

FACULTY OF SCIENCE
Courses taught in English in academic year 2020/21

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DEPARTMENT OF GEOGRAPHY

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | English for Science |
| Course code: | KGEO / E403 |
| ECTS | 5 |
| Level of course: | Bachelor |
| Teacher: | Mgr. Ladislav Bobr |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 per week |
| Completion: | exam |
| Course goal: | The course is intended to improve the specialized geographical word power and communication skills of students as well as to show the possibilities of finding and interpreting different geographical information, and finally to show how to present the results of own research or another work. |
| Abstract: | <ol style="list-style-type: none"> 1. Introductory lesson; 2. Scientific journals and other sources; 3. Writing an abstract I; 4. Writing an abstract II - practical skills; 5. Designing a research topic; 6. Reading scientific papers I - analyzing the structure; 7. Reading scientific papers II - heart of the matter; 8. Discussing the geographical problem I - environmental issues; 9. Discussing the geographical problem II - social issues; 10. Discussing the geographical problem III - regional issues; 11.-13. Presentation of geographical issue; 14. Closing lesson |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Regional geography of Northwestern Bohemia |
| Course code: | KGEO / E100 |
| ECTS: | 10 |
| Level of course: | Bachelor, Master |
| Teacher: | Assoc. Prof. Mgr. Pavel Raška, Ph.D. et al. |
| Term: | Summer + Winter |
| Language of instruction: | English |
| Lectures/exercises: | 5 day per semester |
| Completion: | exam |
| Course goal: | The course focuses on selected geographical aspects of NW Bohemia, mainly as follows: (a) location and geodiversity – evolution of natural environment, landscape types, (b) development of settlement, history and recent demographical trends, (c) economic significance of the region, (d) cross-border relations with Germany (Saxonia), (e) environmental problems and (f) regional development issues. Students are attending consultations, where they get tasks and discussion questions for the above mentioned issues, and concurrently they work on a project covering these issues. |
| Abstract: | <ol style="list-style-type: none"> 1. Location and geodiversity 2. Development of settlement 3. History and recent demographical trends 4. Economic significance of the region 5. Cross-border relations with Germany (Saxony) 6. Environmental problems 7. Regional development issues <p><i>*The course is completed with individual reports (5 pages) based on reading of assigned literature and field observations.</i></p> |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Regional geography of the Czech Republic |
| Course code: | KGEO / E101 |
| ECTS: | 10 |
| Level of course: | Bachelor, Master |
| Teacher: | Assoc. Prof. Mgr. Pavel Raška, Ph.D. et al. |
| Term: | Summer + Winter |
| Language of instruction: | English |
| Lectures/exercises: | 5 day per semester |
| Completion: | exam |
| Course goal: | The course focuses on selected geographical aspects of the Czech Republic, mainly as follows: (a) position in Europe, (b) geodiversity – evolution of natural environment, landscape types, (c) development of settlement, history and recent demographical trends, (d) economic significance, (e) cross-border relations, (f) environmental problems and (g) regional development issues. Students are attending consultations, where they get tasks and discussion questions for the above mentioned issues, and concurrently they work on a project covering these issues. |
| Abstract: | <ol style="list-style-type: none"> 1. Location and geodiversity 2. Development of settlement 3. History and recent demographical trends 4. Economic significance of the region 5. Cross-border relations with Germany (Saxony) 6. Environmental problems 7. Regional development issues <p><i>*The course is completed with individual reports (5 pages) based on reading and comparison of selected issues (e.g. environmental and developmental perspectives) with country/region of origin of the foreign student.</i></p> |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | One-day Geographical Excursion A / Geographische Exkursion A |
| Course code: | KGEO / E023 |
| ECTS: | 5 |
| Level of course: | Bachelor, Master |
| Teacher: | RNDr. Ivan Farský, CSc., Mgr. Jiří Riezner, Ph.D. |
| Term: | Winter + Summer <i>*excursions are scheduled each semester according to the number of students. In case of small numbers, the excursion may be cancelled.</i> |
| Language of instruction: | Deutsch |
| Lectures/exercises: | 1 day per semester |
| Completion: | exam / Prüfung |
| Course goal: | Eins-, Zweitägige Exkursion und Feldpraxis dient zur praktischen Übung. Die Studenten einzelne Aufgaben zu bearbeiten haben (schriftlich oder praktisch). Die auch Terrainbeobachtungen machen. Die Anforderung: Ein Exkursionsplan an der Lehrstuhlseite zu beobachten (Semester Anfang), sich in STAG zu verschreiben. Bearbeiteten Itinerar spätestens 1 Monat nach der Exkursion zur Kontrolle geweben. Gehalt: die Funktionszonen festzustellen, die Naturelemente zu beobachten. Literatur: Regional Fachliteratur (Atlanten, Karten, Jahrbüchr usw.) <i>*excursion is also available for English speaking students.</i> |
| Abstract: | - funktional Zonen - Natur und Umwelt - regional Geographie |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | One-day Geographical Excursion B / Geographische Exkursion B |
| Course code: | KGEO / E024 |
| ECTS: | 5 |
| Level of course: | Bachelor, Master |
| Teacher: | RNDr. Ivan Farský, CSc., Mgr. Jiří Riezner, Ph.D. |
| Term: | Winter + Summer <i>*excursions are scheduled each semester according to the number of students. In case of small numbers, the excursion may be cancelled.</i> |
| Language of instruction: | Deutsch |
| Lectures/exercises: | 1 day per semester |
| Completion: | exam / Prüfung |
| Course goal: | Eins-, Zweitägige Exkursion und Feldpraxis dient zur praktischen Übung. Die Studenten einzelne Aufgaben zu bearbeiten haben (schriftlich oder praktisch). Die auch Terrainbeobachtungen machen. Die Anforderung: Ein Exkursionsplan an der Lehrstuhlseite zu beobachten (Semester Anfang), sich in STAG zu verschreiben. Bearbeiteten Itinerar spätestens 1 Monat nach der Exkursion zur Kontrolle geweben. Gehalt: die Funktionszonen festzustellen, die Naturelemente zu beobachten. Literatur: Regional Fachliteratur (Atlanten, Karten, Jahrbüchr usw.) <i>*excursion is also available for English speaking students.</i> |
| Abstract: | -funktional Zonen - Natur und Umwelt - regional Geographie |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | One-day Geographic Excursion C / Geographische Exkursion C |
| Course code: | KGEO / E064 |
| ECTS: | 5 |
| Level of course: | Bachelor, Master |
| Teacher: | RNDr. Ivan Farský, CSc., Mgr. Jiří Riezner, Ph.D. |
| Term: | Winter semester <i>*excursions are scheduled each semester according to the number of students. In case of small numbers, the excursion may be cancelled.</i> |
| Language of instruction: | Deutsch |
| Lectures/exercises: | 1 day per semester |
| Completion: | exam / Prüfung |
| Course goal: | Eins-, Zweitägige Exkursion und Feldpraxis dient zur praktischen Übung. Die Studenten einzelne Aufgaben zu bearbeiten haben (schriftlich oder praktisch). Die auch Terrainbeobachtungen machen. Die Anforderung: Ein Exkursionsplan an der Lehrstuhlseite zu beobachten (Semester Anfang), sich in STAG zu verschreiben. Bearbeiteten Itinerar spätestens 1 Monat nach der Exkursion zur Kontrolle geben. Gehalt: die Funktionszonen festzustellen, die Naturelemente zu beobachten. Literatur: Regional Fachliteratur (Atlanten, Karten, Jahrbüchr usw.) <i>*excursion is also available for English speaking students.</i> |
| Abstract: | - funktional Zonen - Natur und Umwelt - regional Geographie |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | One-day Geographical Excursion D / Geographische Exkursion D |
| Course code: | KGEO / E065 |
| ECTS: | 5 |
| Level of course: | Bachelor, Master |
| Teacher: | RNDr. Ivan Farský, CSc., Mgr. Jiří Riezner, Ph.D. |
| Term: | Winter + Summer <i>*excursions are scheduled each semester according to the number of students. In case of small numbers, the excursion may be cancelled.</i> |
| Language of instruction: | Deutsch |
| Lectures/exercises: | 1 day per semester |
| Completion: | exam / Prüfung |
| Course goal: | Eins-, Zweitägige Exkursion und Feldpraxis dient zur praktischen Übung. Die Studenten einzelne Aufgaben zu bearbeiten haben (schriftlich oder praktisch). Die auch Terrainbeobachtungen machen. Die Anforderung: Ein Exkursionsplan an der Lehrstuhlseite zu beobachten (Semester Anfang), sich in STAG zu verschreiben. Bearbeiteten Itinerar spätestens 1 Monat nach der Exkursion zur Kontrolle geweben. Gehalt: die Funktionszonen festzustellen, die Naturelemente zu beobachten. Literatur: Regional Fachliteratur (Atlanten, Karten, Jahrbüchr usw.) <i>*exkursion is also available for English speaking students.</i> |
| Abstract: | 1. das Marketing Struktur - der Reiseverkehr 2. Besuch der Messe |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Problems of Development of Czech Regions |
| Course code: | KGEO / E304 |
| Nové ECTS | 5 |
| Level of course: | Bachelor |
| Teacher: | RNDr. Silvie R. Kučerová, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/1 per week |
| Completion: | exam |
| Course goal: | Regional development issues The aim of the course is to present and discuss selected issues of regional and local development, regional policy and territorial management. The themes are presented on the example of Czechia and European countries. The emphasis will be put on the comparison with the situation in students' homeland. |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction 2. Regional disparities in the Czech Republic 3. Public administration 4. Heritage, values conservation 5. Regional policy 6. EU funds 7. Tools of regional policy 8. Regional development in borderland 9. Strategy of local and regional development 10. Selected problems of RD in Usti nad Labem region I-IV |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Field Practice in Human Geography |
| Course code: | KGEO / E312 |
| Nové ECTS | 5 |
| Level of course: | Bachelor |
| Teacher: | Mgr. Ladislav Bobr |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 |
| Completion: | exam |
| Course goal: | The main aim of this course is to examine theoretical and practical knowledge of general and regional social geography by resolution of specific research tasks in the model locations. In this course students will acquire and practice geographic research methods. |
| Abstract: | Introduction the methods of human geographic research Practical application of research methods: <ul style="list-style-type: none"> - in the geography of population and settlements - in the geography of agriculture - in the geography of industry - in the geography of trade and services - in the geography of tourism |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Physische Geographie von Tschechien Selected Chapters from Physical Geography of Czechia |
| Course code: | KGEO / E202 |
| ECTS: | 5 |
| Level of course: | Master |
| Teacher: | Mgr. Jiří Riezner, Ph.D. |
| Term: | Sommersemester |
| Language of instruction: | Deutsch |
| Lectures/exercises: | 2/0 für die Woche |
| Completion: | exam / Prüfung |
| Course goal: | Physische Geographie von Tschechien - Im Rahmen der Veranstaltung wird ein Überblick über: die physisch-geographischen Rahmenbedingungen Tschechiens und ausgewählten Natur- und Kulturlandschaften besonderer Bedeutung gegeben. |
| Abstract: | <ol style="list-style-type: none"> 1. Geologische Entwicklung und Verhältnisse; 2. Geomorphologische; Entwicklung und Gliederung; 3. Klima; 4. Gewässer; 5. Böden; 6. Vegetation und Tierwelt; 7. Böhmisches Mittelgebirge, Erzgebirge; 8. Riesengebirge, Böhmisches Schiefergebirge; 9. Böhmisches Paradies, Křivoklátsko; 10. Třeboňsko, Böhmerwald; 11. Böhmisches Karst, Broumovsko; 12. Thayathal, Pálava, Mährischer Karst; 13. die Mährisch-Schlesische Beskyden, die Weißen Karpaten; 14. Altvatergebirge, Litovelské Pomoraví) |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Geographical Information Systems I |
| Course code: | KGEO / E202 |
| ECTS: | 5 |
| Level of course: | Bachelor |
| Teacher: | Mgr. Martin Dolejš |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 per week |
| Completion: | exam |
| Course goal: | The introductory course of Geographical Information Systems aims at explaining basic terminology, introducing software tools and detailed description of the ESRI products and their functions. |
| Abstract: | <ol style="list-style-type: none"> 1. Software tools for GIS. 2. Basic philosophy of ArcGIS. 3. Working environment in ArcGIS 10.x. 4. Map field. 5. Geodatabase, attributes, data selection. 6. Metadata, ArcCatalogue. 7. Geospatial analysis. 8. Map construction. 9. Working environment in ArcMap. 10.–12. Individual work. 13. Presentation of semestral projects. |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Geographical Information Systems II |
| Course code: | KGEO / E300 |
| ECTS: | 5 |
| Level of course: | Bachelor |
| Teacher: | Mgr. Martin Dolejš |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 per week |
| Completion: | exam |
| Course goal: | The course aims at advanced methods of data processing in GIS, mainly on the applications of 3d Analyst, Spatial Analyst, Network Analyst and other modules. |
| Abstract: | <ol style="list-style-type: none"> 1. Using GIS in geographical projects, specific tools of GIS. 2. Principles of extensions in ArcGIS. 3. Map Algebra. 4. Spatial Analysis. 5. Creating a analysing DEM. 6. Optimal route, corridor, viewshed. 7. Hydrological analysis. 8. Geostatistics I. 9. Geostatistics II. 10. Maplex. 11. Mapbook/Publisher. 12. Model Builder. |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Urban Environmentalistics |
| Course code: | KGEO / E300 |
| ECTS: | 5 |
| Level of course: | Master |
| Teacher: | Assoc. Prof. Mgr. Pavel Raška, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/1 per week |
| Completion: | exam |
| Course goal: | The course introduces students to fundamental problems of urban environment contextualized in the development of cities through the history. The first part is devoted to conceptualization of the “urban” and rationalization of the study of urban environment to address global challenges. The second part gives an overview of specificities of urban environment (soils, climate, hydrologic cycle etc.) in contrast to (semi-)natural areas. Final part provides an introduction to planning theories and paradigms of the 20th century, with emphasis given to environmental issues. |
| Abstract: | <ol style="list-style-type: none"> 1. Defining urban, rural and rurban 2. Urban environment and global challenges I 3. Urban environment and global challenges II 4. Origin and development of cities 5. Historical and “new” cities 6. Urban geology and soils 7. Urban climate 8. Urban hydrological cycle 9. Urban greenery and parks 10. Natural hazards and risks 11. Urbanism and architecture in the 20th Century |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Methods and Application of Historical Geography |
| Course code: | KGEO / E310 |
| ECTS: | 5 |
| Level of course: | Master |
| Teacher: | Assoc. Prof. Mgr. Pavel Raška, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 per week |
| Completion: | exam |
| Course goal: | The course is designed as a cycle of discussion of scholarly papers devoted to data, methods and themes in historical geography/environment history. Students are expected carry an individual minor research based on primary data. |
| Abstract: | <ol style="list-style-type: none"> 1. Historical geography and environmental history 2. The history and the future in landscape science 3. Documentary proxies in historical geography 4. Historical event inventories and time series 5. Old maps 6. Narrative sources and narrative analyses 7. Visual sociology 8. Complexities in land use change studies 9. Presentation of students' projects I 10. Presentation of students' projects II 11. Presentation of students' projects III |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Natural Hazards and Risks |
| Course code: | KGEO / E212 |
| ECTS: | 5 |
| Level of course: | Master |
| Teacher: | Assoc. Prof. Mgr. Pavel Raška, Ph.D. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 per week |
| Completion: | exam |
| Course goal: | The course is intended to introduce students to the fundamental concepts related to natural hazards and risks, basic types of natural hazards including examples from Czechia and abroad. After then, the attention is devoted to model of risks and to the approaches to their assessment from the perspective of geosciences, social sciences and complex modelling at a local/regional scale. |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction - the role of natural hazards in nature-society relations 2. Fundamental concepts - hazards, disaster, risk, vulnerability, exposure 3. Models of natural risks 4. Types of natural risks according to underlying hazard I 5. Types of natural risks according to underlying hazard II 6. Natural hazards in the World 7. Natural hazards in Czechia (Central Europe) 8. Geoscientific approaches to risk assessment I 9. Geoscientific approaches to risk assessment II 10. Social inquiry and risk assessment I 11. Social inquiry and risk assessment I 12. Risk modelling at a local/regional scale 13. <i>*the lesson is reserved for field work</i> |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | GIS Project |
| Course code: | KGEO / E211 |
| ECTS: | 5 |
| Level of course: | Master |
| Teacher: | Mgr. Martin Dolejš |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 per week |
| Completion: | exam |
| Course goal: | The course aims to develop students' skills through team GIS project, including research design and hypothesis, data collection, design of the suitable methodological approach, data processing and presentation (visualisation). |
| Abstract: | Theory: Introduction, problems of large GIS projects in practice, concepts, redaction and work in teams. Practice: Processing of the assigned part of the team GIS project and research report summary and presentation. |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Economic geography I |
| Course code: | KGEO / E306 |
| ECTS: | 5 |
| Level of course: | Bachelor |
| Teacher: | Mgr. Vladan Hruška, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 per week |
| Completion: | exam |
| Course goal: | Basic economic terms and concepts will be discussed within this course. The role of the state in the economy and other topics such as growth-development or environment – economy relation, geography of labour market, geography of finance will be discussed. |
| Abstract: | <ol style="list-style-type: none"> 1. Economy – basic terms 2. Introduction to economic geography 3. Development and economic growth 4. Capitalist economies and political economy 5. Uneven development 6. State and economy 7. Socialist state and development 8. Geography of finance 9. Economy and environment 10. Geography of labour market 11. Excursion in a local enterprise 12. Excursion in an old industrial area of Ústí nad Labem 13. Course revision |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Economic geography II |
| Course code: | KGEO / E405 |
| ECTS: | 5 |
| Level of course: | Bachelor |
| Teacher: | Mgr. Vladan Hruška, Ph.D. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 per week |
| Completion: | exam |
| Course goal: | Course focuses on the topic of globalisation and its impact on spatial distribution of economic activities. Special attention is devoted to the concept of global commodity chains, transnational corporations and geography of services. |
| Abstract: | <ol style="list-style-type: none"> 1. Places of production and deindustrialisation 2. Commodity chains 1 3. Commodity chains 2 4. Technological changes 5. Transnational corporations 1 6. Transnational corporations 2 7. Geography of consumption 8. Geography of services 9. Geography of retail 10. Distance and economic geography 11. Excursion in a local enterprise 12. Excursion in an old industrial area of Ústí nad Labem 13. Course revision |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Theories and concepts of rural geography |
| Course code: | KGEO / E512 |
| ECTS: | 5 |
| Level of course: | Master |
| Teacher: | Mgr. Vladan Hruška, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 1/1 per week |
| Completion: | exam |
| Course goal: | Course aims to inform students about basic concepts and theories of rural geography. Development of rural studies will be discussed and different approaches to the definition of rural will be introduced. Transformation of agriculture and rural space of developed world will be analysed. |
| Abstract: | <ol style="list-style-type: none"> 1. Development of rural studies in the UK and Czechia 2. Definitions of rural 1 3. Definitions of rural 2 4. Transformation of agriculture – productivist agriculture 5. Transformation of agriculture – multifunctional agriculture 6. Alternative food networks 7. Rural restructuring 8. Transformation of post-socialist rural economies 9. Amenity migration 10. Rural development approaches 11. Rural idyll 12. Excursion in Ústí nad Labem surrounding 13. Course revision |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Selected issues of economic geography |
| Course code: | KGEO / E513 |
| ECTS: | 5 |
| Level of course: | Master |
| Teacher: | Mgr. Vladan Hruška, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 1/1 per week |
| Completion: | exam |
| Course goal: | Course aim to inform students about current topics in economic geography influencing local and regional development. Course will be actualised based on up-to-date economic trends of recent economic development in Czechia. |
| Abstract: | <ol style="list-style-type: none"> 1. Economic localisation 2. Geography of added value 1 3. Geography of added value 2 4. Shared economy 5. Alternative food networks 6. Overtourism 7. Amenity migration 8. Rural economies 9. Geography of housing 10. Selected issues based on recent development in Czech economy and society 11. Selected issues based on recent development in Czech economy and society 12. Selected issues based on recent development in Czech economy and society 13. Course revision |

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| Faculty/Institute: | Faculty of Science / Department of Geography |
| Course title: | Cultural Geography |
| Course code: | KGEO / E301 |
| ECTS: | 5 |
| Level of course: | Master |
| Teacher: | Assoc. Prof. Jan Daniel Bláha, Ph.D. |
| Term: | Winter/Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 0/2 per week |
| Completion: | exam |
| Course goal: | The course focuses on following basic features of cultural geography: nations, languages, religions, cultural heritage, customs and traditions. Another important aspect of the course is the concept of culture and its anthropological definition, as well as basic terms and constructs such as “cultural diffusion” and “cultural region”. The specifics of formation of nations and religions, their development, geographical distribution, causes of ethnic and religious conflicts in the world are studied. Attention is also paid to the macro-regional differentiation of the world and the formation of civilizations by different authors. Students elaborate and present their own projects focused on selected ethnic/sub-cultural group or topics of cultural geography. |
| Abstract: | <ol style="list-style-type: none"> 1. The term “culture”. 2. Basic principles of culture. 3. Dynamics and development of culture (cultural change). 4. Groups in contact (acculturation and cultural diffusion) and categorization of culture. 5. Cultural geography and geography of culture (discipline overview and methodology). 6. Anthropogenesis; origin and development of civilization. 7. Language and Religion. 8. Typology of nations and ethnicity. 9. Local and regional culture (concept of cultural region). 10. Cultural heritage. 11. World cultural macro-regions and their specifics (global view of culture). |

