Study plan

Name of study plan: Fyzika plazmatu a termojaderné fúze

Faculty/Institute/Others:
Department:
Branch of study guaranteed by the department: Welcome page
Garantor of the study branch:
Program of study: Plasma Physics and Thermonuclear Fusion
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 program
Minimal number of credits of the block: 0
The role of the block: P

Code of the group: NMSPFPTF1
Name of the group: MDP P_FPTFN 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:

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
02AMF	**Atomic and Molecular Physics** *David Břeň David Břeň (Gar.)*	Z,ZK	4	2+2	Z	P
02DPLA	**Plasma Diagnostics** *Karel Řezáč, Pavel Kubeš, Daniel Klír **Daniel Klír** Karel Řezáč (Gar.)*	Z,ZK	3	2+1	L	P
12FIF	**Inertial Fusion Physics** *Ondřej Klimo **Ondřej Klimo** Ondřej Klimo (Gar.)*	Z,ZK	4	3+1	Z	P
02FT	**Physics of Tokamaks** *Ondřej Ficker Igor Jex (Gar.)*	Z,ZK	4	3+1	Z	P
14NMR	**Materials Science for Reactors** *Petr Haušild **Petr Haušild** Petr Haušild (Gar.)*	ZK	2	1P+1C	6	P
14NAMA	**Materials Science** *Petr Haušild **Petr Haušild** Petr Haušild (Gar.)*	KZ	3	2P+1C		P
12PFTF1	**Computational Physics 1** *Milan Kuchařík **Milan Kuchařík** Ondřej Klimo (Gar.)*	Z,ZK	2	1P+1C	L	P
02PRPLA1	**Laboratory Work in Plasma Physics 1** ***Jana Brotánková*** *Vojtěch Svoboda (Gar.)*	Z	5	0P+3C		P
02PRPL1	**Laboratory Work in Plasma Physics 1** ***Jana Brotánková*** *Vojtěch Svoboda (Gar.)*	Z	2	0+2	Z	P
02PRPLA2	**Praktika fyziky plazmatu 2** *Jana Brotánková, Vojtěch Svoboda **Jana Brotánková** Vojtěch Svoboda (Gar.)*	KZ	5	0P+3C	L	P
02PRPL2	**Laboratory Work in Plasma Physics 2** *Jana Brotánková, Vojtěch Svoboda **Jana Brotánková** Vojtěch Svoboda (Gar.)*	KZ	2	0+2	L	P
02TTJZ	**Technology of Thermonuclear Facilities** *Ondřej Klimo, Ondřej Ficker, Radomír Pánek, Ivan Ďuran, Michal Farník, Slavomír Entler Slavomír Entler (Gar.)*	ZK	3	3+0	L	P
02TPLA1	**Plasma Theory 1** *Petr Kulhánek Petr Kulhánek (Gar.)*	Z,ZK	5	2+2	Z	P
02TPLA2	**Plasma Theory 2** *Petr Kulhánek **Jan Mlynář** Jan Mlynář (Gar.)*	Z,ZK	5	3+1	L	P
02VUTF1	**Research Project 1** ***Jana Brotánková***	Z	6	6	Z,L	P
02VUTF2	**Research Project 2** *Daniel Klír, Jana Brotánková, Vojtěch Svoboda, Ivan Ďuran, Monika Vilémová, Libor Juha, Jakub Svoboda, Miroslav Krůs, Vladimír Scholtz, ... **Ivan Ďuran***	KZ	8	8	L,Z	P

Characteristics of the courses of this group of Study Plan: Code=NMSPFPTF1 Name=MDP P_FPTFN 1st year

