| ***ENVIRONMENTAL AND BIOMATERIAL SCIENCES*** | | | |
|---|---|---|---|
| **A. Povinné kurzy (Compulsory courses)** | **B. Povinně volitelné teoretické kurzy (Compulsory optional courses)** | **C. Povinně volitelné praktické kurzy (Specialized laboratories and practicals)** | **D. Povinně volitelné doplňkové kurzy (Optional courses)** |
| Conference participation | Advances in biotechnology | Laboratory I – Cleanroom | Climate change: Influencing factors and impacts on ecosystem services |
| Doctoral seminar I, II, and III | Advanced biophysical methods in nanomaterial research | Laboratory II – Circular chemistry | High-energy X-ray (synchrotron-based X-ray) analyses |
| International internship | Advances in the application of analytical techniques | Laboratory III – ISO certified analytical measurements | Life-cycle assessment – Sustainable and eco-informed selection of materials |
| Publication and dissemination | Advances in the characterization techniques of materials | Laboratory IV – Advanced microscopy of materials | Mitigation of pollution and toxicity in the environment |
| Thesis preparation I, II, III, and IV | Chemistry and physics of surfaces and interfaces | Laboratory V – Synthesis of emerging inorganic materials | Molecular and cell biology for material research |
| Workshop/summer school | Hydrodynamics | Laboratory VI – Synthesis of emerging organic materials | Principles of circular economy |
| | Ion-beam synthesis and radiation testing of materials for energetic applications | Laboratory VII – Biomedical and immunology testing | Professional and academic German for scientists |
| | Luminescence: From molecules to nanoparticles | Laboratory VIII – Application-oriented testing of materials | |
| | Magnetic properties of functional materials | Laboratory IX – Computational modelling of particle materials and fluid dynamics | |
| | Materials and living systems | | |
| | Materials and principles of energy storage and conversion | | |
| | Materials for tissue engineering and medical use | | |
| | Materials modelling | | |
| | Materials under extreme conditions | | |
| | Microbiology in material research | | |
| | Porous materials | | |
| | Powders and granular materials | | |

# D. POVINNĚ VOLITELNÉ DOPLŇKOVÉ KURZY (OPTIONAL COURSES)

## B-III – Course details

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|---|---|---|---|---|---|
| **Course title** | **Climate change: Influencing factors and impacts on ecosystem services** | | | | |
| **Type** | D. Povinně volitelné doplňkové kurzy (Optional courses) | | | **Recommended year** | 1-2 |
| **Course length** | 12L + 4s | **Hours** | 16 | **Credits** | 10 |
| **Course completion** | Exam | | | **Teaching type** | Lectures, seminar |
| **Verification** | Oral exam, case study presentation | | | | |
| **Guarantor** | **Karim Al Souki, Ph.D.** | | | | |
| **Lecture(s)** | Karim Al Souki, Ph.D. | | | | |
| **Syllabus** | | | | | |

The course will discuss different factors contributing to global climatic change, focusing on the scientific aspects, along with the economic and socio-political implications through a combination of theory, case studies, and students' active contributions. The course will provide students with an advanced understanding of the pieces of evidence of the climate change impacts as well as the different adaptation and mitigation strategies shedding light on the environmental, societal and economic aspects.

Course organization:

1. Climate change: Associated environmental impacts.
2. Climate change: Assessment of the social, economic and political implications.
3. Climate change adaptation strategies.
4. Climate change mitigation strategies.
5. Carbon sequestration as a tool for climate change mitigation: Concepts and case study example.
6. Importance of agriculture to the global mitigation efforts: Concepts and case study example.

Assessment tool for the course is attendance 5 %, project presentation 35 %, and oral exam 60 %.

**Literature**

1. W.-Y. Chen, T. Suzuki, M. Lackner, *Handbook of Climate Change Mitigation and Adaptation*, 2nd Ed., Springer, (2017).
2. OECD, *Enhancing Climate Change Mitigation Through Agriculture*, OECD Publishing, (2019). Available at: https://doi.org/10.1787/e9a79226-en
3. D. Ussir, R. Lal, *Carbon Sequestration for Climate Change Mitigation and Adaptation*, Springer, (2017).
4. P. Kumar, R. K. Singh, M. Kumar, M. Rani, P. Sharma, *Climate Impacts on Sustainable Natural Resource Management*, John Wiley & Sons Ltd., (2022).