DEPARTMENT OF BIOLOGY

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Application of Methods of Molecular Genetics in Studies of Microbial Communities |
| Course code: | KBI/E001 |
| ECTS: | 7 |
| Level of course: | Master |
| Teacher: | Milan Gryndler |
| Term: | Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1/1 per week |
| Completion: | Exam |
| Course goal: | Microbial communities (in soil, in sediments, in composts, etc.) often show high taxonomic diversity and can be studied using various cultivation or molecular methods. The problem connected with application of cultivation methods consists in strong preference for detection of easily culturable microorganisms, while slow growing ones, or these producing small amounts of propagules, are not efficiently detected and unculturable organisms cannot be detected at all. Molecular detection methods are independent on culturability of microorganisms because they detect DNA from different microbial taxa. The course will provide the basic training in most common molecular methods. Their advantages and limitations will be discussed and practical application protocols will be given. |
| Abstract: | <ol style="list-style-type: none"> 1) Introduction: good laboratory practice in molecular genetics, designing the experiments 2) Laboratory exercise 1 - Good laboratory practice 3) Extraction and purification of DNA from microbial cultures (theory), polymerase chain reaction (PCR) use in molecular genetic detection methods (theory), selective DNA primers 4) Laboratory exercise 2 - Extraction and purification of environmental and microbial DNA, PCR 5) Purification of the PCR products, gel electrophoresis, restriction cleavage (theory), gradient gel electrophoresis DGGE and TGGE 6) Laboratory exercise 3 - Purification of the PCR products, gel electrophoresis 7) Methods of the amplicon analysis: RFLP, T-RFLP, RAPD. Ligation of DNA fragments, AFLP 8) Laboratory exercise 4 - Restriction analysis 9) DNA sequencing: Sanger sequencing and high-throughput sequencing methods. The use of sequencing methods in the identification of microorganisms 10) Analysis of sequencing data in microbial ecology 11) Molecular cloning, cloning vectors, heterologous gene expression, expression vectors for E. coli and yeasts. 12) Examples of molecular genetic analysis of microbial communities I. 13) Examples of molecular genetic analysis of microbial communities II. |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Behavior |
| Course code: | KBI/E002 |
| ECTS: | 7 |
| Level of course: | Bachelor/Master |
| Teacher: | Eva Jozífková |
| Term: | Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation per week |
| Completion: | Exam |
| Course goal: | Students will get an introduction to Ethology, Behavioral Ecology, and Sociobiology. The chapters containing Human Ethology, and Evolutionary Psychology are also included. Basic terms, and principles connected to the behavior at these fields of study with examples explaining both animal and human behavior are given. |
| Abstract: | <ol style="list-style-type: none"> 1. The roots of ethology, behavioral ecology and sociobiology Tinbergen's four questions, ultimate and proximate causation 2. Adaptation, fitness, fitness cost x benefits, strategy, tactics, heredity of behaviour, altruism 3. Ethology: Lorenz, Tinbergen, von Frisch, ethology terms 4. Neural x humoral regulation, decision making, aggression 5. Social behaviour, hierarchy, 6. Social systems, mating systems 7. Sexual behavior, alternative reproduction strategy parent-parent conflict 8. Parental behaviour, parental investment, parent-offspring conflict, offspring – offspring conflict, helpers, infanticide, sex ratio 9. Maintenance behavior I. 10. Maintenance behavior II. 11. Signals and communication 12. Ontogeny, play, learning, memory, nurture versus nature, personality 13. Normality and “abnormal behaviour”, human ethology 14. Evolutionary psychology |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Biophysics |
| Course code: | KBI/E003 |
| ECTS: | 7 |
| Level of course: | Bachelor/Master |
| Teacher: | Dominika Wrobel, Dana Gášková |
| Term: | Winter/Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation + 1 exercise per week |
| Completion: | Exam |
| Course goal: | This course is an introduction to biophysics examining main topics in this broad area. The course will cover a wide range of topics, applying physical principles and techniques to different problems in biology. |
| Abstract: | <ol style="list-style-type: none"> 1) Order in an entropy-driven world 2) Molecular building blocks of life 3) Molecular interactions and forces in biology 4) Macromolecular conformation 5) Random walks, diffusion, friction and dissipation 6) Thermodynamics of biosystem 7) Chemical forces and molecular self-assembly |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Biotechnology |
| Course code: | KBI/E004 |
| ECTS: | 7 |
| Level of course: | Bachelor/Master |
| Teacher: | Regina Herma, Michaela Liegertová, Hana Malinská |
| Term: | Winter |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation + 1 exercise per week |
| Completion: | Exam |
| Course goal: | Students will get a theoretical and practical introduction to important methods and techniques in biotechnology. Work with different biological systems will be emphasised. Organisation of the laboratory work and combining the use of different methods for analysis of specific issues will be important. Safety in the laboratory environment will also be covered. |
| Abstract: | <ol style="list-style-type: none"> 1) DNA technologies <ol style="list-style-type: none"> 1.1 DNA manipulation in bacteria, plants, animals and humans - molecular cloning 1.2 Gene editing and beyond 1.3 Basics of Bioinformatics 2) RNA technologies 3) <i>In vitro</i> technologies <ol style="list-style-type: none"> 3.1 Plant cell cultures 3.2 Animal/human cell cultures 4) <i>In vivo</i> technologies <ol style="list-style-type: none"> 4.1 Plant models - phytoremediation 4.2 Animal models - Xenotransplantations in cancer research 5) Lab on Chip technologies and microfluidics 6) Discussion and conclusion |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Ecology |
| Course code: | KBI/E005 |
| ECTS: | 7 |
| Level of course: | Bachelor/Master |
| Teacher: | Michaela Czerneková |
| Term: | Winter/Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation per week |
| Completion: | Exam |
| Course goal: | The ecology is the science of the interactions among living organisms and their environment. This subject is concentrated on the characteristics of the environment of living organisms, ecological factors (abiotics x biotics). The ecology of populations, synecology, aquatic and landscape ecology are the major subjects of these lectures. Other topics include the study of biodiversity, ecosystem, other parts of the biosphere and the relationship between man and the biosphere. |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction to the ecology, syllabus and recommended literature 2. Terminology, definition of ecology, biotic and abiotic environment, classification of factors, field and subject of ecology 3. Organism and his environment, adaptation, divergence and convergence, nomenclature and terminology 4. Ecological factors (abiotics x biotics), climate and clime, classification and characteristics of biomes 5. Territory such as source, special forms of nutrition 6. Ecological characteristic of atmosphere, hydrosphere and pedosphere 7. Interactions among living organisms and their environment, characteristics of the environment of living organisms 8. The ecology of populations, density, distribution, structure, natality and mortality, migration, population dynamics 9. The ecology of guilds, synecology, density, abundance, production, dominance, presence and absence, other characteristic 10. Interspecific and intraspecific interactions among living organisms 11. The study of ecosystem, other parts of the biosphere and the relationship between man and the biosphere 12. The study of biodiversity, diversity index 13. Discussion and conclusion |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Genetics |
| Course code: | KBI/E006 |
| ECTS: | 7 |
| Level of course: | Bachelor/Master |
| Teacher: | Regina Herma, Michaela Liegertová |
| Term: | Winter/Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation + 1 exercise per week |
| Completion: | Exam |
| Course goal: | The goal of this course is to provide students with an overview of the principles of plant and animal genetics including Mendelian and modern concepts of heredity. Developments in molecular genetics will be addressed through the chemistry and physiology of the gene and the nature of gene action in prokaryotic and eukaryotic cells. |
| Abstract: | <p>Introduction to genetics</p> <p>Mitosis and Meiosis</p> <p>Mendelian Genetics: Monohybrid crosses, Dihybrid and Trihybrid crosses</p> <p>Sex Determination and Sex Linkage</p> <p>Gene Interactions</p> <p>Sex, Genes and the Environment</p> <p>Pedigrees and Probabilities, Quantitative Traits, Genetic Testing, Quantitative Genetics</p> <p>Linkage and Genetic Maps</p> <p>Bacterial Genetics</p> <p>DNA Structure, Replication, Gene Expression</p> <p>Control of Gene Expression in Prokaryotes/Eukaryotes</p> <p>PCR and DNA cloning, Blotting and Probing, Applications of Recombinant DNA Technology</p> <p>RNA Viruses and Transposable Elements</p> <p>Chromosomal Mutations: Changes in Structure, Altered Chromosome Number</p> <p>DNA Mutations</p> <p>Mitochondrial DNA</p> <p>Population and Evolutionary Genetics</p> <p>Practical part:</p> <p>Cultivation of bacteria, transformation, isolation of plasmid DNA, PCR, analysis of sequencing results, database searches, general microscopy techniques, cultivation of prokaryotic/eukaryotic cells, transfer of DNA to cells and analysis of gene expressions.</p> |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Molecular and Cell Biology |
| Course code: | KBI/E007 |
| ECTS: | 7 |
| Level of course: | Bachelor/Master |
| Teacher: | Michaela Liegertová, Regina Herma, Milan Gryndler |
| Term: | Winter + Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation + 1 exercise per week |
| Completion: | Exam |
| Course goal: | The main goal of this course is to introduce students into molecular basis of life. Students will learn about synthesis and transformation of biomolecules within the cell. About the connection between the structure of the molecule and its function in living cells. |
| Abstract: | <p>1) Molecular genetics of the cell: Structure, function and synthesis of nucleic acids. Cell biology central dogma about the information flow in the cell. Structure of the genome. Concept of the gene and gene structure. DNA replication and repair. Genetic recombination. Transcription and translation and their regulation. Basic recombinant DNA techniques.</p> <p>2) Cellular biology Structure and ultrastructure of the cell. Organelles and membrane systems (structure and function) Cell division Intracellular protein sorting and secretion. Cytoskeleton and cell motility. Extra- and intracellular signal transduction. Differences and similarities between prokaryotic and eukaryotic cells. Microscopy methods for structural analysis of the eukaryotic cell.</p> |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Mycology |
| Course code: | KBI/E008 |
| ECTS: | 7 |
| Level of course: | Master |
| Teacher: | Milan Gryndler |
| Term: | Summer |
| Language of instruction: | English |
| Lectures/exercises: | 2/0 per week |
| Completion: | Exam |
| Course goal: | Status of Fungi and fungus-like members of Protozoa and Chromista. General characteristics incl. morphology, biology and phylogeny of these groups are given. The basic terminology is explained and a new literature on this field is demonstrated. The systematic treatment of main groups (phyla/divisions, classes, orders and their representatives), their ecology and significance in phytopathology, medicine, health service or biotechnology is given. The theoretical knowledge by practical training is supplemented. |
| Abstract: | <p>Fungi will be introduced as a group of organisms with great ecological importance. A delimitation and basic characterization of this group will be provided, including various aspects of morphology, physiology, ecology and phylogenesis. Basic methods of laboratory manipulation with fungi will be mentioned.</p> <p>Contents:</p> <ol style="list-style-type: none"> 1. General characteristics of fungi as a biological group. Fungi and the history of mankind 2. Classification of fungi 3. Morphology, growth and reproduction of fungi 4. Cultivation of edible fungi 5. Fungal nutrition, metabolism and biomass composition 6. Communication of the fungal cell with the environment 7. Fungi in nature. Diversity and dispersal 8. Medicinal use of fungi 9. Anaerobic fungi 10. Fungal antibiotics penicillin and mucidin. Fungal toxins 11. Pathogenic fungi 12. Arbuscular mycorrhizal symbiosis 13. Orchideoid and ericoid mycorrhizal symbiosis 14. Ectomycorrhizal symbiosis 15. Symbiosis of fungi with animals |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Parasitology |
| Course code: | KBI/E009 |
| ECTS: | 7 |
| Level of course: | Bachelor/Master |
| Teacher: | Karina Vašínová |
| Term: | Winter/Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation per week |
| Completion: | exam |
| Course goal: | The parasitology belongs into the important biological fields. These lectures are concentrated on the general characteristic of parasites, parasitology as field, parasite-host interactions and their biology and ecology. There is also included the basic systematic classification of parasites and characteristic of the main taxonomic groups (protozoans, helminths and parasitic arthropods), special parts are applied to the most important diseases caused by parasites (toxoplasmosis, malaria, encephalitidis, etc.). |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction to parasitology, syllabus and recommended literature 2. The general parasitology - part I (terminology, definition of parasites, hosts and environment, classification of parasites) 3. The general parasitology - part II (life cycles, immunology, parasites and immunity) 4. Protozoology I (characteristic of protozoans, trypanosomosis, leishmaniosis) 5. Protozoology II (trichomoniasis, giardiasis, amoebiasis) 6. Protozoology III (coccidiosis, toxoplasmosis, malaria, balantidiosis) 7. Helminthology I (characteristic of helminths, intestinal trematode) 8. Helminthology II (fasciolosis, dicrocoeliosis, paragonimosis, intestinal cestoid, taeniae) 9. Helminthology III (hymenolepiosis, nematode worms, trichuriasis) 10. Helminthology IV (trichinellosis, ascariasis, enterobiosis, tropical filariosis) 11. Arachnoentomology I (characteristic of parasitic arthropods and acarid) 12. Arachnoentomology II (parasitic insects, lice, kissing bug, dipterous, chigger and flea) 13. Discussion and conclusion |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Plant Physiology |
| Course code: | KBI/E010 |
| ECTS: | 7 |
| Level of course: | Bachelor/Master |
| Teacher: | Hana Malinská |
| Term: | Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation + 1 exercise per week |
| Completion: | Exam |
| Course goal: | The main goal of this subject is to introduce students in the basic principles of plant physiology. An attention will be paid to the connection of plant morphology, physiology, the function of individual types of plant tissues, the molecular biology background of processes in plant cell and molecular base of the most important physiological processes in plants. The course has two forms - theoretical as well as practical. During the practical part, students will be trained in the basic methods of plant physiological studies. |
| Abstract: | <ol style="list-style-type: none"> 1. Basic structure and function of the plant cell 2. Elementary composition and metabolism of plant cell 3. Water regime of plants 4. Mineral nutrition of plants 5. Photosynthesis - primary processes 6. Photosynthesis - secondary processes 7. Respiration of plants 8. Transport of assimilates. Heterotrophic nutrition of plants 9. Growth and development of plants - growth regulators 10. External factors of plant growth and plant development 11. Physiology of seed germination, flower, fruit, seed and tuber development 12. Dormancy and senescence of plants. Plant movement. 13. Plant tissue cultures 14. Physiology of plant stress 15. Genetic determination of physiological process |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Microsystems in Biology and Medicine |
| Course code: | KBI/E011 |
| ECTS: | 7 |
| Level of course: | Bachelor/ Master |
| Teacher: | Marcel Štofik |
| Term: | Winter/Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation per 2 weeks / 2 six-hour sessions of laboratory exercise |
| Completion: | Exam |
| Course goal: | The goal of the course is to provide an overview of the field of microsystems in biology and medical sciences. Students will get to know the current approaches to fabrication of microsystems for bioapplications and have a basic knowledge of the principles in the field of biosensors and microfluidics. Main bioapplications will be reviewed. |
| Abstract: | <p>The main topics of the course:</p> <ol style="list-style-type: none"> 1) An introduction into microsystems in biology and medicine (BioMEMS, uTAS, LOC). 2) Microfabrication techniques of microdevices – materials for microfabrication, patterning and biopatterning, hard and soft microfabrication techniques. 3) Biosensors and their basic principles. 4) An introduction into microfluidics for biology. 5) Microsystems in bioapplications part I – sample treatment (approaches in sample preparation, separation and analysis), microfluidic PCR, microarrays, microfluidic immunoassays, LFIA systems. 6) Microsystems in bioapplications part II – cells on chip (cells cultivation, cells studies on chip, cells sorting, separation and capture on chip), microsystems for tissue engineering (tissues and organs-on-chip), microsystems for animal and plant model studies, Point of care systems, implantable microdevices. |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Animal and Plant Models in Biology |
| Course code: | KBI/E012 |
| ECTS: | 10 |
| Level of course: | Bachelor/Master |
| Teacher: | Hana Malinská, Dominika Wrobel, Michaela Czerneková, Michaela Liegertová |
| Term: | Winter/Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation/ 1 exercise per week |
| Completion: | Exam |
| Course goal: | In this specialized course, the students will get a practical introduction into basic <i>in vitro</i> and <i>in vivo</i> experimental techniques in biology. These include work with plant and animal/human cell cultures (2D/3D) as well as experimental work with living organisms (plants, invertebrates, vertebrates). Particular emphasis will be laid on the design and planning of experimental work, documentation, critical evaluation including qualitative and quantitative analysis of the results, as well as laboratory safety and ethical aspects. |
| Abstract: | Each of the topics usually involves 1 week of theoretical preparation and 1 week of practical laboratory experiment. Topics: 1) Good laboratory practice - Safety rules and regulations 2) <i>in vitro</i> cell cultures – plants <i>Nicotiana tabacum</i> , <i>Solanum tuberosum</i> , <i>Daucus carota</i>), plant cultures, callus cultures, suspension cultures 3) <i>in vitro</i> cell cultures – animals/human (mammalian cell and human carcinoma cell lines) 4) <i>in vivo</i> models – plants (<i>Nicotiana tabacum</i> , <i>Miscanthus x giganteus</i> , model for phytoremediation, stress physiology), <i>Pisum sativum</i> -salinity stress testing 5) <i>in vivo</i> models – invertebrates (Tardigrades as an emerging model for cryptobiosis, pharmaceuticals and cellular biology) 6) <i>in vivo</i> models – vertebrates (<i>Danio rerio</i> - toxicity testing, xenotransplantation, animal welfare and legal issues) |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Laboratory Techniques in Molecular and Cell Biology |
| Course code: | KBI/E013 |
| ECTS: | 10 |
| Level of course: | Bachelor/Master |
| Teacher: | Michaela Liegertová, Lukáš Bystrianský, Stanislav Vinopal, Dominika Wrobel, Regina Herma, Alena Semerádtová |
| Term: | Winter/Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation/ 1 exercise per week |
| Completion: | Exam |
| Course goal: | In this specialized course, the students will get a theoretical and practical introduction to a set of selected important methods and techniques in molecular and cell biology. Furthermore, particular emphasis will be laid on the design and planning of experimental work, documentation, critical evaluation including qualitative and quantitative analysis of the results, as well as laboratory safety aspects. |
| Abstract: | Each of the topics usually involves 1 week of theoretical preparation and 1 week of practical laboratory experiment. Topics: 1) Good laboratory practice - Safety rules and regulations 2) Molecular Cloning + Bioinformatics 3) Flow Cytometry 4) Cell Sorting 5) Quantitative PCR 6) Plate Reader Assays |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Microscopy Techniques in Biology |
| Course code: | KBI/E014 |
| ECTS: | 10 |
| Level of course: | Bachelor + Master |
| Teacher: | Regina Herma, Marcel Štofik, Stanislav Vinopal, David Poustka, Oldřich Benada, Alena Semerádtová |
| Term: | Winter/Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation/ 1 exercise per week |
| Completion: | Exam |
| Course goal: | This specialised course will provide the students with a hands-on-experience in various microscopy techniques and instrumentation. The students will learn the basic hardware/software working principles as well as different sample preparation methods. Emphasis will be laid on the design and planning of experimental work, documentation, critical evaluation including qualitative and quantitative analysis of the results, as well as laboratory safety aspects. |
| Abstract: | Each of the topics usually involves 1 week of theoretical preparation and 1 week of practical laboratory experiment. Topics: 1) Good laboratory practice - Safety rules and regulations 2) Light and Fluorescent Microscopy 3) Confocal microscopy 4) Electron microscopy SEM 5) Electron Microscopy TEM 6) AFM |

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| Faculty/Institute: | Faculty of Science / Department of Biology |
| Course title: | Design and Rapid Prototyping of Microsystems in Biology and Medicine |
| Course code: | KBI/E015 |
| ECTS: | 10 |
| Level of course: | Bachelor + Master |
| Teacher: | Marcel Štofik, Jiří Smejkal, Petr Aubrecht, Petr Panuška, David Poustka |
| Term: | Winter/Summer |
| Language of instruction: | English |
| Lectures/exercises: | 1 individual consultation/ 1 exercise per week |
| Completion: | Exam |
| Course goal: | This practical course provides the basic insight into the technological cycle of microdevices fabrication for the field of biology and medicine. During the course, the planning and designing of the microsystems will be examined. Selected rapid prototyping techniques will be presented. Students will examine how to work with 3D printing technologies, with selected micropatterning technologies (photolithography, laser lithography, soft lithography or μ contact printing). Also sandblasting technology will be presented. Based on the local technical background for microsystems fabrication, students will plan and fabricate their own microsystem under professional guidance. The fabricated microsystems will be tested for its functionality. |
| Abstract: | Each of the topics usually involves 1 week of theoretical preparation and 1 week of practical laboratory experiment. Topics: 1) Good laboratory practice - Safety rules and regulations 2) 3D CAD designing 3) 3D printing by FDM and DLP technique 4) UV and Soft lithography 5) Microblasting technology 6) Microfluidics devices |

