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# HSE PROFESSIONAL

## LIST OF COURSES

MASTER STUDY

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# 1<sup>st</sup> semester

## Principles and Methods of Risk Analysis

1. Risk analysis terminology, ISO 31 000 as a general risk management standard.
2. Systematic approach to risk management - individual steps of risk management, their mutual relationships, and links.
3. Types of danger - physical, chemical, biological. Hazard identification, scenario creation.
4. ISO 31 010 - deterministic and probabilistic approach, qualitative, semiquantitative and quantitative methods of risk analysis.
5. Analysis of selected methods used in Europe and the world, e.g., Dow F&EI, Dow CEI, etc.
6. Risk analysis methods FTA, ETA, HAZOP, etc.
7. Consequence modelling, computer programs ALOHA, EFFECTS, etc.
8. The transition between analysis and risk assessment. Risk Acceptability.
9. Organizational and technical barriers for risk reduction, their effectiveness. Human factor - reliability of human factor.
10. Analysis of basic safety requirements and their use for ensuring the safety of selected technologies based on the risk analysis.
11. Case studies focused on specific examples of risk analysis.
12. Procedure of Quantitative Risk Assessment by CPR 18E Purple Book.
13. Methods for environmental impact assessment of accidents.
14. Risk analysis links to major accident prevention, occupational risks, environmental protection, etc.

## Risk management systems

1. Meaning of management systems (system as a concept including its variability; systems thinking in the context of HSE).
2. Basic management principles - the Deming scheme (plan-do-check-act).
3. Basic elements of the risk management system (characterization, analysis, evaluation – criteria of risk evaluation vs. risk perception, risk management, communication, reassessment) as a continuous and cyclic process, under conditions of operation with varying degrees of human, automation, and robot involvement (influence of industry 4.0).
4. Risk management strategies (risk avoidance/risk elimination, risk reduction, risk transfer), risk matrix.

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5. Evaluation criteria for strategy and risk management measures.
  6. Cost-benefit compensation, risk-based decision making.
  7. Risk management measures (examples).
  8. Introduction to quality management system ISO 9000:2015.
  9. Introduction to ILO guidelines on occupational health and safety management systems, OHS, ISO 45001.
  10. Introduction to the system of prevention of serious accidents.
  11. Possibilities of integration of various risk management systems within the company.
  12. Additional approaches: Inherent safety approach, Control – Process and workplace design, Hazard and risk control, Safety by design (prevention by design), Cleaner production, Green design.
  13. Strategies for defining a problem in relation to change management.

## Basics of Production Technologies

1. Introduction to the issues – basic types of production technologies, European legislation with regard to OSH.
2. Technological preparation – engineering drawings, normalization.
3. Technological working procedures (forming, foundry, surface treatment)
4. Technological working procedures (turning, milling, cutting).
5. Technological working procedures (welding, soldering, bonding).
6. Technological working procedures (quality check, technical tests).
7. Energetics – basic concepts with regard to continuity of other subjects (Environmental Protection, Fire and Explosion Protection, ...).
8. Energetics – basic principles of nuclear, thermal, water and wind power plants.
9. Energetics – combustion of solid, liquid and gaseous fuels.
10. Transport of liquids with a focus on compressors and pumps.
11. Solid materials conveyors, technology for exhaustion in industrial plants.
12. Chemical industry – basic equipment used in chemical industry.
13. Industry 4.0 – basic concepts.
14. Industry 4.0 with regard to robotization of factories (smart industry).

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# The Doctrine of Danger

1. Hazard and risk as an inherent part of the life of an individual, company and society.
2. Hazard and risk terminology; concepts within occupational safety, environmental protection, process safety and disaster risk reduction, their similarities and differences.
3. Process of origin and spread of hazard, model MADS.
4. Deterministic and probabilistic risk concepts.
5. Stakeholders in risk management in the framework of HSE and their relations - risk owners, risk bearers, manager HSE, regulator, regulation enforcement.
6. Hazard and its types and properties, hazards of material objects and situations, hazards identification.
7. Hazardousness as an intensive and hazard as an extensive parameter, possible endangered targets, main hazard types in HSE management.
8. Danger manifestation scenarios, their searching and selection of those relevant for risk management.
9. Uncertainty problems in the process of hazard/risk identification: known/known threats, known/unknown threats, unknown/unknown threats. "Black swam" concept by Taleb.
10. Definition of risk management goals in various conditions as social decision.
11. Identification of possible incident impacts and their quantification and assessment. Problem of impacts harmonization from the point of view of company/society priorities.
12. Ways of uncertainty expression - probability, frequency, other methods.
13. Decision making in HSE management process and their strategies.
14. Risk trade-off, concepts ALARP and ALARA, ethical aspects of HSE, risk and communication.

