STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Risk Assessment in Industry**		Code **1010702131010722582**
Field of study **Chemical and Process Engineering**	Profile of study (general academic, practical) **(brak)**	Year /Semester **2 / 3**
Elective path/specialty **Chemical Engineering**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **1** Classes: **-** Laboratory: **-** Project/seminars: **1**		No. of credits **4**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **4 100%** **4 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student knows: - basics of algebra and theory of probability, - basic knowledge about heat and mass transport and momentum exchange, - principles in chemical reactors engineering, - legal basis in field of process safety according to the Polish law and the European Union legislation, - basic risks that may result from the chemicals used in process industry, - principles of such analysis as: HAZOP, FMEA, ETA and FTA. Basic knowledge about constraction and operating rules of: - equipment, internals and fittings used in chemical and related process industries, - industrial automation.
2	**Skills**	Student has the ability to: - read and understand the Process Flowsheet Diagrams(PFD) and Piping and Instrumentation Diagrams (P&ID) - describe the exchange of mass, heat and momentum, - describe the thermal effects of chemical reactions, - identify hazards and assess them in qualitative manner in the field of chemical industry, - manage the risks of chemical processes through identification of the key steps of risk analysis.
3	**Social competencies**	- The student is aware of the advantages and limitations of individual and team work in solving problems of an industrial nature. - The student is aware of and understands the social aspects of the practical application of her/his knowledge and skills in the field of process safety and related liability.

Assumptions and objectives of the course:

The main aim of the course is to deepen the student's knowledge on the safe operation of equipment and fitings oriented on the identification and analysis of industrial risks through the aplications of various qualitative, semi-quantitative and quantitative methods in order to quantify the risk of:

- the chemical contamination of the environment,
- the hazard of fire,
- the hazard of explosion.

Especially important aspect of the course is the description of dispersion of the chemicals released from industrial plants. In addition, the student is going to be familiarize with the analysis of the causes and consequences of accidents which have occured in the chemical, petrochemical and food industries.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student knows the rules of the following analysis: HAZOP, FMEA, FTA, ETA and LOPA; and the possibility of their quantitative interpretation. - [K_W12]
2. Student knows the rules of calculating Dow indices: CEI and F&EI. - [K_W12]
3. Student knows mathematical models describing basic source models of chemical substances from industrial processes. - [K_W12, K_W13]
4. Student knows the rules of zoning the areas of explosion danger. - [K_W12]
5. Student knows the basic and some specific aspects of health and occupational safety in the chemical and related process industries. - [K_W12]

Skills:

1. Student is able to identify the hazards, quantify and manage the risks associated to the chemical and related industries. - [K_U01]
2. Student is able to apply the such analysis methods as FMEA, FTA, ETA and LOPA in quantitative assessment. - [K_U15, K_U19]
3. Student knows how to utilize the results from CEI and F&EI analysis to design the plant layout. - [K_U11, K_U15]
4. Student is able to perform basic calculations related to the chemical releases. - [K_U19]
5. Student acquire skills required in teamwork and preparation of technical report. - [K_U02]

Social competencies:

1. Student understand and is aware of the social aspects of the practical application of his/her knowledge and skills related to process safety and her/his liability. - [K_K07]
2. Student is aware of the advantages and limitations of individual work and teamwork in solving interdisciplinary problems in the industry. Student is also aware of the responsibilities for collaborative tasks performed in team. - [K_K05]
3. Student is aware of the principles of professionalism and ethics in relation to the storing and processing of process chemicals and hazardous events. - [K_K04]
4. Student knows the limits of his own knowledge and understands the need for lifelong learning, with a particular emphasis on the analysis of industrial accidents. - [K_K04]

Assessment methods of study outcomes

Knowledge

Verification of general knowledge acquired during the course in the form of a test. This refers to points 1-5.

Skills

Practical application of the acquired knowledge in the form of a report on the safety process analysis of the selected industrial plant. The report should include application of few methods presented during the course. The report has be prepared in a group of a few students (maximum 5). Activity in the classroom. This refers to points 1-5.

Social competences

Presentation of the report in the form of a multimedia and oral presentation. Activity in the classroom. This refers to points 1-4.

Course description

The course discusses:

- possibilities for quantitative interpretation of risk analysis methods used in the industry such as HAZOP, FMEA, FTA, ETA and LOPA.
- principles for the Dow indices analyses: Chemical Exposure Index (CEI) and Fire and Explosion Index (F&EI).
- mathematical models describing the basic types of chemical releases from industrial processes, for example the flow of liquid through the hole, the flow of liquid through the hole in the tank, the liquid flow through pipes, the gas flow through the hole, the flow of the gases or vapours through pips, liquid pool evaporation or boiling.
- basic dispersion models.
- case studies of accidents and failures in the chemical and petrochemical industries.

Basic bibliography:

1. Mitkowski P. T., Analiza ryzyka w przemyśle chemicznym, Wydawnictwo Politechniki Poznańskiej, 2012

2. Crowl D. A., Louvar J. F., Chemical Process Safety. Fundamentals with Applications, 3 edycja, Pearson Education, Inc., 2011

3. Zarządzanie ryzykiem w przemyśle chemicznym i procesowym, Praca zbiorowa pod redakcją Adama S. Markowskiego, Wydawnictwo Politechniki Łódzkiej, 2001

4. Woliński M., Ogrodnik G., Tomczuk J., Ocena zagrożenia wybuchem, Szkoła Główna Służby Pożarniczej, Warszawa, 2002.

5. Prawo ochrony środowiska, Dz.U. 2001 Nr 62 poz. 627.

6. Rozporządzenie Ministra Gospodarki z dnia 9 kwietnia 2002 r. w sprawie rodzajów i ilości substancji niebezpiecznych, których znajdowanie się w zakładzie decyduje o zaliczeniu go do zakładu o zwiększonym ryzyku albo zakładu o dużym ryzyku wystąpienia poważnej awarii przemysłowej. Dz.U. 2002 Nr 58 poz. 535.

7. Rozporządzenie Ministra Gospodarki, pracy i polityki społecznej z dnia 29 maja 2003 r. w sprawie wymagań, jakim powinien odpowiadać raport o bezpieczeństwie zakładu o dużym ryzyku, Dz.U. 2001 Nr 62 poz. 970.

Additional bibliography:

1. DOW?s Chemical Exposure Index Guide, edycja 1, American Institute of Chemical Engineers, Nowy Jork, 1994.

2. DOW?s Fire & Explosion Index Hazard Clasification guide, edycja 7, American Institute of Chemical Engineers, Nowy Jork, 1994.

3. Atherton J., Gil F., Hoboken, N.J,. Incidents that define process safety, Center for Chemical Process Safety, Wiley, 2008.

4. Michalik J. S., Gajek A., Tworzenie się niebezpiecznych substancji chemicznych podczas poważnych awarii przemysłowych, Centralny Instytut Ochrony Pracy, 2002.

5. Sanders R. E., Chemical Process Safety - Learning from Case Histories (3rd Edition), Elsevier, 2005 (dostęp elektroniczny przez www.library.put.poznan.pl).

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures and colloquium	15
2. Preparation to colloquium	5
3. Participation in project classes	15
4. Participation in the consultation	2
5. Preparation of report	10
6. Preparation of presentation	3

Student’s workload

Source of workload	hours	ECTS
Total workload	50	4
Contact hours	32	2
Practical activities	15	1