DEPARTMENT OF CHEMISTRY

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| Faculty/Institute: | Faculty of Science / Department of Chemistry |
| Course title: | General Chemistry |
| Course code: | KCH / E100 |
| ECTS: | 5 |
| Level of course: | Bachelor |
| Teacher: | doc. RNDr. Jan Jirsák, Ph.D. |
| Term: | Winter + Summer |
| Language of instruction: | English |
| Lectures/exercises: | 3/4 per week |
| Completion: | Exam |
| Course goal: | The aim of the course is to present modern chemistry and its historical context. Students will be acquainted with terms common to all branches of chemistry. Key topics of the course are: (i) chemical structure of matter, (ii) states, classification and properties of substances, (iii) fundamentals of thermodynamics and its application in chemistry, and (iv) reaction kinetics. |
| Abstract: | <ol style="list-style-type: none"> 1. History of chemistry. Basic chemical laws and quantities. 2. Modern chemistry among other natural sciences and its division. 3. Structure of matter. Elementary particles and field. Atomic nucleus. Historical models of atom. 4. Quantum-mechanical model of atom. 5. Chemical bond. Structure and reactivity of molecules. 6. Intermolecular forces. 7. States of matter. Mixtures, solutions and colloids. 8. PVT behaviour of fluids. 9. Basics of thermodynamics. 10. Thermochemistry. 11. Phase equilibria. 12. Chemical equilibria. 13. Chemical kinetics. 14. Theoretical principles of modern analytical methods. |

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| Faculty/Institute: | Faculty of Science / Department of Chemistry |
| Course title: | Introduction to Inorganic and Organic Chemistry |
| Course code: | KCH / E101 |
| ECTS: | 10 |
| Level of course: | Bachelor |
| Teacher: | doc. Ing. Jan Čermák, CSc., RNDr. Václav Šícha, Ph.D., Mgr. Thu Huong Nguyen Thi, Ph.D. |
| Term: | Winter + Summer |
| Language of instruction: | English |
| Lectures/exercises: | 3/1 per week |
| Completion: | Exam |
| Course goal: | The aim of the inorganic part is to acquaint students with topics related to the periodic table of elements. In this course we will discuss individual chemical elements, their occurrence in nature, chemical and physical properties, laboratory preparation, industrial production, important compounds and application. In the organic part students will learn fundamentals of nomenclature and stereochemistry and acquaint themselves with chemistry of selected classes of organic compounds. |
| Abstract: | <ol style="list-style-type: none"> 1. Periodic table of the elements 2. Basic elements and their chemical compounds (hydrogen and oxygen) 3. Noble gases, halogens, chalcogens 4. Boron group, carbon group, nitrogen group 5. Alkali metals, alkaline earth metals 6. Basic characteristic of metals, production of metals 7. Transition elements 8. Systematic IUPAC nomenclature. Alkanes and cycloalkanes 9. Stereochemistry 10. Haloalkanes. Nucleophilic substitution and elimination reactions 11. Oxidation-reduction in organic chemistry. Alcohols, ethers, and thiols, sulfides 12. Alkenes and alkynes. Addition reaction 13. Arenes. Electrophilic aromatic substitution 14. Aldehydes and ketones. Nucleophilic addition to the carbonyl group |

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| Faculty/Institute: | Faculty of Science / Department of Chemistry |
| Course title: | Applied Thermodynamics: Phase behaviour |
| Course code: | KCH / E103 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | Ing. Magda Škvorová, Ph.D. |
| Term: | Winter + Summer |
| Language of instruction: | English |
| Lectures/exercises: | 2/1 per week |
| Completion: | exam |
| Course goal: | The aim of this course is to apply the theoretical knowledge of physical chemistry to solve various chemical-engineering problems. Modern PC software (EXCEL and MAPLE) and laboratory equipment are used to complete the courses. |
| Abstract: | <ol style="list-style-type: none"> 1. Critical point, critical quantities and their estimation. 2. State behaviour: Introduction 3. Virial equation of state 4. Equation of state; Principle of corresponding states 5. State behaviour (SB) of fluids and empirical laws for SB estimation of mixtures 6. Thermodynamics: Introduction 7. Thermodynamics of the ideal gas; standard states 8. Thermodynamics of real gas: excess quantities 9. Heat and work determination 10. Partial molar quantities 12. Phase equilibrium: Introduction 13. Vapour-liquid equilibrium 14. Liquid-liquid and liquid-solid equilibrium; solubility of gases. |
| Requirements on student/Prerequisites | Physical chemistry (bachelor degree) |

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| Faculty/Institute: | Faculty of Science / Department of Chemistry |
| Course title: | Experimental Methods: Laboratory Tutorials |
| Course code: | KCH / E105 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | Ing. Magda Škvorová, Ph.D. |
| Term: | Winter + Summer |
| Language of instruction: | English |
| Lectures/exercises: | 0/3 per week |
| Completion: | exam |
| Course goal: | The aim of this course is laboratory experiments for determination of physico-chemical properties of pure substances or mixtures in liquid and solid states. Students will realize several laboratory experiments. |
| Abstract: | <p>Overview of proposed experimental works (student should finish 5 of them depending on actual possibilities of individual experimental instruments)</p> <ol style="list-style-type: none"> 1. Calorimetric study of enthalpy of solution, reaction and neutralization 2. Determination of dissociation constants of weak acids by several methods 3. Refractometry of pure compounds 4. Determination of density, viscosity and fluidity of pure liquids by several methods 5. Determination of density, excess molar volumes and refractive index of binary systems in temperature dependence 6. Distillation curve of binary alcohol mixture |
| Requirements on student/Prerequisites | Physical chemistry (bachelor degree) |

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| Faculty/Institute: | Faculty of Science / Department of Chemistry |
| Course title: | Introduction to programming with MATLAB |
| Course code: | KCH / E108 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | doc. Ing. Jaromír Havlica, Ph.D. |
| Term: | Winter + Summer |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | exam |
| Course goal: | This course teaches computer programming in MATLAB. It is suitable for students with little or no previous programming experience. MATLAB combines a desktop environment tuned for iterative analysis and design processes with a programming language that expresses matrix and array mathematics directly. The course includes basic use, graphical representations, and programming in MATLAB software. |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction to Matlab 2. Basic Mathematics 3. Operations on matrix 4. M files 5. Data files and Data types 6. File Input/Output 7. Graphics 8. 2D plots 9. 3D plots 10. Matlab programming 11. Programmer's Toolbox 12. Loops and conditional statements 13. Functions 14. Numerical methods and simulations |

DEPARTMENT OF MATHEMATICS

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Advanced statistical methods |
| Course code: | KMA/E101 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher: | doc. Mgr. Ing. Martin Boďa, PhD. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 1/2 per week |
| Completion: | EXAM |
| Course goal: | The course aims at equipping students with advanced statistical methods applicable in descriptions of natural and socioeconomic phenomena. The course deepens the grasp of linear regression by extending it fully to the multivariate case and reviewing diagnostics and advanced topics that arise in modelling. The course then summarizes basic multivariate statistical methods and gives an introduction to generalized linear models. Finally, the course makes a brief overview of Bayesian statistical analysis and contrasts it with classical (i.e. non-Bayesian) statistics. The ambition is to imprint on students an understanding of statistical thinking. Students are expected to gain practical skills by working with data in program R. |
| Abstract: | <ol style="list-style-type: none"> 1. Multivariate linear regression, diagnostics, transformations and advanced issues in regression modelling. 2. Methods of dimension reduction: principal component analysis, factor analysis. 3. Methods of classification: discriminant analysis, logistic regression. 4. Generalized linear regression models, diagnostics. 5. Bayesian methods: concepts, introduction to Bayesian inference, Bayesian linear regression. |
| Requirements on student/Prerequisites | Good knowledge of basic statistics is prerequisite for this course. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Discrete Mathematics |
| Course code: | KMA/E102 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | RNDr. Martin Kuřil, Ph.D. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | The major topics in this course include sums, recurrences, elementary number theory, binomial coefficients, generating functions. The goal is to become familiar with discrete operations. |
| Abstract: | <ol style="list-style-type: none"> 1. Mathematical induction. 2. Numbers, powers and logarithms. 3. Sums and products. 4. Integer functions and elementary number theory. 5. Permutations and factorials. 6. Binomial coefficients. 7. Harmonic numbers. 8. Fibonacci numbers. 9. Generating functions. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Game Theory |
| Course code: | KMA/E103 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | RNDr. Veronika Pitrová, Ph.D. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | The student will learn the basics of game theory. |
| Abstract: | <ol style="list-style-type: none"> 1. Definition of a game, basic notions. 2. Two-player games (bimatrix games, mixed strategies, Nash's theorem, optimal points of the game). 3. Two-player zero-sum games (matrix games, mixed strategies, fundamental theorem on matrix games, graphical solution of $2 \times n$ matrix games, general solution of matrix games – linear programming). 4. Two-player cooperative games (joint strategy, cooperative payoff region, bargaining problem). 5. n-player cooperative games (coalitions, characteristic function games, imputation, core). 6. Power indices (Shapley value, Banzhaf index). |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Mathematical Analysis I |
| Course code: | KMA/E104 |
| ECTS: | 8 |
| Level of course: | bachelor |
| Teacher: | prof. RNDr. Miroslav Hušek, DrSc. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 3/2 per week |
| Completion: | EXAM |
| Course goal: | Students will learn basic concepts of mathematical analysis, mainly precise definitions of continuity, limits and derivatives. They will also learn how to use those tools in other fields, as physics, economy, and in mathematics (graphing functions, approximation by polynomial functions). |
| Abstract: | <ol style="list-style-type: none"> 1. Real numbers and their properties, suprema and infima, sequences. 2. Limits of sequences, their basic properties. 3. Calculus of limits of sequences. 4. Series of real numbers, their convergence, criteria of series of positive numbers. 5. Series of sign changing numbers, absolute and non-absolute convergence. 6. Continuity of functions and its properties. 7. Basic theorems on continuous functions. 8. Limits of functions. 9. Derivative of functions and its properties. 10. Mean value theorem and its consequences. 11. Derivatives versus monotonicity, convex functions. 12. Applications of derivatives, graphing functions. 13. Approximation by polynomial functions, Taylor polynomials. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Mathematical Analysis II |
| Course code: | KMA/E105 |
| ECTS: | 6 |
| Level of course: | bachelor |
| Teacher: | prof. RNDr. Miroslav Hušek, DrSc. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | Students will learn calculus of integration of real-valued functions of one variable and its applications in geometry and physics. They will also learn basic facts about ordinary differential equations. |
| Abstract: | <ol style="list-style-type: none"> 1. Primitive functions (antiderivatives) and their basic properties. 2. Integration by parts and substitutions. 3. Integration of rational functions and of functions transformed to them. 4. Newton integral and his basic properties. 5. Riemann integral and its relation to Newton integral. 6. Numerical approach to integrals. 7. Application of integrals in geometry (surfaces, volumes, lengths). 8. Application of integrals in physics (centers of mass, work). 9. Ordinary differential equations of 1st order. 10. Ordinary differential equations of 2nd order. 11. Applications of differential equations. |
| Requirements on student/Prerequisites | Good knowledge of differential calculus of functions of one variable is required. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Mathematical Analysis III |
| Course code: | KMA/E106 |
| ECTS: | 5 |
| Level of course: | bachelor, master |
| Teacher: | prof. RNDr. Jan Malý, DrSc. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | Theory of differential and integral analysis of functions of more variables, their usage in geometry and physics. Function series, their convergence, derivatives and integration, power series. |
| Abstract: | <ol style="list-style-type: none"> 1. Continuity and limits of functions of more variables. 2. Deeper properties of partial derivatives, gradient. 3. Implicit functions and their derivatives. 4. Extrema of functions of more variables. 5. Extrema of functions of more variables (constrained). 6. Integration of functions of more variables. 7. Riemann approach, relations to measures, other integrals. 8. Regular mapping, substitution in integrals of functions of more variables. 9. Application of integration of functions of more variables in geometry and in physics. 10. Function series, uniform convergence. 11. Derivative and integration of function series. 12. Power series. |
| Requirements on student/Prerequisites | Good knowledge of differential and integral calculus of functions of one variable is required. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Mathematical Analysis IV |
| Course code: | KMA/E107 |
| ECTS: | 5 |
| Level of course: | bachelor, master |
| Teacher: | prof. RNDr. Jan Malý, DrSc. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | Line and surface integrals and their applications, Fourier series and their calculus, Laplace and Fourier transform, calculus of variations. |
| Abstract: | <ol style="list-style-type: none"> 1. Curves and surfaces. 2. Line integrals. 3. Green theorem. 4. Surface integrals. 5. Gauss-Ostrogradsky theorem. 6. Stokes theorem. 7. Potentials, applications to physics. 8. Fourier series. 9. Fourier integral and transform. 10. Laplace transform. 11. Calculus of variations, fixed end points problems. 12. Free end points problems. |
| Requirements on student/Prerequisites | Good knowledge of differential and integral calculus of functions of more variables is required. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Ordinary differential equations |
| Course code: | KMA/E108 |
| ECTS: | 6 |
| Level of course: | bachelors |
| Teacher: | RNDr. Veronika Pitrová, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | Students will learn the basic topics of the theory of ordinary differential equations, the most important classes and methods for solving of differential equations. In the theoretical part, the existence and uniqueness theorem for non-linear equation and the conversion of the equation of the nth order to the system of the first order equations are included. Further, linear equations and systems of linear equations of the first order will be investigated. Methods of solving equations with separable variables, linear equations and systems of linear equations with constant coefficients, inclusive of variation of constants method, are involved. |
| Abstract: | <ol style="list-style-type: none"> 1. Basic definitions - definition of the solution, general, particular, singular solutions, field of directions, Cauchy problem, boundary-value problem for differential equations. 2. Systems of nonlinear differential equations of the first order, conversion of one equation of the nth order to the system of the first order equations, Cauchy problem for systems of differential equations, existence and uniqueness of the solution, local and global properties. 3. Elementary methods for solving differential equations - equations with separable variables, homogeneous equations and some other types of the first order equations. 4. Linear equations of the first order - existence and uniqueness of the solution, solution to homogeneous and non-homogeneous equations, the formula for variation of constants. 5. Systems of linear equations of the first order - existence and uniqueness of the solution, fundamental solution matrix, the formula for variation of constants, systems of linear equations of the first order with constant coefficients. 6. Linear equations of the nth order, conversion to the systems of the first order linear equations, fundamental system of solutions, Wronskian, equations with constant coefficients, particular solution for special form of right-hand sides. |
| Requirements on student/Prerequisites | Good knowledge of differential and integral calculus of functions of one variable is required. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Probability and Statistics |
| Course code: | KMA/E109 |
| ECTS: | 6 |
| Level of course: | bachelor |
| Teacher: | doc. Mgr. Ing. Martin Boďa, PhD. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | The course aims at equipping students with basic notions of probability theory and mathematical statistics applicable in descriptions of natural and socioeconomic phenomena. The course begins with an elementary introduction into univariate and multivariate descriptive statistics, then makes through a selective overview of probability theory, and finalizes with basic introduction into inferential statistics. The ambition is to imprint on students an understanding of statistical thinking. Students are expected to gain practical skills by working with data in a suitable statistical software package (Microsoft Excel, R). |
| Abstract: | <ol style="list-style-type: none"> 1. Descriptive statistics for univariate and multivariate data: measures of central tendency, dispersion, correlation and dependence. 2. Exploratory data analysis: visual display of quantitative data. 3. Theory of random variables and probability laws. 4. Discrete probability distributions, their properties and applications. 5. Continuous probability distributions, their properties and applications. 6. Laws of large numbers, central limit theorem. 7. Concepts of inferential statistics, theory of random sample. 8. Point and confidence estimation of univariate parameters. 9. Testing of hypotheses of univariate parameters: parametric and non-parametric approaches. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Problem Solving Methods for Mathematics |
| Course code: | KMA/E110 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | RNDr. Veronika Pitrová, Ph.D |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | The course further develops the student's competence in the field of the formulation and the solution of mathematical exercises, problems and problem situations. Attention is paid to independently solving various types of exercises, to choosing appropriate strategies, to taking advantage of knowledge from various mathematical disciplines, to using computers. Students will learn inductive procedures, induction, generalization and stating hypotheses, deduction and proofs, further parametrical exercises, discussion about the number of solutions. |
| Abstract: | 1. Problems, history. 2-6. Strategies of problem solving (analogy, generalization, specialization, algebraic way, geometric way, and so on). 7-10. Method of generated problems. 11-12. Investigation of mathematical situations, models of non-mathematical situations. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Time Series |
| Course code: | KMA/E111 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher: | doc. Mgr. Ing. Martin Boďa, PhD. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 1/2 per week |
| Completion: | EXAM |
| Course goal: | The course seeks to acquaint students with the main concepts of modern time series theory universally applicable in describing the passage of natural and socioeconomic phenomena. Students will master methods of forecasting and analysis of time series based on the Box-Jenkins methodology of ARMA (p,d,q) models. They will understand difficulties associated with non-stationarity, and will learn methods how to tackle its presence. Finally, students will learn the pitfalls of running regressions with non-stationary time series. The course emphasises building of practical skill when working with real-world data in program R. |
| Abstract: | <ol style="list-style-type: none"> 1. Stochastic processes and their main characteristics. Stationary stochastic processes. Wold decomposition. 2. Moving average models MA(q). Condition of invertibility. Autoregressive models AR(p). Yull-Worker equations. Stationarity conditions. Autoregressive-moving average models ARMA(p,q). 3. Coefficient estimation in ARMA (p,q) processes. Box-Jenkins methodology to identification of stationary time series models. 4. Forecasting, trend and seasonality in the framework of the Box-Jenkins model 5. Non-stationary time series. Time series with non-stationary variance, non-stationary mean. ARIMA (p,d,q) models. The use of Box-Jenkins methodology to determination of order of integration. 6. The unit root problem. Spurious trends and regressions. Unit root tests. 7. Unit root and structural changes. Non-stationary time series, trend stationarity versus difference stationarity. 8. Regressive dynamic models. Autoregressive models with distributed lags (ARDL). |
| Requirements on student/Prerequisites | Good knowledge of statistics is prerequisite for this course. |