## Applied statistics

1. Combinatorics
2. Introduction to probability theory
3. Conditional probability and independent events. Bayes theorem. Total probability rule.
4. Random variable and its characteristics
- 5.-7. Basic types of distributions of discrete and continuous random variables
8. Random vector
9. Statistical file with one argument
10. Statistical file with two arguments

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11. Regression and correlation
  12. Point and interval estimation of parameters
  13. Hypothesis testing
  14. Reserve - exercises.

## Applied Chemistry for HSE

1. Introduction to chemistry, structure of matter, basic principles of general chemistry, PSP, nomenclature of inorganic and organic substances.
2. Basic inorganic and organic compounds, chemical reaction.
3. Thermodynamics of chemical reactions.
4. Kinetics of chemical reactions, chemical reactor.
5. Oxidation-reduction chemical processes, explosion, runaway reactions.
6. Unsteady processes, heat, mass and momentum transfer.
7. Processes and equipment of chemical technology.
8. Corrosion of materials.
9. Chemistry of extinguishing agents.
10. Chemistry and fuel technology.
11. Polymers.
12. Chemistry of the environment.
13. Processing of secondary raw materials, waste.
14. Toxicology and toxicity of chemicals.

## Project management

1. Project management – definition of basic terms, standards, standardization, certification (IPMA, PMI, PRINCE)
2. Definition of other terms, relationships, problem definition, goals, design and selection of a suitable solution.
3. Project life cycle, project phases.
4. Project strategy, SMART objectives, triple imperative, logical framework.

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5. Project planning – time, budget.
  6. SW support according to given type of projects.
  7. Project risks and their elimination.
  8. Organizational structure, stakeholders, team selection and composition, team roles, teamwork, communication.
  9. Checking and changes in the project.
  10. Project evaluation and completion.
  11. Solving specific projects.
  12. Management games.
  13. Lectures from practice.
  14. Project defence.

# 2<sup>nd</sup> semester

## Environmental Protection and Safety

1. Introduction to the issues of EP and NL leakages from the safety point of view.
2. Water protection and pollution.
3. Air protection and pollution.
4. Soil and nature protection and pollution.
5. Protection and waste pollution.
6. Environmental impact assessment (EIA, SEA).
7. Integrated pollution prevention and control (IPPC).
8. Environmental management system (EMS).
9. Safety Management System.
10. Environmental impact assessment of serious accidents.
11. H&V index methodology and Environment Accident Index. Case study.
12. Extinguishing waters and their ecotoxicity.
13. Ecoterrorism.
14. Excursion ČOV, Hazardous waste incinerator.

## Fire Protection

1. Introduction to fire dynamics - heat release rate, the course of fire.
2. Introduction to fire dynamics - gas exchange in fire, ceiling flow, smoke layer.
3. Introduction to fire dynamics - heat transfer, gas temperature inside the burning space.
4. Passive fire protection - concept of fire safety, design of fire protection, fire risk.
5. Passive fire protection - materials and building structures and their assessment from the perspective of fire protection.
6. Passive fire protection - principles of design of structures exposed to fire.

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7. Active fire protection - automatic fire detection, alarm systems.
  8. Active fire protection - fire suppression equipment (fixed fire extinguishing equipment, etc.)
  9. Active fire protection - smoke and heat extraction equipment.
  10. Active fire protection - other fire-fighting equipment and measures.
  11. People's behaviour during fire – ensuring the safety of people in the building, evacuation equipment.
  12. People's behaviour during fire – modelling evacuation of people.
  13. Fire modelling using zone models.
  14. Fire modelling using CFD models.

## Principles and Practice of OSH

1. Introduction to OSH; History and the current state of OSH.
2. Basic principles of OSH; Rights and Obligations of key stakeholders.
3. International OSH framework.
4. National policy, OSH programme and system.
5. OSH management in the company.
6. Work risks.
7. Occupational accidents and occupational diseases - case report.
8. Work risk assessment.
9. Prevention of occupational risks and its management.
10. Health surveillance; Occupational medical services; Rehabilitation.
11. OSH support, education and training.
12. Protection and prevention services; Roles, knowledge and skills of OSH professional.
13. Knowledge transfer in OSH.
14. Emerging OSH problems and challenges.