## B-III – Course details

| | | | | | |
|---|---|---|---|---|---|
| **Course title** | **High-energy X-ray (synchrotron-based X-ray) analyses** | | | | |
| **Type** | D. Povinně volitelné doplňkové kurzy (Optional courses) | | | **Recommended year** | 1-2 |
| **Course length** | 12L + 4s | **Hours** | 16 | **Credits** | 10 |
| **Course completion** | Exam | | | **Teaching type** | Lectures, seminar |
| **Verification** | Oral exam | | | | |
| **Guarantor** | **Ing. Miloš Krbal, Ph.D.** | | | | |
| **Lecture(s)** | Ing. Miloš Krbal, Ph.D.<br>doc. RNDr. Stanislav Daniš, Ph.D. | | | | |

**Syllabus**

The course provides a comprehensive overview of modern X-ray structural analyses and imaging, using synchrotron-based X-ray radiation. It covers the fundamental X-ray processes and selected techniques (scattering, spectroscopy and imaging) important to the study of the physical, chemical and biological sciences. Students can benefit from information about the structure of materials beyond the scope of laboratory equipment and expand their possibilities of using highly modern X-ray methods to successfully complete their doctoral studies. The suggested structure of the course and the topics included are given below. The course will take place in the form of oral lectures, but it can also be adjusted to suit the student's individual needs.

The topics covered by the course are, though not limited to:

1. Introduction and overview of the topic – Synchrotrons, generation of Synchrotron-based X-ray radiation and X-ray optics, interaction of X-rays with matter.

2. X-ray scattering techniques – Small-angle X-ray Scattering (SAXS) – to determine the microscale or nanoscale structure of particle systems and colloids, X-ray diffraction (WAXS) – to study parameters of crystalline materials, X-ray reflectivity (XRR) – to obtain a thickness and density of thin films, Structural factor and Pair-distribution functions - to investigate a structure of materials (coordination numbers, atomic specimen, bond lengths), Anomalous X-ray scattering (AXS) to investigate a structure at the X-ray energy just below the absorption edge of studied elements, pressure and temperature effects on lattice parameters, etc.

3. X-ray spectroscopy techniques – X-ray Photo-electron spectroscopy (XPS) and Auger spectroscopy to determine the composition and oxidation states of elements represented, X-ray absorption spectroscopy (XAS: XANES – probing of unoccupied states and continuum states using a promoted electron from core-levels, a fingerprint for each individual structure and EXAFS – to obtain coordination numbers, bond lengths, bond strengths, atomic specimens around an absorbing atom), X-ray polarised XAS to study anisotropic structures, X-ray magnetic circular dichroism (XMCD)- information on magnetic properties of an atom (spin and orbital magnetic moment), Electron energy loss spectroscopy (EELS) – to study composition and the EELS spectrum represents a fingerprint for each individual structure similar to XANES, X-ray emission spectroscopy (XES) – to study the electronic structure of chemical compounds and Time-resolved experiments to probe kinetics.

4. X-ray imaging techniques – X-ray tomography – 3D visualisation of materials, X-ray holography – 3D electron density distribution in solids and real-space investigations of static and dynamic properties of nanoscale systems, Deep X-ray lithography – device fabrication using short wavelength X-ray radiation, and other possible techniques.

As part of the course, the student will be offered a practical course on data analyses of typical (simple) X-ray diffractograms and X-ray spectra to better understand the theoretical background of synchrotron-based X-ray methods.

**Literature**

1. S. P. Cramer, *X-Ray Spectroscopy with Synchrotron Radiation: Fundamentals and Applications*, Springer Nature, (2020).
2. J. Stöhr, *The Nature of X-rays and Their Interactions with Matter*, Springer, (2023).
3. P. Willmott, *An Introduction to Synchrotron Radiation: Techniques and Applications*, John Wiley & Sons Ltd., (2019).
4. P. S. Rahimabadi, M. Khodaei, K. R. Koswattage, Review on applications of synchrotron-based X-ray techniques in materials characterization. *X-ray Spectrometry* **49** (2020) 348.