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| Faculty/Institute: | Faculty of Science / Department of Mathematics |
| Course title: | Topology |
| Course code: | KMA/E112 |
| ECTS: | 6 |
| Level of course: | bachelor, master |
| Teacher: | RNDr. Veronika Pitrová, Ph.D. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | Students will learn basic concepts of topology – basic constructions, separation axioms, compactness, metrizability, functions spaces. |
| Abstract: | <ol style="list-style-type: none"> 1. Basic notions (open and closed subsets, continuity). 2. Basic constructions (subspaces, products, sums, quotients). 3. Separation axioms. 4. Compact spaces. 5. Compactifications. 6. Generalizations of compactness. 7. Normal spaces, Urysohn's lemma. 8. Metrizability. 9. Functions spaces. 10. Stone-Weierstrass theorem. 11. Brouwer's fixed-point theorem. 12. Topological groups. |

DEPARTMENT OF PHYSICS

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Atomic and Nuclear Physics |
| Course code: | KFY / E511 |
| ECTS: | 10 |
| Level of course: | bachelor |
| Teacher: | doc. RNDr. Anna Macková, Ph.D. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 3/2 per week |
| Completion: | credit, exam |
| Course goal: | <ol style="list-style-type: none"> 1. In the frame of the course will be explained the basic concepts of atomic and nuclear physics. We begin with description of atomic models as were developed in accordance to the important experiments accomplished at the beginning of 20th century. 2. Thomson's experiment, discovery of electron, Rutherford experiment leading to the hypothesis of atomic nuclei, the observation of optical spectral lines during study of discharges in gases will be discussed. The study of spectral lines led to the Bohr atom model and to the birth of quantum mechanics itself. The atomic orbital model provided a new theoretical basis for spectroscopy. 3. Main experiments leading to quantum theory introduction will be studied and commented in the frame of classical and quantum physics differences: photoelectric effect and its Einstein's interpretation, Compton's effect and wave-particle duality of particles, Davison-Germer experiment, Planck's interpretation of black-body radiation. 4. Basic ideas and concepts of quantum mechanics will be presented and applied in the frame of quantum-mechanic model of hydrogen atom. Schrödinger equation for hydrogen atom will be solved and then we discuss the meaning of the hydrogen atom wave functions and energies. 5. In the frame of atomic shell structure will be looked through the Frank-Hertz experiment, angular momentum of electron, spin of electron, magnetic behavior of atoms, atomic shell structure in accordance with periodic table of elements. The basic information about the origin, main principles and experimental data connected with atomic optical spectra will be presented and followed by discussion about the basic rules adopted for electromagnetic transition probability. 6. Basic X-ray emission mechanism will be described and X-ray application in material science and medicine will be briefly introduced. 7. The concept of electron spin will be shown on experiments leading to the electron spin discovery (Stern-Gerlach experiments with atomic beam in non-homogeneous magnetic field, Einstein-de Haas experiment dealing with macroscopic magnetic momentum measurement). Spin-orbital coupling of electrons causing fine structure of electronic levels in atoms will be discussed. In the second part of course we will focus on nuclear physics – firstly discovery of proton and neutron and first atomic nuclei models will be introduced. Basic physical quantities as nuclei mass, binding energy as a function of nucleon number will be presented. 8. Natural radioactivity, radioactivity decay rules, conservation laws and types will be described - production of alpha, beta and gamma particles. 9. Cosmic rays origin and physical properties will be presented. Nuclear reactions, types of nuclear radiation, conservation laws and cross sections of these processes in accordance with the type of interaction (strong, weak, electromagnetic interaction) will be mentioned. 10. We will touch the following topics - nuclear models, neutrons and protons in nuclei and their characteristics, basic characteristics of other particles, different types of nuclear reactions, fission and its application in nuclear reactors, detectors of ionizing radiation, main principles of detection of neutral and charged particles. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Electricity and Magnetism |
| Course code: | KFY / E311 |
| ECTS: | 10 |
| Level of course: | bachelor |
| Teacher: | doc. RNDr. Jaroslav Pavlík, CSc. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 4/2 per week |
| Completion: | credit, exam |
| Course goal: | The main aim of this lecture is to introduce students to basics of electricity and magnetism. Preface is discussed basic mathematical appliance of vector algebra and analysis. The lecture continues in study of electric charge and electric field, system of conductors, study of dielectrics, energy and power in electric field, continues with electric current and stationary electric field, magnetic field and non-stationary electromagnetic field and basics of circuits. The course finishes in Maxwell's equations. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Thermodynamics and Statistical Physics |
| Course code: | KFY / E369 |
| ECTS: | 10 |
| Level of course: | master |
| Teacher: | doc. RNDr. Filip Moučka, Ph.D., doc. RNDr. Michal Varady, Ph.D. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 3/1 per week |
| Completion: | credit, exam |
| Course goal: | Theoretical introduction into the equilibrium thermodynamics and statistical physics for students of physics and teachers of physics. |
| Abstract: | <p>Basic principles of Thermodynamics. Entropy. Thermodynamic potentials. Open systems. Phase equilibrium and transitions. Low Temperatures. Ideas and principles of statistical physics: thermodynamic vs. mechanical properties, statistical description, statistical ensemble and distribution, ergodicity, quantum vs. classical mechanical description.</p> <p>Microcanonical ensemble: Liouville's theorem, microcanonical distribution, number of microscopic states.</p> <p>Canonical ensemble: Boltzmann's distribution, canonical partition function, thermodynamic properties in canonical ensembles.</p> <p>Quasiclassical approximation: equipartition theorem, Maxwell-Boltzmann's distribution, Barometric formula.</p> <p>Classical ideal gas: classical approximation, de Broglie wavelength, contributions to canonical partition function and thermodynamic properties: translational, rotational, vibrational, electronic. Heat capacity.</p> <p>Ideal crystal: Classical, Einstein and Debye models, partition functions and heat capacity.</p> <p>Quantum ideal gasses: Bose-Einstein and Fermi-Dirac statistics, blackbody radiation.</p> <p>Interacting systems: molecular models, interaction energy and potentials, virial equation for gasses, the second virial coefficient.</p> <p>Numerical methods in statistical physics: Monte Carlo, Metropolis algorithm, molecular simulation.</p> |
| Literature: | <p>Pippard, A.B.: Elements of Classical Thermodynamics, Cambridge Univ. Press, 1964</p> <p>Fermi, E.: Thermodynamics, Dover Publications, Inc., New York, 1936</p> <p>Mandl, F.: Statistical Physics, John Willey and Sons, 2002</p> <p>Reif, F.: Fundamentals of Statistical and Thermal Physics, McGraw-Hill Series in Fundamentals of Physics, 1965</p> |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Solid State Physics I |
| Course code: | KFY / E861 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | RNDr. Martin Švec, Ph.D. |
| Term: | summer semester |
| Language of instruction: | english |
| Lectures/exercises: | 2/1 per week |
| Completion: | credit, exam |
| Course goal: | Structure of solids, basic principles of experimental techniques of structure determination. Crystal lattice, oscillations of crystal lattice, specific heats. Crystalline defects, stiffness of crystals. Electrical properties of solids. Basics of the band theory of solids. Classification of matters based on electric conductivity. Electrons in periodic potential. Intrinsic and extrinsic semiconductors and their applications. Transport phenomena in solids. Magnetic properties of solids. Superconductivity. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Solid State Physics II |
| Course code: | KFY / E961 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher: | RNDr. Martin Švec, Ph.D. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 2/1 per week |
| Completion: | credit, exam |
| Prerequisites: | KFY/E861 (Solid State Physics I) |
| Course goal: | Optical properties of solids, interaction of electromagnetic radiation with matter, photoconductance. Special properties of surfaces, thermoemission. Experimental methods of solid state physics. Boundaries of two solids, PN transition and it's application in electronics. Boundaries of solids and vacuum, emission of particles, photoeffects at boundaries. Interactions of ions with solids, applications. Basics of physics of thin solid films. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | An Introduction to Quantum Physics |
| Course code: | KFY / E530 |
| ECTS: | 5 |
| Level of course: | Bachelor |
| Teacher: | doc. RNDr. Dušan Novotný, CSc. |
| Term: | summer semester |
| Language of instruction: | english |
| Lectures/exercises: | 3/1 per week |
| Completion: | credit, exam |
| Course goal: | The lecture is the first part of the course, which is aimed at an understanding the fundamentals of quantum mechanics (QM) and its importance in the modern physics. Theoretical and experimental starting points of QM. The mathematical introduction. The postulates of QM - a general discussion. Schrödinger equation. The measurement in QM. The uncertainty relations. The relations of QM to the classical mechanics (the classical limits). Simple problem in one dimension (the free particle, the single-step potential, the continuity equation for probability, the quantum tunnelling, the particle in a potential box). The harmonic oscillator. The angular momentum (the eigenvalue problem of L^2 and L_z). |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Quantum Physics |
| Course code: | KFY / E737 |
| ECTS: | 5 |
| Level of course: | Master |
| Teacher: | doc. RNDr. Dušan Novotný, CSc. |
| Term: | summer semester |
| Language of instruction: | english |
| Lectures/exercises: | 3/1 per week |
| Completion: | credit, exam |
| Prerequisites: | KFY/E530 (An Introduction to Quantum Physics) |
| Course goal: | This lecture is closely continuous with Quantum mechanics II. Hydrogen atom. Spin. Pauli-equation. The approximate methods of the quantum mechanics (QM). The generalization of QM to many-particle systems. Identical particles and the principle of their indistinguishability. Bosons and fermions. The one-particle approximation. The Pauli exclusion principle. The basic idea of a relativistic quantum theory (Klein-Gordon and Dirac equation). |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Measurements and Processing of Experimental Data |
| Course code: | KFY / EA51 |
| ECTS: | 5 |
| Level of course: | master, bachelor |
| Teacher: | doc. RNDr. Jaroslav Pavlík, CSc. |
| Term: | summer semester |
| Language of instruction: | english |
| Lectures/exercises: | 2/0 per week |
| Completion: | credit, exam |
| Course goal: | The subject introduces basic pieces of knowledge for measurement evaluations including errors determination, measurement uncertainty and basics of regression analysis. Random quantities, important distributions of probability, the method of least squares. Directly and indirectly measured quantities. Measurement methods. Interpolation. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Numerical Methods of Hydrodynamics |
| Course code: | KFY / E753 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher: | Doc. RNDr. Michal Varady, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | credit, exam |
| Course goal: | An introductory course on numerical methods based on finite differences algorithms applicable to the solution of partial differential equations in hydrodynamics. The course is eligible to students of computer modelling. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Computer Modelling – Particle Modelling |
| Course code: | KFY / E523 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | Doc. RNDr. Marek Malý, Ph.D., prof. Ing. Martin Lísal, DSc. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | regular consultations |
| Completion: | credit, exam |
| Course goal: | <p>Hardware and software fundamentals of computational physics. Main directions of classical computational physics. Mathematical and computer modelling. Molecular modelling: simulation domains, particle interactions, Monte Carlo methods, molecular dynamics, dissipative particle dynamics, practical examples. Fluid modelling and hybrid modelling.</p> |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Seminar of Computer Modelling I |
| Course code: | KFY / E501 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | Doc. Doc. RNDr. Marek Malý, Ph.D. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 0/2 per week |
| Completion: | credit |
| Course goal: | The purpose of this course is to practice the algorithms used in computer physics such as Molecular Dynamics, Monte Carlo, Simulated Annealing etc. Illustrative problems: Travelling Salesman Problem, Simulation and analysis of the hard spheres system, 1D hybrid modelling of plasma-probe interaction etc. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Programming C/C++ |
| Course code: | KFY / E235 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | Doc. Doc. RNDr. Marek Malý, Ph.D. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 0/3 per week |
| Completion: | credit |
| Course goal: | In the course basics of programming in C/C++ language are presented and practised on PC lab. Students learn to think algorithmically and write console and simple GUI applications. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Programming A |
| Course code: | KFY / E103 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | RNDr. Zdeněk Moravec, Ph.D. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 0/3 per week |
| Completion: | credit |
| Course goal: | Course of programming in the Fortran language (Fortran norms 90 and 95). Using compilers for Linux (Intel Fortran) and using dislin graphics routines. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Physical Problems and Their Solutions A - for secondary school teachers |
| Course code: | KFY / E736 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher: | RNDr. Eva Hejnová, Ph.D., RNDr. Jiří Králík, Ph.D. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 0/2 per week |
| Completion: | credit |
| Prerequisites: | Basic Physics Courses |
| Course goal: | Seminar is aimed at the solving of physical problems from educational physics. The emphasis is given to solving questions concerning misconceptual ideas from mechanics and thermal physics, and some more difficult school problems. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Physical Problems and Their Solutions B - for secondary school teachers |
| Course code: | KFY / EA26 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher: | RNDr. Eva Hejnová, Ph.D., RNDr. Jiří Králík, Ph.D. |
| Term: | summer semester |
| Language of instruction: | english |
| Lectures/exercises: | 0/2 per week |
| Completion: | credit |
| Prerequisites: | Basic Physics Courses |
| Course goal: | Seminar is aimed at the solving of physical problems from educational physics. The emphasis is given to solving questions concerning misconceptual ideas from electricity, magnetism, optics, physics of atoms, and some more difficult school problems. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Physics of Cosmic Plasma and magnetohydrodynamics |
| Course code: | KFY / E865 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher | Doc. RNDr. Michal Varady, Ph.D. |
| Term: | summer semester |
| Language of instruction: | english |
| Lectures/exercises: | 2/1 per week |
| Completion: | credit, exam |
| Course goal: | The course presents an introduction to plasma physics with a stress to applications in the space physics and astrophysics. The first part of the course is devoted to the standard plasma theory (plasma properties, motion of individual charged particles in electromagnetic fields, magnetic mirroring, waves in plasma, transport theory, instabilities, fundamentals of kinetic theory) the second part of the course is devoted to the magnetohydrodynamic description of large scale plasma phenomena. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Modelling of Processes in Technology I |
| Course code: | KFY / E864 |
| ECTS: | 5 |
| Level of course: | bachelor, master |
| Teacher: | Doc. RNDr. Marek Malý, Ph.D. |
| Term: | summer semester |
| Language of instruction: | english |
| Lectures/exercises: | 2/1 per week |
| Completion: | credit, exam |
| Course goal: | The goal of this course is to give an introduction to the software package Simulink for modelling and analysing dynamic systems. Students are acquainted with the basic tools needed to use the Simulink package. Besides of usage of predefined built-in functional blocks also creation of own functional blocks is demonstrated on examples. The possibility to combine Matlab and Simulink for problem solving is demonstrated as well. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Modelling of Processes in Technology II |
| Course code: | KFY / E963 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher: | Doc. RNDr. Marek Malý, Ph.D. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 2/2 per week |
| Completion: | credit, exam |
| Course goal: | Introduction to artificial neural networks, genetic algorithms and some other heuristic optimisation algorithms. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Programming – Matlab |
| Course code: | KFY / E130 |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | RNDr. Martin Švec, Ph.D. |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 0/3 per week |
| Completion: | credit |
| Course goal: | In the course basics of programming in Matlab language are presented and practised. Students learn to think algorithmically and write simple applications. |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Ion Analytic Methods |
| Course code: | KFY / E293 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher: | doc. RNDr. Anna Macková, Ph.D. |
| Term: | winter/summer semester |
| Language of instruction: | english |
| Lectures/exercises: | 18 hours in 3x 6 hour block including practice in laboratory |
| Completion: | credit |
| Prerequisites: | |
| Course goal: | The lecture is focused on the physical description of the main processes taking place in the interaction of charged and neutral particles with the solid, where there are a series of elastic and inelastic processes involving the incident particles and the atoms of the target material. |
| Abstract: | <p>In addition, a neutron nuclear analytical method for elemental analysis, it means neutron activation analysis (NAA) and neutron depth profiling (NDP), will be part of lectures based on nuclear reactions with light nuclei of the studied material. Part of the lecture is a basic description of these phenomena, their physical principles and the use of these processes for qualitative and quantitative elemental analysis of materials. In the frame of the lecture main physical principles and applications of ion analytical methods will be described, which are used for the study of surface properties and solids interface. Ion beam analytical techniques and neutron beam techniques will be directly discussed in connection to significant applications in material science and technology. Ion elastic processes with target nuclei (RBS - Rutherford back scattering, ERDA - RBS-channeling) will be presented as well as inelastic processes with electrons of target atoms or nuclear reactions (PIXE - proton-induced retgenic fluorescence, NRA - analysis by nuclear reactions). At the end of the lecture is presented an overview of methods, their use and comparison of analytical possibilities they provide (sensitivity, depth and area resolution, lowest detectable concentration etc.)</p> <ol style="list-style-type: none"> 1. Elastic and inelastic processes occurring after impact of charged particles on solids 2. Sources of charged particles for nuclear analysis 3. Basic principles of ion spectroscopy, X-ray. and gamma spectroscopy 4. Fundamentals of ion beam analytical methods - RBS, ERDA, quantitative and qualitative analysis 5. Fundamentals of Nuclear Analytical Ion Methods - PIXE PIGE, NRA, Quantitative and Qualitative Analysis 6. Method of ion channeling in crystalline materials 7. Ion microprobe and elemental lateral mapping 8. Application of ion beam analytical methods on different types of materials - sensitivity, element profiling, detection limits 9. Elastic and inelastic processes occurring after the neutrons impact on the solid 10. Neutron sources - nuclear reactors and instrumentation of neutron diffraction and NAA 11. Basic principles of neutron spectroscopy 12. NDP, NAA - nuclear methods and their qualitative and quantitative possibilities 13. Practical exercises at the Tandetron Laboratory, ÚJF AV ČR, v. I. <p>Practical demonstration of knowledge by performing measurements and elaboration of a protocol / presentation on selected topics from the lecture circle.</p> |
| Literature: | <ol style="list-style-type: none"> 1. Tirira J., Serruys Y., Trocellier P.: Forward recoil spectrometry, Plenum Press, New York 1996. Feldman L.C., Mayer J.W.: Fundamentals of surface and thin film analysis, North-Holland, New York 1986. |

