Maastricht University

FSE

Urban Mining

Course code: 8571MinUrbMi
Name coordinator: Laura Kollau l.kollau@maastrichtuniversity.nl
Full period of this minor: Semester II
ECTS credits in total of this minor: 30
Language of instruction: English
Teaching methods: PBL
Assessment methods: Different methods depending on the course (e.g. final paper, presentation, written exam, assignment, etc.).

Keywords/short description:
The Urban Mining minor explores cities as self-sustaining ecosystems, focusing on how urban areas can reuse and recycle their own materials and energy to reduce reliance on external resources. Combining disciplines like environmental science, engineering, and urban planning, the program examines strategies for creating sustainable, "net-zero" cities that efficiently manage resource flows and minimize waste.

Note: This minor contains a combination of mandatory and elective courses making up a total of 30 ECTS for the semester (28 courses). The first two courses listed, "Urban Mining" and "Challenge Team," are mandatory courses comprising of 13 credits which means the remaining 17 credits will be open for your selection from the remaining 26 courses listed subsequently.

Full course description
The 'Urban Mining' minor explores a parallel between urban environments and natural energy systems, shedding light on the intricate dynamics of resource utilization and sustainability. As we commonly acknowledge, fossil fuels store solar energy through the process of photosynthesis, which transforms sunlight into organic compounds like sugars. Eventually, organisms involved in this process, such as plants, algae, and bacteria, undergo transformation into coal, oil, and natural gas over time and specific conditions. Humanity's mining activities extend beyond just extracting these energy sources; we also mine for raw materials crucial for constructing essential items, like for example lithium for our car batteries.
During the "Urban Mining" minor, we will adopt a perspective that treats the city as a human-made counterpart to this natural phenomenon. The city, like an ecosystem, imports a vast array of materials for diverse purposes to sustain itself. As these materials reach the end of their useful life, they are discarded and find their way into landfills, sewage systems, and other waste disposal sites. Net zero energy cities represent a necessary scenario where, in terms of energy and material flows, they function as closed systems. In such cities, there's no need to import external materials or energy for sustaining urban life. While variations in population and advances in science may introduce some fluctuations, the fundamental goal is to maintain a state of equilibrium in terms of material and energy flows. Achieving this equilibrium necessitates that cities essentially "mine"

themselves for resources and materials. The "Urban Mining" minor will delve into the complexities and challenges of this urban mining process, exploring innovative solutions and strategies for achieving sustainable urban environments.
Urban Planning and Design: This discipline focuses on shaping the physical layout and functionality of cities to enhance sustainability.

Course objectives (Intended learning outcomes)

1. …evaluate relevant historical, social, political and economic processes and structures that relate to their chosen areas of study.
2. …undertake critical analysis of strategies, measures and approaches to sustainability that relate to their chosen area of study, demonstrating the likely impact on stakeholders, regions and communities.
3. …analyse and compare different cities and regions with different levels of urbanisation across Europe and apply the chosen areas of study to theories and approaches related to urbanism and urbanisation.
4. …describe and apply underlying concepts and principles according to their chosen areas of study.
5. …analyse and critically appraise the environmental, social and economic systems that relate to their chosen areas of study.
6. …identify, analyse and solve problems, applying relevant research methodologies, theories, information technology, data analysis and interpretation, and techniques of writing to present findings and solutions.
7. …under supervision, design, conduct and evaluate sustainability projects and research, including logistics, risk assessment and ethical approval where appropriate.
8. …consider academic norms and ways of thinking across different disciplines and subject areas, bringing them into play as appropriate.
9. …demonstrate intellectual curiosity, critical thinking, and exercise independence of mind and thought.
10. …communicate ideas clearly, coherently and respectfully, in a range of disciplines and to various stakeholders, in both written and oral form, using appropriate language and referencing.
11. …demonstrate the flexibility and adaptability to collaborate in international and intercultural contexts, learning from others, recognising and respecting diverse perspectives and needs.
12. …work independently, meet deadlines, manage their own time and workload and demonstrate initiative.
13. …reflect on their own learning, to seek and make use of feedback on their own performance, to recognise when further knowledge is required and to undertake the necessary research.

Prerequisites

- Minimum language level: **B2 English proficiency**
- Mandatory physical attendance at **Maastricht University**

Disclaimer

The University makes every effort to ensure that information about the programme/courses is accurate and up to date. Exceptionally, changes may be required due to reasons such as legal or regulatory changes, industrial action, lack of demand, staff changes, changes in government policy, or funding changes.
This minor has a limited number of spots available. After application you will be informed a.s.a.p. about your acceptance.

