Study plan

Name of study plan: Jaderné inženýrství - Aplikovaná fyzika ionizujícího zá ení

Faculty/Institute/Others:

Department:

Branch of study guaranteed by the department: Welcome page

Garantor of the study branch:

Program of study: Nuclear Engineering Type of study: Follow-up master full-time

Required credits: 0

Elective courses credits: 120 Sum of credits in the plan: 120

Note on the plan:

Name of the block: Compulsory courses in the specialization

Minimal number of credits of the block: 0

The role of the block: PS

Code of the group: NMSPJIAFIZ1

Name of the group: MDP P_JIN AFIZ 1st year

Requirement credits in the group:

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

Credits in the group: 0 Note on the group:

Note on the g	roup:					
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
16AMMN	Methods of Analytical Measurement Kate ina Pila ová	KZ	2	2P+0C	2	PS
16EX	Excursion Lenka Thinová	Z	3	1t		PS
16IDOZ	Integral Dosimetry Methods	ZK	2	2+0	2	PS
16IZZP	Ionizing Radiation in the Environment Tomáš echák, Lenka Thinová, Václav Št pán Václav Št pán Václav Št pán (Gar.)	Z,ZK	3	2P+1C	1	PS
17JABE	Nuclear Safety Lenka Frýbortová, ubomír Sklenka Lenka Frýbortová Lenka Frýbortová (Gar.)	ZK	5	4P	Z	PS
02KFM	Quantum Physics Filip Petrásek Petr Jizba Filip Petrásek (Gar.)	Z,ZK	3	2P+1C	Z	PS
16MCRF	Monte Carlo Method in Radiation Physics Tomáš Urban Tomáš Urban Tomáš Urban (Gar.)	Z,ZK	4	2+2	2	PS
16MERV	Instrumentation for Radiation Measurements Petr Pr ša Petr Pr ša Petr Pr ša (Gar.)	Z,ZK	4	2P+2C	1	PS
17PENF	Advanced Experimental Neutron Physics Ond ej Huml Ond ej Huml (Gar.)	KZ	4	1P+3L	L	PS
16PPJRF	Advanced Topics in Nuclear and Radiation Physics Ladislav Musílek Tomáš Urban Ladislav Musílek (Gar.)	Z,ZK	3	2P+1C	1	PS
16PDZNMS	Practicum in Detection and Dosimetry of Ionizing Radiation Pavel Novotný Petr Pr ša Petr Pr ša (Gar.)	KZ	4	0+4	Z	PS
16UMT	Accelerators in Medicine and Technology Kamil Augsten Kamil Augsten Kamil Augsten (Gar.)	KZ	1	1P+0C	1	PS
16VUJI1	Research Project 1 Tomáš Bílý Tomáš Trojek (Gar.)	Z	6	0+6	1	PS
16VUJI2	Research Project 2 Tomáš Trojek, Tomáš Bílý Tomáš Bílý Tomáš Trojek (Gar.)	KZ	8	0+8	2	PS

1 O/ (IVIIVII V	Methods of Analytical Medsarchient	1112	!
Principles, technical per	formance and utilization of methods of chemical analysis. Methodology of analytical determination, gravimetry, titration meth	ods, potentiometr	y, polarography,
refractometry, polarimet	ry, UV-VIS spectroscopy, atomic emission and absorption spectroscopy, infrared and Raman spectroscopy, X-ray structural a	analysis, nuclear r	nagnetic and
electron spin resonance	, mass spectrometry, thermometric methods, gas and liquid chromatography.		1