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| | <p>2. Tesmer J. R., Nastasi M.: Handbook of modern ion beam materials analysis, Materials research society, Pittsburgh 1995.</p> <p>3. Frank L., Král J.: Metody analýzy povrchů; iontové, sondové a speciální metody, Academia, Praha 2002.</p> <p>4. A. Mackova, A. Pratt, Handbook of Spectroscopy: Second, Enlarged Edition, 2-4 (2014) 741-778, Ion/Neutral Probe Techniques (Book Chapter).</p> <p>5. C. Jeynes, M.J. Bailey, N.J. Bright, M.E. Christopher, G.W. Grime, B.N. Jones, V.V. Palitsin, R.P. Webb, "Total IBA" – Where are we?, Nuclear Instruments and Methods in Physics Research B 271 (2012) 107–118.</p> <p>6. A. Zucchiatti, A. Redondo-Cubero, Ion beam analysis: New trends and challenges, Nuclear Instruments and Methods in Physics Research B 331 (2014) 48–54.</p> <p>7. C. Jeynes, N. P. Barradas, and E. Szilágyi, Accurate Determination of Quantity of Material in Thin Films by Rutherford Backscattering Spectrometry, Anal. Chem., 2012, 84 (14), pp 6061–6069.</p> <p>8. Kim Man Yu, Ion Beam Analysis in Materials Science, Lawrence Berkeley National Laboratory.</p> <p>9. https://drive.google.com/file/d/0B2JUoXR-XKz6OWNhZWRjNGYtNTFmNC00YzFiLTkzYjltNjMzOGI2MTlhNmVh/view</p> |
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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Physical methods of thin film deposition |
| Course code: | KFY / E223 |
| ECTS: | 5 |
| Level of course: | master |
| Teacher: | Mgr. Jindřich Matoušek, Ph.D. |
| Term: | summer semester |
| Language of instruction: | english |
| Lectures/exercises: | 2/0 per week |
| Completion: | credit, exam |
| Prerequisites: | |
| Course goal: | <p>The aim of this course is to achieve elementary orientation in the field of thin film deposition technology. The students should understand the relation between the composition and properties of the thin films as well as the influence of the deposition parameters. The blocks covered by this subject are:</p> <p>Plasma discharges (glow discharge and arc) – basic properties, interactions of plasma discharge with electrodes and surfaces.</p> <p>Vacuum evaporation – principle, homogeneity of deposition.</p> <p>Sputtering – principle, DC, pulsed DC and RF sputtering, magnetrons, reactive sputtering.</p> <p>Other methods of thin film deposition – laser ablation, IBAD, Langmuir-Blodgett films, anodic oxidation.</p> <p>Chemical and physicochemical deposition methods – CVD, PE CVD</p> <p>Characterization of the deposition processes – deposition rate measurement, OES, QMS</p> <p>Substrate cleaning and preparation – chemical treatment, annealing, ion etching</p> |
| Abstract: | |
| Literature: | |

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| Faculty/Institute: | Faculty of Science / Department of Physics |
| Course title: | Introduction to Supramolecular chemistry |
| Course code: | KFY / E701 |
| ECTS: | 5 |
| Level of course: | |
| Teacher: | Prof. RNDr. Pavla Čapková, DrSc |
| Term: | winter semester |
| Language of instruction: | english |
| Lectures/exercises: | 3/2 per week |
| Completion: | credit, exam |
| Prerequisites: | Basic knowledge of organic and inorganic chemistry |
| Course goal: | Explanation of basic principles of supramolecular chemistry and its use in nanotechnologies |
| Abstract: | Principles of supramolecular chemistry; Weak intermolecular interactions and H-bond; Host-guest supramolecular structures; Examples of supramolecular complexes and functional nanostructures; Intercalation chemistry; Self-organized structures; Computer design of supramolecular structures; |
| Literature: | Supramolecular Chemistry – Fundamentals and Applications; Advanced Textbook; Katsuhiko Ariga and Toyoki Kunitake |