02AMF	Atomic and Molecular Physics	Z,ZK	4
This lecture course provides a theoretical introduction to atomic and molecular physics.			
02DPLA	Plasma Diagnostics	Z,ZK	3
he goal of the lecture is to obtain the overview of measurements of basic parameters of hot plasma and their components - density, temperature, electromagnetic fields, radiation and energy and temporal and spatial distribution. The students will acquaint with principles, methodic, demonstration, examples and application of basic diagnostics.			
12FIF	Inertial Fusion Physics	Z,ZK	4
These lectures aim to introduce to the topic of inertial confinement fusion (ICF). Physical processes, which take place during the individual stages before and after ignition of the fuel are discussed. The problems (instabilities etc.), which make the inertial confinement and the ignition of the fuel more demanding are discussed and their potential solutions are presented. New projects in the field of ICF including some preliminary reactor designes are reviewed.			
02FT	Physics of Tokamaks	Z,ZK	4
Advanced course on physics of thermonuclear fusion in the magnetic confinement of tokamaks. The course is focused on the physics context, terminology and phenomenology of the subject so that students can substantially improve their understanding of physics background as well as their capacity to search for information and to work independently with scientific literature.			
14NMR	Materials Science for Reactors	ZK	2
Materials for classical and fusion reactors			
14NAMA	Materials Science	KZ	3
Introduction to the Materials Science.			
12PFTF1	Computational Physics 1	Z,ZK	2
The course is giving an overview of some of the well-known computational physics methods in various fields of physics. The first part concentrates on particle simulation methods - molecular dynamics, Monte Carlo method and other methodsof solving the particle transport in self-consistent fields (e.g. Particle in Cell method in plasma physics). The second part concentrates on methods of solving Maxwell equations and in particular on the finite difference, finite elements methods and the method of moments. An introduction to application of computational physics methods in quantum physics (Hartree-Fock method, density functional theory) is also given.			
02PRPLA1	Laboratory Work in Plasma Physics 1	Z	5
The goal of the lecture is performing experimental work on advanced plasma laboratory experiments: either on a fusion device - the GOLEM tokamak, or in a specialized laboratory for training of fusion oriented plasma physics PlasmaLab@CTU. The goal is also obtaining experience with the basics of scientific work.			
02PRPL1	Laboratory Work in Plasma Physics 1	Z	2
The goal of the lecture is performing experimental work on advanced plasma laboratory experiments: either on a fusion device - the GOLEM tokamak, or in a specialized laboratory for training of fusion oriented plasma physics PlasmaLab@CTU. The goal is also obtaining experience with the basics of scientific work.			
02PRPLA2	Praktika fyziky plazmatu 2	KZ	5
The goal of the lecture is performing experimental work on advanced plasma laboratory experiments: either on a fusion device - the GOLEM tokamak, or in a specialized laboratory for training of fusion oriented plasma physics PlasmaLab@CTU. The goal is also obtaining experience with the basics of scientific work.			
02PRPL2	Laboratory Work in Plasma Physics 2	KZ	2
The goal of the lecture is performing experimental work on advanced plasma laboratory experiments: either on a fusion device - the GOLEM tokamak, or in a specialized laboratory for training of fusion oriented plasma physics PlasmaLab@CTU. The goal is also obtaining experience with the basics of scientific work.			
02TTJZ	Technology of Thermonuclear Facilities	ZK	3
The course introduces students to the basic technologies of thermonuclear devices. The aim of the course is to provide students with basic technical information for their future work on fusion experimental facilities. The course provides an overview of solutions, technical problems, possibilities and limits of fusion equipment operation.			
02TPLA1	Plasma Theory 1	Z,ZK	5
The first part of the lecture will be devoted to the individual particles motion in Lagrange and Hamilton formalism for both relativistic and non-relativistic behavior. The particle drifts will be solved in the frame of adiabatic approach. The second part of the lecture will be devoted to magnetohydrodynamics, especially such phenomena as helicity and helical structures, magnetic field-lines reconnection, MHD dynamo and others.			
02TPLA2	Plasma Theory 2	Z,ZK	5
First part of the lecture will be devoted to plasma waves and instabilities. General recipes of obtaining the disperse relation will be discussed, especially linearization and Fourier transform. Magnetoacoustic waves, electromagnetic waves, and basic instabilities will be treated in detail. The second part of the lecture will be devoted to statistical plasma approach, e. g. transport phenomena, and microinstabilities such as Landau damping.			
02VUTF1	Research Project 1	Z	6
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.			
02VUTF2	Research Project 2	KZ	8
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: NMSPFPTF2
Name of the group: MDP P_FPTFN 2nd year
Requirement credits in the group:
Requirement courses in the group: In this group you have to complete at least 8 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
02DPTF1	**Master Thesis 1** ***Jana Brotánková*** *Ondřej Ficker (Gar.)*	Z	10	10	Z,L	P
02DPTF2	**Master Thesis 2** ***Ivan Ďuran*** *Ondřej Ficker (Gar.)*	Z	20	20	L,Z	P
02ITERA	**ITER and the accompanying programme** *Jana Brotánková, Ivan Ďuran* ***Ivan Ďuran*** *Ivan Ďuran (Gar.)*	ZK	2	2P+0C	L	P