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The full minor period is offered in 28 courses:

1

Course name: Urban Mining (Mandatory)
Course code: USS2003
Course Period: P1 & P2
ECTS credits of this course: 5

Full course description
This course provides an introduction to the core concepts and terminology used in urban mining and circular material systems. Students explore how cities function as sources of materials and the social, technological, and economic factors that shape their recovery and reuse. Core themes include material flows, product lifecycles, resource recovery strategies, and the transition toward net-zero and circular cities.

Course objectives (Intended learning outcomes)
TBC

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
TBC

2

Course name: Challenge Team (Mandatory)
Course code: USS2004
Course Period: P3 & P4
ECTS credits of this course: 8

Full course description
In this course, students work in a team on a ‘Challenge’ to address an urban sustainability problem presented by an external client [a representative of "to be determined"]. Students need to translate

the challenge into a researchable problem, write a problem statement and research plan, gather data relevant for understanding and addressing the problem, and develop actionable recommendations and/or support tools for the client. The student team will be coached in weekly tutorial sessions to support and monitor the progressing work.

Course objectives (Intended learning outcomes)
Students have an applied understanding of sustainability issues in urban areas. Students work together in a team and develop skills concerning organization of work, and collaboration in a team. Students set up a joint problem analysis and a research plan based on the assignment given by an external client. Students apply relevant research methods to gather relevant data. Students generate new knowledge and actionable recommendations that help the client to tackle the problem identified.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
None

3

Course name: Urban Europe
Course code: EUS2015
Course Period: P5
ECTS credits of this course: 9

Full course description
In this course we open the map of Europe to focus on cities as sites where various promises and challenges of contemporary Europe's culture and society condensate. Europe is inconceivable without its cities. Historically, cities have been critical sites where the continent's major socio-economic, cultural and political developments took shape. Cities are closely associated with the idea of European modernity, and have acted as laboratories for political and cultural integration. Today, it is primarily in cities that we are confronted with (often global) challenges, such as issues of identity politics, cultural cleavages, forms of social segregation, poverty, pollution and climate change. At the same time, cities are breeding grounds for alternative futures and innovative ways of living and working. This course, as a second elective in the Culture and diversity track of the BA European studies, offers you the opportunity to explore the urban dimensions of Europe's culture and society. You will learn to explore urban Europe by analyzing its discourses and cultural imaginaries, its everyday practices and identities, as well as the material culture of its spatial design, technological (incl. digital) infrastructure, and its natural environment and ecologies. As part of the course, students will organize local urban excursions.

Course objectives (ILOs)

Cities offer ample opportunity to study European culture and diversity in the making. In Urban Europe you will learn to: * identify various sociocultural characteristics of European cities and understand Europe through the lens of “the urban” (incl. the role of cities in European history, and as sites where various promises and challenges of contemporary Europe’s culture and society condensate); * conceptualize the “urban” along five dimensions (i.e., urban formations, publics, fault lines, ecologies, and urban arts and creativity), and use these ideas to explain contemporary sociocultural dimensions of European cities; * understand the role that discourses and imaginaries, social groupings, everyday practices, material culture, technological infrastructures, and natural elements play in shaping current conditions of urban Europe; * communicate complex ideas and concepts from the course readings in verbal and written forms, and explore creative formats of presentation; * generate and integrate your own, hands-on experiences with city life as a way to study European culture and diversity (people) and urban environments (places) in the making. * doing a small empirical case study, incl. a qualitative analysis of different types of primary sources(e.g. visuals, policy discourse, street interviews), and present your work in the form of an academic essay.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Final paper, Presentation

4

Course name: Authority, Expertise and Environmental Change
Course code: ACU2023
Course Period: P5
ECTS credits of this course: 9

Full course description
Scholars agree that the present-day world is undergoing rapid environmental change. Some even discuss names for a new epoch in which humans have an all-pervasive impact on the planet: the ‘Anthropocene’ or the ‘Capitaloscene’. Global warming, plastic pollution and biodiversity loss are just some of the environmental challenges that come with this increased human impact. In this course, we will explore the ways in which modern societies respond to these challenges. How are environmental problems defined? Who is ascribed expertise when it comes to finding solutions? Who has the political authority to govern the global environment? How are alternative environmental futures imagined and decided upon? Rather than as just a technical issue we will, thus, study the environment as an object of scientific controversy, political struggle and societal debate.

