

Study plan

Name of study plan: Dozimetrie a aplikace ionizujícího záření

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: 107

Elective courses credits: 13

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: 107

The role of the block: PO

Code of the group: NMSDAIZPP1

Name of the group: NMSDAIZ - povinné předměty 1. ročník

Requirement credits in the group: In this group you have to gain at least 55 credits

Requirement courses in the group: In this group you have to complete at least 16 courses

Credits in the group: 55

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
16AMM	Methods of Analytical Measurement Hana Pršová	ZK	2	2+0	2	PO
16APLV	Applications of Ionizing Radiation in Science and Industry Tomáš Echáček	ZK	5	4+0	L	PO
16DRZP	Dosimetry and Radioactivity of the Environment Lenka Thinová	ZK	2	2+0	2	PO
16EX	Excursion Lenka Thinová Lenka Thinová (Gar.)	Z	3	1t		PO
16IDOZ	Integral Dosimetry Methods Iva Ambrožová Iva Ambrožová Iva Ambrožová (Gar.)	ZK	2	2+0	2	PO
18MMC	Monte Carlo Method František Gašpar, Miroslav Virius	Z	4	2+2	Z	PO
16MCRF	Monte Carlo Method in Radiation Physics Tomáš Urban, Jaroslav Kluso Tomáš Urban Tomáš Urban (Gar.)	Z,ZK	4	2+2	2	PO
16MER	Instrumentation for Radiation Measurements Petr Prša Petr Prša Petr Prša (Gar.)	ZK	2	2+0	1	PO
16PDZ	Bachelor Practicum in Detection and Dosimetry of Ionizing Radiation Petr Prša	KZ	5	0+4	Z	PO
16RAO	Radiation Protection Tomáš Vrba, Dana Drábová, Jiří Hlávka, Ladislav Tomášek, Marie Davidková, Tomáš Trojek Tomáš Vrba Tomáš Trojek (Gar.)	ZK	4	4+0	1	PO
16SEMA	Seminar Kateřina Pilařová	Z	2	0+2	2	PO
16UAZ	Principles of Ionizing Radiation Application Ladislav Musílek Ladislav Musílek Ladislav Musílek (Gar.)	ZK	2	2+0	1	PO
16ZIVO	Introduction to Environment Lenka Thinová, Hana Pršová Hana Pršová Hana Pršová (Gar.)	KZ	2	2+0	1	PO
16VUDZ1	Research Project 1 Tomáš Trojek	Z	6	0+6	1	PO
16VUDZ2	Research Project 2 Tomáš Trojek	KZ	8	0+8	2	PO
16ZJT	Nuclear Technology Devices Tomáš Echáček, Kamil Augsten Kamil Augsten Tomáš Echáček (Gar.)	ZK	2	2+0	1	PO

Characteristics of the courses of this group of Study Plan: Code=NMSDAIZPP1 Name=NMSDAIZ - povinné předměty 1. ročník

16AMM	Methods of Analytical Measurement	ZK	2
Principles, technical performance and utilization of methods of chemical analysis. Methodology of analytical determination, gravimetry, titration methods, potentiometry, polarography, refractometry, polarimetry, UV-VIS spectroscopy, atomic emission and absorption spectroscopy, infrared and Raman spectroscopy, X-ray structural analysis, nuclear magnetic and electron spin resonance, mass spectrometry, thermometric methods, gas and liquid chromatography.			
16APLV	Applications of Ionizing Radiation in Science and Industry	ZK	5
Applications of ionizing radiation in science and industry inclusive of radioanalytical methods and application of radionuclides and ionizing radiation for analysis and diagnostics of industrial and research processes			
16DRZP	Dosimetry and Radioactivity of the Environment	ZK	2
The curriculum provides complex overview of individual components in public irradiation. Included are information, methods of measurement and dose calculations for each individual source of ionizing radiation. It gives outline of quantities, physical units, effective dose calculations, cost benefit etc. Explained are also predispositions for realization and subsequently for possibilities and types of remediation.			
16EX	Excursion	Z	3
Excursion in research institutes, laboratories and cooperative universities (CERN, JINR, TU Dresden,...) and modern research trends using ionizing radiation.			
16IDOZ	Integral Dosimetry Methods	ZK	2
Integrating solid state dosimeters (films, thermoluminescent, radiophotoluminescent, colorization, exoelectron, lyoluminescent, and chemical dosimeters, nuclear emulsion), solid state track detectors, special neutron dosimeters (Si diode, albedo dosimeters), advantages and disadvantages of different systems, secondary standardisation methods for dose measurement of photons, electrons and neutrons with respect to their use in personal and environmental dosimetry.			
18MMC	Monte Carlo Method	Z	4
This course is devoted to the numerical method Monte Carlo and to its selected applications.			
16MCRF	Monte Carlo Method in Radiation Physics	Z,ZK	4
Basic principles of the MC method, probability theory and selected concepts in mathematical statistics. Ionising radiation transport simulation, photons, neutrons and charged particles interactions and their simulation, modelling of the geometric conditions. Statistical tests of the model calculations, variance reduction techniques. Codes for simulation of radiation transport, MCNP(X) code, properties and scope of usage, input file (description of the geometry, materials, sources, tallies), graphical tools, code user control. Tools for input files creation/editing a visualization (VISED, Sabrina, Body Builder). Examples of application (practical training) concentrated on radiation physics (shielding, radiation fields/beams/sources, spectral/spatial distributions of the dosimetric quantities, responses of detection systems, radiation protection tasks. The basics of working with the program Fluka and Geant, SRIM code for simulation of the transport of charged particles.			
16MER	Instrumentation for Radiation Measurements	ZK	2
Methods of the processing of signal from detectors of ionizing radiation, spectroscopical systems, data processing and overview of the related electronics.			
16PDZ	Bachelor Practicum in Detection and Dosimetry of Ionizing Radiation	KZ	5
Subject is focused on work with spectrometric detectors, TL dosimeters, gel dosimeters, ionization chambers, scintillators, radiation sources, and nuclear electronics and software. Practical knowledge about interactions of ionizing radiation and effect caused by radiation in matter should be improved.			
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 fulfill all requirements defined in the permit of SONS.			
16SEMA	Seminar	Z	2
An oral presentation of Research project results. The students evaluate the presentation of their colleagues in a written form.			
16UAZ	Principles of Ionizing Radiation Application	ZK	2
Historical outline of applications, review of interaction of radiation with a matter, ionizing radiation sources for applications, detectors and devices for applications, evaluation of radionuclide measurements, use of penetration and scattering of radiation beams, activation analysis, X-ray fluorescence methods, tracer methods, radionuclides in age determination, further possibilities for the use of ionizing radiation.			
16ZIVO	Introduction to Environment	KZ	2
Ozone layer reduction, global warming (greenhouse effect), acid rain, smog, chemicalization, astrophysical theory, cosmic rays, primordial elements, atmosphere contamination, measuring of imissions and emissions, hydrosphere, waste dumping, fossil fuel, alternative sources, solar energy, water energy, wind energy, geothermal energy, biomass combustion, hydrogen energetic, galvanic and fuel couples, principle of sustainable development			
16VUDZ1	Research Project 1	Z	6
Student on the assignment of work and under the guidance of a supervisor prepares an individual for a given topic for 2 semesters.			
16VUDZ2	Research Project 2	KZ	8
Student on the assignment of work and under the guidance of a supervisor prepares an individual for a given topic for 2 semesters.			
16ZJT	Nuclear Technology Devices	ZK	2
Basic scheme of nuclear reactor and nuclear power plant, chain fission reaction development, factors influencing reactivity, internal fuel cycle, main components of nuclear energetic reactor, most important reactor types, linear high-voltage accelerators, linear high-frequency accelerators, accelerators based on cyclotron, microtron, betatron, electron and proton synchrotrons, electron and ion sources for accelerators, targets.			