02PINCE	**Pinches** *Pavel Kubeš, Daniel Klír, Jiří Limpouch **Daniel Klír** Daniel Klír (Gar.)*	ZK	2	2P+0C	Z	P
12PFTF2	**Computational Physics 2** *Ondřej Klimo **Ondřej Klimo** Ondřej Klimo (Gar.)*	Z,ZK	2	1+1	Z	P
02STFU1	**Seminar FPTF1** *Jaroslav Čeřovský Igor Jex (Gar.)*	Z	2	0P+2S	Z	P
02STFU2	**Seminar FPTF2** *Jan Mlynář **Jan Mlynář** Jan Mlynář (Gar.)*	Z	2	0P+2S	L	P
02TFS	**Thermonuclear Fusion and Society** *Vojtěch Svoboda Vojtěch Svoboda (Gar.)*	Z	2	2P+0C	Z	P

Characteristics of the courses of this group of Study Plan: Code=NMSPFPTF2 Name=MDP P_FPTFN 2nd year

02DPTF1	Master Thesis 1	Z	10
The diploma 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.			
02DPTF2	Master Thesis 2	Z	20
The diploma 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.			
02ITERA	ITER and the accompanying programme	ZK	2
Students will learn details on the ITER basic parameters and components of ITER: the superconducting magnets, vacuum pumping, fuel cycle, cryoplant, nuclear safety, operation scenarios, ITER plasma diagnostics, schedule of construction and operation. Besides, history of the project, forms of international collaboration, projects IFMIF and DEMO as well as major fusion research centres in the world will be presented.			
02PINCE	Pinches	ZK	2
This subject is focused on physics and technology of magnetic pinches which represent the most efficient way how to generate high-energy density plasmas (>100 kJ/cm3). The lectures will introduce students into the basic theory, contemporary research topics, and applications of magnetic pinches. One of the objectives of the subject is to demonstrate that the pinch effect naturally occurs in laboratory and space plasmas and has an impact on many applications. The subject Magnetic pinches, therefore, contributes to a better understanding of fundamental processes in plasmas.			
12PFTF2	Computational Physics 2	Z,ZK	2
Structure of hydrodynamic code, representation of structured and unstructured computational meshes. Tools for code debugging and profiling, error detection. Code parallelization, memory hierarchy, supercomputers. Euler equations on moving computational mesh. Eulerian, Lagrangian, and ALE methods, staggered discretization. Methods for mesh smoothing, methods for conservative interpolations of functions between meshes. Applications in simulations of laser/target interactions. Generalization for elastic materials. Methods of artificial intelligence in computational physics.			
02STFU1	Seminar FPTF1	Z	2
Seminars based on invited lectures given by experts in the field of research and development of thermonuclear fusion. Students are encouraged to participate in seminars of neighbouring fields according to the subject of their diploma thesis.			
02STFU2	Seminar FPTF2	Z	2
Seminars based on invited lectures given by experts in the field of research and development of thermonuclear fusion. Students are encouraged to participate in seminars of neighbouring fields according to the subject of their diploma thesis.			
02TFS	Thermonuclear Fusion and Society	Z	2
While the scientific lecture goes from the simplest to more complicated, from the known to the new, this lecture goes from the old to the new. It connects the fusion devices and formulas with their authors. It explains the logics behind the direction of the controlled thermonuclear fusion, including the necessary or surprising mistakes, and dead ends. The lecture clarifies the place of fusion in the society, including the role of popularization, and the role of fusion in the future energy resources scheme. The fusion news are included in the lecture.			