Course objectives (ILOs)

The course aims to generate understanding of how authority and expertise with regard to the environment is generated in present-day society. Students will be trained to use these insights for analysing concrete environmental controversies and writing a policy brief.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Final paper, Attendance, Assignment

5

Course name: ICT Revolutions: Continuity and Change
Course code: DSO1003
Course Period: P4
ECTS credits of this course: 8

Full course description
The course challenges the idea that the world is experiencing a digital revolution. It systematically compares technological revolutions since the Late Middle Ages until the end of the 20th century (from the printing press to the internet) with today's digital transformation. We focus on differences and similarities between the past and the present in order to understand continuity and change. You will find out who is empowered by digital transformations, who is excluded from promises of progress and development, and whether it is possible to steer changes in information and communication technologies (ICTs).

Course objectives (ILOs)
By the end of this course you will be able to: * Identify and define various information and communication 'revolutions' since the late Middle Ages * Explain the origins and consequences of technological change in these 'revolutions' * Apply knowledge of the past to new and emerging situations in the digital present, taking into account assumptions, promises and fears surrounding technological innovation * Articulate the above mentioned definitions, explanations, and critiques in an academic research paper

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Final paper

6

Course name: Qualitative Research Methods: Foundations and Practices
Course code: DSO2504

Course Period: P4
ECTS credits of this course: 7

Full course description
This course introduces you to different methods for qualitative data collection (e.g., in-depth interviews, ethnography, (online) participant observation and focus groups) and forms of qualitative data analysis (e.g. Grounded Theory, discourse analysis, thematic analysis, and qualitative content analysis) using a combination of problem-based, interactive, and applied techniques. We will explore how qualitative research methods can be applied to answer research questions about how digital technologies are used, created, and influence our daily lives. This course prepares you for independent qualitative research in the third year of your studies. You will be expected to work independently and in small teams to conduct a small-scale, qualitative research project, analyse the data collected and present and write about your findings, challenges encountered, and the ethical implications of your approach.

Course objectives (ILOs)
At the end of this course, you will be able to: * Select and apply appropriate qualitative methods for different areas of research relating to digital societies; * Motivate and critically evaluate qualitative methods to respond to different types of research questions that may arise as a result of the development and use of digital technologies; * Implement different qualitative data collection methods, such as qualitative interviews and (online) participant observation * Analyse, interpret, and present your findings; * Reflect on the ethical dilemmas in qualitative research.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Final paper

7

Course name: Introduction to Game Theory
Course code: SCI2010
Course Period: P4
ECTS credits of this course: 5

Full course description
Consider a real-life situation where people, who may or may not have conflicting interests, make strategic decisions. When gametheorists use the word game, they mean a model (a simplification) of such a situation that can be analyzed and solved mathematically. The branch of mathematics that does this is called Game Theory. In the Game Theory course the students will get an introduction to various different types of games and their solution concepts. Many examples will be discussed to clarify the issues and exercises will be provided to learn how to compute solutions. More specifically, the following fundamental issues will be encountered:

Course objectives (ILOs)
To familiarize the students with the fundamentals of Game Theory. * Fairness & cooperation * Rationality & Common * Knowledge * Expectations * Threats & Manipulations * Nonmanipulability In most games that are discussed during the course, the strategic possibilities of the players determine what can happen. We will discuss the games in order of increasing strategic possibilities. So as the course progresses, the games and the strategies, and therefore also the mathematics, become more complex.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
There will be two written exams (one midterm and one final exam).

8

Course name: Mathematical Tools for Scientists
Course code: MAT1007
Course Period: P5
ECTS credits of this course: 5

Full course description
This course builds on the material in the introductory courses in Semester 1 and introduces some new concepts that are important in many natural sciences. It is most suitable for students interested in taking non-mathematical focused courses who want to further their understanding of mathematics and need to fulfill their MAT requirement. (Physics, mathematics and computer science focusedstudents should expect to take other Mathematics courses – ratherthan this one). The topics covered include further differentiation and integration, differential equations, mathematical series, exponential decay and growth. Some vectors and matrices may be covered, as well as an introduction to linear algebra.This course will focus on the application of mathematical tools to problemswhich are challenging or impractical to solve withoutthem.

