

Study plan

Name of study plan: Jaderná chemie

Faculty/Institute/Others:

Department:

Branch of study guaranteed by the department: Welcome page

Garantor of the study branch:

Program of study: Applications of Natural Sciences

Type of study: Follow-up master full-time

Required credits: 91

Elective courses credits: 29

Sum of credits in the plan: 120

Note on the plan:

Name of the block: Compulsory courses of the specialization

Minimal number of credits of the block: 91

The role of the block: PO

Code of the group: NMSJCHPP1

Name of the group: NMSJCH - povinné p edm ty 1. ro ník

Requirement credits in the group: In this group you have to gain at least 51 credits

Requirement courses in the group: In this group you have to complete at least 14 courses

Credits in the group: 51

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
15RAEK	Helena Filipská Helena Filipská Helena Filipská (Gar.)	ZK	2	2+0	Z	PO
15EXK2	Excursion 2 Alena Zavadilová, Barbora Drtinová Alena Zavadilová Alena Zavadilová (Gar.)	Z	1	5 dn	L	PO
15FCHN3	Physical Chemistry 3 Václav uba Václav uba Václav uba (Gar.)	Z,ZK	2	1+1	Z	PO
15FCH4	Physical Chemistry 4 Jan Bárta	ZK	5	3+2	L	PO
15PJCH	Practical Exercises in Nuclear Chemistry Kate ina ubová, Miroslava Semelová, Pavel Bartl Miroslava Semelová Kate ina ubová (Gar.)	KZ	4	0+4	Z	PO
15PRACH	Practical Exercises in Radiation Chemistry Jan Bárta, Lenka Prouzová Procházková Lenka Prouzová Procházková Jan Bárta (Gar.)	KZ	3	0+3	L	PO
15SEPM	Practical Exercises in Separation Methods Miroslava Semelová, Pavel Bartl, Mojmír N mec Miroslava Semelová Mojmír N mec (Gar.)	KZ	3	0+3	Z	PO
15PRAKN	Internship Václav uba Václav uba Václav uba (Gar.)	Z	4	2 týd	L	PO
15RACH	Radiation Chemistry Václav uba Václav uba Václav uba (Gar.)	ZK	4	3+0	L	PO
15RAM	Radioanalytical Methods Jan John Jan John Jan John (Gar.)	ZK	3	3+0	L	PO
15STP	Trace Radiochemistry Helena Filipská Helena Filipská Helena Filipská (Gar.)	ZK	3	3+0	L	PO
15SMJ1	Separation Methods in Nuclear Chemistry 1 Mojmír N mec Mojmír N mec Mojmír N mec (Gar.)	ZK	3	3+0	Z	PO
15VUCH1	Research Project 1 Kate ina ubová, Miroslava Semelová, Pavel Bartl, Lenka Prouzová Procházková, Mojmír N mec, Jan John, Petr Distler Lenka Prouzová Procházková Lenka Prouzová Procházková (Gar.)	Z	6	0+6	Z	PO
15VUCH2	Research Project 2 Kate ina ubová, Pavel Bartl, Lenka Prouzová Procházková, Mojmír N mec, Jan John, Petr Distler Lenka Prouzová Procházková Lenka Prouzová Procházková (Gar.)	KZ	8	0+8	L	PO

Characteristics of the courses of this group of Study Plan: Code=NMSJCHPP1 Name=NMSJCH - povinné p edm ty 1. ro ník

15RAEK		ZK	2
The first part of the course deals with general problems of the environment. Then composition of and natural processes in basic parts of biogeosphere, biogeochemical cycles of elements and natural environmental radioactivity are discussed in detail. The last part describes sources of environmental pollution, migration, chemical reactions and effects of pollutants in the environment and presents analysis of basic problems of radioecology.			
15EXK2	Excursion 2	Z	1
The excursion aims at mediating the students the acquaintance with various radiochemical and radiation methods used in practice.			
15FCHN3	Physical Chemistry 3	Z,ZK	2
At the beginning of the course, a general description and explanation of laws affecting behaviour of the particle systems is provided. Subsequently, particle systems are described at molecular level. Follows the study on the matter in motion, based on its inner structure, properties of structural elements, mutual interactions and force fields. The course also contains some practical applications and fundamental calculations.			
15FCH4	Physical Chemistry 4	ZK	5
In the first part of the Physical chemistry 4 devoted to reaction kinetics, the course is focused on the reaction rate, isolated reactions of various orders, simultaneous reactions, flow-through reactors and temperature dependence of the rate constants. Hard-sphere collision theory, activated-complex theory and chemical dynamics are thoroughly discussed here. The chain reactions of atoms and free radicals and reactions in liquid solutions are discussed, too. These subjects are trained by solving of selected reaction systems. In the second part of the course, the students are taught essentials of solids, particularly the types of bonds in solids, crystal structure and its description and crystal symmetry. The attention is also devoted to the origin of X-radiation and its use for crystal structure studies. The Debye-Scherrer's method and its application in various cases is thoroughly described here.			
15PJCH	Practical Exercises in Nuclear Chemistry	KZ	4
The exercise give the students practical introduction to fundamental principles of nuclear processes such as radionuclide decay, preparation of radionuclides with thermal neutron activation and utilization of radioactive equilibrium e.g. in radionuclide generators. The nuclear chemistry / radiochemistry processes such as Szilard-Chalmers effects, and principles of coprecipitation are demonstrated, too.			
15PRACH	Practical Exercises in Radiation Chemistry	KZ	3
In this practical exercises, the students will familiarize themselves with the principles of experimental radiation chemistry and photochemistry and obtain knowledge in the practical applications of radiation and photochemical methods for characterization of irradiation sources (chemical dosimetry for determination of dose rate in ionizing radiation sources, chemical actinometry for evaluation of photon flow in non-ionizing radiation sources), syntheses of various inorganic materials (metals, simple oxides, indirect synthesis of multicomponent oxides) and other applications of photochemical reactions.			
15SEPM	Practical Exercises in Separation Methods	KZ	3
This advanced exercise consists of set of practical tasks aiming to show fundamental radiochemical separation methods, their modifications and utilization at work with radionuclides. Students apply knowledge received in lectures „Separation methods in Nuclear Chemistry 1“ and „Nuclear Chemistry“ and are also using skill acquired in previous laboratory exercises. Tasks are including extraction, chromatographic, coprecipitation procedures and principles, in which good work management and proper handling with open radioactive sources and nuclear waste is necessary. Various types of radionuclides, single or in genetic relationship are used.			
15PRAKN	Internship	Z	4
The internship aims at providing the student with practical experience.			
15RACH	Radiation Chemistry	ZK	4
Part one of this course deals with the formation of Primary Intermediate Products of radiolysis (PIP) caused by the absorption of ionizing radiation in matters. General overview of their properties and reactions leading to the formation of Stable Products of Radiolysis (SPR) is given in this part as well. The part two (systematic radiation chemistry) is dedicated to the radiolysis of selected material systems.			
15RAM	Radioanalytical Methods	ZK	3
The course gives a detailed overview of all main radioanalytical methods, specifically: Indicator methods, analysis by means of naturally occurring radioactive elements, isotope dilution analysis (IDA), substoichiometric IDA, radio-reagent methods, radiometric titrations, radio-release methods, RIA, activation analysis, irradiation with thermal neutrons, irradiation with fast and resonance neutrons, irradiation with charged particles and gamma-rays, non-activation interaction analysis, X-ray fluorescence analysis, PIXE, RBS.			
15STP	Trace Radiochemistry	ZK	3
The course deals with the state (speciation) and physicochemical behaviour of very low concentrations (traces) of matter, especially radionuclides, in homogeneous and microheterogeneous systems and with methods of their study. It presents detailed discussion of formation and properties of colloidal forms of radionuclides and of methods of work with solutions containing traces to be studied. The object of the lecture is also the distribution of traces in macroheterogeneous systems, particularly the coprecipitation, adsorption and electrodeposition of traces.			
15SMJ1	Separation Methods in Nuclear Chemistry 1	ZK	3
This lecture consists of several chapters, at the beginning the chemistry of complex compounds, its generation and stability is discussed followed with speciation calculations. Next chapter gives a general overview of the separation methods and their comparison. Further, the fundamentals of liquid-liquid extraction, extraction of chelates, extraction chromatography, theory of ion exchange together with ion-exchange chromatography, and other chromatographic methods are discussed, all including theoretical aspects of the methods, widely used agents, and practical examples. The whole lecture is oriented to utilization of these methods in nuclear and radiochemistry, their advantages and specific requirements in the field.			
15VUCH1	Research Project 1	Z	6
Thesis for internal defence.			
15VUCH2	Research Project 2	KZ	8
Thesis for internal defence.			