Name of the block: Elective courses
Minimal number of credits of the block: 0
The role of the block: V

Code of the group: NMSPFPTFV
Name of the group: MDP P_FPTFN 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**
12DRP	**Differential Equations on Computer** *Richard Liska **Richard Liska** Richard Liska (Gar.)*	Z,ZK	5	2+2	Z	V
16DNEU	**Neutron Dosimetry** *Michal Košťál, Ondřej Ploc **Ondřej Ploc** Ondřej Ploc (Gar.)*	ZK	2	2+0	3	V
02EADP	**Experimental data analysis in plasma physics** *Jakub Seidl (Gar.)*	Z	3	0P+2C	L	V
12LPZ	**Laser-plasma as a Source of Particles and Radiation** *Jaroslav Nejdl **Jaroslav Nejdl** Jaroslav Nejdl (Gar.)*	ZK	2	2+0	Z	V
02ZLSTF2	**Summer School of Plasma Physics and Fusion Physics 2** *Vojtěch Svoboda (Gar.)*	Z	1	1týd.	L	V
01MMNS	**Mathematical Modelling of Non-linear Systems** *Michal Beneš **Michal Beneš** Michal Beneš (Gar.)*	ZK	3	1P+1C	Z	V

12NIPL	**Low Temperature Plasmas and Discharges** *Jaroslav Nejdl, Michal Nevrkla **Jaroslav Nejdl** Jaroslav Nejdl (Gar.)*	Z,ZK	4	4	Z	v
12OSP	**Optical Spectroscopy** *Martin Michl **Martin Michl** Martin Michl (Gar.)*	KZ	2	2+0	L	v
02PMPL	**Computer Modelling of Plasma** *Radek Plašil Radek Plašil (Gar.)*	Z,ZK	3	2+1	L	v
12POEX	**Computer Control of Experiments** *Miroslav Čech **Miroslav Čech** Miroslav Čech (Gar.)*	Z	2	2+0	L	v
12SFMC1	**Computer Simulations in Many-particle Physics 1** *Milan Předota **Richard Liska** Richard Liska (Gar.)*	Z,ZK	4	3+1	Z	v
12SFMC2	**Computer Simulations in Many-particle Physics 2** *Milan Předota, Karel Houfek Richard Liska (Gar.)*	ZK	2	2+0	L	v
16REL	**Radiation Effects in Matter** *Kateřina Pilařová **Kateřina Pilařová** Kateřina Pilařová (Gar.)*	ZK	2	2+0	Z	v
01SUP	**Start-up Project** *Přemysl Rubeš **Přemysl Rubeš** Přemysl Rubeš (Gar.)*	KZ	2	2P+0C		v
11SUPR	**Superconductivity and Low Temperature** *Zdeněk Janů, Martin Ledinský **Martin Ledinský** Martin Ledinský (Gar.)*	ZK	4	4	Z	v
16ZIVO	**Introduction to Environment** *Hana Průšová **Hana Průšová** Hana Průšová (Gar.)*	KZ	2	2+0	1	v
02PMCF	**Topics in Magnetic Confinement Fusion** *Ondřej Ficker Ondřej Ficker (Gar.)*	KZ	2	0+2	L	v
16ZJT	**Nuclear Technology Devices** *Tomáš Čechák, Kamil Augsten **Kamil Augsten** Tomáš Čechák (Gar.)*	ZK	2	2+0	1	v
02ZLSTF1	**Winter School of Plasma Physics and Fusion Physics 1** *Vojtěch Svoboda (Gar.)*	Z	1	1týd.	Z	v

Characteristics of the courses of this group of Study Plan: Code=NMSPFPTFV Name=MDP P_FPTFN Optional courses

12DRP	Differential Equations on Computer	Z,ZK	5

Ordinary differential equations, analytical methods; Ordinary differential equations, numerical methods, Runge-Kutta methods, stability; Partial differential equations, analysis, hyperbolik, parabolic and elliptic equations, posedness of differential equaitons; Partial differential equations, numerical solution, finite difference methods, difference schemes, order of approximation, stability, convergence, modified equation, diffusion, dispersion; Conservation laws and their numerical solution, shallow water equations, Euler equations, Lagrangian methods, ALE methods; Practical computation in Matlab system for numerics and Maple for analysis of schemes.

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.

02EADP	Experimental data analysis in plasma physics	Z	3

The goal of the course is to provide students with the opportunity to gain practical experience by solving projects in the field of data science. Several tasks focused on analyzing data from fusion experiments with magnetic plasma confinement, using various diagnostic systems (microwaves, visible spectroscopy, infrared cameras, electrical probes, etc.), give students the chance to learn how to apply Bayesian approaches, neural networks, and computations on graphics cards to obtain the required information about the plasma state. Furthermore, it introduces the advantages of applying forward and backward models in plasma diagnostics. This approach mimics workflows common in research and development projects, where the requirement is to design a method for obtaining a certain type of information from measured data.