K7

16EX Excursion Excursion in research institutes, laboratories and cooperative universities (CERN, JINR, TU Dresden,...) and modern research trends usig ionizing radiation 16IDOZ Integral Dosimetry Methods 2 7K 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. Ionizing Radiation in the Environment The course provides a comprehensive view of the source of ionizing radiation occurring in the environment. It includes information, methods of measuring, and calculating effective doses from individual sources of ionizing radiation and discusses related radiation protection. 17JABE **Nuclear Safety** ZK 5 The course gives information about requirements for safety assessment of nuclear facilities. New knowledge is connected with information get from other courses focussed on reactor physics, reactor thermomechanics and dynamics. During lectures are discussed principles of defence in depth, deterministic and probabilistic safety assessment, accidents with loss of coolant, and accidents with positive reactivity and criticality. Next part of the course follows up use of operation experiences and lessons learned from important events. The last part is focussed on safety aspect of operation of different types of reactors and their comparison to PWR and safety aspects of operation of research reactors. 02KFM Quantum Physics State description, wave function, postulates of quantum mechanics, Born's statistical interpretation, expectation values, Schrödinger equation, Heisenberg uncertainty principle, quantization of angular momentum, solution of simple systems, hydrogen atom. Monte Carlo Method in Radiation Physics 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 fines 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 16MERV Z.ZK Instrumentation for Radiation Measurements The lecture focuses on ionizing radiation detector signal processing, data acquisition and data processing. Among others, the most important topics are: energetic spectrometry, time spectrometry, coincidence measurements, pulse shape discrimination and spectrum deconvolution. Integral parts of the subject are several laboratory exercises. Thus, students are able to obtain practical experience and skills. The exercises are focused on detector signal processing by NIM standard electronic modules mostly. Students will learn how to operate an oscilloscope at advanced level as well. Absolvents should be able to design, build, operate and execute diagnostics of simple electronic circuit made of NIM standard modules. 17PENF Advanced Experimental Neutron Physics Practical exercises with non-reactor neutron sources, neutron detection, determination of basic properties of radionuclide neutron sources (AmBe, Cf252), neutron spectrometry using Boner spheres and scintillation detectors, neutron beam attenuation by various materials, acceleration based neutron sources (D-D, D-T generators), properties of photoneutron sources, neutron dosimetry, neutron activation analysis, and more. 16PPJRF Advanced Topics in Nuclear and Radiation Physics Z,ZK The course extends and complements the knowledge acquired in the bachelor's program Nuclear Engineering at FNSPE CTU in Prague in subjects 16URF1 and 16URF2 or in similar courses at other university. Therefore, it deals with the level of difficulty corresponding to the master's level of the issue of atomic nuclei, their characteristics and models, the interaction of ionizing radiation with matter, radioactivity and nuclear reactions, and provides basic information on the physics of high energy particles. Particular attention is also paid to quantities characterizing the field and interaction of ionizing radiation in accordance with current international recommendations. 16PDZNMS Practicum in Detection and Dosimetry of Ionizing Radiation ΚZ This course builds upon the Elementary Labs course and is conducted through laboratory exercises focused on advanced experimental tasks in the field of ionizing radiation detection and dosimetry. Students gain deeper insight into nuclear instrumentation commonly used in practice. Each laboratory session concludes with the preparation of a report that includes a description of the experiment, measured data, its analysis including uncertainty estimation, and interpretation of the results. Emphasis is placed on independent work, careful documentation of experiments, and the ability to clearly present the findings. Accelerators in Medicine and Technology This course provides an introduction to particle accelerators, their historical development, classification, and key operational parameters. Students will learn about ion sources and various types of linear and circular accelerators, and other advanced technologies. Special emphasis is placed on the practical applications of accelerators, particularly in medicine (e.g., radiotherapy, diagnostics) and industry (e.g., material analysis, sterilization), as well as in fundamental research, illustrated with concrete examples Research Project 1 The research project is based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by the project supervisor during common regular meetings and discussions. 16VUJI2 ΚZ 8 Research Project 2 The research project is based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by the project supervisor during common regular meetings and discussions. Code of the group: NMSPJIAFIZ2

Name of the group: MDP P_JIN AFIZ 2nd year

Requirement credits in the group:

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

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) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
16AIZM	Medical Application of Ionizing Radiation Tereza Hanušová, Anna Jelínek Michaelidesová Tereza Hanušová Tereza Hanušová (Gar.)	Z,ZK	3	2+1	3	PS
16APIZ1	Applications of Ionizing Radiation 1 Tomáš echák, Tomáš Trojek, Václav Procházka Tomáš Trojek Tomáš echák (Gar.)	ZK	3	3P+0C	L	PS

