Course code: ………………. **Plan position:** ……………

A. INFORMATION ABOUT THE COURSE

B. Basic information

Name of course	**Basics of molecular thermodynamics**
Field of studies	Chemical Technology
Level of studies	First degree
Profile of studies	General academic
Form of studies	Stationary
Specialty	1. Chemical process technology 2. Bioengineering 3. Chemistry and technology of cosmetics
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	Fundamentals of Physics
Introductory requirements	Basics of thermodynamics from the course of physics, knowledge of differential and integral calculus

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
summer	30	15					5

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	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. Thermodynamic factors and state equation: perfect gas, perfect and semi-perfect gas, real gas equation. Specific heat: specific heat of perfect gases, thermal capacity, temperature dependence of specific heat and average specific heat. First Principle of Thermodynamics: energy conservation principle, internal energy, enthalpy. First Principle of Thermodynamics for closed and open systems, internal energy and enthalpy as a function of state. Thermodynamic transformations; characteristic transformations of ideal and semi-ideal gases, reversible and irreversible transformations. Thermodynamic circuits: the concept of circulation, types of circuits, energy efficiency of circulation. Second Principle of Thermodynamics: formulation of the second principle of thermodynamics and the concept of entropy, reversible Carnot cycle, thermodynamic temperature scale.
Classes	The equation of perfect and semi-perfect gas, the equation of real gas. 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. Thermodynamic process; basic transformations of perfect and semi-perfect gases, reversible and irreversible processes. Thermodynamic cycles and the Second Principle of Thermodynamics: energy efficiency, reversible Carnot cycle.

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	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	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	15
Student's own work	Preparation for classes	20
	Reading assignments	25
	Other (preparation for exams, tests, carrying out a project etc)	20
Total student workload		125
	Number of ECTS points	**5**