12LPZ	Laser-plasma as a Source of Particles and Radiation	ZK	2

Students will get acquinted with physical principles of interaction of intense laser beams with matter with a stress on generation of secondary sources of radiation and accelerated particles and selected applications of these sources. After definition of basic quantities and description of interaction of bound electron with low frequency field, the principles of high-order harmonic generation and generation of single attosecund pulseswill be explained followed by plasma-based x-ray lasers and radiation from hot plasma. Next block of lectures will focus on methods of generation hard x-rays from relativistic laser beams, electron and ion acceleration and selected interdisciplinary applications of these secondary sources.

02ZLSTF2	Summer School of Plasma Physics and Fusion Physics 2	Z	1

Regular international "Student Summer School of Plasma and Fusion Physics" should help students to improve their communication skills. Each participating student presents a talk on his research.

01MMNS	Mathematical Modelling of Non-linear Systems	ZK	3

The course consists of basic terms and results of the theory of finite- and infinitedimensional dynamical systems generated by evolutionary differential equations, and description of bifurcations and chaos. Second part is devoted to the explanation of basic results of the fractal geometry dealing with attractors of such dynamical systems.

12NIPL	Low Temperature Plasmas and Discharges	Z,ZK	4

Atomic collision phenomena; basic concepts and relations; elastic scattering; ionization and excitation; three-particle recombination. Brehmsstrahlung; radiative capture; line radiation. Processes in partially ionized gas. Gas in thermodynamic equilibrium. Ionized gas in electric field. Phenomena on electrodes. Breakdown of gas in D.C. and A.C. electric fields. Gas discharges; V-A charakteristics. Glow discharge. Self-sustaining D.C. arc discharge. Low pressure discharge with heated cathode. Electrical probes.

12OSP	Optical Spectroscopy	KZ	2

Basics of spectroscopic behaviour of atoms and molecules. Elementary experimental techniques for optical spectroscopy.

02PMPL	Computer Modelling of Plasma	Z,ZK	3

The goal of the lecture is to acquaint the students with basic methods of computer modelling in physics and to apply these techniques to the study of physical processes in both low-temperature and high-temperature plasmas.

12POEX	Computer Control of Experiments	Z	2

Introduction. Basic design of computers, microcomputers. Hardware: computer-experiment interconnection (interfaces RS232C,IEE488, A/D and D/A converters, sensors, drivers, etc.) Software: operating systems for control of experiments (real time OS, multitasking, multiuser). Basic theory of control systems. Programming languages for control (assembler, C, etc.) Introduction to TCP/IP protocols. Control of experiments via Internet.

12SFMC1	Computer Simulations in Many-particle Physics 1	Z,ZK	4

Computer simulation types and possibilities, classical continuous and lattice model systems, principles of the Monte Carlo and molecular dynamics methods, the Ising model, model of hard spheres and of Lennard-Jones liquid, realization of simulations and measurement, simulations in various thermodynamic ensembles.

12SFMC2	Computer Simulations in Many-particle Physics 2	ZK	2

Advanced methods of Monte Carlo and molecular dynamics and their applications to various problems: critical phenomena, complex molecules, non-equilibrium phenomena, transport coefficients, kinetic MC, optimalization problems, quantum MC, ab initio simulations, Car-Parrinello method.

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.			
01SUP	Start-up Project	KZ	2
11SUPR	Superconductivity and Low Temperature	ZK	4
The subject of course is: low temperature physics, including cooling methods, low temperature technique, and measurement of low temperatures; macroscopic quantum phenomena in quantum fluids (superfluidity and superconductivity), quantum crystals and diffusion, mesoscopic phenomena in electron systems, quantum Hall effects, Coulomb blockade and single electron transistor.			
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			
02PMCF	Topics in Magnetic Confinement Fusion	KZ	2
This course provides an opportunity to students interested in magnetic confinement fusion to enhance their knowledge of fusion physics and technology by special topics that are not covered by the mainstream courses. At the same time, it is a platform where students can meet young research scientists from the COMPASS tokamak. In the end of the course students are expected to present results of their own research task.			
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.			
02ZLSTF1	Winter School of Plasma Physics and Fusion Physics 1	Z	1
Regular international "Student Winter School of Plasma and Fusion Physics" should help students to improve their communication skills. Each participating student presents a talk on his research.			