Code of the group: NMSDAIZPP2

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

Requirement credits in the group: In this group you have to gain at least 52 credits

Requirement courses in the group: In this group you have to complete at least 11 courses

Credits in the group: 52

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
16AIZM	Medical Application of Ionizing Radiation Tereza Hanušová, Petra Osman íková, Anna Jelínek Michaelidesová Leoš Novák (Gar.)	Z,ZK	3	2+1	3	PO
16DPDZ1	Master Thesis 1 Tomáš Trojek	Z	10	0+10	3	PO

16DPDZ2	Master Thesis 2 <i>Tomáš Trojek</i>	Z	20	0+20	4	PO
16FNEI	Physics and Technic of the Nonionizing Radiation <i>Lenka Thinová</i>	ZK	2	2+0	3	PO
16MMM	Mathematical Methods and Modelling <i>Tomáš Urban Jaroslav Kluso (Gar.)</i>	Z	2	0+2	3	PO
16MEIZ	Metrology of Ionizing Radiation <i>Pavel Novotný Pavel Novotný Tomáš Trojek (Gar.)</i>	Z,ZK	4	2+1	Z	PO
16MDOZ	Microdosimetry <i>Marie Davidková</i>	ZK	2	2+0	3	PO
16SEM1	Seminar 1	Z	2	0+2	3	PO
16SEM2	Seminar 2 <i>Kateřina Pilařová Kateřina Pilařová (Gar.)</i>	Z	2	0+2	L	PO
16SPDO	Spectrometry in Dosimetry <i>Tomáš Čechák</i>	ZK	3	2+0	Z	PO
16UCF	Introduction to Particle Physics	ZK	2	2+0	3	PO

Characteristics of the courses of this group of Study Plan: Code=NMSDAIZPP2 Name=NMSDAIZ - povinné p edm ty 2. ro ník

16AIZM	Medical Application of Ionizing Radiation The lectures aim at medical physics in applications of ionising radiation in medicine - in diagnostic and interventional radiology, nuclear medicine, and radiotherapy.	Z,ZK	3
16DPDZ1	Master Thesis 1 Student on the assignment of work and under the guidance of a supervisor prepares an individual for a given topic for 2 semesters.	Z	10
16DPDZ2	Master Thesis 2 Student on the assignment of work and under the guidance of a supervisor prepares an individual for a given topic for 2 semesters.	Z	20
16FNEI	Physics and Technic of the Nonionizing Radiation Curriculum offers complimentary information regarding the electromagnetic spectrum in the nonionizing radiation wavelength area. Focus is on biological effects of nonionizing radiation and its use in physical praxis. The subject matter is complemented by information about principles, biological effects and methods used in fields of magnetic resonance and ultrasound as applied in various types of technical or medical equipment.	ZK	2
16MMM	Mathematical Methods and Modelling Application of mathematical methods, modelling and data processing in dosimetry, radiological physics, medicine and experimental physics. Processing, analysis and evaluation of spectra (peak search and fitting, deconvolution), data analysis, statistical processing and visualization (smoothing, numerical differentiation, creation of histograms), modelling (Monte Carlo method) and examples of applications (calculation of the response of detection systems, efficiency and resolution, calculations of the angular energy distributions of dosimetric quantities in radiation fields/beams, measuring methods simulation/design). Demonstration/training of applications of selected codes (Gnuplot, ROOT, MCNP, Vised, Sabrina, Body Builder,SRIM/TRIM, Geant).	Z	2
16MEIZ	Metrology of Ionizing Radiation Objectives and requirements of metrology, interpretation of radiation quantities and units in metrology, theoretical and experimental basis of metrology (uncertainties, relative and absolute measurements, data processing and evaluation of results of measurements, radiation etalons), evaluation of basic radiation quantities (activity, emission rate, exposure, absorbed dose), intercomparison measurements, metrology law and relevant regulations.	Z,ZK	4
16MDOZ	Microdosimetry Basic characteristics of ionising radiation energy transfer to matter, importance of inelastic collisions of charged particles, excitation function, etc. Track and characteristics of ionising particles, time evolution of the energy transfer process. Microdosimetry, basic principles and approaches, stochastic and non-stochastic quantities, linear energy transfer, lineal energy, specific energy. Microdosimetry and biological effects of radiation, microdosimetry and radiation protection, etc.	ZK	2
16SEM1	Seminar 1 The student may listen to the presentations of PhD student's research activities.	Z	2
16SEM2	Seminar 2 An oral presentation of Master's Thesis results. The presentation is evaluated by the other attendees of the seminary in a written form. The students are encouraged to write an article summarizing their Master thesis.	Z	2
16SPDO	Spectrometry in Dosimetry Objectives and applications of radiation spectrometry; properties and parameters of spectrometric systems (alpha radiation, beta radiation, gamma and X radiation); applications of computers in analysis of spectra; optimisation of calibration procedures; latest nuclear data and other required constants; detailed characteristics and parameters of spectrometric apparatus with semiconductor and scintillation detectors.	ZK	3
16UCF	Introduction to Particle Physics In the modern particle physics experiments, there are specialists from other fields of science and engineering including dosimetry. The aim of this lecture is to provide an introduction into problems of particle physics and the terminology used there for students of dosimetry.	ZK	2

