New York, Wallingford (UK) 1997.<br><br>5. Shah, R.K. and Focke, W.W., Plate Heat Exchangers and Their Design Theory, in Heat Transfer Equipment Design, ed. R.K. Shah, E.C. Subbarao, and R.M. Mashelkar, Hemisphere, Washington, DC, 1983<br><br>6. Webb RL. Principles of enhanced heat transfer, New York: Wiley, 1994<br><br>Cz. B<br><br>1. Das S.K. et al.: Nanofluids: Science and Technology, Wiley, 2007.<br>2. Ali M.H. (ed): Hybrid nanofluids for convection heat transfer, AP, 2020<br><br>Cz. C<br><br>1. Bergman T.L., Lavine A.S., Incropera F.P., Dewitt D.P.: Fundamentals of heat and mass transfer, J. Wiley&Sons, 2011<br><br>2. Kreith F., Manglik R.M., Bohn M.S., Tiwari S.: Principles of heat transfer, Cengage Learning, 2011</td></tr>
<tr><td>Supplementary literature</td><td>Journals:<br><br>• Nanomaterials<br>• Powder Technology<br>• Particuology<br>• J. Therm. Anal. Calorim.<br>• Int. J. Heat Mass Transfer<br>• Nanoscale Research Letters<br>• Heat Transfer Engineering<br>• Experimental Thermal and Fluid Science<br>• Applied Thermal Engineering</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">A study/design on the use of heat exchangers in selected installations:<br><br>• cryogenic installations,<br>• nuclear reactor cooling systems,<br>• microgravity conditions (space stations, installations on the moon),<br>• heat exchangers in the pharmaceutical, food and other industries with increased hygiene standards,<br>• installations of very high pressures and / or very high temperatures,<br>• installations with highly corrosive agents,<br>• special purpose installations,<br>• mini- and micro heat exchangers</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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