Course objectives (ILOs)
* To acquire an understanding of mathematical tools that are useful in solving problems within the Natural Sciences; * To be able to applythese tools to appropriate situations and correctly evaluatenumerical solutions; * To gain an appreciation of the suitability for using mathematical tools in certain scientific situations and develop alifelong appreciation for the useof mathematics in science.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods

Written exam, Final paper, Attendance, Assignment

9

Course name: Probability and Statistics
Course code: MAT2005
Course Period: P5
ECTS credits of this course: 5

Full course description
Many real-life situations involve uncertainty and give rise to problems in the fields of probability theory or statistics. In this course, the focus will be on the deep understanding of tools which are necessary to analyse such situations. Firstly, we will address (or refresh) basics of probability theory and the underlying combinatorial principles, because it is impossible to properly understand statistical concepts without understanding probability and its mathematical foundations. Subsequently, we will focus on (both discrete and continuous) random variables, conceptsof expectation, mean, variance and independence, proceeding to probability distributions (e.g. discrete uniform, binomial, multinomial, hypergeometric, geometric, Poisson, continuous uniform, normal, gamma, exponential). Here we will learn for what problemsthese distributions are useful and under which assumptions they can/should be applied, stressing also common misconceptions when trying to apply certain concept blindly (which unfortunately happens very often among applied scientists). We will extend our scope to multi- dimensional random variables and joint, conditional, and marginal probability distributions. We will also discuss random sampling, sample distributions of means and variances, and the central limit theorem, again focusingon common misconceptions relatedto these topics.Then we address statistical estimation (point estimation and interval estimation; confidence intervals). Finally,we will discuss various hypothesis tests, goodness-of-fit tests and tests for independence and homogeneity. In their presentation/report, students will focus on a selected statistical topic and how this can be applied in practice,using scientific articlesin applied probability/statistics as their study source.

Course objectives (ILOs)
* To have deep understanding of fundamental concepts in probability and statistics, including how these concepts are derived, why they are useful, what assumptions you have to pose whenapplying them, etc.; * To be familiar with the most frequently used probability distributions/densities and statistical procedures (statistical estimation and hypothesis tests), here again with focus on the deep understanding as opposed to approaching these concepts as a “blackbox” or a “recipe”; * To develop a critical thinking when deciding whether certain statistical procedure is the most suitablefor a certain problem, as opposed to blindly applyinga pre-specified procedure; * To be able to read and summarize scientific articles in applied probability/statistics.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Written exam, Attendance, Assignment

10

Course name: Linear Algebra
Course code: MAT2004
Course Period: P5
ECTS credits of this course: 5

Full course description
In this course you will gain insights into algebraic and geometric concepts including vectors, matrices, linear transformations, eigenvalues and eigenvectors and orthogonality. You will learn to perform basic algorithmic calculations with matrices and equations in order to solve different problems. You will also gain insights into the applications of linear algebra in several fields.

Course objectives (ILOs)
This course provides an introduction to the main topics of linear algebra. Emphasis is on understanding the basic concepts and techniques, and on developing the practical skills to solve problems from a wide range of application areas.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Written exam, Attendance, Assignment

11

Course name: Introduction to Earth Sciences
Course code: INT1007
Course Period: P5
ECTS credits of this course: 5

Full course description
This course will provide you with a basic understanding of processes acting on our planet. Earth Sciences is an interdisciplinary field, combining branches of physics, chemistry and biology in a pursuit to better understand the Earth and its features. We will unravel the geological past and gain a better understanding of all the factors impacting our planet, responsible for shaping the Earth as we know it. You will become aware of the importance of time, and learn how to think in different timescales. The continents with its mountain ranges, the vast oceans, the atmosphere and life, all are continuously subjected to change, although often hidden on human timescales. This course will focus on how the Earth continuously seems to change throughout its 4.5 billion years of existence.

Course objectives (ILOs)
During this course you will develop a fundamental understanding of the abiotic and biotic processes responsible for shaping our planet. From the formation of our Solar System to the Earth as we know it today, you will gain insight on the enormous powers continuously impacting and changing the planet.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Written exam, Presentation, Attendance, Assignment

12

Course name: 3D Visualizations and Transformations
Course code: PRA2029
Course Period: P5
ECTS credits of this course: 2.5

Full course description
The skill involves interpreting images of various objects from 2D and 3D perspectives, in addition to analysing a chosen object's symmetries to explain the relations between its physical form and function. This analysis will involve explaining the analysis through an animated to be created with a 3D visualization software.

Course objectives (ILOs)
At the end of this skills course, students will be able to: - * interpret, and be able to sketch, different 2D views of a 3D object (e.g., isometric, one- and two-point perspectives) * apply geometric relations and constraints between shapes and forms (e.g., points, lines, angles) with respect to the origin planes (XY, YZ, and XZ) of a Cartesian coordinate system * collaborate with peers to explain the science behind a physical object with respect to the (a)symmetries present in the objects * decompose objects into their basic shapes and accurately recreate a scaled model from the corresponding 2D views using work features (planes, axes, points) and feature creations (extrude, revolve, sweep) * learn about various methods to scan 3D objects (i.e., photogrammetry, 3D scanning)

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Participation, Presentation, Attendance, Assignment

13

Course name: General Chemistry
Course code: CHE2010/PRA2034
Course Period: P5
ECTS credits of this course: 5

Full course description
The emphasis of this course will be to extend a number of essential topics from the Introduction to Chemistry course. The first part of the course will focus on bonding in molecules, molecular symmetry, character tables, and their applications. The second part will examine intermolecular forces and what factors impact phases transitions certain physical properties. In the final part, the course focuses on solution equilibria and properties.