Name of the block: Elective courses

Minimal number of credits of the block: 0

The role of the block: V

Code of the group: NMSDAIZVP

Name of the group: NMSDAIZ - volitelné 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
16DNEU	Neutron Dosimetry <i>Michal Košál, Ondřej Ploc Ondřej Ploc (Gar.)</i>	ZK	2	2+0	3	v
16DZAR	Dosimetry of Internal Radiation Sources <i>Ladislav Musílek Ladislav Musílek Ladislav Musílek (Gar.)</i>	ZK	2	2+0	4	v
02EMJF	Experimental Methods of Nuclear Physics	ZK	3	2+0	Z	v
16KLD	Clinical Dosimetry <i>Tereza Hanušová</i>	ZK	2	2+0	4	v
16KPD	Design of Ionizing Radiation Semiconductor Detectors <i>Martin Kákona (Gar.)</i>	Z	3	0+3	L	v
16PDIZ	Practicum in Dosimetry of Ionizing Radiation <i>Václav Štápník Václav Štápník Václav Štápník (Gar.)</i>	KZ	4	0+4	L	v
16PMM	Laboratory Exercises - Ionizing Radiation Measurement Methods <i>Petr Prša Petr Prša (Gar.)</i>	Z	2	0+2	Z	v
16REL	Radiation Effects in Matter <i>Kateřina Pílaová Kateřina Pílaová Kateřina Pílaová (Gar.)</i>	ZK	2	2+0	Z	v
16RBIO	Radiobiology <i>Marie Davidková Marie Davidková Marie Davidková (Gar.)</i>	ZK	2	2+0	L	v
16RZP	Radionuclides in the Environment <i>Lenka Thínová</i>	ZK	2	2+0	L	v
16FSC	Fundamentals of Physics of Scintillators and Phosphors <i>Martin Níkl Martin Níkl Martin Níkl (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
16ZED	Treatment of Experimental Data <i>Kateřina Pílaová Kateřina Pílaová Kateřina Pílaová (Gar.)</i>	ZK	2	2+0	1	v

Characteristics of the courses of this group of Study Plan: Code=NMSDAIZVP Name=NMSDAIZ - volitelné p edm ty