17APIZ2	Application of Ionizing Radiation 2 Martin Cesnek, Marcel Miglierini, Milan Štefánik Milan Štefánik Martin Cesnek (Gar.)	Z,ZK	3	2P+1L	L	PS
16DPJI1	Master Thesis 1 Jan Frýbort Tomáš Trojek (Gar.)	Z	10	0+10	3	PS
16DPJI2	Master Thesis 2 Jan Frýbort Tomáš Trojek (Gar.)	Z	20	0+20	4	PS
16MMM	Mathematical Methods and Modelling Tomáš Urban Jaroslav Kluso (Gar.)	Z	2	0+2	3	PS
16MEIZ	Metrology of lonizing Radiation Pavel Novotný Pavel Novotný Tomáš Trojek (Gar.)	Z,ZK	4	2+1	Z	PS
16MDOZI	Microdosimetry David John Anna Jelínek Michaelidesová Anna Jelínek Michaelidesová (Gar.)	KZ	2	2P+0C	Z	PS
16PFE	Overview of Elementary Particle Physics Jan Smolík Jan Smolík (Gar.)	KZ	2	2P+0C	Z	PS
16SEM2	Seminar 2 Kate ina Pila ová Kate ina Pila ová (Gar.)	Z	2	0+2	L	PS
16SPD	Spectrometry in Dosimetry Pavel Novotný Pavel Novotný Tomáš echák (Gar.)	ZK	2	2P+0C	Z	PS

16AIZM	Medical Application of Ionizing Radiation	Z,ZK	3
The lectures aim a	at medical physics in applications of ionising radiation in medicine - in diagnostic and interventional radiology, nuclear medicin	ne, and radiotherapy.	
16APIZ1	Applications of lonizing Radiation 1	ZK	3
Applications of ion	nizing radiation 1 inclusive of radioanalytical methods and application of radionuclides and ionizing radiation for analysis and	diagnostics of industrial	and research
processes.			
17APIZ2	Application of Ionizing Radiation 2	Z,ZK	3
The course provid	les overview of possibilities of the applications of ionizing radiation namely in the field of characteriza-tion and diagnostic of m	naterials for the sake of	science and
technology. Empha	asis will be given to advanced methods of materials characterization which utilize atomic and nuclear physical processes. Se	veral diagnostic method	ds based upon
ionizing radiation v	will be introduced.		
16DPJI1	Master Thesis 1	Z	10
The diploma proje	ct is based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by	y the project supervisor	during commo
regular meetings a	and discussions.		
16DPJI2	Master Thesis 2	Z	20
The diploma proje	ct is based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by	y the project supervisor	during commo
regular meetings a	and discussions.		
16MMM	Mathematical Methods and Modelling	Z	2
Application of mat	hematical methods, modelling and data processing in dosimetry, radiological physics, medicine and experimental physics. Pr	ocessing, analysis and	evaluation of
Carlo method) and	rch and fitting, deconvolution), data analysis, statistical processing and visualization (smoothing, numerical differentiation, cred examples of applications (calculation of the response of detection systems, efficiency and resolution, calculations of the angulation fields the angulation of the company manufacture of applications of special and a company manufacture of a company ma	gular energy distribution	ns of dosimetr
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Name of the block: Elective courses Minimal number of credits of the block: 0

