

LEARNING MODULE DESCRIPTION (SYLLABUS)

PHYSICAL CHEMISTRY

I. General information

1. Module title
Physical Chemistry
2. Module code
PhCh2
3. Module type
compulsory
4. Programme title
Chemistry
5. Cycle of studies
second cycle of studies
6. Year of studies
First year
7. Terms in which taught
Second - summer
8. Type of classes and the number of contact hours
Lectures: 15 hours; laboratory: 30 hours
9. Number of ECTS credits
5
10. Name, surname, academic degree/title of the module lecturer/other teaching staff/ e-mail
Andrzej Molski, Professor., Prof. dr hab., amolski@amu.edu.pl/ Marta Waligórska, PhD.
11. Language of classes
English

II. Detailed information

1. Module aim (aims) : To introduce and illustrate topics in advanced applied physical chemistry.

Lectures will cover the following three topics:

Topic 1	Data analysis and visualization: - descriptive vs inferential statistics - discrete (e.g. binomial) vs continuous (e.g Gaussian) distributions - fitting data to models: linear least squares - case study: Anscombe's quartet
Topic 2	Molecular interactions: - electric properties of molecules (Clausius-Mossotti equation) - interactions between molecules (e.g. Lennard-Jones potential) - structure of simple liquids (radial distribution function) - case study: molecular dynamics simulation of argon
Topic 3	Macromolecules and self-assembly: - structures of macromolecules (proteins, DNA, RNA) - properties of macromolecules (electrical, optical, mechanical)

- aggregation vs self-assembly (kinetics and morphology)
- case study: diffusion limited aggregation

Laboratory practicals:

Lab 1	Determination of the Stern-Volmer Constant for Fluorescence Quenching
Lab 2	The Belousov-Zabotynski Reaction
Lab 3	Diffusion Limited Aggregation
Lab 4	Determination of the Hydrodynamic Radius of a Molecule by Viscometry
Lab 5	Chemical Reactions in Micellar Solutions
Lab 6	Electrolytic and Buffer Properties of Aqueous Solutions of Amino Acids

2. Pre-requisites in terms of knowledge, skills and social competences (where relevant)
Basic knowledge of physics, chemistry and applied mathematics

3. Module learning outcomes in terms of knowledge, skills and social competences and their reference to programme learning outcomes

Learning outcomes symbol*	Upon completion of the course, students will:	Reference to programme learning outcomes#
PhCh2_01	know selected notions of advanced physical chemistry	CHE2_W01, CHE2_W02, CHE2_W06, CHE2_U01
PhCh2_02	know selected laws of advanced physical chemistry	CHE2_W01, CHE2_W02, CHE2_W04, CHE2_W05, CHE2_W06, CHE2_U05, CHE2_U08, CHE2_U09, CHE2_U11
PhCh2_03	be able to carry out an experiment using scientific instruments	CHE2_W01, CHE2_W04, CHE2_W07, CHE2_U02, CHE2_U06, CHE2_U08, CHE2_U12, CHE2_U13, CHE2_U14 CHE2_K01, CHE2_K02
PhCh2_04	be able to carry out physico-chemical calculations and interpret the results	CHE2_W01, CHE2_W02, CHE2_U05, CHE2_U07, CHE2_U08
PhCh2_05	be able to discuss selected topics in physical chemistry	CHE2_W01, CHE2_W02, CHE2_W07, CHE2_U01, , CHE2_U10, CHE2_U12, CHE2_U15, CHE2_K01, CHE2_K02
PhCh2_06	be able to prepare a written report	CHE2_U01, CHE2_U06, CHE2_U06, CHE2_U08, CHE2_U14, CHE2_U15
PhCh2_07	be able apply safety rules in laboratory work	CHE2_W07, CHE2_U15, CHE2_K04

* module code,

programme learning outcomes

01, 02... - learning outcome number

4. Learning content

Learning content symbol	Learning content description	Reference to module learning outcomes
TK_01	Kinetics of selected physiochemical processes	PhCh2_1, PhCh2_02, PhCh2_03, PhCh2_04, PhCh2_05, PhCh2_06, PhCh2_07
TK_02	Selected chemical equilibria	PhCh2_1, PhCh2_02, PhCh2_03, PhCh2_04, PhCh2_05, PhCh2_06, PhCh2_07
TK_03	Elements of modelling and visualisation of physico-chemical processes	PhCh2_1, PhCh2_02, PhCh2_03, PhCh2_04, PhCh2_05, PhCh2_06, PhCh2_07
TK_04	Elements of data analysis	PhCh2_1, PhCh2_02, PhCh2_03, PhCh2_04, PhCh2_05, PhCh2_06, PhCh2_07