DEPARTMENT OF INFORMATICS

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Digital Systems |
| Course code: | KI/ECIS |
| ECTS: | 8 |
| Level of course: | bachelor |
| Teacher: | doc. Sergii Babichev, DSc., Ing. Petr Haberzettl |
| Term: | summer and winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 3/2per week |
| Completion: | Exam |
| Course goal: | The aim of the course is to acquaint students with the principles of logic circuits operation, combinational and sequential logic circuits and characteristics of the basic components of microcomputers and their connection to the bus system. The aim of the exercise is to programming and development of simple applications. |
| Abstract: | <ol style="list-style-type: none"> 1. Boolean functions and Boolean expressions 2. Combinational networks and synthesis of combinational circuits 3. Mathematical models of behavior of sequential circuit 4. Finite state automata as a model for the behavior of an asynchronous sequential circuit 5. State assignment for sequential circuits and their minimization 6. Design of synchronous sequential circuits 7. Synthesis of asynchronous sequential circuits 8. Iterative circuits 9. Basic parts of microcomputers 10. Development of microprocessors and microcomputers 11. Peripheral equipment of microcomputers, Interrupt system 12. Memory circuits and support circuits 13. Serial communication - electrical standards, communication protocols, serial bus |
| Requirements on student/Prerequisites | Introductory course of digital systems – knowledge of the basic circuits principles |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Data Analysis and Visualisation |
| Course code: | KI/EDAV |
| ECTS: | 9 |
| Level of course: | bachelor |
| Teacher: | doc. RNDr. Sergii Babichev, CSc., RNDr. Zbyšek Posel, Ph.D., RNDr. Jiří Škvor, Ph.D., |
| Term: | Summer semester/ Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 3/3 per week |
| Completion: | EXAM |
| Course goal: | The course focuses on the presentation of information that are necessary to the basic and comprehensive evaluation of the data. Emphasis is placed on gaining the ability to visualize data by appropriate means. An integral part of the course is the practical application of theoretical knowledge on available data using appropriate software tools (typically Python, R, Matlab, Excel). |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction to Matlab 2. Programming and plotting in Matlab 3. Matrices and matrix operation in Matlab 4. Function of one real variable, numerical differentiation and integration 5. Ordinary differential equations 6. Signal and image processing: filtering, transformation (Fourier, wavelets) 7. Introduction to R: data structures, writing functions, control statements, loops, data manipulation, plots etc. 8. Basic concepts of descriptive statistics: methods of data processing, frequency distribution (histogram, polygon) 9. The statistical analysis of univariate data: moment/quantile measures of central tendency, variability, skewness and kurtosis 10. Statistical analysis of multivariate data: correlation, factor and cluster analysis 11. Regression analysis: linear and nonlinear regression models 12. Analysis of time series: graphical analysis, decomposition, autocorrelation, trend modeling 13. Summary of selected techniques of static and dynamic visualization |
| Requirements on student/Prerequisites | basics of procedural programming (conditional statements, loops, procedures) elementary algebra and calculus |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Dependability of Information Systems |
| Course code: | KI / EDEP |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | doc. RNDr. Viktor Maškov, DrSc., |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/1 per week |
| Completion: | Exam |
| Course goal: | The course gives introduction into the problem of dependability of information systems. The issues of self-checking and self-diagnosis of computing systems will be explained in details during the given course. The main subject of the course focuses on the tasks of reliability and fault-tolerance of information system. |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction to the problems of dependability 2. Fault-tolerance of information systems 3. Techniques for providing fault-tolerance of information systems 4. Self-checking and self-diagnosis at system level 5. N-variant programming and object oriented programming 6. Exception handling in N-variant programming 7. Competing and cooperative concurrent systems 8. Conversation in distributed systems 9. Coordinated atomic actions 10. Dependability of distributed applications 11. Using groups of objects for providing fault-tolerance of complex systems 12. Dependability concepts with respect to malicious faults |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Dependability of Hardware Systems |
| Course code: | KI / EDHW |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | doc. RNDr. Viktor Maškov, DrSc. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/1 per week |
| Completion: | Exam |
| Course goal: | The course gives introduction into the problems of HW system dependability. The course gives the knowledge of how to assess the reliability of hardware and gives the explanation of what reliability control means. More attention will be devoted to the fault-tolerance of hardware and to the reliable group communication. |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction to the problems of dependability of hardware. 2. Basics of terminology. 3. Measurement of reliability of HW. 4. Measures and metrics. 5. Measurement techniques. 6. Development of reliable HW. 7. Reliability control. 8. Fault-tolerance of hardware. 9. Redundant structures. 10. Fault trees. 11. Fault-tolerance of distributed systems. 12. Reliable group communication. |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Data Mining Techniques based on R Software |
| Course code: | KI/EDMR |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | doc. Sergii Babichev, DrSc. |
| Term: | Summer semester, Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | <p>This e-learning course is focused to students who are planning to work as IT specialists in the fields related to analytics, data mining solutions, marketing etc., who want to learn about both the practical application and implementation of data mining methods based on one of the modern programming languages R.</p> <p>The aim of the course is to acquire knowledge and practical experience in the field of information processing, including the acquisition of useful skills. Software R offers a large number of methods for implementing of the functional programming paradigm during the corresponding project creation and implementation. For these reasons, the proposed course is actual and interesting for students who are focused to development and practical implementations of IT technologies based on R language.</p> <p>The course is available on moodle webpage by link: https://kacer.ujep.cz/course/view.php?id=65 . Přístup pro hosty: data_mining_R</p> |
| Abstract: | <ol style="list-style-type: none"> 1) Data visualization techniques in R 2) Basic concepts of regression analysis 3) Basic of data exploration in R 4) Techniques of data managing and transforming 5) Basics of data clustering. Clustering quality criteria 6) K-means, C-means and Hierarchical Clustering Algorithms in R 7) Density-Based DBSCAN and OPTICS Clustering Algorithms in R 8) Data Classification: Basic Concepts and Application with R 9) Basics of Fuzzy Logic. Steps of Fuzzy Inference Process Implementation 10) Practical Implementation of Fuzzy Inference Techniques Based on R Software Tools 11) Basics Concepts of Time Series Processing. Techniques of Time Series Analysis and Processing Based on R Software Tools 12) Applying Data Mining Techniques for Data Processing Based on R Software Tools |
| Requirements on student/Prerequisites | Basics of programming in R |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Algorithms and Data Structures |
| Course code: | KI/EDSA |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | Mgr. Květuše Sýkorová, RNDr. Jiří Škvor, Ph.D. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | The course is targeted to the basic data structures, especially is focussed on the list, queue, stack, linked list, hash table, index, searching tree structures and on the algorithms over this structures. Attention is paid not only to the formal description of above mentioned structures and algorithms, but also to its practical implementation. |
| Abstract: | <ol style="list-style-type: none"> 1. Terminology, time complexity, memory complexity 2. Basic data structures - array, list, stack, queue 3. Sorting algorithms $O(n^2)$ - SelectSort, InsertSort, BubbleSort 4. Sorting algorithms $O(n^k)$ - ShellSort, KnuthSort, HeapSort 5. Sorting algorithms $O(n \cdot \log_k n)$ - QuickSort, MergeSort 6. Sorting algorithms $O(k \cdot n)$ - RadixSort, BucketSort 7. Searching algorithms - Brute Force, Binary Search, Interpolation Search 8. Indexing - Dense Index, Sparse Index, Multilevel Index 9. Hashing - Close Hash Table, Open Hash Table, Perfect Hash, Rehash 10. Tree structures - properties, Binary Tree, Binary Search Tree 11. Tree structures - Digi Tree, B-Tree 12. Balanced tree structures - AVL-tree, Red-Black tree 13. Special tree structures - Trie, Splay, Treap, Randomized BST 14. Algorithms of computational geometry |
| Requirements on student/Prerequisites | Basics of procedural programming (conditional statements, loops, procedures) |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Dependability of Software Systems |
| Course code: | KI / EDSW |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | doc. RNDr. Viktor Maškov, DrSc. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/1 per week |
| Completion: | Exam |
| Course goal: | In the course, the basics of development of reliable software are given. The course gives the knowledge of how to assess the achieved level of reliability of software and explains what should be done in order to improve software reliability if needed. The students will be acquainted with the existing facilities used for modeling of software reliability. More attention will be devoted to the architectures of fault-tolerant software. |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction to the problems of dependability of software. 2. Basics of SW engineering. 3. SW verification. 4. SW validation. 5. SW reliability. 6. Tools for SW assessment. 7. Models of SW reliability. 8. Diagnosis of SW. 9. Architectures of fault-tolerant SW. 10. Diagnosis model of a SW system. Comparators and consistent set of units. 11. Tools used for developing a reliable SW. 12. Formal methods for developing a reliable SW. |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Database Systems |
| Course code: | KI / EDSY |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | Mgr. Jiří Fišer, Ph.D., doc. RNDr. Viktor Maškov, DrSc., |
| Term: | winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2per week |
| Completion: | Exam |
| Course goal: | Aim of this course is to gain basic theoretical knowledge of database systems design oriented to relational systems. Design of models combines three ways of data processing: conceptual modelling (ER model), database modelling (relational model using normal forms) and object-relational modelling (object oriented concept). |
| Abstract: | <ol style="list-style-type: none"> 1. Basic principles and history of database systems. 2. Basic conceptions and principles (object, entity, attribute, relation, query, view). 3. Database systems architecture. 4. Conceptual data model (ER model). 5. Relational data model (entity, relation, integrity, domains). 6. Transformation of conceptual model into relational model. 7. Database design. 8. Normalization and denormalization of relational data model. 9. Database languages - SQL basics. 10. Database languages - DDL SQL, DML SQL. 11. Database languages - DQL SQL, DCL SQL. 12. Transactions and triggers, failure recovery. 13. Introduction to object-relational database design. |
| Requirements on student/Prerequisites | Basics of procedural programming (loops, procedures), elementary data types (numbers, string, booleans), principles of efficient data representation (hashes, binary trees) |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Data Storage and Processing |
| Course code: | KI / EDUL |
| ECTS: | 8 |
| Level of course: | bachelor |
| Teacher: | Ing. Pavel Kuba, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/3 per week |
| Completion: | Exam |
| Course goal: | The objective of this course is to provide introduction into multidimensional databases and data warehouses and principles of data mining. |
| Abstract: | <ol style="list-style-type: none"> 1. Basic principles of online analytical processing (OLAP) and online transaction processing (OLTP) 2. Architecture of multidimensional databases 3. Architecture of data models and data warehouses 4. Transformation of relational databases into multidimensional databases and data warehouses 5. Extract, Transform and Load (ETL) phase 6. Creation and accessing methods 7. Reports and client applications 8. Working with OLAP databases 9. Data warehouse development 10. Statistical principles of data mining 11. Data mining: physical and conceptual models 12. Data mining: algorithms, evaluation and verification of models |
| Requirements on student/Prerequisites | Basic knowledge of programming and databases. |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | GUI Programming |
| Course code: | KI / EGUI |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | RNDr. Petr Kubera, Ph.D. |
| Term: | summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | Exam |
| Course goal: | The objective of this course is to initiate the students to the concept of visual programming and event driven programming. |
| Abstract: | <ol style="list-style-type: none"> 1. Event driven programming, delegates, events, design pattern Observer 2. Visual design of application, working with forms, dialogs. 3. SDA, MDA application, collecting data from forms 4. Working with XML, serialization, SOAP 5. Globalization and localization 6. Working with databases 7. Multithreading, visual multithreaded application 8. Usage graphics libraries (GDI+, DirectX, OpenGL, XNA) 9. Printing 10. User defined components 11. Reflection, plugins 12. Network applications |
| Requirements on student/Prerequisites | Advanced knowledge of OOP (C# or Java or C++) or in Python. |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Information and Communication Technologies |
| Course code: | KI/EICT |
| ECTS: | 8 |
| Level of course: | bachelor |
| Teacher: | Ing. Pavel Kuba, Ph.D. |
| Term: | Winter and Summer term |
| Language of instruction: | English |
| Lectures/exercises: | 2/3 per week |
| Completion: | Pre-Exam |
| Course goal: | The course will provide students with competencies in three main areas, i.e. hardware, software and other IT skills, which could be used at work with computer and its administration. Students will acquire basic knowledge about PC components and will practice the use of the Office packages, Windows, Linux, and gain awareness of safety in the network, especially on the Internet. Competence in the area of software applied in the course will be practiced in seminary work. Students will also learn how to use the more advanced features of Office packages. |
| Abstract: | <ol style="list-style-type: none"> 1. Linux OS architecture: file systems, users, processes, 2. Introduction to the system shells, working with files and directories 3. Users and groups, permissions, management 4. Process management, priorities, signals, interprocess communication 5. Tools for text processing, pipes, grep 6. System services, principles of services configuration 7. The individual hardware components of a computer and work with them, work with computer peripherals, the safe use of a computer, computer network 8. Presentation of the currently used version of the operating system MS WINDOWS, orientation in the system, work with folders, system administration at the user level, basic programs, data compression 9. Software competence (MS WORD): the creation of a coherent document such as seminar work, bachelor's thesis and letter, sharing document and mail merge 10. Software competence (MS EXCEL): comprehensive data processing, statistical data processing, creation of schemas 11. Software competence (MS POWERPOINT): making professional presentations, and common mistakes 12. Other IT skills: a basic overview, safe use of public computer network, netiquette, news in the area of IT (hardware, software, applications) |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Internet Technologies and Protocols |
| Course code: | KI/EITP |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | RNDr. Jan Krejčí, Ph.D. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 1/2 per week |
| Completion: | Exam |
| Course goal: | The course focuses on the application layer of TCP / IP model and its corresponding layers of the ISO/OSI reference model. Students in the lecture will become familiar with the most commonly used protocols and services on the Internet. Within the workshops, students will configure individual services and monitor computer communications, in which they will detect and analyze individual protocols and their packets. |
| Abstract: | <ol style="list-style-type: none"> 1. Basic concepts, repetition of TCP / IP and reference model ISO / OSI 2. Description of the application layer and its functions 3. Transport layer protocols ISO / OSI - TCP, UDP 4. Records of relational layers ISO / OSI - PAP, SSL 5. Connecting to a remote console - TELNET, RSH, SSH 6. Connecting to a remote GUI - VNC, RDP 7. Sharing of data - FTP, NFS, SAMBA 8. Web services - HTTP, HTTPS 9. E-mail communication - POP3, SMTP, IMAP 10. Online Syndication - RSS, Atom 11. Protocol for real-time communication - IRC, Jabber 12. Configuration Protocol Network - BOOTP, DHCP, DNS 13. Protocols for transmission of multimedia and publishing - UPnP (DLNA), RTP, RSTP, RCTP" |
| Requirements on student/Prerequisites | Fundamentals of Computer Networks and Protocols |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Numerical Methods |
| Course code: | KI / ENME |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | doc. RNDr. Sergii Babichev, CSc., RNDr. Petr Kubera, Ph.D., RNDr. Jiří Škvor, Ph.D., |
| Term: | winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | Exam |
| Course goal: | Introduction to numerical mathematics for students of computer science. |
| Abstract: | <ol style="list-style-type: none"> 1. Function approximation, Lagrange interpolation 2. Definition of spline function, interpolation via spline-construction, derivation 3. Numerical quadrature, Newton-Cotes rules 4. Romberg's quadrature method, Gaussian quadrature rules 5. Method for nonlinear equations, Newton's (Newton-Rhapson) method 6. Fixed point method, root finding for polynomials, Horner scheme 7. System of linear equation, conditional number, Gaussian elimination 8. LU factorization, Cholesky and QR factorization 9. Basic iterative methods for the solution of linear algebraic equations 10. Eigenvalues of matrix, power method 11. Numerical solution of ODE, one step methods, Runge-Kutta methods 12. Gradient methods |
| Requirements on student/Prerequisites | Basic from linear algebra (vectors, matrices, vector spaces) and analysis. |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Object Oriented Design |
| Course code: | KI / EOON |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | RNDr. Petr Kubera, Ph.D. |
| Term: | winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 1/2 per week |
| Completion: | Exam |
| Course goal: | This course is focused on object-oriented design and software analysis in UML. Students will become familiar with structural and behavioral view and appropriate UML diagrams. At the same time students will gain an overview of selected approaches and methodologies of software development. |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction into UML, overview of software 2. The basics building blocks of UML 3. Use case diagrams 4. Structural diagrams 5. Behavioral diagrams 6. Diagram of interactions 7. Software development approaches 8. Unified Process 9. Waterfall model 10. Prototype model 11. Extreme programming 12. Overview of another software development approaches |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Optimization |
| Course code: | KI / EOPT |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | RNDr. Petr Kubera, Ph.D., |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | Exam |
| Course goal: | This course provides an introduction to basic optimization techniques. We emphasise linear programming, including integer programming and selected methods for solving nonlinear problems. An integral part of the course is solving practical problems using appropriate software. |
| Abstract: | <ol style="list-style-type: none"> 1. Mathematical properties of linear programming 2. Graphical solution of linear optimization problems 3. Primal simplex method 4. The duality theory in linear programming, the dual simplex method 5. The transportation problem, the assignment problem 6. Sensitivity analysis of LP 7. Integer programming (Gomory's cutting plane method, branch and bounds method) 8. Dynamic programming and application 9. Minimization in 1D (quadratic interpolation method, golden cut method, Fibonacci numbers method) 10. Nonlinear optimization problems without restrictions 11. Least squares method 12. Nonlinear optimization problems with restrictions |
| Requirements on student/Prerequisites | Basics from linear algebra and analysis (differential calculus). |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Operating Systems Principles and Administration |
| Course code: | KI / EOSY |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | Mgr. Jiří Fišer, Ph.D., Ing. Pavel Kuba, Ph.D., |
| Term: | Summer semester, Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | Exam |
| Course goal: | <p>Lectures: The course is focused on basic principles of contemporary operating systems and on their internal structures, especially from the view of application programmers (i.e. at the level of kernel interface, e.g. POSIX and Win32).</p> <p>Exercises: Laboratory exercises are focused on gaining practical experience with administration of operating systems. The aim of this practically based course is to introduce students to the principles of the most widely used enterprise systems with emphasis on their reliability and security. The focus will be to understand and manage Microsoft Windows Server environment and Active Directory group policies.</p> |
| Abstract: | <p>Exercises:</p> <ol style="list-style-type: none"> 1. Operating system architecture 2. Memory management 3. Memory virtualization 4. Shared memory 5. Task management (CPU scheduling) 6. Threading 7. Synchronization 8. Interprocess communication 9. I/O subsystem 10. File system 11. Operating system security 12. Operating systems and MIMD (SMP) <p>Lectures:</p> <ol style="list-style-type: none"> 1. Directory Services - an overview, history, function, safety aspects, LDAP 2. Active Directory - domains, organizational units, sites 3. Trees and forest, global catalog, DNS integration 4. Working with AD objects, ADSI, methods of administration 5. Methods of OS deployment, directory services and applications 6. The roles and functions of the server, terminal services, Internet Information Server 7. Network Services, DNS, DHCP, DirectAccess 8. Security and distribution groups, profiles, trusts, NTDSUTIL 9. Group Policy 10. Redundant Array of Independent Disks 11. PowerShell scripting environment 12. Methods of unattended installation |
| Requirements on student/Prerequisites | practical usage and configuration experience with Linux or MS Windows |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Computer Architecture |
| Course code: | KI/EPCA |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | Ing. Pavel Kuba, Ph.D. |
| Term: | Winter and Summer term |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | EXAM |
| Course goal: | This course is focused on computer hardware, and principles of IBM architecture. Individual subsystems of PC are discussed with a focus on modern trends. Laboratory classes provide students with experience in the area of computer hardware of type IBM PC and its accessories: The construction of several types of computers, their configuration, installation of basic software and troubleshooting of hardware and software issues. |
| Abstract: | <ol style="list-style-type: none"> 1. Architecture of digital computers-design, usage, building blocks of contemporary computers, computer assembly 2. Motherboard architecture and buses-components, architecture, chipsets, control unit (Northbridge, Southbridge), BIOS (Setup), UEFI. 3. Peripherals buses- ISA-PCIE, standards, comparison, usage 4. Architecture of microprocessor, types of architecture (RISC, CISC), ALU unit, control unit, instruction set, instruction cycle, addressing,... 5. Memory, principles, classification,... 6. Harddisks and its structure, construction, principles, classification 7. Display and graphical subsystem, principles, classification, CRT, LCD, parameters 8. Sound system of computer, principles of audio recording, digitalization, FM synthesis, wave table synthesis, sound files 9. Computer interfaces, classification, USB, FireWire, PS/2 ... 10. Diagnostics, measuring physical characteristics (voltage, current, power, etc.), testing components 11. PC maintenance, installing and configuring OS 12. Writing simple scripts OS 13. Backup OS, RAID, UPS 14. BIOS setup and flashing the BIOS, firmware |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Hardware Programming |
| Course code: | KI/EPGH |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | doc. Sergii Babichev, DSc., Ing. Petr Haberzettl |
| Term: | winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 1/2per week |
| Completion: | Exam |
| Course goal: | Basic principles of programming of embedded systems (and all universal processors on machine-code level in general) are introduced. The course covers both universal approach and detail description of selected hardware embedded platform. |
| Abstract: | <ol style="list-style-type: none"> 1. Architecture of processors (from programmer point of view) 2. Addressing (base and index registers) 3. Hardware interrupts 4. Bit-oriented memory access 5. Memory management 6. Programmable hardware device (ports, analog-to-digital converter etc.) 7. Assembler and machine code 8. Assembler - macros 9. Programming of embedded devices 10. High-level programming languages with support of hardware programming 11. Sensors 12. Actuators |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Programming I |
| Course code: | KI / EPGL1 |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | Mgr. Jiří Fišer, Ph.D. |
| Term: | winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | Exam |
| Course goal: | <p>Introductory course to programming which is focused on object oriented programming and basic algorithmization (procedural paradigm). Students become familiar with basic OOP concepts (object, class, methods) and procedural constructs (condition, loops). Basic classes of objects (numbers, booleans, strings), collections (lists, dictionaries) and I/O devices (streams) are also covered.</p> <p>The course is not based on particular programming language, but the utilization of OOP language with static typing, garbage collection and complete reflection (as Java or C#) is presumed.</p> |
| Abstract: | <ol style="list-style-type: none"> 1. basic concepts of object oriented programming (object, class) 2. elementary classes (numbers, strings, booleans) and their interfaces 3. class properties and methods (parsing strings, formatting) 4. variables (definition, assignment) 5. basic structure of program, procedural structures 6. text-oriented input and output 7. (extension) methods (parameter passing, return values) 8. list (indexation, iteration, duplication) 9. definition of classes (constructors, methods) 10. encapsulation (properties) 11. dictionaries (hash-based mapping) 12. byte- and character-oriented input and output (file streams) |
| Requirements on student/Prerequisites | None, elementary programming experience is an advantage |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Programming II |
| Course code: | KI / EPGL2 |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | Mgr. Jiří Fišer, Ph.D. |
| Term: | summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | Exam |
| Course goal: | <p>Second part of introductory programming course develops students' skills in the field of practical object oriented programming. The core part of course is based on object polymorphism (provided by mechanism of shared interfaces and class inheritance) and its utilization in more complex application in form of standard design patterns.</p> <p>This course also covers some parts of standard libraries (GUI, regular expressions, XML processing) and principles of exceptions.</p> |
| Abstract: | <ol style="list-style-type: none"> 1. shared interfaces and polymorphism 2. singleton design pattern and class (static) attributes and methods 3. object creation (factory method design pattern) 4. modifications of interfaces (adapter and facade design pattern) 5. dynamic extension of object functionality (decorator design pattern) 6. class inheritance 7. utilization of inheritance and alternatives 8. UML class diagrams - global view of object system 9. separation of abstraction from implementation (bridge design pattern) 10. processing structured texts (XML, regular expression) 11. encapsulation of simple action and deferred processing 12. exceptional situations and exceptions |
| Requirements on student/Prerequisites | Basics of procedural programming (loops, procedures), basics of object oriented programming (class, methods), interface of containers (list, dictionary) and file streams. |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Internet Programming |
| Course code: | KI / EPIN |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | doc. RNDr. Viktor Maškov, DrSc. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | Exam |
| Course goal: | The course focuses on the basics of XML technologies. More attention will be given to the development of XML files and to the XML Schema. While studying the course, the students will develop XML applications such as SVG (Scalable Vector Graphics) and SMIL (Synchronized Multimedia Integration Language). All the described technologies are the standards of W3C organization. It is assumed that students are already acquainted with basics of markup language XHTML, stylesheet CSS and protocols TCP/IP, HTTP which are needed to understand the issues of the course. |
| Abstract: | <ol style="list-style-type: none"> 1. Basic Internet technologies and protocols 2. Markup language XHTML 3. Stylesheet CSS 4. Markup language XML - syntax, elements, attributes 5. XML - namespaces 6. XML/DTD (definition of legal elements of XML file) 7. DTD - using entities 8. DTD - directives "INCLUDE" and "IGNORE" 9. XML - Schema (XSD: elements, attributes, facets) 10. XML - Schema (XSD: indicators, element substitution, data types) 11. SVG 12. SMIL |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Programming for Mobile Platforms |
| Course code: | KI / EPMP |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | Mgr. Jiří Fišer, Ph.D. |
| Term: | summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 1/2 per week |
| Completion: | Exam |
| Course goal: | <p>Course of programming on mobile platforms (i.e. smartphones, tablets) focuses on typical features of these platforms - prolonged life cycle, sandboxing, dynamic GUI and integration of hardware and software services. Specific platform may vary according to IT trends.</p> <p>This course has been created within the project CZ. 1.07/2.2.00/28.0296 "Intersectoral linkages and support practice in natural science and technical study programmes UJEP"</p> |
| Abstract: | <ol style="list-style-type: none"> 1) main principles 2) description of targeted platform 3) IDE and compilation chain 4) basic design patterns and idioms 5) application manifest and security 6) GUI principles 7) 2D graphics 8) internet services 9) geolocation 10) sensors 11) persistent storage and databases 12) preparation of seminar work |
| Requirements on student/Prerequisites | Programming language Java, GUI programming |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Parallel Programming |
| Course code: | KI / EPPG |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | Mgr. Jiří Fišer, Ph.D., RNDr. Zbyšek Posel, Ph.D., |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | Exam |
| Course goal: | Introductory course in parallel programming is based on classification and description of parallel systems and their basic principles. The course is focused on SMP systems with shared memory using threads (OpenMPI, Parallel-LINQ), however both asymmetrical systems (GPGPU) and massive parallelism are presented as well. Parallel implementation of basic algorithms and operations are presented in seminars. |
| Abstract: | <ol style="list-style-type: none"> 1. Principles and classification of parallel systems (Flynn's taxonomy, massively parallel systems, SMP). 2. Efficiency of parallelization (Amdahl's law, GustafsonBarsis' law). 3. Tasks and threads. Operating system support for parallelism. 4. Memory. Low-level access (caching). 5. OpenMP in C. 6. Practical application of OpenMP. 7. Parallel-LINQ and parallel tasks in C#. 8. Practical application of Parallel-LINQ. 9. OpenCL. 10. Practical application of OpenCL. 11. MPI. 12. Practical application of MPI. 13. Automatic parallelization. |
| Requirements on student/Prerequisites | Procedural programming (loops, procedures function). Programming language C. |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Computer Networks |
| Course code: | KI/EPSI |
| ECTS: | 10 |
| Level of course: | bachelor |
| Teacher: | RNDr. Jan Krejčí, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 4/2 per week |
| Completion: | Exam |
| Course goal: | The course focuses on layers L1, L2 and L3 of ISO / OSI reference model. The students will learn about the kinds of lectures transmission medium for data communication, active components in a computer network serving the switching and routing. In practical exercises they will try to model various tasks of routing protocols and routing, design of network addresses and their ranges, and not least the creation of virtual networks. |
| Abstract: | <ol style="list-style-type: none"> 1. Fundamentals of Computer Networks and Protocols 2. Protocols in TCP/IP 3. Transmission media and connectivity 4. Addressing in networks (VLSM, CIDR) 5. Architecture of switches 6. Functions of L2 and L3 switches (STP, RSTP, MST) 7. Architecture of routers 8. Routing (static) and RIP routing protocol 9. Routing protocols EIGRP, OSPF 10. Routing in Wireless Networks 11. Solving problems in routing 12. Virtual networks and routing between them (VLAN, VPN) 13. Security of switches" |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Use of Robot Kits |
| Course code: | KI/EROB |
| ECTS: | 5 |
| Level of course: | bachelor |
| Teacher: | RNDr. Jan Krejčí, Ph.D. |
| Term: | Summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 1/2 per week |
| Completion: | Exam |
| Course goal: | The aim of the course is to acquaint students in more detail with the use of LEGO Mindstorms robotic kits. They will deal with projects that require sophisticated design and programming using a kit and its control unit. Part of the course will be discussions about the possibility of using robotic kits in education and demonstration of the use of a robot as a means of teaching algorithms or basics of programming. |
| Abstract: | <ol style="list-style-type: none"> 1. Introduction to LEGO Mindstorms, design and creation of the first robot. 2. LEGO Mindstorms programming environment. 3. Programming techniques: <ol style="list-style-type: none"> a. robot movement in space, b. use of input and output modules, c. sensor data processing, d. responses to different inputs, e. working with variables and constants, f. parallel processes. 4. Methods and activities developing algorithmic thinking using robotic kits. 5. Robotics in education, examples of LEGO Mindstorms activities. |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Security Technologies |
| Course code: | KI/ESEC |
| ECTS: | 7 |
| Level of course: | bachelor |
| Teacher: | RNDr. Jan Krejčí, Ph.D. |
| Term: | Winter semester |
| Language of instruction: | English |
| Lectures/exercises: | 2/2 per week |
| Completion: | Exam |
| Course goal: | The course is designed as a basic introduction to the security field of information technology with an emphasis on basic concepts, methods, principles and techniques used in specific areas. Subject describes the system management data security, the types of analyzes and appropriate countermeasures. It analyzes different types and principles of threats, the most common defense / protection technologies including a general description of the basic methods of protecting data and information on the level of network and computer itself. Subject explains the certification process and the principles of eGovernment including quality standards of information security management. |
| Abstract: | <ol style="list-style-type: none"> 1. IT Architecture and Infrastructure 2. Information security - basic axioms, principles, classification, tools. 3. Information security management systems - services, methods, verification of security 4. Analysis of the threats and risks - assets, threats, vulnerabilities, risks, threats, countermeasures. 5. Contemporary threats of information technologies - types, techniques, options. 6. AAA framework - principles, classification, purpose, use. 7. Infrastructure PKI - basic axioms, dig. signature, hash functions, use. 8. Infrastructure PKI - dig. certificate, certificate authority. 9. Computer security - basic defensive / protective technologies, techniques, tools and methods. 10. Data security - the life cycle of data, data distribution, backup and deletion of data. 11. Principles of security and protection of data in a computer network (in the Internet). 12. Protocols and methods of security and of safety data in a computer network (in the Internet). 13. Data protection of wireless networks - principles, classification, use. |
| Requirements on student/Prerequisites | <ul style="list-style-type: none"> • Introduction to base construction of IBM PC a its subsystems. • Introduction to computer wired and wireless networks. • Introduction into the problem of dependability of information systems |