The role of the block: V

Code of the group: NMSPJIAFIZV

Name of the group: MDP P_JIN AFIZ Optional courses

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) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
01DIZO	Digital Image Processing Barbara Zitová Barbara Zitová Barbara Zitová (Gar.)	ZK	4	2P+2C		V
16DNEU	Neutron Dosimetry Michal Koš ál, Ond ej Ploc Ond ej Ploc Ond ej Ploc (Gar.)	ZK	2	2+0	3	V
16DZAR	Dosimetry of Internal Radiation Sources Ladislav Musílek	ZK	2	2+0	4	V
16KLD2	Clinical Dosimetry 2 Tomáš Trojek, Tereza Hanušová, Josef Novotný Tereza Hanušová Tereza Hanušová (Gar.)	ZK	2	2P+0C	Z	V
16KPD	Design of Ionizing Radiation Semiconductor Detectors	Z	3	0+3	L	V
04MGA1	English for Academic Purposes Speaking Practice - intermediate Nathaniel Patton (Gar.)	Z	2	0+2	L,Z	٧
04MGA2	Academic English Writing and Presentation Course - intermadiate Darren Copeland (Gar.)	Z	2	0+2	L,Z	V
18MEMC	Monte Carlo Method Jaromír Kukal, Miroslav Virius Miroslav Virius (Gar.)	Z,ZK	4	2P+2C	Z	V
16PDIZ	Practicum in Dosimetry of Ionizing Radiation Václav Št pán	KZ	4	0+4	L	V
16REL	Radiation Effects in Matter Kate ina Pila ová Kate ina Pila ová (Gar.)	ZK	2	2+0	Z	V
16RAO	Radiation Protection Tomáš echák, Tomáš Trojek, Miroslav Hýža, Darina Trojková, Ladislav Tomášek Tomáš Trojek Tomáš Trojek (Gar.)	ZK	4	4+0	1	V
16RBIO	Radiobiology	ZK	2	2+0	L	V
01SUP	Start-up Project P emysl Rubeš P emysl Rubeš (Gar.)	KZ	2	2P+0C		V
01SU1	Machine Learning 1 Jan Flusser Jan Flusser (Gar.)	ZK	3	2P+1C		V
16FSC	Fundamentals of Physics of Scintillators and Phosphors	ZK	2	2+0	L	V
16ZKLD	Basics of Clinical Dosimetry Tereza Hanušová	ZK	2	2P+0C		V

	Jan Flusser Jan Flusser Jan Flusser (Gar.)					
16FSC	Fundamentals of Physics of Scintillators and Phosphors	ZK	2	2+0	L	V
16ZKLD	Basics of Clinical Dosimetry Tereza Hanušová	ZK	2	2P+0C		V
haracteristics of th	ne courses of this group of Study Plan: Code=NMSPJIAFIZV Nar	me=MDP P_、	JIN AFIZ	Optional	courses	
01DIZO D	Digital Image Processing				ZK	4
mage sampling and quanti	ization, Shannon theorem, aliasing basic image operations, histogram, contrast stretchin	ıg, noise removal	, image sha	rpening linea	r filtering in t	he spatial ar
frequency domains, convol	lution, Fourier transform edge detection, corner detection feature detection image degra	dations and their	modelling,	inverse and V	Viener filterir	ng, restoration
of motion-blurred and out-o	of-focus blurred images image segmentation mathematical morphology image registration	on and matching				
16DNEU N	leutron Dosimetry				ZK	2
Methods based on nuclear	r reactions with neutrons, methods based on recoiled nuclei, the time-of-flight method, ne	eutron selectors	and monoch	romators, act	tivation meth	ods, method
of integrating neutron dosir	metry, possibilities of use of various methods, calibration of neutron dosimeters and other	er dose and dose	rate measu	uring instrume	ents.	
16DZAR D	Posimetry of Internal Radiation Sources				ZK	2
Assessment of the radiatio	on burden during internal contamination by radioactive materials, dosimetric quantities, c	ompartment mod	dels of the k	inetics of radi	ioactive mate	erials, ways