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# Management of Chemicals

1. Introduction to Chemicals Management (MCHL).
2. Basic principles and tools of MCHL.
3. International organizations and Conventions; stakeholders.
4. Chemical life cycle.
5. Hazardous properties of substances - physicochemical, toxicological and ecotoxic.
6. Classification of Hazardous Chemicals, the Globally Harmonized System.
7. Risk assessment (health).
8. Risk assessment (for the environment).
9. Risk management.
10. Handling hazardous chemicals in a company.
11. Transport of hazardous chemicals (ADR, RID).
12. Hazardous properties of waste.
13. Classification of hazardous waste.
14. Handling and transporting hazardous waste.

## Introduction to scientific modelling

1. Basic physical concepts (space, time, matter, energy) as a basis for causality of causes and consequences.
2. Approaches to models in terms of science theory (prediction, representation, etc.).
3. Models as tools for decision support.
4. Physical and mathematical models / simulations.
5. Validation, verification and calibration of mathematical models.
6. Aspects of complexity and interdisciplinarity.
7. Aspects of probability and uncertainty.
8. Input data and their uncertainties.

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9. Visualization and presentation of quantitative data.
  10. Propagation of errors and uncertainty quantification of mathematical models.
  11. Methods of sensitivity analysis of mathematical models.
  12. Metamodels and their applications in specific branches of exact sciences.
  13. Practical applications and interpretation of mathematical modelling results.
  14. Computational simulations and their use (e.g., identifying causes of incidents and increasing emergency alert).

## Product safety

1. Introduction to product safety.
2. Product safety systems – legislation.
3. Standardization and technical standards, harmonized documents.
4. Legal basis of the new approach to certification.
5. Testing and proving product properties.
6. Accreditation and notification.
7. Metrology and measurement management system.
8. Product documentation, declaration of conformity, instructions for use
9. Responsibility for products and their users
10. Individual EU regulations and directives on product groups.
11. Basic principles and distribution of explosion.
12. Introduction to explosion prevention.
13. Primary, secondary and tertiary (design) explosion prevention.
14. ATEX (application of the EU product directive EU 94/9/ES).

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# Principles of physical measurement

1. Technical measurements and technical experiment.
2. Metrological quantities and equations, distribution of meters, measurement errors and uncertainties.
3. Electromagnetic waves, optics, optical instruments, the effect of radiation on health.
4. Lasers, masers, security classes, thermal imaging cameras and their applications.
5. Metal detectors, georadars - principles and applications.
6. Basic spectroscopic methods (IR, Raman, THz).
7. Acoustic waves - sound, ultrasound and infrasound. Vibration, noise and vibration measurement, impact on health.
8. Non-destructive defectoscopy.
9. Physical field.
10. Ionizing radiation, types, sources, interaction of radiation with matter, shielding.
11. Dosimetry.
12. Objectives, principles and methods of radiation protection.
13. Detectors of ionizing radiation.
14. Types, properties, sources, effects and use of non-ionizing radiation and protection systems.

# 3<sup>rd</sup> semester

## Fire protection and society

1. Fires and their impact on society.

2. Statistics, its evaluation.

3. Fire hazards (division).

4. Reducing impacts of fires on people and property.

Status of the state, citizen, owner, operator and insurance companies.

5. Regulatory and control activities of the state.

6. Influence of insurance companies on fire protection.

7. The role of the citizen in the security of fire protection (FP).

8. The role of the owner and operator in the security of fire protection (FP).

9. Documentation of fire protection, its preparation and management, Repressive fire protection.

10. Authority of the state (public administration) and owner (operator) in the repressive fire protection.

11. Fire protection units.

12. Procedures of the owner and units in dealing with fires.

13. Fire-fighting training (thematic exercises...).

## Sustainable Business

1. Introduction to Business Economics and Entrepreneurship.

2. Typology of business entities.

3. Property and capital structure of the company.

4. Business environment.

5. Business plan and strategy.

6. Enterprise resource planning – ERP.

7. BCM concept.

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8. CBA analysis.
  9. Business trends.
  10. Sustainable development.

## Work Hygiene and Ergonomics

1. Introduction to occupational hygiene and ergonomics, risk factors of the working environment, their basic classification and specifics.
2. Hygiene limit values, preventive health care system; programmes and campaigns.
3. Thermal and cold load, characteristics, specifics, health impacts, prevention.
4. Chemicals, characteristics, specifics, health impacts, prevention.
5. Dust, characteristics, specifics, health impacts, prevention.
6. Physical load and working postures, characteristics, specifics, health impacts, prevention.
7. Mental and visual stress, characteristics, specifics, health impacts, prevention.
8. Biological agents, characteristics, specifics, health impacts, prevention.
9. Noise, characteristics, specifics, health impacts, prevention.
10. Vibrations, characteristics, specifics, health impacts, prevention.
11. Non-ionizing radiation and electromagnetic fields, characteristics, specifics, health impacts, prevention.
12. Health risk assessment, their evaluation and management.
13. Selected models of risk factors and their specifics.
14. Subject summary.