16DNEU	Neutron Dosimetry	ZK	2
Methods based on nuclear reactions with neutrons, methods based on recoiled nuclei, the time-of-flight method, neutron selectors and monochromators, activation methods, methods of integrating neutron dosimetry, possibilities of use of various methods, calibration of neutron dosimeters and other dose and dose rate measuring instruments.			
16DZAR	Dosimetry of Internal Radiation Sources	ZK	2
Assessment of the radiation burden during internal contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of radioactive materials, ways of taking into account age dependence in dosimetric models, limitation of validity of used models and procedures, assessment of the radiation burden from radiopharmaceuticals in nuclear medicine - basic concepts, general procedure for calculating the absorbed dose from radiopharmaceuticals, finding data about the biological behaviour of radiopharmaceuticals, tables of absorbed doses and limitation of their validity, radiation burden for children, burden from contaminants in radiopharmaceuticals, development of methods for assessment of the radiation burden from internal sources, methods of measurement of internal contamination, detection in-vivo, excreta monitoring, monitoring of workplaces.			
02EMJF	Experimental Methods of Nuclear Physics	ZK	3
The lecture describes basic physical processes, methods and equipment used in experimental nuclear physics and in some practical applications.			
16KLD	Clinical Dosimetry	ZK	2
Specific requirements for radiation beam dosimetry as well as radiation protection aspects will be discussed for clinically used beams. Absolute and relative dosimetry methods including instrumentation and in-vivo dosimetry technology and their possibilities and limitations in clinical dosimetry will be analysed. Optimisation and minimization of absorbed dose from X-ray examinations, dose determination based on activity of applied radiopharmaceutical.			
16KPD	Design of Ionizing Radiation Semiconductor Detectors	Z	3
Klí ová slova:: detectors, Gaiger mode, A/D convertor			
16PDIZ	Practicum in Dosimetry of Ionizing Radiation	KZ	4
The curriculum comprises collection of the most important exercises in Dosimetry. It enables student's familiarization with physical parameters and constants, supports competency in measuring dosimetric parameters and provides information concerning preferred methods for ionizing radiation measurement results processing. It is a tool for introducing students to the practical aspects of scientific research work. The duration of each single task is 4 hours, followed by results processing. Work protocol is not required, however what is expected is active participation in selection of alternative solution methods, requiring complex application of theoretical knowledge.			
16PMM	Laboratory Exercises - Ionizing Radiation Measurement Methods	Z	2
This study subject consists of several practical exercises and experimental demonstrations. The goal is to teach the students how to connect and operate electronic modules for ionizing radiation detector signal processing. NIM standard modules will be used predominantly. Additionally, the work with oscilloscope will be exercised intensively. Graduates will be able to design, build and operate simple electronic circuit using NIM standard modules. This circuit should perform required duty, selected by the teacher. It is recommended to absolve the subject in the same semester as subject Instrumentation for Radiation Measurements.			
16REL	Radiation Effects in Matter	ZK	2
History of radiolysis, track, stages of radiolysis, reaction kinetics, radiation chemical yield, experiments in radiolysis, classical methods, pulse radiolysis, EPR, primary products of radiolysis, excited states, solvated electrons, free radicals, radiolysis of gases, water, water solutions, organic liquids, radiolysis of solid materials, ionic crystals, polymers, glasses, metals and alloys, radiation technology, sterilisation, crosslinking and degradation of polymers, treatment of foods.			
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.			
16RZP	Radionuclides in the Environment	ZK	2
The curriculum focuses on presenting an overview of the most important ionizing radiation sources, sorted according their origin (natural versus manmade). Further the course aim is to inform about characteristics of individual radio nuclides, their behavior in the environment, opportunity for their transport, accumulation or transfer amid environments. Overview of radioactive and non-radioactive ore deposits, process of their discovery, mining and clean-up of the mining consequences.			

16FSC	Fundamentals of Physics of Scintillators and Phosphors	ZK	2
Electronic band structure of solids, interaction of X, gamma and beta rays and particle beams with solids, principle of scintillation. Energy levels in forbidden gap. Luminescence centers and traps for charge carriers. Absorption and luminescence processes, energy transfer, quenching. History of scintillator and phosphor development. Main characteristics and parameters. Technology basics. Examples of applications.			
01ZPB1	Introduction to Computer Security 1	Z	2
01ZPB2	Introduction to Computer Security 2	Z	2
16ZED	Treatment of Experimental Data	ZK	2
Statistical analysis of experimental data; univariate data; calibration; regression; multivariate data			

List of courses of this pass:

Code	Name of the course	Completion	Credits
01ZPB1	Introduction to Computer Security 1	Z	2
01ZPB2	Introduction to Computer Security 2	Z	2
02EMJF	Experimental Methods of Nuclear Physics	ZK	3
The lecture describes basic physical processes, methods and equipment used in experimental nuclear physics and in some practical applications.			
16AIZM	Medical Application of Ionizing Radiation	Z,ZK	3
The lectures aim at medical physics in applications of ionising radiation in medicine - in diagnostic and interventional radiology, nuclear medicine, and radiotherapy.			
16AMM	Methods of Analytical Measurement	ZK	2
Principles, technical performance and utilization of methods of chemical analysis. Methodology of analytical determination, gravimetry, titration methods, potentiometry, polarography, refractometry, polarimetry, UV-VIS spectroscopy, atomic emission and absorption spectroscopy, infrared and Raman spectroscopy, X-ray structural analysis, nuclear magnetic and electron spin resonance, mass spectrometry, thermometric methods, gas and liquid chromatography.			
16APLV	Applications of Ionizing Radiation in Science and Industry	ZK	5
Applications of ionizing radiation in science and industry inclusive of radioanalytical methods and application of radionuclides and ionizing radiation for analysis and diagnostics of industrial and research processes			
16DNEU	Neutron Dosimetry	ZK	2
Methods based on nuclear reactions with neutrons, methods based on recoiled nuclei, the time-of-flight method, neutron selectors and monochromators, activation methods, methods of integrating neutron dosimetry, possibilities of use of various methods, calibration of neutron dosimeters and other dose and dose rate measuring instruments.			
16DPDZ1	Master Thesis 1	Z	10
Student on the assignment of work and under the guidance of a supervisor prepares an individual for a given topic for 2 semesters.			
16DPDZ2	Master Thesis 2	Z	20
Student on the assignment of work and under the guidance of a supervisor prepares an individual for a given topic for 2 semesters.			
16DRZP	Dosimetry and Radioactivity of the Environment	ZK	2
The curriculum provides complex overview of individual components in public irradiation. Included are information, methods of measurement and dose calculations for each individual source of ionizing radiation. It gives outline of quantities, physical units, effective dose calculations, cost benefit etc. Explained are also predispositions for realization and subsequently for possibilities and types of remediation.			
16DZAR	Dosimetry of Internal Radiation Sources	ZK	2
Assessment of the radiation burden during internal contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of radioactive materials, ways of taking into account age dependence in dosimetric models, limitation of validity of used models and procedures, assessment of the radiation burden from radiopharmaceuticals in nuclear medicine - basic concepts, general procedure for calculating the absorbed dose from radiopharmaceuticals, finding data about the biological behaviour of radiopharmaceuticals, tables of absorbed doses and limitation of their validity, radiation burden for children, burden from contaminants in radiopharmaceuticals, development of methods for assessment of the radiation burden from internal sources, methods of measurement of internal contamination, detection in-vivo, excreta monitoring, monitoring of workplaces.			
16EX	Excursion	Z	3
Excursion in research institutes, laboratories and cooperative universities (CERN, JINR, TU Dresden,...) and modern research trends using ionizing radiation.			
16FNEI	Physics and Technic of the Nonionizing Radiation	ZK	2
Curriculum offers complementary information regarding the electromagnetic spectrum in the nonionizing radiation wavelength area. Focus is on biological effects of nonionizing radiation and its use in physical praxis. The subject matter is complemented by information about principles, biological effects and methods used in fields of magnetic resonance and ultrasound as applied in various types of technical or medical equipment.			
16FSC	Fundamentals of Physics of Scintillators and Phosphors	ZK	2
Electronic band structure of solids, interaction of X, gamma and beta rays and particle beams with solids, principle of scintillation. Energy levels in forbidden gap. Luminescence centers and traps for charge carriers. Absorption and luminescence processes, energy transfer, quenching. History of scintillator and phosphor development. Main characteristics and parameters. Technology basics. Examples of applications.			
16IDOZ	Integral Dosimetry Methods	ZK	2
Integrating solid state dosimeters (films, thermoluminescent, radiophotoluminescent, colorization, exoelectron, lyoluminescent, and chemical dosimeters, nuclear emulsion), solid state track detectors, special neutron dosimeters (Si diode, albedo dosimeters), advantages and disadvantages of different systems, secondary standardisation methods for dose measurement of photons, electrons and neutrons with respect to their use in personal and environmental dosimetry.			
16KLD	Clinical Dosimetry	ZK	2
Specific requirements for radiation beam dosimetry as well as radiation protection aspects will be discussed for clinically used beams. Absolute and relative dosimetry methods including instrumentation and in-vivo dosimetry technology and their possibilities and limitations in clinical dosimetry will be analysed. Optimisation and minimization of absorbed dose from X-ray examinations, dose determination based on activity of applied radiopharmaceutical.			
16KPD	Design of Ionizing Radiation Semiconductor Detectors	Z	3
Klí ová slova:: detectors, Geiger mode, A/D convertor			
16MCRF	Monte Carlo Method in Radiation Physics	Z,ZK	4
Basic principles of the MC method, probability theory and selected concepts in mathematical statistics. Ionising radiation transport simulation, photons, neutrons and charged particles interactions and their simulation, modelling of the geometric conditions. Statistical tests of the model calculations, variance reduction techniques. Codes for simulation of radiation transport, MCNP(X) code, properties and scope of usage, input file (description of the geometry, materials, sources, tallies), graphical tools, code user control. Tools for input files			