aking into account age dep	pendence in dosimetric models, limitation of validity of used models and procedures, asse	ssment of the rad	diation burde	en from radiop	oharmaceutio	cals in nucle
medicine - basic concepts,	general procedure for calculating the absorbed dose from radiopharmaceuticals, finding	data about the b	oiological be	haviour of rac	diopharmace	euticals, table
of absorbed doses and limit	itation of their validity, radiation burden for children, burden from contaminants in radiopl	harmaceuticals,	developmen	t of methods	for assessm	ent of the
radiation burden from inter-	rnal sources, methods of measurement of internal contamination, detection in-vivo, excre	eta monitoring, m	onitorina of	workplaces		
	-, , ,,, , , ,, -	•		p.acco.		
	Clinical Dosimetry 2	<u> </u>	<u>-</u>		ZK	2
16KLD2 C		ods in accordance				_
16KLD2 C	Clinical Dosimetry 2		e with the ra	apid developn	ment of techr	-
16KLD2 C Learning outcomes of the of field: small field dosimetry,	Clinical Dosimetry 2 course unit The aim of the course is to acquaint students with advanced dosimetric meth		e with the ra	apid developn	ment of techr	-
16KLD2 C Learning outcomes of the of field: small field dosimetry, 16KPD D	Clinical Dosimetry 2 course unit The aim of the course is to acquaint students with advanced dosimetric meth dosimetry in magnetic field, proton beams, special technologies. Furthermore, it should		e with the ra	apid developn	ment of techr	nologies in th
16KLD2 C Learning outcomes of the or field: small field dosimetry, 16KPD D Klí ová slova:: detectors, G	Clinical Dosimetry 2 course unit The aim of the course is to acquaint students with advanced dosimetric meth dosimetry in magnetic field, proton beams, special technologies. Furthermore, it should besign of Ionizing Radiation Semiconductor Detectors		e with the ra	apid developn	ment of techr	nologies in th
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Radiation Effects in Matter 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 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. 16RBIO ZK 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 modificators of the cell response to irradiation; theories and models for cell survival and radiation biology of normal and neoplastic tissue systems 01SUP Start-up Project ΚZ 01SU1 Machine Learning 1 ΖK 3 [1] features for description and recognition of 2-D shapes [2] invariant features, Fourier descriptors, moment invariants, differential invariants [3] statistical pattern recognition, supervised and nonsupervised classification, NN- classifier, linear classifier, Bayessian classifier [4] clustering in a feature space, iterative and hierarchical methods [5] dimensionality reduction of a feature space Fundamentals of Physics of Scintillators and Phosphors 16FSC 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. Basics of Clinical Dosimetry 16ZKLD ZK 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.