Course objectives (ILOs)
* To extend knowledge of bonding theories within larger molecules * To obtain an understanding of the various mathematical relationships present in ideal and real gases * To use the concepts of intermolecular forces to predict physical properties of substances * To gain a deeper and broader understanding of solution equilibria

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Written exam, Participation, Attendance

14

Course name: Imaging Engineering
Course code: INT2014
Course Period: P5
ECTS credits of this course: 5

Full course description
Imaging technologies are at the forefront of scientific exploration and analysis across a diverse set of fields. This course introduces the fundamental principles and advanced techniques of imaging engineering applied across a range of areas. This may include biomedical imaging, planetary exploration and space observation. Through a combination of theoretical knowledge, hands-on exercises and case studies, students will explore the technical challenges and innovative solutions in these fields.

Course objectives (ILOs)
At the end of this course, students will be able to: * Understand the underlying principles of various imaging systems and how they are applied to capture data. * Analyse and evaluate the functionality of different imaging modalities. * Critically assess the limitations and challenges of imaging systems.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Participation, Presentation, Attendance

15

Course name: Python Programming Language
Course code: PRA2031
Course Period: P4
ECTS credits of this course: 2.5

Full course description
Python is one of the most popular programming languages in the world. It is a high-level programming language, which was designed to emphasize code readability. Its application ranges from web applications over scientific computing to artificial intelligence projects. In this course you will expand your knowledge and understanding of python programming by working in groups on an example project from one of the scientific fields (biology, physics and chemistry). Together, we will learn the basics of object-oriented programming, take a closer look at methods within classes and code debugging methods. You will learn to identify and use relevant python packages for your project and to document your code so that is understandable to other people. Furthermore, this course will introduce git and GitHub repositories for version control, collaborative programming work, and code sharing.
Course objectives (ILOs)
* Learn to use the principles object-oriented programming and classes in python * Explore using python to program, simulate and visualise a problem * Learn basic, essential techniques to debug your code, using virtual environments and package managements * Using GitHub repositories for version control, collaborative programming and code sharing

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Written exam, Participation, Presentation, Attendance, Assessment, Observation

16

Course name: Laboratory and Research Skills
Course code: BENS2002
Course Period: P4
ECTS credits of this course: 5

Full course description
This course builds up on the course “Experimentation in Science and Engineering”. After being introduced to the lab environment, students will continue and go further on performing scientific research in a laboratory setting. Starting with the planning of the experiments and understanding their fundamental principles. The topics of the experiments are related to industrial processes that are translated to small-scale laboratory settings. Importantly, students will keep in mind safety, sustainability and time management. The course is designed in a way that incorporates chemistry, biotechnology and engineering experiments.

Course objectives (ILOs)
* To be able to relate research questions to the appropriate scientific theory. * To be able to relate scientific theory to a research experiment. * To learn to setup a scientific research experiment. * To familiarize students with the executing of scientific research experiments. * To be able to perform basic laboratory experiments in a safe manner. * To be able to analyse and process the data. * To learn to report and communicate the outcomes in a scientific manner.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
TBC

17

Course name: Global Supply Chain Management
Course code: BENC2025
Course Period: P4
ECTS credits of this course: 5

Full course description
Nowadays, business activities are interconnected worldwide. Raw materials come from one region, are shipped to another area for processing, and are eventually sold on the global market. Although this phenomenon is not new, companies are always faced with new challenges because of this complexity. Supply chains must therefore find a balance between efficiency and effectiveness. The simplification of processes, for example by working with a limited number of suppliers, can promote efficiency, but in the event of a supply chain disruption, the customer does expect their products to be delivered. The Global Supply Chain Management course addresses this. In the course, we look at how companies select suppliers, organize and manage and adjust the process. Cases about supply chain resilience, lean global supply chains, cultural differences and differences in legislation and regulations are discussed in the course.