## Safety culture

1. Safety culture – history, definition, development.
2. From Nuclear Safety to HSE, main trends in the field of Safety Culture.
3. Phases of development of Safety culture in the company - basic indicators.
4. How to measure Safety culture?
5. Safe behaviour - a key factor of Safety culture, principles of human behaviour, model of human behaviour.

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6. Creating safe routines, group behaviour, changes in human behaviour, psychological aspects important for creating safe habits.
  7. The role of individual levels of leadership in creating a Safety culture, effective leadership.
  8. Mission, vision and goals - their role in Safety culture. HSE promotion.
  9. Communication as a key factor in achieving a high-level Safety culture.
  10. Employee engagement and involvement in HSE.
  11. Tools for safety management and their connection with Safety culture.
  12. Interconnection of process safety and HSE.
  13. Development of Safety culture – change management.
  14. The most common problems in implementing programmes to develop a Safety culture, deterioration of Safety culture.

## Investigation of incidents and accidents

1. What is investigation of incidents and accidents and what is it for?
2. Typology of incidents.
3. Incident investigation process.
4. Obtaining information on the course of the incident and the connections, including proper process operation.
5. Analysis of acquired information.
6. Evidence and hypotheses, evaluation of hypotheses.
7. Confirming and disproving hypotheses.
8. Identification of risk control mechanisms and their failure.
9. Methods of analysis: DOE, FTA, ETA.
10. Methods of analysis: MORT, security barriers analysis.
11. Primary and root causes, their relationship and importance.
12. Lessons learned.
13. Action plan and its implementation.

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14. Importance of accidents and incidents investigations for the company, industrial segment and society.

## Human Resource Management

1. Historical development of human resources management.
2. Human resources management strategy and policy.
3. Recruitment, selection and adaptation of employees.
4. Employee training and development.
5. Employee assessment.
6. Rewarding employees.
7. Motivation of employees.
8. Communication.
9. Leadership, leadership styles.
10. Teams and team cooperation.
11. Work performance management of employees.
12. Ethics of human resources management.
13. International human resources management.
14. Organizational culture.

## Occupational Medicine

1. Introduction of the issues, concepts and definition.
2. Healthy working environment.
3. Risk factors and hazards in the work environment.
4. Chemical factors in the working environment and their effect on human health.
5. Biological factors in the working environment and their effect on human health.
6. Physical factors in the working environment and their effect on human health.
7. Risks and hazards of the external environment within the work performance.

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8. Epidemiology of occupational accidents and injuries.

9. Psychology of working environment.

10. Mental disorders and working environment.

11. First aid, KPR.

12. Risk specification and stratification, HACCP.

13. Health protection and promotion.

14. Standard operating procedures and regulations.

## Physical security systems

1. Assessment of company security protection, so-called security and safety.

2. Maslow pyramid, Pyramid of security, modelling of physical security.

3. Capacity and design issues of physical security, synergy and domino effect in the physical protection of the company.

4. Physical protection segments.

5. ALARA rule, economic aspect of physical protection.

6. Risk identification. Structural and process protection of a company.

7. Technical protection - mechanical security systems for protection of perimeter, housing, space and objects.

8. Technical protection - electronic security and emergency systems.

9. Technical protection - technical tools of detection of dangerous objects.

10. Regime protection - regime measures, security measures for objects.

11. Physical security - activities, tasks, forms, methods and competences.

12. Protection of secret information and security of premises designated for handling secret information.

13. Security management - principles, approaches, documentation.



# 4<sup>th</sup> semester

## Practice of HSE Professional

After successful completion of this subject, students will be able to:

1. Perform several practical tasks in the field of safety, health and / or the environmental protection.
2. Apply relevant national and international legislation and correct practice principles to a wide range of scenarios.
3. Develop a report or other internal document suitable for presentation to the competent authorities.
4. Communicate professionally through presentations and reports using discipline-specific language.

## Diploma thesis seminar

Assignment of thesis, its goal.

Thesis writing process.

Basics of typography.

Basic structure of the thesis.

Information on individual chapters of the thesis.

Processing of pictures, tables and graphs, tools.

Formal principles of the final thesis processing.

Literary sources, quotation of sources in the text of the thesis.

Types and simplification of the final thesis processing.

Cooperation with the supervisor and consultant of the final thesis.

Preparation of presentation of the final thesis, its presentation.

Course of the thesis defence, reaction to comments.