List of courses of this pass:

Code	Name of the course	Completion	Credits
01DIZO	Digital Image Processing	ZK	4
image sampling ar	d quantization, Shannon theorem, aliasing basic image operations, histogram, contrast stretching, noise removal, image sharpening l	inear filtering in the	spatial and
frequency domain	s, convolution, Fourier transform edge detection, corner detection feature detection image degradations and their modelling, inverse a	nd Wiener filtering	, restoration
	of motion-blurred and out-of-focus blurred images image segmentation mathematical morphology image registration and mato	ching	
01SU1	Machine Learning 1	ZK	3
[1] features for des	cription and recognition of 2-D shapes [2] invariant features, Fourier descriptors, moment invariants, differential invariants [3] statistical properties of the comment invariant of the comment invariant invariant invariants.	oattern recognition	, supervised
and nonsupervise	ed classification, NN- classifier, linear classifier, Bayessian classifier [4] clustering in a feature space, iterative and hierarchical method	ls [5] dimensionalit	y reduction
	of a feature space		
01SUP	Start-up Project	KZ	2
02KFM	Quantum Physics	Z,ZK	3
State description	n, wave function, postulates of quantum mechanics, Born's statistical interpretation, expectation values, Schrödinger equation, Heise	nberg uncertainty	principle,
	quantization of angular momentum, solution of simple systems, hydrogen atom.		
04MGA1	English for Academic Purposes Speaking Practice - intermediate	Z	2
Optional course of	iffers Master's Degree students at intermediate level of English a chance to improve, develop, and strengthen their vocabulary and sp	eaking skills. Cour	se syllabus
will respon	nd to specific professional interests and situations of students and choice of topics will be agreed on with tutor. Course is a non-grade	d assessment cou	rse.
04MGA2	Academic English Writing and Presentation Course - intermadiate	Z	2
Optional course, a	possible free sequel to course 04MGA1, offers Master's degree students at intermediate level of English a chance to develop, improve	e, and strengthen	their writing
and presentation	skills. Syllabus will respond to specific professional needs of participants, but will include also writing and preparing a presentation on	own research topi	c, a search,
instruction on wri	ting Master thesis in English and presenting chosen facts. Course will thus prepare students for presentations at conferences. Course	is a non-graded a	ssessment
	course.		
16AIZM	Medical Application of Ionizing Radiation	Z,ZK	3
The lectu	ures aim at medical physics in applications of ionising radiation in medicine - in diagnostic and interventional radiology, nuclear medici	ne, and radiothera	py.
16AMMN	Methods of Analytical Measurement	KZ	2
Principles, technic	al performance and utilization of methods of chemical analysis. Methodology of analytical determination, gravimetry, titration methods	, s, potentiometry, po	olarography
refractometry, po	olarimetry, UV-VIS spectroscopy, atomic emission and absorption spectroscopy, infrared and Raman spectroscopy, X-ray structural an	alysis, nuclear mag	gnetic and
	electron spin resonance, mass spectrometry, thermometric methods, gas and liquid chromatography.		
16APIZ1	Applications of Ionizing Radiation 1	ZK	3
Applications of io	nizing radiation 1 inclusive of radioanalytical methods and application of radionuclides and ionizing radiation for analysis and diagnos	tics of industrial an	d research
	processes.		
16DNEU	Neutron Dosimetry	ZK	2
Methods based or	nuclear reactions with neutrons, methods based on recoiled nuclei, the time-of-flight method, neutron selectors and monochromators	s, activation method	ds, methods
of integ	rating neutron dosimetry, possibilities of use of various methods, calibration of neutron dosimeters and other dose and dose rate mea	suring instruments	3.
16DPJI1	Master Thesis 1	Z	10
The diploma proje	ct is based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by the proj	ect supervisor duri	ing commor
	regular meetings and discussions.	-	

