(faculty stamp)

COURSE DESCRIPTION

1. Course title: DESIGN AND DEVELOPMENT OF EXPLOSIVES **2. Course code:**

3. Validity of course description: 2019/2020

4. Level of studies: 1st cycle of higher education

5. Mode of studies: intramural studies

6. Field of study: INDUSTRIAL AND ENGINEERING CHEMISTRY (RCH)

7. Profile of studies: general

8. Programme: --

9. Semester: VI

10. Faculty teaching the course: Department of Physical Chemistry and Technology of Polymers (RCh4)

11. Course instructor: Tomasz Jarosz, Ph.D., M.Eng., assistant

12. Course classification: common courses

13. Course status: elective

14. Language of instruction: English

15. Pre-resquisite qualifications: --

16. Course objectives: Introduction to the strategies of designing explosives and numerical predicting of their properties. Introductory methods of composing multi-component explosives and determining the threat posed by them, including requirements for setting the explosion risk zones and requirements for sites where explosives are stored.

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Knowledge of computer-assisted calculations, as required for performing chemical calculations and solving hypothetical problems; familiarity with the software used in chemistry	Final project	Seminar	K_W01++ K_U09++
2.	Knowledge about chemical reactions, their course and catalytic systems	Final project, Oral presentation	Seminar	K_W02++ K_W03++ K_W09+++
3.	Knowledge of basic work safety and hygiene guidelines; knowledge of procedures for the safe handling of chemicals and the sorting and disposal of chemical waste in adherence to pro-environmental regulations	Final project, Oral presentation	Seminar	K_W11++ K_K02++ K_U18+
4.	Ability to perform chemical calculations, use them for own purposes, analyse their results and explain them	Final project, Oral presentation	Seminar	K_U07+++ K_U15+++
5.	Ability to gather and process the required information and use a selection of software for assisting the realisation of tasks typical for chemistry; ability to describe chemical issues using mathematical methods	Final project, Oral presentation	Seminar	K_U01++ K_U07++ K_U08++

6.	Ability to work as part of a team when conducting experiments and interpreting and analysing the acquired data; awareness of being responsible for tasks realised as part of a team	Final project, Oral presentation	Seminar	K_U02++ K_K05++
7.	Awareness of the responsibility for initiating research, experiments or observations; understanding the social aspects of the practical application of acquired knowledge and skills, as well as the related responsibility	Final project, Oral presentation	Seminar	K_U15++ K_W10++ K_U17+

18. Teaching modes and hours

Lecture/ BA/MA Seminar / Class / Project / Laboratory

Seminar 60

19. Syllabus description:

Seminar: Methodology of calculating the theoretical properties of explosive materials and mixtures (oxygen balance, temperature, heat and energy of the explosion, etc.). Types of explosive compounds and explosophore groups. Explosives work and storage safety. Threat classes of explosives, according to the ADR treaty. Excursions to industrial sites dealing with explosives and their storage. Calculating theoretical properties of explosive mixtures and materials (oxygen balance, temperature, heat and energy of the explosion, etc.). Designing explosives that would exhibit a particular set of properties. Determination of the explosion threat zone, depending on the type and amount of explosive. Calculating the requirements of sites where explosives are being stored. Presentation and discussion of final projects – design of explosives exhibiting particular sets of features

20. Examination: no

21. Primary sources:

1. Mader C. L., Numerical modeling of explosives and propellants, CRC Press, 2008;
2. Cheret R., Detonation of condensed explosives, Springer-Verlag, 1993;
3. Dremin A., Toward detonation theory, Springer, 1999;
4. Shekhar H., "Studies on empirical approaches for estimation of detonation velocity of high explosives." Central European Journal of Energetic Materials 9.1 (2012): 39-48;
5. Price M. A., Ang H. G., "Modeling for detonation and energy release from peroxides and non-ideal improvised explosives." Central European Journal of Energetic Materials 6.3-4 (2009): 239-254;
6. Regulation of the Minister of Economy, of October 28, 2002, regarding storage rooms and facilities for storing explosives, weapons, ammunition and products for military or police purposes;
7. PN-EN 13631-15:2007 (explosives for civil uses – high explosives – part 15: calculation of thermodynamic properties) standard.

22. Secondary sources:

1. Suceska M., Test Methods for Explosives, Springer-Verlag New York, 1995
2. Meyer R., Kohler J., Explosives, Wiley-VCH inc., 2002.
3. Fedoroff B. T., Oliver R. Sheffield; Encyclopedia of Explosives and Related Items, vol 1-10, Picatinny Arsenal, 1974.
4. Urbański T., Chemistry and Technology of Explosives, vol 1-3, Pergamon Press, 1967.
5. Kubota N., Propellants and explosives: Termochemical aspects of combustion, Wiley-VCH inc., 2002.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode:	Contact hours/ Student workload hours
1	Lecture	-/-
2	Classes	-/-
3	Laboratory	-/-
4	Project	-/-
5	BA/MA Seminar	60/60
6	Other	/-
	Total number of hours	60/60

24. Total hours: 120

25. Number of ECTS credits: 4

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory, classes, projects): 1

26. Comments:

Approved:

……. ……

(date, Instructor's signature) (*date, the Director of the Faculty Unit signature)*