

# Course Specifications

Valid in the academic year 2023-2024

## Risk and Safety at the Chemical Industry (E900542)

Course size	(nominal values; actual values may depend on programme)				
Credits 6.0	Study time 180 h				
Course offerings in aca	demic year 2023-2024				
A (semester 1)	English	Gent			
Lecturers in academic y	vear 2023-2024				
Pastor, Elsa			BARCEL03	3 lecturer-in-charge	
Offered in the following programmes in 2023-2024				crdts	offering
International Master of Science in Fire Safety Engineering				6	А

#### Teaching languages

English

#### Keywords

Quantitative risk analysis, fires, explosions, dispersion of toxic substances

#### Position of the course

During this course the students learn to identify the risks associated to smart chemical factories and related installations; to evaluate the effects and consequences of severe accidents; to quantify and analyse technological risks.

#### Contents

- 1 Introduction to technological risk management (Introduction to accidental environmental impact - Risk: definition, types and metrics - Risk tolerability -Accidental scenarios at the chemical industry - Risk analysis structure);
- 2 Hazards identification (Hazards identification techniques: definition and types -Hazardous materials at the chemical industry - Historical Analysis - Hazard & Operability (HAZOP) - Hazard Identification (HAZID) - Fault trees and event trees);
- 3 Source Term (Introduction to source terms calculations Flow of liquid through a hole in a tank - Flow of gas or vapour through a hole - Evaporation of a liquid from a pool - General guidelines for source term calculations in QRA)
- 4 Atmospheric dispersion (Meteorological factors Dispersion modelling: release types and models type - Gaussian models for neutral gases - Heavy gas dispersion - Consequence analysis – Vulnerability)
- 5 Runaway reactions (- Historical analysis Exothermicity Risk analysis and process engineering Study cases)
- 6 Fire accidents (- Types of fires Flammability Modelling: solid body model, pool fires, boilover, jet fires, fireballs, flashfires Vulnerability)
- 7 Explosions (- Types of explosions Blast and overpressure Explosions modelling: vapour cloud explosions, BLEVE, vessel explosions, dust explosions – Vulnerability)
- 8 Quantitative risk analysis (Introduction to QRA: aim of the study and phases -Standards in QRA - Examples of simplified and complex set-ups)
- 9 Risk mitigation strategies (Prevention and protection safeguards LOPA analysis)

#### Initial competences

Insight into the basic concepts of physics, chemistry, thermodynamics, heat and mass transfer. Gather, look up, interpret, integrate and present relevant information in a systematic manner.

#### **Final competences**

- 1 Apply risk identification techniques. Identify and understand hazards associated to chemical substances.
- 2 Know the main source term models and apply those with simplified hypothesis.
- 3 Quantify the effects and consequences of toxic releases.
- 4 Understand the phenomena associated to runaway reactions. Know risk mitigation strategies in case of runaways.
- 5 Quantify the effects and consequences of industrial fires and explosions.
- 6 Know the objectives and different parts of QRA. Apply QRA standards in a real system.
- 7 Know the different layers of protection in chemical processes.

#### Conditions for credit contract

This course unit cannot be taken via a credit contract

#### Conditions for exam contract

This course unit cannot be taken via an exam contract

#### **Teaching methods**

Group work, Seminar, Lecture, Practical, Independent work

#### Extra information on the teaching methods

Theory and exercises are taught during lectures, periodic individual assignments, study cases in groups, lab sessions

#### Learning materials and price

All material needed can be found digitally on the course web (for free)

#### References

- Casal Fàbrega, Joaquim. Evaluation of the effects and consequences of major accidents in industrial plants [on line]. 2n ed. Amsterdam: Elsevier, [2018]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail. action?docID=5056836. ISBN 9780444638922.
- Mannan, Sam. Lees' Loss prevention in the process industries: hazard identification, assessment and control. 4th ed. Elsevier. 2012. ISBN 9780123971890. https://doi.org/10.1016/C2009-0-24104-3
- CCPS. Guidelines for evaluating the characteristics of vapor cloud explosions, flash fires and BLEVEs. Nova York. CCPS-AIChE, 2010. ISBN 9780470935101.
- Center for Chemical Process Safety. Guidelines for Chemical Process Quantitative Risk Analysis. American Institute of Chemical Engineers. New York, 2000. ISBN: 9780816907205

#### Course content-related study coaching

Interactive support through the electronic learning environment, in person after agreement on date and immediately before and after classes.

#### Assessment moments

end-of-term and continuous assessment

#### Examination methods in case of periodic assessment during the first examination period

Written assessment with multiple-choice questions, Written assessment with open-ended questions, Written assessment

#### Examination methods in case of periodic assessment during the second examination period

Written assessment with multiple-choice questions, Written assessment with open-ended questions, Written assessment

#### Examination methods in case of permanent assessment

Assignment

#### Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

#### Extra information on the examination methods

The examination of the course consists of three parts: A written mid-term exam, a written final exam and the continuous assessment. The continuous assessment consists of seven assignments: 1) Solving individually a source term exercise, 2) Solving individually a fire effects exercise, 3) Solving individually an explosions effect exercise, 4) Solving a BLEVE study case in groups, 5) Solving a practicum case with ALOHA software in groups, 6) Solving a runaway homework assignment, 7) Solving an event-tree questionnaire individually.

#### Calculation of the examination mark

30% mid-term exam, 40% final exam, 30% continuous assessment

### Facilities for Working Students

There are no special facilities for working students