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16DPJI2	Master Thesis 2	Z	20
The diploma projec	ct is based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by the proje regular meetings and discussions.	ct supervisor dur	ing commor
16DZAR		ZK	2
	Dosimetry of Internal Radiation Sources radiation burden during internal contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by radioactive materials, dosimetric quantities, compartment models of the kinetics of the contamination by th		1
	age dependence in dosimetric models, limitation of validity of used models and procedures, assessment of the radiation burden from rad		
•	oncepts, general procedure for calculating the absorbed dose from radiopharmaceuticals, finding data about the biological behaviour of	•	
of absorbed dos	es and limitation of their validity, radiation burden for children, burden from contaminants in radiopharmaceuticals, development of met	hods for assessn	nent of the
radiat	tion burden from internal sources, methods of measurement of internal contamination, detection in-vivo, excreta monitoring, monitoring	g of workplaces.	
16EX	Excursion	Z	3
Excur	sion in research institutes, laboratories and cooperative universities (CERN, JINR, TU Dresden,) and modern research trends usig in	onizing radiation.	
16FSC	Fundamentals of Physics of Scintillators and Phosphors	ZK	2
	ructure of solids, interaction of X, gamma and beta rays and particle beams with solids, principle of scintillation. Energy levels in forbidde		
nd traps for charg	e carriers. Absorption and luminescence processes, energy transfer, quenching. History of scintillator and phosphor development. Main ch	naracteristics and	parameters
401007	Technology basics. Examples of applications.	71/	
16IDOZ	Integral Dosimetry Methods ate dosimeters (films, thermoluminescent, radiophotoluminescent, colorization, exoelectron, lyoluminescent, and chemical dosimeters,	ZK	2
	ecial neutron dosimeters (Si diode, albedo dosimeters), advantages and disadvantages of different systems, secondary standardisation m		
ao., ao., ao., ap.,	of photons, electrons and neutrons with respect to their use in personal and environmental dosimetry.		.0000.011.01
16IZZP	Ionizing Radiation in the Environment	Z,ZK	3
-	des a comprehensive view of the source of ionizing radiation occurring in the environment. It includes information, methods of measuri	,	1
•	doses from individual sources of ionizing radiation and discusses related radiation protection.		
16KLD2	Clinical Dosimetry 2	ZK	2
earning outcomes	s of the course unit The aim of the course is to acquaint students with advanced dosimetric methods in accordance with the rapid devel	opment of techno	logies in th
field: sm	nall field dosimetry, dosimetry in magnetic field, proton beams, special technologies. Furthermore, it should deepen theoretical knowled	dge (cavity theory	').
16KPD	Design of Ionizing Radiation Semiconductor Detectors	Z	3
	Klí ová slova:: detectors, Gaiger mode, A/D convertor		
16MCRF	Monte Carlo Method in Radiation Physics	Z,ZK	4
	the MC method, probability theory and selected concepts in mathematical statistics. Ionising radiation transport simulation, photons, no		-
	their simulation, modelling of the geometric conditions. Statistical tests of the model calculations, variance reduction techniques. Code		
	(X) code, properties and scope of usage, input file (description of the geometry, materials, sources, tallies), graphical tools, code user risualization (VISED, Sabrina, Body Builder). Examples of application (practical training) concentrated on radiation physics (shielding, ra		-
	stributions of the dosimetric quantities, responses of detection systems, radiation protection tasks. The basics of working with the prog		
spootial opatial al	our ballone of the addition quantities, responses of actorion by terms, radiation protection tacks. The basics of working with the prog		
	code for simulation of the transport of charged particles.	ram Fluka and G	carri, Ortini
16MDOZI	code for simulation of the transport of charged particles. Microdosimetry		
16MDOZI Basic characteristi	code for simulation of the transport of charged particles. Microdosimetry ics of ionising radiation energy transfer to matter, importance of inelastic collisions of charged particles, excitation function, etc. Track a	KZ	2
Basic characteristi	Microdosimetry	KZ and characteristic	2 s of ionising
Basic characteristi	Microdosimetry ics of ionising radiation energy transfer to matter, importance of inelastic collisions of charged particles, excitation function, etc. Track a	KZ and characteristic energy transfer, li	2 s of ionising
Basic characteristi	Microdosimetry ics of ionising radiation energy transfer to matter, importance of inelastic collisions of charged particles, excitation function, etc. Track a ution of the energy transfer process. Microdosimetry, basic principles and approaches, stochastic and non-stochastic quantities, linear	KZ and characteristic energy transfer, li	2 s of ionising
Basic characteristi articles, time evol 16MEIZ he course introdu	Microdosimetry ics of ionising radiation energy transfer to matter, importance of inelastic collisions of charged particles, excitation function, etc. Track a ution of the energy transfer process. Microdosimetry, basic principles and approaches, stochastic and non-stochastic quantities, linear specific energy. Experimental and computational microdosimetry. Microdosimetry applied in radiobiology, radiation protection, radio Metrology of Ionizing Radiation ces students to the metrology, including its legislative framework. Fundamental and general concepts of the field (calibration, verification)	KZ und characteristic energy transfer, li therapy. Z,ZK u, legally controlle	2 s of ionising neal energy 4 d measuring
