

## Cooling systems

|                     |   |
|---------------------|---|
| Faculty of          | <b>Mechanical and Power Engineering</b> |
| Name in English     | <b>Cooling systems</b>                  |
| Name in Polish      | <b>Systemy chłodnicze</b>               |
| Main field of study | <b>Power Engineering</b>                |
| Specialization      | -                                       |
| Level of studies    | <b>II level</b>                         |
| Form of studies     | <b>full-time</b>                        |
| Kind of subject     | <b>optional-specialization</b>          |
| Subject code        | <b>W09ENG-SM2360</b>                    |
| Group of courses    | <b>NO</b>                               |

|   | Lecture    | Classes | Laboratory | Project    | Seminar |
|---|------------|---------|------------|------------|---------|
| Number of hours of organized classes in University (ZZU)                        | 30         |         |            | 15         |         |
| Number of hours of total student workload (CNPS)                                | 50         |         |            | 50         |         |
| Form of crediting   | Zaliczenie |         |            | Zaliczenie |         |
| For group of courses mark final course with (X)                                 |            |         |            |            |         |
| Number of ECTS points   | 2          |         |            | 2          |         |
| including number of ECTS points for practical (P) classes                       |            |         |            | 2          |         |
| including number of ECTS points for direct teacher-student contact (BU) classes | 1,28       |         |            | 0,76       |         |

### PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

|    |  |
|----|--|
| 1. | Proficiency in fundamental concepts of thermodynamics, fluid mechanics, heat and mass transfer, and technical drawing, demonstrated through successful grade(s). |
| 2. | Proficiency in refrigerants and compression refrigeration systems demonstrated through positive grade(s).  |
| 3. | Proficiency in technical drawing validated by positive grade(s).   |

### SUBJECT OBJECTIVES

|    |  |
|----|--|
| C1 | Introduce students to the regulations and standards governing refrigeration and cooling system design and operation.             |
| C2 | Provide students with knowledge about system classification, their functioning, and practical applications.                      |
| C3 | Familiarize students with safety regulations influencing system selection and operation, including the choice of working fluids. |
| C4 | Develop students' skills in designing cooling and refrigeration systems.   |

### SUBJECT LEARNING OUTCOMES

|                        |   |
|------------------------|---|
| relating to knowledge: |   |
| PEU_W01                | Demonstrates knowledge of rules and standards for designing and operating refrigeration systems and refrigeration facilities. |
| PEU_W02                | Possesses knowledge of industrial, retail, and household refrigeration equipment, including refrigerated transport solutions. |
| PEU_W03                | Exhibits expertise in the cooling of a variety of food products, including meat, vegetables, and beverages.                   |
| relating to skills:    |   |

|         |  |
|---------|--|
| PEU_U01 | Can select an appropriate cooling system for specific products or applications.                                    |
| PEU_U02 | Can calculate the required capacity for a refrigeration system, designing the system, and choosing its components. |

## PROGRAMME CONTENT

| Form of classes - lecture |   | Number of hours |
|---------------------------|---|-----------------|
| Wy1-2                     | Introduction to the lecture. The basic rules and standards for safety and design of cooling systems and refrigeration plants, including the standard EN 378 for refrigerating systems and heat pumps. | 4               |
| Wy3-5                     | Refrigerated facility design. Building considerations and thermal envelope.   | 6               |
| Wy6-9                     | Industrial cooling systems (cooling of fruits, vegetables, meat, fish, etc. and other products.)  | 8               |
| Wy10-11                   | Household and retail store cooling systems (refrigerators, freezers, vending machines, ice dispensers, etc.)  | 6               |
| Wy12-14                   | Refrigerated transport (incl. refrigerated trucks, railway cars, air, and marine cargo)   | 6               |
| Wy15                      | Final test.   | 2               |
| Suma godzin               |   | 30              |

| project     |  | Number of hours |
|-------------|--|-----------------|
| Pr1         | Organizational aspects, literature and material selection, project content discussion, assignment of individual project topics, and the timeline for completing project phases   | 2               |
| Pr2-3       | Creating a comprehensive technology overview for the developed system tailored to each facility, and crafting implementation guidelines for location-specific refrigeration systems.   | 4               |
| Pr4-7       | Creating construction plans for cold rooms or spaces with cooling equipment, choosing the refrigeration system concept, performing system load calculations, determining refrigeration cycle calculations, designing installation diagrams, selecting system components, developing system-related pipeline designs, creating project drawings (including essential plans and sections), and finalizing the technical description for the proposed system. | 8               |
| Pr8         | Submission of the complete project report.   | 1               |
| Suma godzin |  | 15              |

| TEACHING TOOLS USED |  |
|---------------------|--|
| N1                  | Traditional lecture with multimedia presentation.                        |
| N2                  | The project - consultation, discussion, and presentation of the project. |
| N3                  | Own work - the project development.                                      |
| N4                  | Own work - self-study and preparation for the final test.                |

## EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

| Evaluation (F– forming (during semester), C– concluding (at semester end)) | Educational effect number | Way of evaluating educational effect achievement |
|--|---------------------------|--|
| P1   | PEU_W01-W03               | Result of the final test.                        |
| P2   | PEU_U01-U02               | Quality of the project report.                   |

## PRIMARY AND SECONDARY LITERATURE

| Primary literature |  |
|--------------------|--|
| 1                  | 2014 ASHRAE® Handbook - Refrigeration (SI Edition) (@Knovel)                                     |
| 2                  | 2017 ASHRAE® Handbook - Fundamentals (SI Edition) (@Knovel)                                      |
| 3                  | Stoecker, Wilbert F: Industrial refrigeration handbook. New York, McGraw-Hill, 1998.             |
| 4                  | Ibrahim Dinçer: Refrigeration systems and applications. Chichester : John Wiley & Sons, 2003.    |
| 5                  | EN 378:2008+A2:2012 Refrigerating systems and heat pumps – Safety and environmental requirements |

| Secondary literature |  |
|----------------------|--|
| 1                    | Diverse online resources containing catalogs of refrigeration components and units.  |
| 2                    | EN 1861:1998 Refrigerating systems and heat pumps - System flow diagrams and piping and instrument diagrams - Layout and symbols |
| 3                    | EN 13136:2013 Refrigerating systems and heat pumps -Pressure relief devices and their associated piping – Method for calculation |

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

|                  |                                |
|------------------|--------------------------------|
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