Code of the group: NMSJCHPP2

Name of the group: NMSJCH - povinné p edm ty 2. ro ník

Requirement credits in the group: In this group you have to gain at least 40 credits

Requirement courses in the group: In this group you have to complete at least 5 courses

Credits in the group: 40

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
15DPCH1	Master Thesis 1 <i>Kateřina Ľubov, Pavel Bartl, Mojmr Nmec, Jan John, Petr Distler, Jn Kozempel, Barbora Neužilov, Jaroslav Ľervenk, Libor Juha Jan John (Gar.)</i>	Z	10	10	Z	PO

15DPCH2	Master Thesis 2 <i>Kate ina ubová, Pavel Bartl, Jan John, Petr Distler, Ján Kozempel, Barbora Neužilová, Libor Juha, Michal Sakmár, Ivo Sv tlík Petr Distler Jan John (Gar.)</i>	Z	20	20	L	PO
15PRN	Radionuclide Production <i>Ond ej Lebeda Ond ej Lebeda Ond ej Lebeda (Gar.)</i>	ZK	2	2+0	Z	PO
15SEM1	Seminar 1 <i>Kate ina ubová Kate ina ubová Kate ina ubová (Gar.)</i>	Z	4	0+4	Z	PO
15SEM2	Seminar 2 <i>Kate ina ubová Kate ina ubová Kate ina ubová (Gar.)</i>	Z	4	0+4	L	PO

Characteristics of the courses of this group of Study Plan: Code=NMSJCHPP2 Name=NMSJCH - povinné p edm ty 2. ro ník

15DPCH1	Master Thesis 1 Diploma work.	Z	10
15DPCH2	Master Thesis 2 Diploma work.	Z	20
15PRN	Radionuclide Production An overview of the different ways in which radionuclides may be produced (natural sources, nuclear reactions, generators). Classification of nuclear reactions (neutron, charged particles and photon induced reactions, their course, cross-sections). Calculations of radionuclide yields and their modelling for different production set-ups. Design and operation of target systems (solid, liquid and gaseous). Target processing with respect to the subsequent use of the produced radionuclide. Radionuclides generators, production, and their use.	ZK	2
15SEM1	Seminar 1 Getting acquainted with advanced radiochemical and radiation-chemical topics.	Z	4
15SEM2	Seminar 2 Get acquainted with radiochemical and radiation problems.	Z	4

Name of the block: Elective courses

Minimal number of credits of the block: 0

The role of the block: V

Code of the group: NMSJCHVP

Name of the group: NMSJCH - voliteľné p edm ty

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
15AODP	Waste Analysis	ZK	2	2+0	Z	v
15APRM	Application of Radiation Methods <i>Viliam Mú ka Viliam Mú ka Viliam Mú ka (Gar.)</i>	ZK	2	2+0	L	v
15NUK1	Aplication of Radionuclides 1 <i>Ji í Mizera Ji í Mizera Ji í Mizera (Gar.)</i>	ZK	3	2+0	Z	v
15NUK2	Aplication of Radionuclides 2 <i>Ji í Mizera Ji í Mizera Ji í Mizera (Gar.)</i>	ZK	3	2+0	L	v
15ASCH	Astrochemistry <i>Martin Ferus Martin Ferus Martin Ferus (Gar.)</i>	ZK	2	2+0	L	v
16BAF	Biochemistry and Pharmacology <i>Jan Ková Jan Ková (Gar.)</i>	ZK	2	2+0	1	v
15CHL1	Chemistry of the Pharmaceuticals	ZK	3	2+0	L	v
15CHJE	The Chemistry of Operation of Nuclear Power Plants <i>Barbora Drtinová Barbora Drtinová Barbora Drtinová (Gar.)</i>	ZK	2	2+0	Z	v
15CHRP	Chemistry of Radioactive Elements <i>Jan John Jan John Jan John (Gar.)</i>	ZK	2	2+0	Z	v
15FCH5	Physical Chemistry 5 <i>Lenka Prouzová Procházková Lenka Prouzová Procházková Lenka Prouzová Procházková (Gar.)</i>	ZK	2	2+0	Z	v
15GIMCH	Glycoconjugates and Immunochemistry <i>Petr Pompach Petr Pompach Petr Pompach (Gar.)</i>	ZK	3	2+0	L	v
15HCHE	Hydrochemistry <i>Vladimír Sýkora Vladimír Sýkora Vladimír Sýkora (Gar.)</i>	ZK	2	2+0	Z	v
15HYPE	Hydrology and Pedology	ZK	2	2+0	Z	v
15INS2	Instrumental Methods 2 <i>Alena Zavadilová</i>	ZK	2	2+0	Z	v
15ISY	Isotopic Syntheses <i>Ján Kozempel, Martin Vlk Martin Vlk Ján Kozempel (Gar.)</i>	ZK	2	2+0	L	v
15LMB	Practical Exercises in Microbiology <i>Kate ina Demnerová Kate ina Demnerová Kate ina Demnerová (Gar.)</i>	KZ	4	0+6	Z	v