creation/editing a visualization (VISED, Sabrina, Body Builder). Examples of application (practical training) concentrated on radiation physics (shielding, radiation fields/beams/sources, spectral/spatial distributions of the dosimetric quantities, responses of detection systems, radiation protection tasks. The basics of working with the program Fluka and Geant, SRIM code for simulation of the transport of charged particles.

16MDOZ	Microdosimetry	ZK	2
Basic characteristics of ionising radiation energy transfer to matter, importance of inelastic collisions of charged particles, excitation function, etc. Track and characteristics of ionising particles, time evolution of the energy transfer process. Microdosimetry, basic principles and approaches, stochastic and non-stochastic quantities, linear energy transfer, lineal energy, specific energy. Microdosimetry and biological effects of radiation, microdosimetry and radiation protection, etc.			
16MEIZ	Metrology of Ionizing Radiation	Z,ZK	4
Objectives and requirements of metrology, interpretation of radiation quantities and units in metrology, theoretical and experimental basis of metrology (uncertainties, relative and absolute measurements, data processing and evaluation of results of measurements, radiation etalons), evaluation of basic radiation quantities (activity, emission rate, exposure, absorbed dose), intercomparison measurements, metrology law and relevant regulations.			
16MER	Instrumentation for Radiation Measurements	ZK	2
Methods of the processing of signal from detectors of ionizing radiation, spectroscopical systems, data processing and overview of the related electronics.			
16MMM	Mathematical Methods and Modelling	Z	2
Application of mathematical methods, modelling and data processing in dosimetry, radiological physics, medicine and experimental physics. Processing, analysis and evaluation of spectra (peak search and fitting, deconvolution), data analysis, statistical processing and visualization (smoothing, numerical differentiation, creation of histograms), modelling (Monte Carlo method) and examples of applications (calculation of the response of detection systems, efficiency and resolution, calculations of the angular energy distributions of dosimetric quantities in radiation fields/beams, measuring methods simulation/design). Demonstration/training of applications of selected codes (Gnuplot, ROOT, MCNP, Vised, Sabrina, Body Builder,SRIM/TRIM, Geant).			
16PDIZ	Practicum in Dosimetry of Ionizing Radiation	KZ	4
The curriculum comprises collection of the most important exercises in Dosimetry. It enables student's familiarization with physical parameters and constants, supports competency in measuring dosimetric parameters and provides information concerning preferred methods for ionizing radiation measurement results processing. It is a tool for introducing students to the practical aspects of scientific research work. The duration of each single task is 4 hours, followed by results processing. Work protocol is not required, however what is expected is active participation in selection of alternative solution methods, requiring complex application of theoretical knowledge.			
16PDZ	Bachelor Practicum in Detection and Dosimetry of Ionizing Radiation	KZ	5
Subject is focused on work with spectrometric detectors, TL dosimeters, gel dosimeters, ionization chambers, scintillators, radiation sources, and nuclear electronics and software. Practical knowledge about interactions of ionizing radiation and effect caused by radiation in matter should be improved.			
16PMM	Laboratory Exercises - Ionizing Radiation Measurement Methods	Z	2
This study subject consists of several practical exercises and experimental demonstrations. The goal is to teach the students how to connect and operate electronic modules for ionizing radiation detector signal processing. NIM standard modules will be used predominantly. Additionally, the work with oscilloscope will be exercised intensively. Graduates will be able to design, build and operate simple electronic circuit using NIM standard modules. This circuit should perform required duty, selected by the teacher. It is recommended to absolve the subject in the same semester as subject Instrumentation for Radiation Measurements.			
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 fulfill 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.			
16REL	Radiation Effects in Matter	ZK	2