Basic characteristi articles, time evol 16MEIZ he course introdu	Microdosimetry ics of ionising radiation energy transfer to matter, importance of inelastic collisions of charged particles, excitation function, etc. Track a lution of the energy transfer process. Microdosimetry, basic principles and approaches, stochastic and non-stochastic quantities, linear specific energy. Experimental and computational microdosimetry. Microdosimetry applied in radiobiology, radiation protection, radio Metrology of Ionizing Radiation ces students to the metrology, including its legislative framework. Fundamental and general concepts of the field (calibration, verification assuring standards, measurement accuracy) are explained. Further, the methods of atomic and nuclear physics quantities determination	KZ und characteristic energy transfer, li therapy. Z,ZK u, legally controlle	2 s of ionising neal energy 4 d measuring
tasic characteristicarticles, time evolution 16MEIZ he course introduinstruments, mea	Microdosimetry ics of ionising radiation energy transfer to matter, importance of inelastic collisions of charged particles, excitation function, etc. Track a ution of the energy transfer process. Microdosimetry, basic principles and approaches, stochastic and non-stochastic quantities, linear specific energy. Experimental and computational microdosimetry. Microdosimetry applied in radiobiology, radiation protection, radio Metrology of Ionizing Radiation ces students to the metrology, including its legislative framework. Fundamental and general concepts of the field (calibration, verification assuring standards, measurement accuracy) are explained. Further, the methods of atomic and nuclear physics quantities determination radiation exposure, absorbed dose) are discussed in detail.	KZ und characteristic energy transfer, li therapy. Z,ZK u, legally controlle n (activity, source	2 s of ionising neal energy 4 d measurin emission,
Basic characteristicarticles, time evolution 16MEIZ the course introdution instruments, means 16MERV	Microdosimetry ics of ionising radiation energy transfer to matter, importance of inelastic collisions of charged particles, excitation function, etc. Track a lution of the energy transfer process. Microdosimetry, basic principles and approaches, stochastic and non-stochastic quantities, linear specific energy. Experimental and computational microdosimetry. Microdosimetry applied in radiobiology, radiation protection, radio Metrology of Ionizing Radiation ces students to the metrology, including its legislative framework. Fundamental and general concepts of the field (calibration, verification assuring standards, measurement accuracy) are explained. Further, the methods of atomic and nuclear physics quantities determination radiation exposure, absorbed dose) are discussed in detail. Instrumentation for Radiation Measurements	KZ and characteristic energy transfer, li therapy. Z,ZK a, legally controlle n (activity, source	2 s of ionising neal energy 4 d measuring emission,
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	Radiation Protection	ZK	4
16RAO The aim of the sub	ject is to provide a self-contained overview of the radiation protection with a special focus on general principles. The subject is based on the		
	er documents, which specifies radiation protection in the Czech Republic and EU. The course is accepted as training, which allows obta		
	radiation protection. Participants will receive an appropriate certificate of attendance when fulfil all requirements defined in the permit	• .	
16RBIO	Radiobiology	ZK	2
The presented led	- 	processes of ra	diation action
•	aterial; mechanisms of radiation damage to DNA and other cell components; types of damages and their repair; subcellular and cellular	-	
irradiation; physic	eal, biological and chemical modificators of the cell response to irradiation; theories and models for cell survival and radiation biology of	normal and neo	plastic tissue
	systems.		
16REL	Radiation Effects in Matter	ZK	2
History of radiol	lysis, track, stages of radiolysis, reaction kinetics, radiation chemical yield, experiments in radiolysis, classical methods, pulse radiolysis	s, EPR, primary	products of
radiolysis, excite	ed states, solvated electrons, free radicals, radiolysis of gases, water, water solutions, organic liquids, radiolysis of solid materials, ionic	crystals, polyme	ers, glasses,
	metals and alloys, radiation technology, sterilisation, crosslinking and degradation of polymers, treatment of foods.		
16SEM2	Seminar 2	Z	2
An oral presenta	ation of Master's Thesis results. The presentation is evaluated by the other attendees of the seminary. The students are encouraged to	write an article s	ummarizing
	their Master thesis.		
16SPD	Spectrometry in Dosimetry	ZK	2
The course deal	ls with methods and applications of ionizing radiation (i.e. photons, charged particles and neutrons) spectrometry. The most important t	ypes of detector	s, individual
	components of the electronic system used in spectrometry as well as spectra analysis procedures are discussed in detail.		
16UMT	Accelerators in Medicine and Technology	KZ	1
This course prov	vides an introduction to particle accelerators, their historical development, classification, and key operational parameters. Students will	learn about ion s	ources and
various types of	linear and circular accelerators, and other advanced technologies. Special emphasis is placed on the practical applications of accelera	tors, particularly	in medicine
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(e.g	g., radiotherapy, diagnostics) and industry (e.g., material analysis, sterilization), as well as in fundamental research, illustrated with cond	crete examples.	
(e.g 16VUJI1	g., radiotherapy, diagnostics) and industry (e.g., material analysis, sterilization), as well as in fundamental research, illustrated with conditional Research Project 1	rete examples.	6
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