Course objectives (ILOs)
The main objective of the course is to provide students with insight into the complexity of global supply chains. In addition to concepts from supply chain management, the course also makes

connections with other domains: legislation, financing, engineering. This emphasizes the transdisciplinary aspect of the program and provides students with tools to deal with complexity in supply chains.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
TBC

18

Course name: Ecosystems
Course code: BENC2024
Course Period: P4
ECTS credits of this course: 5

Full course description
Ecosystems are central to addressing business and societal challenges; they foster collaboration and the pooling of resources to drive innovation aligned with the UN Sustainable Development Goals. In this course, you'll adopt a managerial perspective to create and manage ecosystems—physical, digital, or hybrid. You'll explore strategic, engineering, and technological intersections, stakeholder relationships, and real-world examples such as Brightlands campuses and global hubs like Silicon Valley. Through designing your own ecosystems, you'll build practical skills in developing value propositions and collaboration structures, highlighting the practical relevance of ecosystem management.

Course objectives (ILOs)
TBC

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
TBC

19

Course name: Environmental Science and Technology
Course code: BENC2026
Course Period: P4
ECTS credits of this course: 5

Full course description

The impact of human activity threatens the destruction of the natural environment, yet the natural environment is essential to sustain human activity. Here, we will study both the most pressing environmental challenges together with their potential solutions. Emphasis is given to the underlying science and technology of these challenges and solutions. We will cover a diverse range of topics, ranging from climate change to diversity loss, and from geoengineering to carbon capture. This course uses a student-centric learning approach based on flipped classrooms and peer teaching. Students can expect that they will have to give a presentation at least once every two weeks.

Course objectives (ILOs)
Students will be able to: * Describe in their own words current environmental challenges and the science that underlies them. * Describe a broad range of potential technological solutions to these environmental challenges, whilst demonstrating critical understanding of their benefits and limitations. * Analyse and evaluate scientific and engineering literature to determine the key messages. * Confidently present complex scientific and engineering content in a professional manner.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
TBC

20

Course name: Data Science
Course code: BENC2011
Course Period: P5
ECTS credits of this course: 5

Full course description
This course offers a practical introduction to data science, beginning with Python fundamentals and progressing through data processing with Pandas—from basic manipulations to cleaning and refining datasets. You'll learn to explore data, extract insights through exploratory analysis, and apply machine learning methods like classification and regression. Through hands-on projects, you'll develop the skills to gather, prepare, and analyze real-world data, enabling you to build effective data-driven solutions.

Course objectives (ILOs)
Learn about the data science lifecycle; * Apply Python as a programming language to perform data analysis tasks; * Become acquainted with the data manipulation process and how to achieve this in Python; * Get introduced to basic machine learning algorithms and their applications, network science techniques for modeling, analyzing and reasoning about relationships between entities * Understand and apply data interpretation and visualization tools

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
TBC

21

Course name: Commercialising Science and Technology
Course code: BENC2003
Course Period: P4
ECTS credits of this course: 5

Full course description
This course aims to help you understand how to commercialize a technology, scientific discovery, or technical product. In doing so, we will adopt a strongly entrepreneurial lens and draw from examples in entrepreneurial practice. The course is intended for students who want to leverage their technology or science background by starting their own business, extending an existing business, or gaining knowledge on technology commercialization. Through a series of practice cases, readings, activities, and sessions with instructors and peers, you examine key topics, including the economics of innovation, product development, business planning and strategy, intellectual property, and fundraising. We will also examine the human aspects of innovation, specifically the role of idea finding, location, team dynamics, roles, and challenges in starting a tech company. Finally, as an integral part of this course, you will develop an informative case study and a start-up idea for a technology of your choice. The mindset and tools learned in this course will help you one day to start your own business or to innovate successfully within a technology company.

Course objectives (ILOs)
Primary goal: To understand how science-based research and technological breakthroughs can be transformed into new business. Secondary goals: [1] To develop a solid theoretical understanding of the process of market opportunity identification and evaluation in the context of new technologies. [2] To explore the frontier of current knowledge when it comes to creating value from technological inventions and managing early-stage commercialization processes. [3] To practically apply your knowledge on early stage commercialization efforts. [4] To channel back your practically acquired knowledge into theoretical conceptualizations of the entrepreneurial opportunity identification and evaluation process.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
TBC

22

Course name: Data Science and Analysis
Course code: CEN2016
Course Period: P5
ECTS credits of this course: 5

Full course description
The course builds on the knowledge obtained during the course Basic Programming Skills and is valuable to students choosing any of the three concentrations in year 3. Within the modern world and in science, abundant streams of data are generated. This course focuses on methods to pre-process, analyse and interpret relevant information. Items that are introduced are datamining, pre-processing, databases, explore data, datatypes, labelling, machine learning and data visualizations. You apply these techniques in computer assignments that are completed in appropriate software environment. Furthermore, data management is an essential aspect to conduct responsible research. You learn to understand the general rules of appropriate data management and define roles and responsibilities regarding data management. You study scientific literature on this topic with a focus on an engineering and natural sciences point of view. Subsequently, you are required to develop and implement a communication plan dealing with data management issues.