15MSZP	Modelling and Simulation of Radionuclide Migration in the Environment <i>Aleš Vetešník, Dušan Vopálka Aleš Vetešník Dušan Vopálka (Gar.)</i>	Z,ZK	3	2+1	Z	v
15OFKL	General Pharmacology	ZK	2	2+0	Z	v
15ZSCH	Protection of Environment <i>Helena Filipská Helena Filipská Helena Filipská (Gar.)</i>	ZK	2	2+0	Z	v
15PRMB	Practical Exercises in Radiation Methods in Biology and Medicine <i>Ján Kozempel, Martin Vlk Martin Vlk Ján Kozempel (Gar.)</i>	KZ	4	0+4	L	v
15PRAM	Practical Exercises in Radioanalytical Methods <i>Miroslava Semelová, Pavel Bartl, Mojmír N mec Miroslava Semelová Mojmír N mec (Gar.)</i>	KZ	4	0+4	L	v
15RMBM	Radiation Methods in Biology and Medicine <i>Václav uba Václav uba Václav uba (Gar.)</i>	ZK	2	2+0	L	v
16RAO	Radiation Protection <i>Jiří Martiník, Darina Trojčková, Dana Drábová, Jiří Hluka, Ladislav Tomášek, Tomáš Trojek Jiří Martiník Tomáš Trojek (Gar.)</i>	ZK	4	4+0	1	v
16RBIO	Radiobiology <i>Marie Davidková Marie Davidková Marie Davidková (Gar.)</i>	ZK	2	2+0	L	v
15RDFM	Radiopharmaceuticals 1 <i>Ondřej Lebeda Ondřej Lebeda Ondřej Lebeda (Gar.)</i>	ZK	2	2+0	Z	v
15RFM2	Radiopharmaceuticals 2 <i>Ján Kozempel, Martin Vlk, Marek Moša Martin Vlk Ján Kozempel (Gar.)</i>	ZK	2	2+0	Z	v
15SMJ2	Separation Methods in Nuclear Chemistry 2 <i>Mojmír N mec Mojmír N mec Mojmír N mec (Gar.)</i>	ZK	2	2+0	L	v
15SRZP	Determination of Radionuclides in Environment <i>Mojmír N mec Mojmír N mec Mojmír N mec (Gar.)</i>	ZK	2	2+0	L	v
01SM	Statistical Methods with Applications	ZK	2	2+0	L	v
11SFBM	Structure and Function of Biomolecules <i>Petr Kolenko, Tomáš Kova Petr Kolenko Petr Kolenko (Gar.)</i>	Z,ZK	3	2+1	Z	v
15STA	Structure Analysis 1 <i>Ján Kozempel, Martin Vlk Martin Vlk Ján Kozempel (Gar.)</i>	Z,ZK	3	2+1	L	v
15STA2	Struktura Analysis 2 <i>Martin Vlk</i>	ZK	2	2+0	Z	v
15TJM	Nuclear Materials Technology <i>Barbora Drtinová</i>	ZK	2	2+0	L	v
15TPC	Technology of Fuel Cycles of Nuclear Power Stations <i>Kateřina ůbová, Karel Štamberg Kateřina ůbová Kateřina ůbová (Gar.)</i>	ZK	2	2+0	Z	v
15TRF	Radiopharmaceuticals Technology <i>Ján Kozempel, Martin Vlk Martin Vlk Ján Kozempel (Gar.)</i>	ZK	2	2+0	L	v
15TZO	Waste Management and Treatment <i>Martin Kubal Martin Kubal Martin Kubal (Gar.)</i>	ZK	2	2+0	Z	v
15TZRCH	Theoretical Foundations of Radiation Chemistry <i>Libor Juha Libor Juha Libor Juha (Gar.)</i>	ZK	2	2+0	Z	v
15TOX	Toxicology <i>Martin Vlk</i>	ZK	2	2+0	Z	v
15UFCB	Introduction to Photochemistry and Photobiology <i>Lenka Prouzová Procházková, Libor Juha Lenka Prouzová Procházková Libor Juha (Gar.)</i>	ZK	2	2+0	Z	v
15VJZ	Decommissioning of Nuclear Facilities <i>Kateřina ůbová Kateřina ůbová Kateřina ůbová (Gar.)</i>	ZK	2	2+0	L	v
01ZPB1	Introduction to Computer Security 1 <i>Petr Voká Petr Voká Petr Voká (Gar.)</i>	Z	2	1+1		v
01ZPB2	Introduction to Computer Security 2 <i>Petr Voká Petr Voká Petr Voká (Gar.)</i>	Z	2	1+1		v

Characteristics of the courses of this group of Study Plan: Code=NMSJCHVP Name=NMSJCH - volitelné předměty

15AODP	Waste Analysis	ZK	2
Course of selected methods applied in environmental analyses. Course is focussed to a solid, slurry or gaseous matrixes, including introduction to sampling techniques and preconcentration techniques.			
15APRM	Application of Radiation Methods	ZK	2
The beginning part is devoted to the quantities and units of interaction of ionizing radiation with matter, the description of radiation sources and facilities. Next chapters are devoted to radiation technologies such as sterilization, cross-linking and degradation of polymers, polymerization, grafting and curing, radiation treatment of agricultural products, radiation synthesis, Last but not least, attention is devoted also to radiation processing in environment, radiation in medical applications, economic considerations and dosimetry in context of safety.			
15NUK1	Application of Radionuclides 1	ZK	3
In the introduction, nuclear methods and their basic principles are generally classified. It is followed by explanation of the specific features of working methods in radiochemistry. The following lectures introduce separately physical principles and practical applications of radiochronometry, methods based on chemical, biological and physical effects of ionizing radiation, indicator methods, isotope exchange reactions and isotopic effects. The most important technical and industrial applications of radionuclides are presented.			
15NUK2	Application of Radionuclides 2	ZK	3
The course is oriented to applications of nuclear methods and radionuclides, particularly in the field scientific research. The first part of the course presents production and application of artificial radionuclides, labeled organic compounds, and generators of short-lived radionuclides. Another part of the course focuses on isotope exchange reactions and methods of their investigation. It is followed by explanation of thermodynamic and kinetic isotopic effects. The remaining lectures are devoted to applications of nuclear methods in general and physical chemistry to study kinetics and mechanism of chemical reactions, structure of chemical compounds, solid phase surfaces, catalysis, and to determine physico-chemical parameters.			