## B-III – Course details

| | | | | | |
|---|---|---|---|---|---|
| **Course title** | **Life-cycle assessment – Sustainable and eco-informed selection of materials** | | | | |
| **Type** | D. Povinně volitelné doplňkové kurzy (Optional courses) | | | **Recommended year** | 1-2 |
| **Course length** | 12L + 4s | **Hours** | 16 | **Credits** | 10 |
| **Course completion** | Exam | | | **Teaching type** | Lectures, seminar |
| **Verification** | Oral exam | | | | |
| **Guarantor** | **Katrien Boonen, MSc.** | | | | |
| **Lecture(s)** | Katrien Boonen, MSc. | | | | |
| **Syllabus** | | | | | |

This course will teach students how to evaluate the environmental impact of a system by means of Life Cycle Assessment (LCA). An LCA is a comprehensive assessment of the environmental impacts directly or indirectly caused by a system (e.g., product, service, technology) over its entire life cycle (Fig. 1). Calculating the environmental impact is necessary for promoting improvement effort. LCA helps to avoid burden shifting, as it covers a wide range of impacts (i.e. climate change, particulate matter formation, eutrophication, ecotoxicity, resource depletion etc.) and the whole life cycle, from cradle to grave.

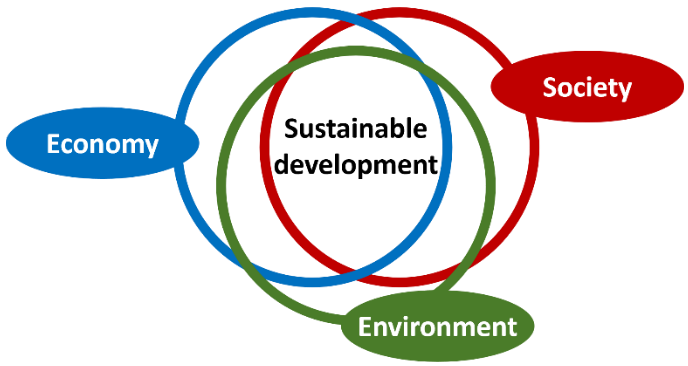


Fig. 1. Principles and impact of LCA.

This course consists of a theoretical part, in which the principles of LCA will be explained, and a practical part, in which the students will do their own LCA. Each student will perform a life cycle assessment on a topic of their choice, if possible related to their PhD topic. During the lectures, they will receive instructions on how to perform each phase of the LCA, according to the ISO 14040/44 framework. After each phase, their findings will be reviewed by the instructor. At the end of the course, the students will present the outcome of their analysis to their fellow students.

The topics covered by the course are:

1. Introduction:
    - What is LCA?,
    - Why is LCA important?,
    - LCA procedure, 4 phases of an LCA,
    - Standards and guidelines,
    - Benefits and limitations of LCA compared to other sustainability assessment tools,
    - Environmental impacts of different types of materials,
    - Homework: the students will choose the topic of their LCA.

2. Phase 1: Goal and scope definition
    - Items to be included in the goal and scope of the study,
    - What to consider when defining these?,
    - Importance of methodological choices, e.g., allocation procedures, system boundaries for reuse and recycling, attributional and consequential modelling,
    - Homework: the students will prepare the goal and scope of their chosen topic.

3. Phase 2: Inventory analysis
   - Data to collect and data sources,
   - Practical instructions on how to collect and validate data,
   - Homework: the students will prepare the data inventory of their chosen topic.

4. Phase 3: Impact assessment
   - Cause-effect chain, midpoint and endpoint indicators,
   - Calculating the potential environmental impacts of the system (classification, characterisation, normalisation and weighting),
   - Homework: the students will perform the impact assessment of their chosen topic.

5. Phase 4: Interpretation
   - What to take into account when interpreting the results?,
   - Sensitivity and uncertainty analyses,
   - Homework: the students will interpret the results of their chosen topic.

6. Presentation and discussion of the students' LCAs.

**Literature**

1. ISO 14040: 2006 - Environmental management - Life cycle assessment - Principles and framework.
2. ISO 14044: 2006 - Environmental management - Life cycle assessment - Requirements and guidelines.
3. M. F. Ashby, *Materials and the Environment: Eco-informed Material Choice*, 3rd Ed. Butterworth-Heinemann, (2021).

**Online resources**

Articles that explain LCA terminology, methodology, new developments etc.: https://pre-sustainability.com/articles
Environmental Footprint methods proposed by the European Commission: https://ec.europa.eu/environment/eussd/smgp/index.htm

## B-III – Course details

| | | | | | |
|---|---|---|---|---|---|
| **Course title** | **Mitigation of pollution and toxicity in the environment** | | | | |
| **Type** | D. Povinně volitelné doplňkové kurzy (Optional courses) | | | **Recommended year** | 1-2 |
| **Course length** | 18L | **Hours** | 18 | **Credits** | 10 |
| **Course completion** | Exam | | | **Teaching type** | Lectures |
| **Verification** | Oral exam | | | | |
| **Guarantor** | **doc. Ing. Pavel Krystyník, Ph.D.** | | | | |
| **Lecture(s)** | doc. Ing. Pavel Krystyník, Ph.D. | | | | |

**Syllabus**

1. Concepts of general, industrial, and environmental toxicology.
2. Chemical contaminants and their toxicity, heavy metals, inorganic contaminants.
3. Persistent organic pollutants and other hazardous environmental substances (bisphenols, polymer monomers, phthalates), PAHs, PCBs, dioxins, pesticides, pharmaceuticals, etc.
4. Substances endangering the ozone layer and other significant organic contaminants (nitriles, amines, nitro compounds, epoxides).
5. Classification system for substances hazardous to health and the environment, and risk assessment systems.
6. Introduction to the issue. Relationship between the chemical industry and the environment.
7. Traditional methods of industrial wastewater treatment.
8. Advanced oxidation processes for industrial wastewater treatment.
9. Special electrochemical processes for industrial wastewater treatment.

**Literature**

1. J. Chang *et al.*, Toxicological effects, environmental behaviors and remediation technologies of herbicide atrazine in soil and sediment: A comprehensive review. *Chemosphere* **307** (2022) 136006.
2. K. H. H. Aziz, R. Kareem, Recent advances in water remediation from toxic heavy metals using biochar as a green and efficient adsorbent: A review. *Case Stud. Chem. Environ. Eng.* **8** (2023) 100495.
3. E. Hodgson, *A Textbook of Modern Toxicology*, 4th Ed., John Wiley & Sons, Inc, (2010).
4. A. Saravanan *et al.*, Effective water/wastewater treatment methodologies for toxic pollutants removal: Processes and applications towards sustainable development. *Chemosphere* **280** (2021), 130595.
5. J. M. Poyatos *et al.*, Advanced oxidation processes for wastewater treatment: State of the art. *Water Air Soil Pollut.* **205** (2010) 187.
6. M. P. Shah, *Removal of Emerging Contaminants Through Microbial Processes*, Springer, (2020).
7. R. G. Simon *et al.*, Current to clean water – Electrochemical solutions for groundwater, water, and wastewater treatment. *Chemie Ingenieur Technik* **90** (2018) 1832.

## B-III – Course details

| | | | | | |
|---|---|---|---|---|---|
| **Course title** | **Molecular and cell biology for material research** | | | | |
| **Type** | D. Povinně volitelné doplňkové kurzy (Optional courses) | | | **Recommended year** | 1-2 |
| **Course length** | 36L + 24l | **Hours** | 60 | **Credits** | 10 |
| **Course completion** | Pre-exam credit, exam | | | **Teaching type** | Lectures, laboratory |
| **Verification** | Pre-exam credit: laboratory protocols<br>Written exam | | | | |
| **Guarantor** | **Ing. Stanislav Vinopal, Ph.D.** | | | | |
| **Lecture(s)** | Ing. Stanislav Vinopal, Ph.D.<br>Mgr. Olga Šebestová Janoušková Ph.D.<br>prof. RNDr. Milan Gryndler, CSc. | | | | |
| **Syllabus** | | | | | |

**Motivation**

Expertise in biomaterial research requires a profound understanding of cellular behaviour, especially in the context of the various external environments. Cells produce many useful biomolecules, including complex types of extracellular matrix (ECM), some of which, such as hyaluronan, collagen and others, have already been successfully commercialized. At the same time, recent research indicates that cell-material interactions have a significant impact on cellular behaviour, including changes in cell metabolism, signalling, gene expression patterns and even cell identity. Hence, advanced knowledge of molecular and cell biology is the key to the rational design of both innovative biomaterials as well as for the creation of synthetic artificial materials intended to interact with living matter.

**Objectives**

The objective of the course is to provide students with the knowledge of contemporary and cutting-edge comprehension of cellular functions and interactions on a molecular scale. The initial segment of the course will delve into key intracellular processes, followed by an examination of cellular behaviour and interplay within tissues. The later lectures will deepen the discussion to encompass the realm of reciprocal cellular interactions with the external environment, encompassing a special emphasis on novel materials, which will be a central focal point of this course.
By successfully completing this course, students will acquire a comprehensive set of skills and knowledge at the forefront of cellular and molecular biology, empowering them to excel in the dynamic field of biomaterial research and development.

*Profound understanding of cellular behaviour*. Students will develop a nuanced understanding of how cells function at the molecular level and will be able to critically analyse the molecular mechanisms that drive cellular responses.

*Cellular-tissue interactions*. Students will understand how cells collaborate within tissues. They will also gain insights into the complex network of biomolecules that contribute to the structural integrity and functionality of tissues.

*Insight into cell-material interactions*. Students will get familiar with the critical nexus of cell-material interactions, comprehending their profound influence on cellular behaviour and identity. This knowledge will equip students with the tools to design and engineer innovative biomaterials that elicit specific cellular responses, contributing to advancements in medical devices, regenerative medicine, and tissue engineering.

*Integration of multidisciplinary knowledge.* Students will develop the ability to integrate knowledge from various fields, including biology, chemistry, and materials science. They will be able to assess complex biological processes, dissect intricate molecular pathways, and evaluate the potential impact of synthetic materials on cellular behaviour.

*Application of cutting-edge research*. By engaging with recent advancements in the field, students will learn to apply the latest research findings to real-world scenarios. This will enable students to contribute to the development of groundbreaking biomaterials and their implementation in diverse biomedical contexts.

Overall, this course will provide students with a comprehensive toolkit of skills and knowledge essential for a successful career in biomaterial research.

**The theoretical part of the course will cover the following topics.**

1. Composition of the cell.
    - Prokaryotic cells,
    - Eukaryotic cells (fungi vs. plant vs. animal).
2. Key cellular processes
    - Gene expression and its regulation,
    - Cell cycle (including DNA replication and repair),
    - Cell metabolism,
    - Cell signalling,
    - Cellular differentiation,
    - Cell death.
3. Tissues
    - Composition of tissues,
    - Cell-cell interactions,
    - Cell-extracellular matrix (ECM) interactions, cell adhesions.
4. Interactions of cells with the external environment
    - Cell migration,
    - Cell signalling related to the external environment,
    - Cell proliferation and differentiation,
    - Cell fate reprogramming.
5. Advances in regulation of cellular responses by materials
    - Mechanosensation and mechanotaxis,
    - Galvanotaxis,
    - Chemotaxis,
    - ECM remodelling.

**The practical part of the course will cover practical aspects of the theoretical topics**
- Cell cycle assays,
- Cellular metabolism and death assays,
- Cell migration assays,
- Formation of an epithelial sheet, cellular growth in 3-D.

**Literature**

1. B. Alberts, *Molecular Biology of the Cell*, 7th Ed., W. W. Norton & Company, (2022).
2. H. F. Lodish, *Molecular Cell Biology*, 9th Ed., W. H. Freeman, (2021).
3. S. SenGupta *et al.*, The principles of directed cell migration. *Nat. Rev. Mol. Cell Biol.* **22** (2021) 529.
4. H. De Belly *et al.*, Interplay between mechanics and signalling in regulating cell fate. *Nat. Rev. Mol. Cell Biol.* **23** (2022) 465.
5. M. R. Zanotelli *et al.*, Mechanoresponsive metabolism in cancer cell migration and metastasis. *Cell Metab.* **33** (2021) 1307.
6. A. Lai *et al.*, Mechanosensing by Piezo1 and its implications for physiology and various pathologies. *Biol. Rev.* **97** (2022) 604.
7. A. Inman, M. Smutny, Feeling the force: Multiscale force sensing and transduction at the cell-cell interface. *Semin. Cell Dev. Biol.* **120** (2021) 53.
8. M. Ermis *et al.*, Micro and Nanofabrication methods to control cell-substrate interactions and cell behavior: A review from the tissue engineering perspective. *Bioact. Mater.* **3** (2018) 355.
9. J. Jo et al., Molecular regulators of cellular mechanoadaptation at cell–material interfaces. *Front. Bioeng. Biotechnol.* **8** (2020) 608569.
10. S. Metwally, U. Stachewicz, Surface potential and charges impact on cell responses on biomaterials interfaces for medical applications. *Mater. Sci. Eng. C* **104** (2019) 109883.
11. A. Isser *et al.*, Biomaterials to enhance antigen-specific T cell expansion for cancer immunotherapy. *Biomaterials* **268** (2021) 120584.