Course objectives (ILOs)
TBC

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
TBC

23

Course name: General Chemistry Laboratory
Course code: PRA2034
Course Period: P5
ECTS credits of this course: 2.5

Full course description
This course focuses on topics in base skills needed in a chemistry laboratory. These topics will be taught using a series of lab experiments designed to develop a battery of lab skills needed for more advanced chemistry courses.

Course objectives (ILOs)
* Recognize standard laboratory glassware and analytical equipment. * Correctly carry out common laboratory procedures. Measure and report quantities with appropriate precision. * Convert raw data to a physically meaningful form for communication.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Attendance

24

Course name: Calculus
Course code: MAT2006
Course Period: P4
ECTS credits of this course: 5

Full course description
In this course, we will discuss,among others, the following topics:limits and continuity, integration and differentiation, inverse and transcendental functions. In addition to the main facts and concepts, problem solving strategies will be discussed as well. Both the intuition behind the concepts and their rigorous definitions will be presented along with a number of examples and formal mathematical proofs, to facilitate a better understanding of the concepts. Furthermore, these objectives will be reinforced through short digitalinteractive sessions organized during the lectures. Knowledge and understanding: Calculus offers an indispensable basis, in the contents as well as in the methodologies, for studying and applying exact sciences, which will be built on during the rest of the curriculum. Applying knowledge: The skills and facts which are taught in this course are of use for most of modern engineering or scientific problems. After the completion of the course, the students should be able to solve simple problems in the areas mentioned above and to judge the validity of a mathematical argument,which is relatedto the material of the course. This is specifically tested in an assignment. Skills: After having passed the course, the student will be able to tackle not only the standard type of problems (graph-drawing, calculation of maxima and minima of functions, computing limits etc.),but also applyhis/her knowledge to considerably more relevant problems.

Course objectives (ILOs)
- To become familiar with functions and limits.
- To become familiar with differentiation.
- To understand how to use differentiation and limits/continuity to sketch the graph of a function.
- To become familiar with integration.

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Written exam, Attendance, Assignment

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Course name: Circular Economy as a Societal Change
Course code: external course at the University of Eastern Finland
Course Period: P4 & P5 (actual beginning and ending times may vary)
ECTS credits of this course: 3

Full course description
The course studies circular economy as a societal change, that touches many aspects of life. Both social, political and judicial preconditions of the circular economy are examined. The course is multidisciplinary and provides perspectives to circular economy through environmental policy, environmental law and geography. The different sections of the course examine of the objectives related to circular economy from the perspective of different actors, industries, social responsibility and legislation.
The main themes discussed on the course include inter alia: • Circular economy solutions to the challenge of natural resources overconsumption • The societal change required by circular economy and steering of the change • The social and cultural dimensions of circular economy • Circular economy as a regional phenomenon • Circular economy through topical example sectors
Modes of study
The course is an online course. Completing the course requires passing the assignments given during the course. The assignments are related to the different sections of the course and are completed independently.
If you plan to complete course assignments, you must register on the DigiCampus MOOC platform no later than the first week of the course. The registration deadline is announced on each course's instruction page
The course runs twice a year in spring and autumn semesters.

Course objectives (ILOs)
After completing the course, the student

- can analyze circular economy from a social scientific perspective
- can apply the concepts and theories used in social scientific research into circular economy
- understands the premises of circular economy and the different dimensions and actors of the societal transition related to circular economy

Prerequisites
Course can be taken by students from any discipline. The course does not require previous background with social scientific studies.

Assessment methods
0-5. The course grade is based on the evaluation of different learning assignments completed during the course.

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Course name: Commercializing One's Knowhow
Course code: external course at the University of Eastern Finland
Course Period: P4&P5 (actual beginning and ending times may vary)
ECTS credits of this course: 2

Full course description
The content of the course includes:

- the core features of academic entrepreneurship
- analysis of entrepreneurship and future work skills in the light of characteristics, knowhow and values
- evaluation of students' characteristics, values, knowledge and knowhow through different methods; evaluation of future working opportunities
- commercialization of knowhow

Study methods independent study in an online course, assignments Total 54 hours.