15ASCH	Astrochemistry	ZK	2
The aim of this lecture is to summarize present knowledge of chemistry in the universe. The lecture should be focused mainly on chemistry of our solar system, interstellar clouds, origin of life, interstellar compounds detection techniques and history of astrochemistry.			
16BAF	Biochemistry and Pharmacology	ZK	2
Concise overview of organic chemistry, biochemistry and pathology of body fluids, biochemistry of breathing, biochemistry of digestion and resorption, kidneys and urine, biochemical significance of liver, metabolism of water and minerals, metabolism of trace elements, nutrition. Basic principles of pharmacology - biotransformation of pharmaceuticals, their absorption, distribution and elimination, pharmacodynamics, classification of pharmaceuticals, chemotherapeutics, radiopharmaceuticals and diagnostic preparations, conditions for such products and for their fabrication.			
15CHL1	Chemistry of the Pharmaceuticals	ZK	3
The course is focussed to the therapeutic and diagnostic applications of chemical substances - pharmaceuticals. It is based on the anatomical-therapeutical-chemical classification system (ATCC) and gives basic informations about the use of chemical substances in human medicine. The application formulations and pharmaceutical databases are also discussed. The aim of the course is not only the demonstration of pharmaceutically active compounds, but also the discussion of their application in connection with mechanisms of action.			
15CHJE	The Chemistry of Operation of Nuclear Power Plants	ZK	2
At first, the principles of water treatment processes, the sources of radioactive contamination and the principles of the treatment of all types of wastes are discussed. The main attention is paid to the individual technological operations used to the purification of feeding waters and cooling circuits waters and of all liquid and gaseous radioactive media encountered in NPP. The technological operations used to the treatment of wastes and the corrosion problems of the construction materials are discussed in detail, too.			
15CHRP	Chemistry of Radioactive Elements	ZK	2
The course gives a detailed overview of chemical properties of all known radioactive elements from the group of cis-uranium elements, actinoids and trans-actinoids.			
15FCH5	Physical Chemistry 5	ZK	2
Selected chapters of electrochemistry and theory of solutions. Electrode phenomena, electric double layer, electrochemical methods in chemical analysis, galvanic cells, corrosion. Methods of the reduction of equilibrium thermodynamic data to the zero ionic strength.			
15GIMCH	Glycoconjugates and Immunochemistry	ZK	3
The course is focused on the history and present of immunochemistry and molecular immunology. The most important molecules of immunity system are thoroughly discussed (antibody, T-cell receptor, HLA antigens, complement, adhesive molecules) as well as technical aspects of experimental immunology techniques, details of immunology measurements and appropriate instrumentation.			
15HCHE	Hydrochemistry	ZK	2
The course gives a detailed description of the genesis, incidence, characteristics and importance of organic and inorganic constituents of water. It also presents the requirements for quality of natural waters, drinking water and waste water.			
15HYPE	Hydrology and Pedology	ZK	2
The course provides informations about the precipitation and movement of water in the environment, measurements and evaluation of relevant data. It includes basic hydrology, emphasizing and understanding the concepts, principles and ideas of hydrologic processes, infiltration and soil water processes. Hydrology of reservoirs, wetlands and ground water is also presented.			
15INS2	Instrumental Methods 2	ZK	2
Second part of the overview of selected modern instrumental methods for research in physical chemistry and analysis , theoretical fundamentals , instrumental technique, utilization and application.			
15ISY	Isotopic Syntheses	ZK	2
In the general part of the lecture students become familiar with the preparation of enriched stable nuclides and radionuclides, nomenclature of labelled compounds, basic principles of safety and specific requirements for laboratory equipment and experimental setup for work with isotopes. Next, laboratory operations with labelled compounds and methods of structural, isotopic and radiometric analyses are discussed, together with specificity of carrier-added and carrier-free preparations, fast and online syntheses, automated syntheses, biosyntheses. In the systematic part of the lecture, the isotope-specific methods of the most common elements are particularly discussed, together with the applications of labelled compounds.			
15LMB	Practical Exercises in Microbiology	KZ	4
The first part of practical exercises is devoted to the principles of microbiological work, cultivation of micro-organisms, morphology and cytology of micro-organisms. In the the next part, the students observe the influence of external conditions on micro-organisms and they learn to isolate the micro-organisms as well as to evaluate of cell count in environment. Finally, the attention is devoted to study of micro-organism growth, fundamental genetics preparations, host strains of Escherichia coli and identification of micro-organisms.			
15MSZP	Modelling and Simulation of Radionuclide Migration in the Environment	Z,ZK	3
Introduction in ecological modelling focused on the problems of radionuclide migration in the environment. Formulation of mathematical and computer models, characterization of their qualities. Models of dissolved contaminants interaction with the solids phase, including sophisticated multi-component models. Practical modelling in the PHREEQC environment. Simulation exercises with transport codes prepared in the GoldSim environment.			
15OFKL	General Pharmacology	ZK	2
Annotation In the course of General pharmacology there are taught essentials of pharmacodynamics (e.g. interactions of drugs with receptors, molecular targets for drug action), fundamentals of pharmacokinetics (e.g. the half-life and its uses), drug interactions, introduction to clinical trials of drugs, adverse drug reactions, etc. Students are also taught pharmacology of autonomous system and a prescription writing.			
15ZOCH	Protection of Environment	ZK	2
The course provides basic information about detrimental pollutants, about their impact on flora and fauna including man. It presents overview on the environmental sampling, sample analysis in order to control the concentrations and pollutant migration, determining the limits and environmental legislation. The migration of pollutants in the environment and possible ways of the environment protection and pollution prevention will be discussed.			
15PRMB	Practical Exercises in Radiation Methods in Biology and Medicine	KZ	4
Students get knowledge of practical work with mikroorganisms and ezymes, including preparation of samples for irradiation. They get knowledge of basic aspects of work with radionuclide generator, preparation of labelled compounds and determination of radiochemical purity.			
15PRAM	Practical Exercises in Radioanalytical Methods	KZ	4
Exercise is focused to practical carrying out of various radioanalytical methods from determination of solubility constant over radiometric titrations to determination of various radionuclides in the environment. It also includes substoichiometric dilution analysis, radioimmunological, rentgenfluorescence, and neutron activation analyses.			
15RMBM	Radiation Methods in Biology and Medicine	ZK	2
In the first part, the sources of ionizing radiation (IR) used in biology and medicine are thoroughly discussed. Description of interaction of IR with matter and influence of ionizing radiation on biologically important structures and organisms follows. The last part of the course is dedicated to theory of radiobiological action, radiodiagnostic and radiotherapeutical methods, safeguard and dozimetry.			
16RAO	Radiation Protection	ZK	4
The aim of the subject is to provide a self-contained overview of the radiation protection with a special focus on general principles. The subject is based on the actual ICRP recommendation no. 103 and other documents, which specifies radiation protection in the Czech Republic and EU. The course is accepted as training, which allows obtaining special competence in radiation protection. Participants will receive an appropriate certificate of attendance when fulfil all requirements defined in the permit of SONS.			