## B-III – Course details

| | | | | | |
|---|---|---|---|---|---|
| **Course title** | **Principles of circular economy** | | | | |
| **Type** | D. Povinně volitelné doplňkové kurzy (Optional courses) | | | **Recommended year** | 1-2 |
| **Course length** | 20L | **Hours** | 20 | **Credits** | 10 |
| **Course completion** | Exam | | | **Teaching type** | Lectures |
| **Verification** | Oral exam | | | | |
| **Guarantor** | **doc. Dr. Ing. Pavel Kuráň** | | | | |
| **Lecture(s)** | **doc. Dr. Ing. Pavel Kuráň** | | | | |
| **Syllabus** | | | | | |

The course complements and expands students' knowledge in the field of circular economy and methods of analysing recycled products (Fig. 1). Lectures will be dedicated to an explanation of recycling methods of common municipal and industrial waste with a special focus on mechanical and chemical recycling methods. The main aim is to provide a comprehensive overview of what type of recycling method is suitable for recycling a particular municipal or industrial waste and how to analyse the products of chemical recycling methods, especially pyrolysis oils from plastics and biomass.

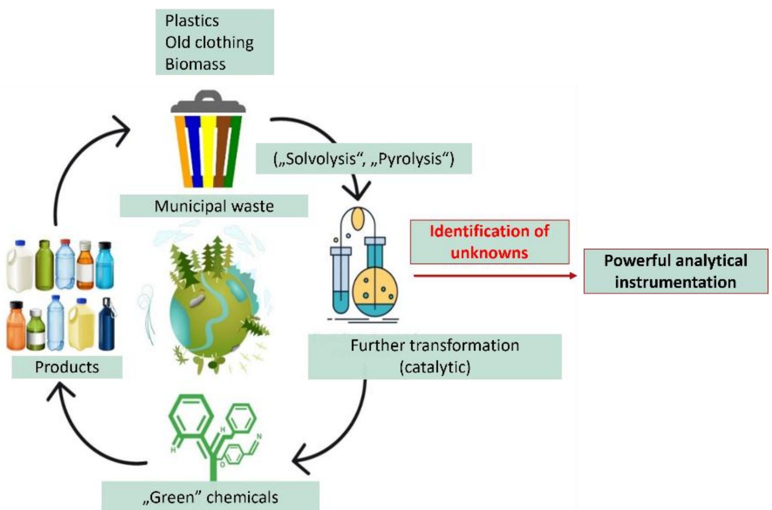


Fig. 1. Principles of chemical recycling of waste – plastics, clothing, biomass and others.

The course consists of the following topics:

1. Introduction to circular economy, legislation, and terminology of recycling methods.
2. Definition and description of mechanical recycling – merits and demerits of recycling.
3. Selected application of mechanical recycling.
4. Definition and description of chemical recycling – thermal and chemical processes.
5. Thermal processes of chemical recycling (pyrolysis, gasification).
6. Selected application of thermal processes (pyrolysis).
2. Chemical processes of chemical recycling – solvolysis (glycolysis, hydrolysis…), selective dissolution.
3. Selected application of solvolysis and selective dissolution.
4. Analysis of chemical recycling products, especially pyrolysis oils.
5. Corrosion in chemical recycling.
6. Modern trends in chemical recycling methods.