List of courses of this pass:

Code	Name of the course	Completion	Credits
01MMNS	Mathematical Modelling of Non-linear Systems	ZK	3
The course consists of basic terms and results of the theory of finite- and infinitedimensional dynamical systems generated by evolutionary differential equations, and description of bifurcations and chaos. Second part is devoted to the explanation of basic results of the fractal geometry dealing with attractors of such dynamical systems.			
01SUP	Start-up Project	KZ	2
02AMF	Atomic and Molecular Physics	Z,ZK	4
This lecture course provides a theoretical introduction to atomic and molecular physics.			
02DPLA	Plasma Diagnostics	Z,ZK	3
he goal of the lecture is to obtain the overview of measurements of basic parameters of hot plasma and their components - density, temperature, electromagnetic fields, radiation and energy and temporal and spatial distribution. The students will acquaint with principles, methodic, demonstration, examples and application of basic diagnostics.			
02DPTF1	Master Thesis 1	Z	10
The diploma 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.			
02DPTF2	Master Thesis 2	Z	20
The diploma 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.			
02EADP	Experimental data analysis in plasma physics	Z	3
The goal of the course is to provide students with the opportunity to gain practical experience by solving projects in the field of data science. Several tasks focused on analyzing data from fusion experiments with magnetic plasma confinement, using various diagnostic systems (microwaves, visible spectroscopy, infrared cameras, electrical probes, etc.), give students the chance to learn how to apply Bayesian approaches, neural networks, and computations on graphics cards to obtain the required information about the plasma state. Furthermore, it introduces the advantages of applying forward and backward models in plasma diagnostics. This approach mimics workflows common in research and development projects, where the requirement is to design a method for obtaining a certain type of information from measured data.			
02FT	Physics of Tokamaks	Z,ZK	4
Advanced course on physics of thermonuclear fusion in the magnetic confinement of tokamaks. The course is focused on the physics context, terminology and phenomenology of the subject so that students can substantially improve their understanding of physics background as well as their capacity to search for information and to work independently with scientific literature.			
02ITERA	ITER and the accompanying programme	ZK	2
Students will learn details on the ITER basic parameters and components of ITER: the superconducting magnets, vacuum pumping, fuel cycle, cryoplant, nuclear safety, operation scenarios, ITER plasma diagnostics, schedule of construction and operation. Besides, history of the project, forms of international collaboration, projects IFMIF and DEMO as well as major fusion research centres in the world will be presented.			
02PINCE	Pinches	ZK	2
This subject is focused on physics and technology of magnetic pinches which represent the most efficient way how to generate high-energy density plasmas (>100 kJ/cm3). The lectures will introduce students into the basic theory, contemporary research topics, and applications of magnetic pinches. One of the objectives of the subject is to demonstrate that the pinch effect naturally occurs in laboratory and space plasmas and has an impact on many applications. The subject Magnetic pinches, therefore, contributes to a better understanding of fundamental processes in plasmas.			
02PMCF	Topics in Magnetic Confinement Fusion	KZ	2
This course provides an opportunity to students interested in magnetic confinement fusion to enhance their knowledge of fusion physics and technology by special topics that are not covered by the mainstream courses. At the same time, it is a platform where students can meet young research scientists from the COMPASS tokamak. In the end of the course students are expected to present results of their own research task.			