16RBIO	Radiobiology	ZK	2
The presented lectures are aimed at basis of radiation biology. Students are introduced into biological effects of ionizing radiation; physical and chemical processes of radiation action in biological material; mechanisms of radiation damage to DNA and other cell components; types of damages and their repair; subcellular and cellular sensitivity and response to irradiation; physical, biological and chemical modifiers of the cell response to irradiation; theories and models for cell survival and radiation biology of normal and neoplastic tissue systems.			
15RDFM	Radiopharmaceuticals 1	ZK	2
The course introduces fundamentals of nuclear chemistry applications in research, development and production of radiopharmaceuticals. The first part of the course is focused on issues of appropriate radionuclide selection, general requirements for PET and SPECT diagnostics and therapeutic radiopharmaceuticals, ways of their application and labelling chemistry. The second part of the course provides fundamentals of routine production and quality control of radiopharmaceuticals (GMP rules) and discusses in detail production of a few particular radiopharmaceuticals. In the end of the course, students will learn about the last trends in the research of radiopharmaceuticals.			
15RFM2	Radiopharmaceuticals 2	ZK	2
The basic principles of nuclear chemistry. A survey of radionuclides used in nuclear medicine. The common methods of radiopharmaceuticals preparations. Quality and control of radiopharmaceuticals. The basic radiopharmaceuticals and their use in human diagnostic and therapy.			
15SMJ2	Separation Methods in Nuclear Chemistry 2	ZK	2
The lecture is based and involves Separation Methods in Radiochemistry I. Additional aspects of extraction separation methods such as classification and description of the ion-pair formation extraction système, extraction with mixtures of agents, and accessories and devices used in solvent extraction. Separations with ion-exchange resins including accessories and high performance liquid chromatography are discussed in more details. Finally, the lecture includes membrane separation processes, thermochromatography, distillation and electrochemical methods.			
15SRZP	Determination of Radionuclides in Environment	ZK	2
The introduction of the lecture consist of the list of the important and monitored radionuclides in the environment and their abundance. Sample types, sampling and pre-treatment of samples are discussed followed with quality assurance of analysis and their relation. The attention is also paid to individual instrumental separation methods for environmental samples such as gamma-ray spectrometry and gross alpha and beta activities measurement. Finally, the methods for determination of the selected radionuclides (isotopes of uranium and plutonium, ²¹⁰ Po, ²¹⁰ Pb, ²²⁶ Ra, ²²² Rn, ³ H, ¹⁴ C, ⁸⁵ Kr, ¹³¹ I, ¹³⁷ Cs, ⁹⁰ Sr) are discussed.			
01SM	Statistical Methods with Applications	ZK	2
The course consists of selected methods of statistical data analysis such as: linear regression and correlation, analysis of variance, nonparametric methods, contingency tables, simulation of random variables and their application. The aim is to illustrate the use of statistical procedures on examples. Solutions of concrete examples by use of statistical software are also included.			
11SFBM	Structure and Function of Biomolecules	Z,ZK	3
Knowledge of macromolecular structure is crucial for the understanding of its function. The subject is focused on the introduction to building blocks of macromolecules, overall structure and its structure: function relationship including macromolecular complexes.			
15STA	Structure Analysis 1	Z,ZK	3
Methods of molecular spectroscopy, fundamental principles. Nuclear magnetic resonance, ¹ H and ¹³ C NMR techniques in organic structural analysis. Special techniques 2D NMR, COSY, HECTOR. Infrared spectroscopy, fundamental principles. Finger print and practical applications in analysis. UV-VIS spectroscopy, fundamental principles. Mass spectrometry, methods, ionization techniques, fragmentations, applications in structural analysis.			
15STA2	Strukture Analysis 2	ZK	2
1. Basic principals of magnetic resonance, signal processing, shielding of nuclei, chemical shift, spin-spin interaction, relaxation, signals in NMR. 2. NMR spectrometer ? construction and function, basic techniques, Fourier transformation, double-resonance, relaxation time measurements, signal suppression, 3. Samples preparation, solvents, standards 4. ¹ H-NMR techniques. 5. ¹³ C-NMR techniques. 6. Other techniques: ¹⁵ N, ¹⁸ F, ³¹ P, ² H, ³ H etc. 7. Specialities in NMR. 2D-NMR (COSY, NOESY, TOCSY, HECTOR), solid-state NMR (MAS) 8. Interpretation of spectral data: ¹ H, ¹³ C, ¹⁵ N, ³¹ P, special techniques ³ H/ ² H. 9. Interpretation and measurement APT, DEPT, COESY, NOESY, TOCSY, HMQBC ? isotopical modifications 10. Application of NMR.			
15TJM	Nuclear Materials Technology	ZK	2
At first, the basic types of fuel cycles of nuclear power stations, the strategy of the handling with spent fuels and the basic aspects and problems of spent fuel reprocessing are discussed, i.e., e.g., cooling, criticality and the safety of the system, recovery of uranium and plutonium. From the chemical-technological point of view, the attention is paid to (i) PUREX and THOREX procedures, (ii) the treatment and disposal of radioactive wastes, (iii) the transmutation processes and P&T fuel cycles, and (iv) the technology of manufacturing of Th - fuel and of metallic Zr of nuclear grade.			
15TPC	Technology of Fuel Cycles of Nuclear Power Stations	ZK	2
At first, the basic types of uranium ores and their classification, and physical and radiometric ore dressing methods are specified. The main attention is paid to the chemical-technological operations by means of which the products of technical grade and then of nuclear grade, as metallic U, UO ₂ , UN, UC and UF ₆ , are obtained. In this domain, the sol-gel processes and uranium isotopes separations are implicated. The manufacturing of fuel elements, based on metallic uranium, on tablets of UO ₂ or MOX fuel (UO ₂ +PuO ₂), and of assemblies for basic types of nuclear reactors (LWR, FBR and HTGR) is described. The principles of spent fuel reprocessing and of radioactive wastes treatment are mentioned, too.			
15TRF	Radiopharmaceuticals Technology	ZK	2
1. Research and development of radiopharmaceuticals, preclinical and clinical studies. 2. Raw materials and precursors of radiopharmaceuticals. 3. Specificity of radiopharmaceuticals preparation and production. 4. Sources of radionuclides, target systems and apparatuses (gaseous, liquid, solid), natural and enriched materials, their recycling. 5. Manipulation with high activities, biological shielding. Automated synthesizers (dedicated/universal, separation modules, microfluidic systems, process parameters sensors, etc.). 6. Sterile and non-sterile preparations. Dispensing, formulation, sterilization and marking. 7. Pharmacopoeia and process quality control methods of radiopharmaceuticals. 8. Processes validation, quality assurance and management systems, documentation. 9. Logistics of radiopharmaceuticals production. 10. Legislation requirements for radiopharmaceuticals preparation and production.			
15TZO	Waste Management and Treatment	ZK	2
The course deals with the importance of waste for the national economy, with the various technologies for their recovery and disposal and with the optimal measures for prevention and minimization of their production and adverse impacts on the environment. At the beginning of course principal legislative measurements in waste management, waste sources and origin and hazardous properties of waste are mentioned. Further, principal technologies of waste treatment (recycling, landfilling, thermal processes, biological processes, physico-chemical processes), methods of their recovery and disposal and the technological and organisational measures for their prevention and minimisation are discussed in detail.			
15TZRCH	Theoretical Foundations of Radiation Chemistry	ZK	2
Theoretical description of an interaction of ionizing radiation with matter. Theory of primary processes in radiation chemistry: excitation and ionization. Recombination kinetics; charge and energy transfer in molecular systems. Inelastic electron scattering. Primary radiation chemical yields. Formation, structure and properties of solvated electrons. Track theory and models. Radiation chemical kinetics. Theory of an action of ionizing radiation in solids (electron-phonon interaction; radiation defects in crystals) and gases. State-of-matter effects in radiation chemical reactivity.			
15TOX	Toxicology	ZK	2
The lecture gives a comprehensive survey of toxicology of chemicals. It deals with general and special toxicology, legislation and work safety in chemical laboratory. Several selected chapters are devoted to analytical and predictive toxicology. General toxicology explains toxic indices, their determination and interpretation, hazard and risk, mechanisms of absorption, distribution, biotransformation and elimination of chemicals in a body, mechanisms of toxic effects and factors governing these effects. Physicochemical and biochemical interpretation of toxic actions is stressed.			

15UFCB	Introduction to Photochemistry and Photobiology	ZK	2
At the beginning, an absorption of UV/vis radiation in molecular system and the energy transfer is explained and discussed. Then, photochemical laws and quantum yields of photochemical reactions are defined. Experimental techniques in photochemistry are reviewed. The light is also shed on the relationship between photochemistry and radiation chemistry / plasma chemistry. Classes and nature of different photochemical reactions are described in general. Within a part of the course devoted to the systematic photochemistry, the key reactions of illuminated inorganic, coordination, organometallic, organic and bio-organic compounds are reviewed. Practical utilization of photochemical reactions is summarized (photography, photolithography, photochemical syntheses, environmental photochemistry, etc.). Fundamentals of biological action of UV/vis radiation are exposed in the course. Special attention is paid to photosynthesis, vision, and photodynamic therapy.			
15VJZ	Decomissioning of Nuclear Facilities	ZK	2
1. History, situation, long-term operation. 2. Strategy of decomissioning. 3. Stages of decomissioning. 4. Legislation 5. Costs 6. Treatment of the waste: characterization, inventory of radionuclides, storage and storage			
01ZPB1	Introduction to Computer Security 1	Z	2
01ZPB2	Introduction to Computer Security 2	Z	2

List of courses of this pass:

Code	Name of the course	Completion	Credits
01SM	Statistical Methods with Applications	ZK	2
The course consists of selected methods of statistical data analysis such as: linear regression and correlation, analysis of variance, nonparametric methods, contingency tables, simulation of random variables and their application. The aim is to illustrate the use of statistical procedures on examples. Solutions of concrete examples by use of statistical software are also included.			
01ZPB1	Introduction to Computer Security 1	Z	2
01ZPB2	Introduction to Computer Security 2	Z	2
11SFBM	Structure and Function of Biomolecules	Z,ZK	3
Knowledge of macromolecular structure is crucial for the understanding of its function. The subject is focused on the introduction to building blocks of macromolecules, overall structure and its structure: function relationship including macromolecular complexes.			
15AODP	Waste Analysis	ZK	2
Course of selected methods applied in environmental analyses. Course is focussed to a solid, slurry or gaseous matrixes, including introduction to sampling techniques and preconcentration techniques.			
15APRM	Application of Radiation Methods	ZK	2
The beginning part is devoted to the quantities and units of interaction of ionizing radiation with matter, the description of radiation sources and facilities. Next chapters are devoted to radiation technologies such as sterilization, cross-linking and degradation of polymers, polymerization, grafting and curing, radiation treatment of agricultural products, radiation synthesis, Last but not least, attention is devoted also to radiation processing in environment, , radiation in medical applications, economic considerations and dosimetry in context of safety.			
15ASCH	Astrochemistry	ZK	2
The aim of this lecture is to summarize present knowledge of chemistry in the universe. The lecture should be focused mainly on chemistry of our solar system, interstellar clouds, origin of life, interstellar compounds detection techniques and history of astrochemistry.			
15CHJE	The Chemistry of Operation of Nuclear Power Plants	ZK	2
At first, the principles of water treatment processes, the sources of radioactive contamination and the principles of the treatment of all types of wastes are discussed. The main attention is paid to the individual technological operations used to the purification of feeding waters and cooling circuits waters and of all liquid and gaseous radioactive media encountered in NPP. The technological operations used to the treatment of wastes and the corrosion problems of the construction materials are discussed in detail, too.			
15CHL1	Chemistry of the Pharmaceuticals	ZK	3
The course is focussed to the therapeutic and diagnostic applications of chemical substances - pharmaceuticals. It is based on the anatomical-therapeutical-chemical classification system (ATCC) and gives basic informations about the use of chemical substances in human medicine. The application formulations and pharmaceutical databases are also discussed. The aim of the course is not only the demonstration of pharmaceutically active compounds, but also the discussion of their application in connection with mechanisms of action.			
15CHRP	Chemistry of Radioactive Elements	ZK	2
The course gives a detailed overview of chemical properties of all known radioactive elements from the group of cis-uranium elements, actinoids and trans-actinoids.			
15DPCH1	Master Thesis 1 Diploma work.	Z	10
15DPCH2	Master Thesis 2 Diploma work.	Z	20
15EXK2	Excursion 2	Z	1
The excursion aims at mediating the students the acquaintance with various radiochemical and radiation methods used in practice.			
15FCH4	Physical Chemistry 4	ZK	5
In the first part of the Physical chemistry 4 devoted to reaction kinetics, the course is focused on the reaction rate, isolated reactions of various orders, simultaneous reactions, flow-through reactors and temperature dependence of the rate constants. Hard-sphere collision theory, activated-complex theory and chemical dynamics are thoroughly discussed here. The chain reactions of atoms and free radicals and reactions in liquid solutions are discussed, too. These subjects are trained by solving of selected reaction systems. In the second part of the course, the students are taught essentials of solids, particularly the types of bonds in solids, crystal structure and its description and crystal symmetry. The attention is also devoted to the origin of X-radiation and its use for crystal structure studies. The Debye-Scherrer's method and its application in various cases is thoroughly described here.			
15FCH5	Physical Chemistry 5	ZK	2
Selected chapters of electrochemistry and theory of solutions. Electrode phenomena, electric double layer, electrochemical methods in chemical analysis, galvanic cells, corrosion. Methods of the reduction of equilibrium thermodynamic data to the zero ionic strength.			
15FCHN3	Physical Chemistry 3	Z,ZK	2
At the beginning of the course, a general description and explanation of laws affecting behaviour of the particle systems is provided. Subsequently, particle systems are described at molecular level. Follows the study on the matter in motion, based on its inner structure, properties of structural elements, mutual interactions and force fields. The course also contains some practical applications and fundamental calculations.			

15GIMCH	Glycoconjugates and Immunochemistry	ZK	3
The course is focused on the history and present of immunochemistry and molecular immunology. The most important molecules of immunity system are thoroughly discussed (antibody, T-cell receptor, HLA antigens, complement, adhesive molecules) as well as technical aspects of experimental immunology techniques, details of immunology measurements and appropriate instrumentation.			
15HCHE	Hydrochemistry	ZK	2
The course gives a detailed description of the genesis, incidence, characteristics and importance of organic and inorganic constituents of water. It also presents the requirements for quality of natural waters, drinking water and waste water.			
15HYPE	Hydrology and Pedology	ZK	2
The course provides informations about the precipitation and movement of water in the environment, measurements and evaluation of relevant data. It includes basic hydrology, emphasizing and understanding the concepts, principles and ideas of hydrologic processes, infiltration and soil water processes. Hydrology of reservoirs, wetlands and ground water is also presented.			
15INS2	Instrumental Methods 2	ZK	2
Second part of the overview of selected modern instrumental methods for research in physical chemistry and analysis , theoretical fundamentals , instrumental technique, utilization and application.			
15ISY	Isotopic Syntheses	ZK	2
In the general part of the lecture students become familiar with the preparation of enriched stable nuclides and radionuclides, nomenclature of labelled compounds, basic principles of safety and specific requirements for laboratory equipment and experimental setup for work with isotopes. Next, laboratory operations with labelled compounds and methods of structural, isotopic and radiometric analyses are discussed, together with specificity of carrier-added and carrier-free preparations, fast and online syntheses, automated syntheses, biosyntheses. In the systematic part of the lecture, the isotope-specific methods of the most common elements are particularly discussed, together with the applications of labelled compounds.			
15LMB	Practical Exercises in Microbiology	KZ	4
The first part of practical exercises is devoted to the principles of microbiological work, cultivation of micro-organisms, morphology and cytology of micro-organisms. In the the next part, the students observe the influence of external conditions on micro-organisms and they learn to isolate the micro-organisms as well as to evaluate of cell count in environment. Finally, the attention is devoted to study of micro-organism growth, fundamental genetics preparations, host strains of Escherichia coli and identification of micro-organisms.			
15MSZP	Modelling and Simulation of Radionuclide Migration in the Environment	Z,ZK	3
Introduction in ecological modelling focused on the problems of radionuclide migration in the environment. Formulation of mathematical and computer models, characterization of their qualities. Models of dissolved contaminants interaction with the solids phase, including sophisticated multi-component models. Practical modelling in the PHREEQC environment. Simulation exercises with transport codes prepared in the GoldSim environment.			
15NUK1	Aplication of Radionuclides 1	ZK	3
In the introduction, nuclear methods and their basic principles are generally classified. It is followed by explanation of the specific features of working methods in radiochemistry. The following lectures introduce separately physical principles and practical applications of radiochronometry, methods based on chemical, biological and physical effects of ionizing radiation, indicator methods, isotope exchange reactions and isotopic effects. The most important technical and industrial applications of radionuclides are presented.			
15NUK2	Aplication of Radionuclides 2	ZK	3
The course is oriented to applications of nuclear methods and radionuclides, particularly in the field scientific research. The first part of the course presents production and application of artificial radionuclides, labeled organic compounds, and generators of short-lived radionuclides. Another part of the course focuses on isotope exchange reactions and methods of their investigation. It is followed by explanation of thermodynamic and kinetic isotopic effects. The remaining lectures are devoted to applications of nuclear methods in general and physical chemistry to study kinetics and mechanism of chemical reactions, structure of chemical compounds, solid phase surfaces, catalysis, and to determine physico-chemical parameters.			
15OFKL	General Pharmacology	ZK	2
Annotation In the course of General pharmacology there are taught essentials of pharmacodynamics (e.g. interactions of drugs with receptors, molecular targets for drug action), fundamentals of pharmacokinetics (e.g. the half-life and its uses), drug interactions, introduction to clinical trials of drugs, adverse drug reactions, etc. Students are also taught pharmacology of autonomous system and a prescription writing.			
15PJCH	Practical Exercises in Nuclear Chemistry	KZ	4
The exercise give the students practical introduction to fundamental priciples of nuclear processes such as radionuclide decay, preparation of radionuclides with thermal neutron activation and utilization of radioactive equilibrium e.g. in radionuclide generators. The nuclear chemistry / radiochemistry processes such as Szilard-Chalmers effects, and principles of coprecipitation are demonstrated, too.			
15PRACH	Practical Exercises in Radiation Chemistry	KZ	3
In this practical exercises, the students will familiarize themselves with the principles of experimental radiation chemistry and photochemistry and obtain knowledge in the practical applications of radiation and photochemical methods for characterization of irradiation sources (chemical dosimetry for determination of dose rate in ionizing radiation sources, chemical actinometry for evaluation of photon flow in non-ionizing radiation sources), syntheses of various inorganic materials (metals, simple oxides, indirect synthesis of multicomponent oxides) and other applications of photochemical reactions.			
15PRAKN	Internship	Z	4
The internship aims at providing the student with practical experience.			
15PRAM	Practical Exercises in Radioanalytical Methods	KZ	4
Exercise is focused to practical carrying out of various radioanalytical methods from determination of solubility constant over radiometric titrations to determination of various radionuclides in the environment. It also includes substoichiometric dilution analysis, radioimmunological, rentgenfluorescence, and neutron activation analyses.			
15PRMB	Practical Exercises in Radiation Methods in Biology and Medicine	KZ	4
Students get knowledge of practical work with mikroorganisms and ezymes, including preparation of samples for irradiation. They get knowledge of basic aspects of work with radionuclide generator, preparation of labelled compounds and determination of radiochemical purity.			
15PRN	Radionuclide Production	ZK	2
An overview of the different ways in which radionuclides may be produced (natural sources, nuclear reactions, generators). Classification of nuclear reactions (neutron, charged particles and photon induced reactions, their course, cross-sections). Calculations of radionuclide yields and their modelling for different production set-ups. Design and operation of target systems (solid, liquid and gaseous). Target processing with respect to the subsequent use of the produced radionuclide. Radionuclides generators, production, and their use.			
15RACH	Radiation Chemistry	ZK	4
Part one of this course deals with the formation of Primary Intermediate Products of radiolysis (PIP) caused by the absorption of ionizing radiation in matters. General overview of their properties and reactions leading to the formation of Stable Products of Radiolysis (SPR) is given in this part as well. The part two (systematic radiation chemistry) is dedicated to the radiolysis of selected material systems.			
15RAEK		ZK	2
The first part of the course deals with general problems of the environment. Then composition of and natural processes in basic parts of biogeospere, biogeochemical cycles of elements and natural environmental radioactivity are discussed in detail. The last part describes sources of environmental pollution, migration, chemical reactions and effects of pollutants in the environment and presents analysis of basic problems of radioecology.			

15RAM	Radioanalytical Methods	ZK	3
The course gives a detailed overview of all main radioanalytical methods, specifically: Indicator methods, analysis by means of naturally occurring radioactive elements, isotope dilution analysis (IDA), substoichiometric IDA, radio-reagent methods, radiometric titrations, radio-release methods, RIA, activation analysis, irradiation with thermal neutrons, irradiation with fast and resonance neutrons, irradiation with charged particles and gamma-rays, non-activation interaction analysis, X-ray fluorescence analysis, PIXE, RBS.			
15RDFM	Radiopharmaceuticals 1	ZK	2
The course introduces fundamentals of nuclear chemistry applications in research, development and production of radiopharmaceuticals. The first part of the course is focused on issues of appropriate radionuclide selection, general requirements for PET and SPECT diagnostics and therapeutic radiopharmaceuticals, ways of their application and labelling chemistry. The second part of the course provides fundamentals of routine production and quality control of radiopharmaceuticals (GMP rules) and discusses in detail production of a few particular radiopharmaceuticals. In the end of the course, students will learn about the last trends in the research of radiopharmaceuticals.			
15RFM2	Radiopharmaceuticals 2	ZK	2
The basic principles of nuclear chemistry. A survey of radionuclides used in nuclear medicine. The common methods of radiopharmaceuticals preparations. Quality and control of radiopharmaceuticals. The basic radiopharmaceuticals and their use in human diagnostic and therapy.			
15RMBM	Radiation Methods in Biology and Medicine	ZK	2
In the first part, the sources of ionizing radiation (IR) used in biology and medicine are thoroughly discussed. Description of interaction of IR with matter and influence of ionizing radiation on biologically important structures and organisms follows. The last part of the course is dedicated to theory of radiobiological action, radiodiagnostic and radiotherapeutical methods, safeguard and dozimetry.			
15SEM1	Seminar 1	Z	4
Getting acquainted with advanced radiochemical and radiation-chemical topics.			
15SEM2	Seminar 2	Z	4
Get acquainted with radiochemical and radiation problems.			
15SEPM	Practical Exercises in Separation Methods	KZ	3
This advanced exercise consists of set of practical tasks aiming to show fundamental radiochemical separation methods, their modifications and utilization at work with radionuclides. Students apply knowledge received in lectures „Separation methods in Nuclear Chemistry 1“ and „Nuclear Chemistry“ and are also using skill acquired in previous laboratory exercises. Tasks are including extraction, chromatographic, coprecipitation procedures and principles, in which good work management and proper handling with open radioactive sources and nuclear waste is necessary. Various types of radionuclides, single or in genetic relationship are used.			
15SMJ1	Separation Methods in Nuclear Chemistry 1	ZK	3
This lecture consists of several chapters, at the beginning the chemistry of complex compounds, its generation and stability is discussed followed with speciation calculations. Next chapter gives a general overview of the separation methods and their comparison. Further, the fundamentals of liquid-liquid extraction, extraction of chelates, extraction chromatography, theory of ion exchange together with ion-exchange chromatography, and other chromatographic methods are discussed, all including theoretical aspects of the methods, widely used agents, and practical examples. The whole lecture is oriented to utilization of these methods in nuclear and radiochemistry, their advantages and specific requirements in the field.			
15SMJ2	Separation Methods in Nuclear Chemistry 2	ZK	2
The lecture is based and involves Separation Methods in Radiochemistry I. Additional aspects of extraction separation methods such as classification and description of the ion-pair formation extraction système, extraction with mixtures of agents, and accessories and devices used in solvent extraction. Separations with ion-exchange resins including accessories and high performance liquid chromatography are discussed in more details. Finally, the lecture includes membrane separation processes, thermochromatography, distillation and electrochemical methods.			
15SRZP	Determination of Radionuclides in Environment	ZK	2
The introduction of the lecture consist of the list of the important and monitored radionuclides in the environment and their abundance. Sample types, sampling and pre-treatment of samples are discussed followed with quality assurance of analysis and their relation. The attention is also paid to individual instrumental separation methods for environmental samples such as gamma-ray spectrometry and gross alpha and beta activities measurement. Finally, the methods for determination of the selected radionuclides (isotopes of uranium and plutonium, 210Po, 210Pb, 226Ra, 222Rn, 3H, 14C, 85Kr, 131I, 137Cs, 90Sr) are discussed.			
15STA	Structure Analysis 1	Z,ZK	3
Methods of molecular spectroscopy, fundamental principles. Nuclear magnetic resonance, 1H and 13C NMR techniques in organic structural analysis. Special techniques 2D NMR, COSY, HECTOR. Infrared spectroscopy, fundamental principles. Finger print and practical applications in analysis. UV-VIS spectroscopy, fundamental principles. Mass spectrometry, methods, ionization techniques, fragmentations, applications in structural analysis.			
15STA2	Strukture Analysis 2	ZK	2
1.Basic principals of magnetic resonance, signal processing, shielding of nuclei, chemical shift, spin-spin interaction, relaxation, signals in NMR. 2.NMR spectrometer ? construction and function, basic techniques, Fourier transformation, double-resonance, relaxation time measurements, signal supresion, 3.Samples preparation, solvents, standards 4.1H-NMR techniques. 5.13C-NMR techniques. 6.Other techniques: 15N, 18F, 31P, 2H, 3H etc. 7.Specialities in NMR. 2D-NMR (COSY, NOESY, TOCSY, HECTOR), solid-state NMR (MAS) 8.Interpretation of spectral data: 1H, 13C, 15N, 31P, special techniques 3H/2H. 9.Interpretation and measurement APT, DEPT, COESY, NOESY, TOCSY, HQMBC ? isotopical modifications 10.Aplication of NMR.			
15STP	Trace Radiochemistry	ZK	3
The course deals with the state (speciation) and physicochemical behaviour of very low concentrations (traces) of matter, especially radionuclides, in homogeneous and microheterogeneous systems and with methods of their study. It presents detailed discussion of formation and properties of colloidal forms of radionuclides and of methods of work with solutions containing traces to be studied. The object of the lecture is also the distribution of traces in macroheterogeneous systems, particularly the coprecipitation, adsorption and electrodeposition of traces.			
15TJM	Nuclear Materials Technology	ZK	2
At first, the basic types of fuel cycles of nuclear power stations, the strategy of the handling with spent fuels and the basic aspects and problems of spent fuel reprocessing are discussed, i.e., e.g., cooling, criticality and the safety of the system, recovery of uranium and plutonium. From the chemical-technological point of view, the attention is paid to (i) PUREX and THOREX procedures, (ii) the treatment and disposal of radioactive wastes, (iii) the transmutation processes and P&T fuel cycles, and (iv) the technology of manufacturing of Th - fuel and of metallic Zr of nuclear grade.			
15TOX	Toxicology	ZK	2
The lecture gives a comprehensive survey of toxicology of chemicals. It deals with general and special toxicology, legislation and work safety in chemical laboratory. Several selected chapters are devoted to analytical and predictive toxicology. General toxicology explains toxic indices, their determination and interpretation, hazard and risk, mechanisms of absorption, distribution, biotransformation and elimination of chemicals in a body, mechanisms of toxic effects and factors governing these effects. Physicochemical and biochemical interpretation of toxic actions is stressed.			
15TPC	Technology of Fuel Cycles of Nuclear Power Stations	ZK	2
At first, the basic types of uranium ores and their classification, and physical and radiometric ore dressing methods are specified. The main attention is paid to the chemical-technological operations by means of which the products of technical grade and then of nuclear grade, as metallic U, UO2, UN, UC and UF6, are obtained. In this domain, the sol-gel processes and uranium isotopes separations are implicated. The manufacturing of fuel elements, based on metallic uranium, on tablets of UO2 or MOX fuel (UO2+PuO2), and of assemblies for basic types of nuclear reactors (LWR, FBR and HTGR) is described. The principles of spent fuel reprocessing and of radioactive wastes treatment are mentioned, too.			

15TRF	Radiopharmaceuticals Technology 1.Research and development of radiopharmaceuticals, preclinical and clinical studies. 2.Raw materials and precursors of radiopharmaceuticals. 3.Specificity of radiopharmaceuticals preparation and production. 4.Sources of radionuclides, target systems and apparatuses (gaseous, liquid, solid), natural and enriched materials, their recycling. 5.Manipulation with high activities, biological shielding. Automated synthesizers (dedicated/universal, separation modules, microfluidic systems, process parameters sensors, etc.). 6.Sterile and non-sterile preparations. Dispensing, formulation, sterilization and marking. 7.Pharmacopoeia and process quality control methods of radiopharmaceuticals. 8.Processes validation, quality assurance and management systems, documentation. 9.Logistics of radiopharmaceuticals production. 10.Legislation requirements for radiopharmaceuticals preparation and production.	ZK	2
15TZO	Waste Management and Treatment The course deals with the importance of waste for the national economy, with the various technologies for their recovery and disposal and with the optimal measures for prevention and minimization of their production and adverse impacts on the environment. At the beginning of course principal legislative measurements in waste management, waste sources and origin and hazardous properties of waste are mentioned. Further, principal technologies of waste treatment (recycling, landfilling, thermal processes, biological processes, physico-chemical processes), methods of their recovery and disposal and the technological and organisational measures for their prevention and minimisation are discussed in detail.	ZK	2
15TZRCH	Theoretical Foundations of Radiation Chemistry Theoretical description of an interaction of ionizing radiation with matter. Theory of primary processes in radiation chemistry: excitation and ionization. Recombination kinetics; charge and energy transfer in molecular systems. Inelastic electron scattering. Primary radiation chemical yields. Formation, structure and properties of solvated electrons. Track theory and models. Radiation chemical kinetics. Theory of an action of ionizing radiation in solids (electron-phonon interaction; radiation defects in crystals) and gases. State-of-matter effects in radiation chemical reactivity.	ZK	2
15UFCB	Introduction to Photochemistry and Photobiology At the beginning, an absorption of UV/vis radiation in molecular system and the energy transfer is explained and discussed. Then, photochemical laws and quantum yields of photochemical reactions are defined. Experimental techniques in photochemistry are reviewed. The light is also shed on the relationship between photochemistry and radiation chemistry / plasma chemistry. Classes and nature of different photochemical reactions are described in general. Within a part of the course devoted to the systematic photochemistry, the key reactions of illuminated inorganic, coordination, organometallic, organic and bio-organic compounds are reviewed. Practical utilization of photochemical reactions is summarized (photography, photolithography, photochemical syntheses, environmental photochemistry, etc.). Fundamentals of biological action of UV/vis radiation are exposed in the course. Special attention is paid to photosynthesis, vision, and photodynamic therapy.	ZK	2
15VJZ	Decommissioning of Nuclear Facilities 1. History, situation, long-term operation. 2. Strategy of decommissioning. 3. Stages of decommissioning. 4. Legislation 5. Costs 6. Treatment of the waste: characterization, inventory of radionuclides, storage and storage	ZK	2
15VUCH1	Research Project 1 Thesis for internal defence.	Z	6
15VUCH2	Research Project 2 Thesis for internal defence.	KZ	8
15ZCOH	Protection of Environment The course provides basic information about detrimental pollutants, about their impact on flora and fauna including man. It presents overview on the environmental sampling, sample analysis in order to control the concentrations and pollutant migration, determining the limits and environmental legislation. The migration of pollutants in the environment and possible ways of the environment protection and pollution prevention will be discussed.	ZK	2
16BAF	Biochemistry and Pharmacology Concise overview of organic chemistry, biochemistry and pathology of body fluids, biochemistry of breathing, biochemistry of digestion and resorption, kidneys and urine, biochemical significance of liver, metabolism of water and minerals, metabolism of trace elements, nutrition. Basic principles of pharmacology - biotransformation of pharmaceuticals, their absorption, distribution and elimination, pharmacodynamics, classification of pharmaceuticals, chemotherapeutics, radiopharmaceuticals and diagnostic preparations, conditions for such products and for their fabrication.	ZK	2
16RAO	Radiation Protection The aim of the subject is to provide a self-contained overview of the radiation protection with a special focus on general principles. The subject is based on the actual ICRP recommendation no. 103 and other documents, which specifies radiation protection in the Czech Republic and EU. The course is accepted as training, which allows obtaining special competence in radiation protection. Participants will receive an appropriate certificate of attendance when fulfil all requirements defined in the permit of SONS.	ZK	4
16RBIO	Radiobiology The presented lectures are aimed at basis of radiation biology. Students are introduced into biological effects of ionizing radiation; physical and chemical processes of radiation action in biological material; mechanisms of radiation damage to DNA and other cell components; types of damages and their repair; subcellular and cellular sensitivity and response to irradiation; physical, biological and chemical modifiers of the cell response to irradiation; theories and models for cell survival and radiation biology of normal and neoplastic tissue systems.	ZK	2

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