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|---|---|
| **Literature** | |

1. Harrison *et al.*, *Waste as a Resource (Issues in Environmental Science and Technology*, RSC Publishing, (2013).
2. R. Francis, *Recycling of Polymers: Methods, Characterization and Aplications*, Wiley-VCH Verlag, (2016).
3. Ch. Meskers, E. Worrell, M. A. Reuter, *Handbook of Recycling: State-Of-The-Art for Practitioners, Analysts, and Scientists*, Elsevier, (2023).
4. RPA Europe. Chemical Recycling of Polymeric Materials from Waste in the Circular Economy. Final report prepared for the European Chemicals Agency (2021). Available online at: https://www.mpo.cz/assets/cz/prumysl/chemicke-latky-a-smesi/reach-povinnosti-a-informace/2021/11/Zprava-Chemicka-recyklace.pdf
5. J. Snow, J. Lederer, P. Kuran, P. Koutnik, Dechlorination during pyrolysis of plastics: Effect of municipal plastic waste composition. *Fuel Proc. Technol.* **248** (2023) 107823.
6. J. Hubacek, J. Hubáček, J. Lederer, P. Kuráň, P. Koutník, Z. Gholami, M. Zbuzek, M. Bačiak, Dechlorination during pyrolysis of plastics: The potential of stepwise pyrolysis in combination with metal sorbents. *Fuel Proc. Technol.* **231** (2022) 107226.

## B-III – Course details

| | | | | | |
|---|---|---|---|---|---|
| **Course title** | **Professional and academic German for scientists** | | | | |
| **Type** | D. Povinně volitelné doplňkové kurzy (Optional courses) | | | **Recommended year** | 1-2 |
| **Course length** | 8L + 16s | **Hours** | 24 | **Credits** | 10 |
| **Course completion** | Exam | | | **Teaching type** | Lectures, seminar |
| **Verification** | Oral exam | | | | |
| **Guarantor** | **Mgr. Martina Nesládková, M.A.** | | | | |
| **Lecture(s)** | Mgr. Martina Nesládková, M.A. | | | | |

**Syllabus**

**The aim of the course is to improve the German fluency of doctoral students to communicate with the partner Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Dresden, Germany.** Although all scientists and professionals at IKTS do speak English, the knowledge of the local native language will promote mutual collaboration and demonstrate the commitment of doctoral students. It can also help students to disseminate their research activity to potential employers in Saxony and Germany. The course will develop students' communication skills and improve their understanding and knowledge of the professional German language. The course will focus on the development of spoken and written communication skills in relation to published research, technical communication, and dissemination of scientific work to professionals but also to the public. Students will learn how to work with scientific texts and express themselves on topics in their field of study by using complex language structures and general as well as professional vocabulary. They will be able to communicate effectively in both work and study environments thus building their self-confidence in their language competencies. Students will be able to observe and also participate in professional discussions related to their topic of research and interest. The course will introduce theoretical backgrounds of the language, but predominantly students will be encouraged to actively use and practice the language during the course.

The course content is as follows:

1. General specifics of professional/academic language in relation to vocabulary and grammar structures.
2. Grammar structures typical for academic as well as professional text and their role in academic/research context.
3. Learning strategies useful for understanding complex professional texts and work instructions.
4. Relevant linguistic resources for specific professional language activities (e.g., argumentation, definitions, description of an experiment).
5. Relevant professional/academic language structures and useful vocabulary for successful communication in specific communication situations (e.g., lectures, discussions, conference presentations).
6. Understanding of statistics, graphs and diagrams and their oral or written description.
7. Describing the funding and conduct of research, writing a report on the research process, and disseminating research results.

**Literature**

1. G. Schade, S. Drumm, U. Henning, B. Hufeisen, *Einführung in die deutsche Sprache der Wissenschaften, Ein Lehrbuch für Deutsch als Fremdsprache Mit einem Lösungsschlüssel*. Erich Schmidt Verlag, (2020). Also, available online at https://www.esv.info/t/daf14/aktualisierung.html
2. H. Esselborn-Krumbiegel, *Richtig wissenschaftlich schreiben: Wissenschaftssprache in Regeln und Übungen*, UTB, (2022).
3. M. Moll, W. Thielmann, *Wissenschaftliches Deutsch*, UTB, (2022).
4. A. Burdumy, *German Reading Skills for Academic Purposes*, Routledge, (2020).