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| Faculty/Institute: | Faculty of Science / Department of Informatics |
| Course title: | Automata and Formal Language Theory |
| Course code: | KI / ETFI |
| ECTS: | 9 |
| Level of course: | bachelor |
| Teacher: | Doc. Ing. Mgr. Jiří Barilla, CSc. |
| Term: | Winter and summer semester |
| Language of instruction: | English |
| Lectures/exercises: | 4/2 per week |
| Completion: | Exam |
| Course goal: | In this course, students will learn the theoretical foundations of finite automata, grammars and pushdown automata. The emphasis is on linking the mathematical theory with practical implementation. The acquired knowledge will enable students a better understanding of the basic principles of computers designing and fundamentals of programming languages. Automata theory is closely connected with the theory of formal languages and therefore automata are often referred to as the class of formal languages that can be recognized. |
| Abstract: | <ol style="list-style-type: none"> 1. The Basic Mathematical Ideas. 2. Propositional Logic. 3. Sets and Relations, relational Structures, Mapping. 4. Boolean Algebra. 5. Languages and Automata, Finite Automata 6. Recognize Languages by Finite Automata 7. Reduction and Realization of Finite Automata. 8. Nondeterministic Finite Automata. 9. Regular Expressions and Languages. 10. Transcription Systems and Grammars, Chomsky hierarchy. 11. Regular Grammars and Languages. 12. Context-Free Languages. 13. Pushdown Automata. |