Course objectives (ILOs)

- understand the opportunities and barriers related to entrepreneurship
- evaluate their own characteristics, knowledge and knowhow and use different methods of evaluation
- recognize markets (from the perspectives of entrepreneur and employee) where there could be demand for their strengths and skills

Prerequisites
Please check the course requirements yourself to make sure you are eligible.

Assessment methods
Assignments graded pass/fail

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Course period 5: Sustainable.now
Course code: external course at the University of Eastern Finland
Course Period: P5 (actual beginning and ending times may vary)
ECTS credits of this course: 5

Full course description
The course offers a substantial knowledge package on the concept of sustainable development, its ecological, social, economic and cultural dimensions, as well as the connections and tensions between the dimensions. The ethical viewpoint through the course provides a foundation for examining sustainable development also as a political and normative concept. The course also emphasises the importance of agency and the different roles of an individual. A student gets the opportunity to examine the sustainability of their lifestyle from the perspective of their individual choices, but on the other hand, sustainability and climate challenges are also presented as structural and systemic problems. There are plenty of practical examples and cases that illustrate sustainability

challenges and how to solve them. Student plans and performs assignment to study chosen theme from different perspectives of sustainability and reports the results in an essay.

Course objectives (Intended Learning Outcomes)
After the course, the student is familiar with sustainable development as a political and normative concept, and recognises its ecological, social, economic and cultural dimensions and the connections and conflicts related to them. The student understands that sustainable development and the wicked problems related to it, such as climate change, require multidisciplinary cooperation and problem-solving skills. The student understands the significance of individual agency and global responsibility as well as the need for comprehensive transformation. Student learns sustainability related data collection, problem-solving and analysing through phenomenon-based learning.

Prerequisites
None

Assessment methods:
Multiple-choice questions, learning assignments, summary, essay. The grade (0-5) will be given based on the essay.

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Course name: Landscape Geography and Collaborative Knowledge Creation
Course code: external course at the University of Eastern Finland
Course Period: P4 & P5 (actual beginning and ending times may vary)
ECTS credits of this course: 2

Full course description
Content
In this online course, you will acquire knowledge about collaborative knowledge creation and civic engagement within the realm of landscape governance. The course content will provide insights into landscape governance, sustainable landscapes, civic engagement, and collaborative knowledge creation in the context of both natural and cultural landscapes. Additionally, you will gain an understanding of how cooperation among stakeholders, actors, and citizens operates through real-world examples from various countries. With the information gained from this course, you may adopt new pro-environmental values and attitudes. This may prompt you to become an active citizen and strive to minimize the negative impact of your behavior in both natural and built environments. Your capacity to employ a landscape approach and manage the multifaceted process of landscape governance will expand. The primary objective of this MOOC is to enhance awareness of landscapes and promote collaborative governance of both cultural and natural landscapes.
Course content:

- Landscape
- European Landscape Convention
- Citizen science and citizen science technologies
- Civic engagement

- Collaborative knowledge creation
- Traditional & local knowledge
- Scenario building

Modes of study

Study methods: Massive Open Online Course – MOOC the MOOC includes both study materials and assignments 54 working hours in total, e.g. 8-10 working hours per week for 5-6 weeks
Evaluation criteria: pass - fail
Compulsory individual survey in the beginning and in the end of the course. Automatically evaluated assignments in the end of the study modules 2-4 5. The final assignment is evaluated by a teacher. In each of the assignment a passed accomplishment requires 50% of the maximum points.
The MOOC is open around the year expect two weeks maintenance break from 1st to 14th of August. The final evaluation and the marking into the study record takes place four times in a year:

- performances at the latest 31.3., evaluation in April
- performances at the latest 30.6., evaluation in August
- performances at the latest 30.9., evaluation in October
- performances at the latest 31.12., evaluation in January

Teaching methods

Online studies on DigiCampus study platform

Learning material

Presentations, videos, articles etc. learning materials are handed out during the MOOC

Course objectives (ILOs)

After completing the course, the student • is familiar with landscape approach • recognizes the key questions concerning landscape governance, collaborative knowledge creation and civic engagement • has enhanced their landscape awareness • is able to manage innovative and participatory technologies supporting landscape planning • is able to co-create simple scenarios for the use of landscape management

Prerequisites

Please check the course requirements yourself to make sure you are eligible.

Assessment methods

Pass - fail. Compulsory individual survey in the beginning and in the end of the course.Automatically evaluated assignments in the end of the study modules 2-5. The final assignment is evaluated by a teacher. In each of the assignment a passed accomplishment requires 50% of the maximum points.