History of radiolysis, track, stages of radiolysis, reaction kinetics, radiation chemical yield, experiments in radiolysis, classical methods, pulse radiolysis, EPR, primary products of radiolysis, excited states, solvated electrons, free radicals, radiolysis of gases, water, water solutions, organic liquids, radiolysis of solid materials, ionic crystals, polymers, glasses, metals and alloys, radiation technology, sterilisation, crosslinking and degradation of polymers, treatment of foods.			
16RZP	Radionuclides in the Environment	ZK	2
The curriculum focuses on presenting an overview of the most important ionizing radiation sources, sorted according their origin (natural versus manmade). Further the course aim is to inform about characteristics of individual radio nuclides, their behavior in the environment, opportunity for their transport, accumulation or transfer amid environments. Overview of radioactive and non-radioactive ore deposits, process of their discovery, mining and clean-up of the mining consequences.			
16SEM1	Seminar 1	Z	2
The student may listen to the presentations of PhD student's research activities.			
16SEM2	Seminar 2	Z	2
An oral presentation of Master's Thesis results. The presentation is evaluated by the other attendees of the seminary in a written form. The students are encouraged to write an article summarizing their Master thesis.			
16SEMA	Seminar	Z	2
An oral presentation of Research project results. The students evaluate the presentation of their colleagues in a written form.			
16SPDO	Spectrometry in Dosimetry	ZK	3
Objectives and applications of radiation spectrometry; properties and parameters of spectrometric systems (alpha radiation, beta radiation, gamma and X radiation); applications of computers in analysis of spectra; optimisation of calibration procedures; latest nuclear data and other required constants; detailed characteristics and parameters of spectrometric apparatus with semiconductor and scintillation detectors.			
16UAZ	Principles of Ionizing Radiation Application	ZK	2
Historical outline of applications, review of interaction of radiation with a matter, ionizing radiation sources for applications, detectors and devices for applications, evaluation of radionuclide measurements, use of penetration and scattering of radiation beams, activation analysis, X-ray fluorescence methods, tracer methods, radionuclides in age determination, further possibilities for the use of ionizing radiation.			
16UCF	Introduction to Particle Physics	ZK	2
In the modern particle physics experiments, there are specialists from other fields of science and engineering including dosimetry. The aim of this lecture is to provide an introduction into problems of particle physics and the terminology used there for students of dosimetry.			
16VUDZ1	Research Project 1	Z	6
Student on the assignment of work and under the guidance of a supervisor prepares an individual for a given topic for 2 semesters.			
16VUDZ2	Research Project 2	KZ	8
Student on the assignment of work and under the guidance of a supervisor prepares an individual for a given topic for 2 semesters.			

16ZED	Treatment of Experimental Data Statistical analysis of experimental data; univariate data; calibration; regression; multivariate data	ZK	2
16ZIVO	Introduction to Environment Ozone layer reduction, global warming (greenhouse effect), acid rain, smog, chemicalization, astrophysical theory, cosmic rays, primordial elements, atmosphere contamination, measuring of imissions and emissions, hydrosphere, waste dumping, fossil fuel, alternative sources, solar energy, water energy, wind energy, geothermal energy, biomass combustion, hydrogen energetic, galvanic and fuel couples, principle of sustainable development	KZ	2
16ZJT	Nuclear Technology Devices Basic scheme of nuclear reactor and nuclear power plant, chain fission reaction development, factors influencing reactivity, internal fuel cycle, main components of nuclear energetic reactor, most important reactor types, linear high-voltage accelerators, linear high-frequency accelerators, accelerators based on cyclotron, microtron, betatron, electron and proton synchrotrons, electron and ion sources for accelerators, targets.	ZK	2
18MMC	Monte Carlo Method This courseis devoted to the numerical method Monte Carlo and to its selected applications.	Z	4

For updated information see <http://bilakniha.cvut.cz/en/FF.html>

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