5. Reading list

- 1) Peter Atkins and Julio de Paula Atkins' Physical Chemistry, 10th Ed, Oxford University Press 2014.
- 2) 'The Chemistry Maths Book, 2nd Edition', Erich Steiner, Oxford University Press 2008.

III. Additional information

1. Reference of learning outcomes and learning content to teaching and learning methods and assessment methods

Symbol of module learning outcome*	Symbol of module learning content#	Methods of teaching and learning	Assessment methods of LO achievement&
PhCh2_01	TK_01, TK_02, TK_03, TK_04	Lectures, pre-lab quizzes, laboratory work, laboratory reports	F- discussion, observation, correction of laboratory work, S- grading of quizzes, assessment of final exam
PhCh2_02	TK_01, TK_02, TK_03, TK_04	Lectures, pre-lab quizzes, laboratory work, laboratory reports	F- discussion, observation, correction of laboratory work, S- grading of quizzes, assessment of final exam
PhCh2_03	TK_01, TK_02, TK_03, TK_04	Lectures, pre-lab quizzes, laboratory work, laboratory reports	F- discussion, observation, correction of laboratory work, S- grading of quizzes, assessment of final exam
PhCh2_04	TK_01, TK_02, TK_03, TK_04	Lectures, pre-lab quizzes, laboratory work, laboratory reports	F- discussion, observation, correction of laboratory work, S- grading of quizzes, assessment of final exam
PhCh2_05	TK_01, TK_02, TK_03, TK_04	Lectures, pre-lab quizzes, laboratory work, laboratory reports	F- discussion, observation, correction of laboratory work, S- grading of quizzes, assessment of final exam
PhCh2_06	TK_01, TK_02, TK_03, TK_04	Lectures, pre-lab quizzes, laboratory work, laboratory reports	F- discussion, observation, correction of laboratory work, S- grading of quizzes, assessment of final exam
PhCh2_07	TK_01, TK_02, TK_03, TK_04	Lectures, pre-lab quizzes, laboratory work, laboratory reports	F- discussion, observation, correction of laboratory work, S- grading of quizzes, assessment of final exam

PhCh2_08	TK_01, TK_02, TK_03,TK_04	Lectures, pre-lab quizzes, laboratory work, laboratory reports	F- discussion, observation, correction of laboratory work, S- grading of quizzes, assessment of final exam
PhCh2_09	TK_01, TK_02, TK_03,TK_04	Lectures, pre-lab quizzes, laboratory work, laboratory reports	F- discussion, observation, correction of laboratory work, S- grading of quizzes, assessment of final exam

* e.g. KHT_01 – module code as in Table in II.3 and II.4; # e.g. TK_01 – learning content symbol as in II.4

& Please include both formative (F) and summative (S) assessment

2. Student workload (ECTS credits)

Activity types	Mean number of hours* spent on each activity type
Contact hours with the teacher as specified in the programme	45
Preparation for laboratory	25
Completion of laboratory reports	15
Preparation for exam	25
Case studies (2 projects)	20
Total hours	130
Total ECTS credits for the module	5

* Class hours – 1 hour means 45 minutes; *Independent study – examples of activity types: (1) preparation for classes, (2) data analysis, (3) library-based work, (4) writing a class report, (5) exam preparation, etc.

3. Assessment criteria

- Final grade will be assigned based on assessment of laboratory exercises and written examination.
- To pass the course at least 4 (out of 5) laboratory exercises must be completed.
- To complete a laboratory exercise a pre-lab quiz must be passed and a satisfactory laboratory report of the experiment work must be completed in due time.
- The labs contribute 0-5 additional points to the final exam score (only for the first exam, not for any retake exam).
- The exam contributes 0-25 points to the final point score
- Final grades:
3.0 (16-20 pts), **3.5** (21-23 pts), **4.0** (24-26 pts), **4.5** (27-28 pts), **5.0** (29-30pts).