02PMPL	Computer Modelling of Plasma	Z,ZK	3
The goal of the lecture is to acquaint the students with basic methods of computer modelling in physics and to apply these techniques to the study of physical processes in both low-temperature and high-temperature plasmas.			
02PRPL1	Laboratory Work in Plasma Physics 1	Z	2
The goal of the lecture is performing experimental work on advanced plasma laboratory experiments: either on a fusion device - the GOLEM tokamak, or in a specialized laboratory for training of fusion oriented plasma physics PlasmaLab@CTU. The goal is also obtaining experience with the basics of scientific work.			
02PRPL2	Laboratory Work in Plasma Physics 2	KZ	2
The goal of the lecture is performing experimental work on advanced plasma laboratory experiments: either on a fusion device - the GOLEM tokamak, or in a specialized laboratory for training of fusion oriented plasma physics PlasmaLab@CTU. The goal is also obtaining experience with the basics of scientific work.			
02PRPLA1	Laboratory Work in Plasma Physics 1	Z	5
The goal of the lecture is performing experimental work on advanced plasma laboratory experiments: either on a fusion device - the GOLEM tokamak, or in a specialized laboratory for training of fusion oriented plasma physics PlasmaLab@CTU. The goal is also obtaining experience with the basics of scientific work.			
02PRPLA2	Praktika fyziky plazmatu 2	KZ	5
The goal of the lecture is performing experimental work on advanced plasma laboratory experiments: either on a fusion device - the GOLEM tokamak, or in a specialized laboratory for training of fusion oriented plasma physics PlasmaLab@CTU. The goal is also obtaining experience with the basics of scientific work.			
02STFU1	Seminar FPTF1	Z	2
Seminars based on invited lectures given by experts in the field of research and development of thermonuclear fusion. Students are encouraged to participate in seminars of neighbouring fields according to the subject of their diploma thesis.			
02STFU2	Seminar FPTF2	Z	2
Seminars based on invited lectures given by experts in the field of research and development of thermonuclear fusion. Students are encouraged to participate in seminars of neighbouring fields according to the subject of their diploma thesis.			
02TFS	Thermonuclear Fusion and Society	Z	2
While the scientific lecture goes from the simplest to more complicated, from the known to the new, this lecture goes from the old to the new. It connects the fusion devices and formulas with their authors. It explains the logics behind the direction of the controlled thermonuclear fusion, including the necessary or surprising mistakes, and dead ends. The lecture clarifies the place of fusion in the society, including the role of popularization, and the role of fusion in the future energy resources scheme. The fusion news are included in the lecture.			
02TPLA1	Plasma Theory 1	Z,ZK	5
The first part of the lecture will be devoted to the individual particles motion in Lagrange and Hamilton formalism for both relativistic and non-relativistic behavior. The particle drifts will be solved in the frame of adiabatic approach. The second part of the lecture will be devoted to magnetohydrodynamics, especially such phenomena as helicity and helical structures, magnetic field-lines reconnection, MHD dynamo and others.			
02TPLA2	Plasma Theory 2	Z,ZK	5
First part of the lecture will be devoted to plasma waves and instabilities. General recipes of obtaining the disperse relation will be discussed, especially linearization and Fourier transform. Magnetoacoustic waves, electromagnetic waves, and basic instabilities will be treated in detail. The second part of the lecture will be devoted to statistical plasma approach, e. g. transport phenomena, and microinstabilities such as Landau damping.			
02TTJZ	Technology of Thermonuclear Facilities	ZK	3
The course introduces students to the basic technologies of thermonuclear devices. The aim of the course is to provide students with basic technical information for their future work on fusion experimental facilities. The course provides an overview of solutions, technical problems, possibilities and limits of fusion equipment operation.			
02VUTF1	Research Project 1	Z	6
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.			
02VUTF2	Research Project 2	KZ	8
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.			
02ZLSTF1	Winter School of Plasma Physics and Fusion Physics 1	Z	1
Regular international "Student Winter School of Plasma and Fusion Physics" should help students to improve their communication skills. Each participating student presents a talk on his research.			
02ZLSTF2	Summer School of Plasma Physics and Fusion Physics 2	Z	1
Regular international "Student Summer School of Plasma and Fusion Physics" should help students to improve their communication skills. Each participating student presents a talk on his research.			
11SUPR	Superconductivity and Low Temperature	ZK	4
The subject of course is: low temperature physics, including cooling methods, low temperature technique, and measurement of low temperatures; macroscopic quantum phenomena in quantum fluids (superfluidity and superconductivity), quantum crystals and diffusion, mesoscopic phenomena in electron systems, quantum Hall effects, Coulomb blockade and single electron transistor.			
12DRP	Differential Equations on Computer	Z,ZK	5
Ordinary differential equations, analytical methods; Ordinary differential equations, numerical methods, Runge-Kutta methods, stability; Partial differential equations, analysis, hyperbolik, parabolic and elliptic equations, posedness of differential equaitons; Partial differential equations, numerical solution, finite difference methods, difference schemes, order of approximation, stability, convergence, modified equation, diffusion, dispersion; Conservation laws and their numerical solution, shallow water equations, Euler equations, Lagrangian methods, ALE methods; Practical computation in Matlab system for numerics and Maple for analysis of schemes.			
12FIF	Inertial Fusion Physics	Z,ZK	4
These lectures aim to introduce to the topic of inertial confinement fusion (ICF). Physical processes, which take place during the individual stages before and after ignition of the fuel are discussed. The problems (instabilities etc.), which make the inertial confinement and the ignition of the fuel more demanding are discussed and their potential solutions are presented. New projects in the field of ICF including some preliminary reactor designes are reviewed.			
12LPZ	Laser-plasma as a Source of Particles and Radiation	ZK	2
Students will get acquinted with physical principles of interaction of intense laser beams with matter with a stress on generation of secondary sources of radiation and accelerated particles and selected applications of these sources. After definition of basic quantities and description of interaction of bound electron with low frequency field, the principles of high-order harmonic generation and generation of single attosecund pulseswill be explained followed by plasma-based x-ray lasers and radiation from hot plasma. Next block of lectures will focus on methods of generation hard x-rays from relativistic laser beams, electron and ion acceleration and selected interdisciplinary applications of these secondary sources.			
12NIPL	Low Temperature Plasmas and Discharges	Z,ZK	4
Atomic collision phenomena; basic concepts and relations; elastic scattering; ionization and excitation; three-particle recombination. Brehmsstrahlung; radiative capture; line radiation. Processes in partially ionized gas. Gas in thermodynamic equilibrium. Ionized gas in electric field. Phenomena on electrodes. Breakdown of gas in D.C. and A.C. electric fields. Gas discharges; V-A charakteristics. Glow discharge. Self-sustaining D.C. arc discharge. Low pressure discharge with heated cathode. Electrical probes.			

