# COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Mechanical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Mechanical Engineering</td><td colspan="2">Degree level and programme type</td><td>Bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6"></td><td colspan="2">Study profile</td><td></td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Refrigeration and Heat Pumps Engineering</td><td colspan="2">Course code</td><td>FME-00280S</td></tr>
<tr><td colspan="2">Course type</td><td></td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>30</td><td>15</td><td>15</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Mathematics I, Engineering Mechanics, Thermodynamics</td></tr>
<tr><td>Course objectives</td><td colspan="9">Getting by students understanding with in depth operation of refrigeration and heat pumps systems, possessing skills for analysis of analysis of operation of refrigeration and heat pumps systems; practical demonstration of measurement approaches of basic thermodynamic parameters and properties in refrigeration and heat pump system; possessing skills of calculation of refrigeration and heat pumps cycles</td></tr>
<tr><td>Course content</td><td colspan="9">Lecture:<br>Basic principles of refrigeration systems operation; Thermodynamics of wet vapour; Properties of refrigerants; Thermodynamics of compression refrigeration and heat pump systems (single stage, two-stage and cascade), Technical equipment applied in compression refrigeration and heat pump systems (compressors, heat exchangers, thermostatic valves, auxiliary equipment); Environmental issues of operation of refrigeration systems; Thermal driven refrigeration systems and heat pumps (sorption and ejector systems); Thermoelectric systems; Basic principles of cryogenics; heat sources for heat pumps; Air-source heat pumps, water-source heat pumps, geothermal heat pumps, Cooperation of heat pumps with heating systems<br>Classes:<br>using of properties charts; calculations of Linde cycles one stage and two-stage; analysis of performance of refrigeration systems and heat pumps; simplified calculations of absorption cycles<br>Laboratory:<br>Heat exchangers - Thermal characteristics, heat transfer coefficient, Compression refrigeration system and heat pumps - coefficient of performance, cycle identification; thermal performance; automatic control principles applications in refrigeration and heat pump engineerring</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Regular lectures: regular lectures with presentations<br>Regular classes: blackboard classes, work in groups, discussion, homework assignments</td></tr>
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| | **Self- study under supervision: tutorial sessions with worked examples, discussion, problem solving, homework assignments.**<br>**Laboratory: experimentations in groups under supervision of a teacher, lab reports preparing, problems solving.** | | |
| **Assessment method** | **Lecture - written and oral exam; classes – calculation of simple problems evaluation; laboratory classes – pre-lab tests, lab reports evaluation** | | |
| **Symbol of learning outcome** | **Learning outcomes** | **Reference to the learning outcomes for the field of study** | |
| **LO1** | Student describes with understanding basic concepts of refrigeration engineering terms, definitions, and fundamental principles, | M1_W06 | |
| **LO2** | Student performs basic calculations of refrigeration cycles | M1_W06, M1_U20 | |
| **LO3** | Student is able to do the elementary measurements of quantities applied in refrigeration engineering | M1_W06, M1_U20 | |
| **LO4** | Student understands the operation of refrigeration systems and analyse the effects of operation parameters on performance of the systems | M1_W06, M1_U11 | |
| **LO5** | | | |
| **LO6** | | | |
| **Symbol of learning outcome** | **Methods of assessing the learning outcomes** | **Type of tuition during which the outcome is assessed** | |
| **LO1** | written exam | L | |
| **LO2** | written exam, in-class tests, pre-lab tests, lab reports grading | L, C, LC | |
| **LO3** | written exam, in-class tests, pre-lab tests, lab reports grading | L, C, LC | |
| **LO4** | written exam, in-class tests, pre-lab tests, lab reports grading | L, C, LC | |
| **LO5** | | | |
| **LO6** | | | |
| **Student workload (in hours)** | | **No. of hours** | |
| **Calculation** | lecture attendance or self-study | 30 | |
| | participation in classes or self study | 15 | |
| | participation in laboratory classes | 15 | |
| | preparation for classes and laboratory classes | 30 | |
| | working on reports | 15 | |
| | participation in student-teacher sessions related to the classes | 20 | |
| | preparation for and participation in exams/tests | 30 | |
| | **TOTAL:** | **155** | |
| **Quantitative indicators** | | **HOURS** | **No. of ECTS credits** |
| **Student workload – activities that require direct teacher participation** | | **60** | **6** |
| **Student workload – practical activities** | | **55** | |
| **Basic references** | **1. Çengel Y.A., Boles M.A., Thermodynamics. An Engineering Approach, McGraw-Hill Book, 2015.** | | |

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|---|---|---|
| | 2. Whitman W.C., Johnson W.M., Tomczyk J.A., Silberstein E., Refrigeration and Air Conditioning Technology, 7th Edition, Delmar, Cengage Learning, 2013<br>3. Althouse A.D., Turnquist C.H., Bracciano A.F., Braciano C.C., Bracciano G.M., Modern Refrigeration and Air Conditioning, 19th Ed. The Goodheart-Willcox Company, Inc. | |
| Supplementary references | 1. Trott A.R., Welch T., Refrigeration and Air-Conditioning, 3rd edition, Butterworth-Heinemann, 2000<br>2. Hundy G.F., Trott A.R., Welch T., Refrigeration and Air-Conditioning, 4rd edition, Butterworth-Heinemann, 2008<br>3. Rajput R.K., Thermal Engineering, Laxmi Publications, 2010. | |
| Organisational unit conducting the course | Department of Thermal Engineering | Date of issuing the programme |
| Author of the programme | Dariusz Butrymowicz | 2025-02-07 |

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar