

Course code: 02-EMS-BOMT-SP1 / 02-EMS-BOMT-SP2

Plan position:

A. INFORMATION ABOUT THE COURSE

B. Basic information

| | |
|---|---|
| Name of course | Basics of molecular thermodynamics |
| Field of studies | |
| Level of studies | |
| Profile of studies | General academic |
| Form of studies | Stationary |
| Specialty | |
| Unit responsible for the field of studies | Faculty of Chemical Technology and Engineering |
| Name and academic degree of teacher(s) | Prof. Adam Gadomski, Dr Jacek Siódmiak, Dr Natalia Kruszewska |
| Introductory courses | |
| Introductory requirements | |

C. Semester/week schedule of classes

| Semester | Lectures (W) | Auditorium classes (Ć) | Laboratory classes (L) | Project classes (P) | Seminar (S) | Field classes (T) | Number of ECTS points |
|---------------|-----------------|------------------------------|------------------------------|---------------------------|----------------|-------------------------|-----------------------------|
| winter/summer | 30 | 15 | | | | | 8 |

2. LEARNING OUTCOME

| No. | Learning outcomes description | The reference to the learning outcomes of specific field of study | The reference to the learning outcomes for the area |
|------------------|---|---|---|
| KNOWLEDGE | | | |
| W1 | The student knows the basic laws of thermodynamics and should be able to explain these phenomena on the basis of phenomenological thermodynamics and statistical physics. | K_W02 | P6S_WG |
| SKILLS | | | |
| U1 | He works individually and in a team. | K_U02 | P6S_UO P6S_UK |
| U2 | Can apply molecular thermodynamics principles and examine thermodynamics from a microscopic point of view. Student should be able to describe thermodynamic processes using equations. Is able to calculate all the thermodynamic functions in terms of molecular properties and apply them to chemical kinetics. | K_U09 | P6S_UW |

| SOCIAL COMPETENCES | | | |
|--------------------|--|-------|--------|
| K1 | He understands the need for training and improving his competences professional. | K_K01 | P6S_KK |

3. TEACHING METHODS

A. Traditional methods used

| |
|---|
| Multimedia lectures. Classes performed by students under supervision of academic staff. |
|---|

4. METHODS OF EXAMINATION

| |
|--|
| Lectures - written exam, classes - submit reports. |
|--|

5. SCOPE

| | |
|----------|--|
| Lectures | <p>Thermodynamic system and state parameters: intensive and extensive state parameters, the Zero Principle of Thermodynamics, concepts of heat and work and their relation to energy, the basis of balancing.</p> <p>Thermodynamic factors and state equation: perfect gas, perfect and semi-perfect gas, real gas equation.</p> <p>Specific heat: specific heat of perfect gases, thermal capacity, temperature dependence of specific heat and average specific heat.</p> <p>First Principle of Thermodynamics: energy conservation principle, internal energy, enthalpy.</p> <p>First Principle of Thermodynamics for closed and open systems, internal energy and enthalpy as a function of state.</p> <p>Thermodynamic transformations; characteristic transformations of ideal and semi-ideal gases, reversible and irreversible transformations.</p> <p>Thermodynamic circuits: the concept of circulation, types of circuits, energy efficiency of circulation.</p> <p>Second Principle of Thermodynamics: formulation of the second principle of thermodynamics and the concept of entropy, reversible Carnot cycle, thermodynamic temperature scale.</p> |
| Classes | <p>The equation of perfect and semi-perfect gas, the equation of real gas.</p> <p>First Principle of Thermodynamics: energy conservation principle, internal energy, enthalpy, first principle of thermodynamics for closed and open systems, internal energy and enthalpy as functions of state.</p> <p>Thermodynamic process; basic transformations of perfect and semi-perfect gases, reversible and irreversible processes.</p> <p>Thermodynamic cycles and the Second Principle of Thermodynamics: energy efficiency, reversible Carnot cycle.</p> |

6. METHODS OF VERIFICATION OF LEARNING OUTCOMES

| LEARNING OUTCOME | Form of assessment | | | | | |
|------------------|--------------------|--------------|------------|---------|--------------|---------|
| | Oral examination | Written exam | Colloquium | Project | Presentation | Reports |
| W1 | | x | x | | | |
| U1 | | | x | | x | |
| U2 | | | x | | | |
| K1 | | x | x | | | |

7. LITERATURE

| | |
|--------------------------|--|
| Basic literature | <ol style="list-style-type: none"> 1. S.R. de Groot, P. Mazur, Non-equilibrium Thermodynamics, Dover, New York, 1984. 2. P. Atkins, J. de Paula, Physical Chemistry, Oxford University Press, Oxford, United Kingdom, 2014. 3. A.W. Adamson, A.P. Gast, Physical Chemistry of Surface, Wiley-Interscience, New York, 1997. 4. J. E. Verwey, J. T. G. Overbeek, Theory of The Stability of Lyophobic Colloids, Elsevier, Amsterdam, 1948. 5. P. Flory, Principles of Polymer Chemistry; Cornell University Press: Ithaca, NY, USA, 1953. |
| Supplementary literature | <ol style="list-style-type: none"> 1. J.S. Rowlinson, B. Widom, Molecular Theory of Capillarity, Clarendon Press, London, 1982. 2. J. Israelashvili, Intermolecular and Surface Forces, Academic Press, London 1992. 3. J. D. Ferry, Viscoelastic Properties of Polymers, Wiley & Sons, New York, 1980. 4. Online openstax textbooks: openstax.org |

8. TOTAL STUDENT WORKLOAD REQUIRED TO ACHIEVE EXPECTED LEARNING OUTCOMES EXPRESSED IN TIME AND ECTS CREDITS

| Student's activity | | Student workload– number of hours |
|--|--|--------------------------------------|
| Classes conducted under a direct supervision of an academic teacher or other persons responsible for classes | Participation in classes indicated in point 1B | 45 |
| | Supervision hours | 10 |
| Student's own work | Preparation for classes | 50 |
| | Reading assignments | 55 |
| | Other (preparation for exams, tests, carrying out a project etc) | 40 |
| Total student workload | | 200 |
| Number of ECTS points | | 8 |