GHENT UNIVERSITY

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 academic year 2023-2024

A (semester 1) English Gent

Lecturers in academic year 2023-2024

Pastor, Elsa BARCELO3 lecturer-in-charge

Offered in the following programmes in 2023-2024	crdts	offering
International Master of Science in Fire Safety Engineering	6	A

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