12OSP	Optical Spectroscopy	KZ	2
	Basics of spectroscopic behaviour of atoms and molecules. Elementary experimental techniques for optical spectroscopy.		
12PFTF1	Computational Physics 1	Z,ZK	2
	The course is giving an overview of some of the well-known computational physics methods in various fields of physics. The first part concentrates on particle simulation methods - molecular dynamics, Monte Carlo method and other methodsof solving the particle transport in self-consistent fields (e.g. Particle in Cell method in plasma physics). The second part concentrates on methods of solving Maxwell equations and in particular on the finite difference, finite elements methods and the method of moments. An introduction to application of computational physics methods in quantum physics (Hartree-Fock method, density functional theory) is also given.		
12PFTF2	Computational Physics 2	Z,ZK	2
	Structure of hydrodynamic code, representation of structured and unstructured computational meshes. Tools for code debugging and profiling, error detection. Code parallelization, memory hierarchy, supercomputers. Euler equations on moving computational mesh. Eulerian, Lagrangian, and ALE methods, staggered discretization. Methods for mesh smoothing, methods for conservative interpolations of functions between meshes. Applications in simulations of laser/target interactions. Generalization for elastic materials. Methods of artificial intelligence in computational physics.		
12POEX	Computer Control of Experiments	Z	2
	Introduction. Basic design of computers, microcomputers. Hardware: computer-experiment interconnection (interfaces RS232C,IEE488, A/D and D/A converters, sensors, drivers, etc.) Software: operating systems for control of experiments (real time OS, multitasking, multiuser). Basic theory of control systems. Programming languages for control (assembler, C, etc.) Introduction to TCP/IP protocols. Control of experiments via Internet.		
12SFMC1	Computer Simulations in Many-particle Physics 1	Z,ZK	4
	Computer simulation types and possibilities, classical continuous and lattice model systems, principles of the Monte Carlo and molecular dynamics methods, the Ising model, model of hard spheres and of Lennard-Jones liquid, realization of simulations and measurement, simulations in various thermodynamic ensembles.		
12SFMC2	Computer Simulations in Many-particle Physics 2	ZK	2
	Advanced methods of Monte Carlo and molecular dynamics and their applications to various problems: critical phenomena, complex molecules, non-equilibrium phenomena, transport coefficients, kinetic MC, optimalization problems, quantum MC, ab initio simulations, Car-Parrinello method.		
14NAMA	Materials Science	KZ	3
	Introduction to the Materials Science.		
14NMR	Materials Science for Reactors	ZK	2
	Materials for classical and fusion reactors		
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.		
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.		
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		
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.		

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