## Study plan

## Name of study plan: Solid State Engineering

Faculty/Institute/Others:

Department:

Branch of study guaranteed by the department: Welcome page

Garantor of the study branch:

Program of study: Solid State 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 program

Minimal number of credits of the block: 0

The role of the block: P

Code of the group: NMSPIPLAJ1

Name of the group: MDP P\_IPLNAJ 1st year

Requirement credits in the group: In this group you have to gain at least credits (at most 0) 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:

Note on the gro	•					
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
11FDEL	Physics of Dielectrics Kate ina Aubrechtová Dragounová, Zden k Bryknar Kate ina Aubrechtová Dragounová Zden k Bryknar (Gar.)	ZK	2	2P+0C	L	Р
11FKOV	Physics of Metals Hanuš Seiner Hanuš Seiner (Gar.)	ZK	2	2P+0C	Z	Р
11FMGL	Physics of Magnetic Solids Jaroslav Hamrle, Štefan Zajac Jaroslav Hamrle Štefan Zajac (Gar.)	ZK	2	2P+0C	L	Р
11POLO	Physics of Semiconductors Martin Ledinský Martin Ledinský (Gar.)	ZK	4	4P+0C	Z	Р
11PSP	Practical Exercises from Solid State Structure Analysis Ji í apek, Monika Ku eráková <b>Ji í apek</b> Ji í apek (Gar.)	KZ	6		Z	Р
11SAEX1	Seminar and Excursions 1 Jan Drahokoupil, Petr Kolenko Petr Kolenko Petr Kolenko (Gar.)	Z	4		Z	Р
11SAEX2	Seminar and Excursions 2 Jan Drahokoupil, Petr Kolenko Petr Kolenko Petr Kolenko (Gar.)	Z	4		L	Р
11STPL	Seminar in Solid State Theory Hanuš Seiner, Petr Sedlák, Dalibor Rep ek Hanuš Seiner Hanuš Seiner (Gar.)	KZ	2	0+2	L	Р
11TPL1	Solid State Theory 1 Jaroslav Hamrle, Ladislav Kalvoda Ladislav Kalvoda (Gar.)	ZK	6	4+0	Z	Р
11TPL2	Solid State Theory 2 Jaroslav Hamrle, Ladislav Kalvoda Ladislav Kalvoda (Gar.)	ZK	3	2+0	L	Р
11VUIP1	Research Project 1 Ladislav Kalvoda Ladislav Kalvoda (Gar.)	Z	6	0+6	Z	Р
11VUIP2	Research Project 2 Ladislav Kalvoda Ladislav Kalvoda (Gar.)	KZ	8	0+8	L	Р

Characteristics of the courses of this group of Study Plan: Code=NMSPIPLAJ1 Name=MDP P\_IPLNAJ 1st year

11FDEL	Physics of Dielectrics	ZK	2
Electrical, thermal, and	mechanical properties of dielectrics and switching of polarization in ferroelectrics are described in details. Interaction of elect	romagnetic field v	with dielectric
materials is studied in a	a wide frequency range from point of view of classical and quantum physics.		
11FKOV	Physics of Metals	ZK	2
The purpose of this lec	ture is to introduce the undergraduate students to the study of the physical properties of metals and alloys.		'
11FMGL	Physics of Magnetic Solids	ZK	2
The origin of the magne	etic moment. Fundamental magnetic interactions. Magnetic susceptibility. Diamagnetism and paramagnetism. Substances wit	h spontaneous m	agnetization -
ferromagnetic, antiferro	magnetic, ferrimagnetic ordering. Domain structure and magnetization processes. Magnetic relaxation and resonance pheno	mena. Spintronics	3.

11POLO	Physics of Semiconductors	ZK	4
Lectures give an overvi	ew of fundamental physical phenomena used for design and operation of semiconductor elements. Physics of electric, galvan	nomagnetic, therm	noelectric,
thermomagnetic, photoe	electric and optical properties of intrinsic and doped semiconductors is explained in detail with respect to possibilities of their effe	ctive modification a	and optimization.
Considerable attention i	is also paid to explanation of the properties of P-N junction and metal-semiconductor contact.		
11PSP	Practical Exercises from Solid State Structure Analysis	KZ	6
The aim of this practica	training is to introduce the students the fundamentals of X-ray and neutron diffraction methods for diagnostics of structure d	lependant propert	ies of solids.
11SAEX1	Seminar and Excursions 1	Z	4
The subject is recomme	ended for preparation of the diploma thesis solution. It consists of lectures of research workers, advisors, postgraduates and	undergraduates	
11SAEX2	Seminar and Excursions 2	Z	4
Excursions of students t	o selected departments of partner universities and institutes of Czech Academy of Sciences (CAS). Practical demonstrations	and active particip	ation of students
on hot topics of solid sta	ate physics. Discussion of own research results and their presentation as a training for defenses of students theses.		
11STPL	Seminar in Solid State Theory	KZ	2
The purpose of this lect	ure is to solve numerical problems of theory of solids and physics of condensed state.		
11TPL1	Solid State Theory 1	ZK	6
Types of bonds in solids	s. Symmetry of crystalline solids. Vibrations of crystalline lattice and its thermal properties. Band electron structure of crystalli	ine solids. Localize	ed states of
electrons in nonideal so	lids.		
11TPL2	Solid State Theory 2	ZK	3
Electric, magnetic and t	hermal properties of itinerant electrons in solids, Bolzmann kinetic equation, transport and optical phenomena in solids		
11VUIP1	Research Project 1	Z	6
11VUIP2	Research Project 2	KZ	8

Code of the group: NMSPIPLAJ2

Name of the group: MDP P\_IPLNAJ 2nd year

Requirement credits in the group: In this group you have to gain at least credits (at most 0)

Requirement courses in the group: In this group you have to complete at least 8 courses

Credits in the group: 0

Note on the 9	noup.					
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
11DPIP1	Master Thesis 1 Ladislav Kalvoda Ladislav Kalvoda (Gar.)	Z	10	0+10	Z	Р
11DPIP2	Master Thesis 2 Ladislav Kalvoda Ladislav Kalvoda (Gar.)	Z	20	0+20	L	Р
11YFPOR	Physics of Surfaces and Interfaces  Ladislav Kalvoda, Jakub Sko dopole Ladislav Kalvoda Ladislav Kalvoda (Gar.)	ZK	2	2P+0C	Z	Р
11YOPTX	Optical Properties of Solids Zden k Bryknar, Eva Mihóková Eva Mihóková Zden k Bryknar (Gar.)	ZK	2	2P+0C	Z	Р
11YSIK	Computer Simulation of Condensed Matter Jan Drahokoupil, Petr Sedlák, Ladislav Kalvoda Ladislav Kalvoda (Gar.) Kalvoda (Gar.)	Z,ZK	5		Z	Р
11YSAEX3	Seminar and Excursions 3 Jan Drahokoupil, Petr Kolenko Jan Drahokoupil Jan Drahokoupil (Gar.)	Z	4		Z	Р
11YSAEX4	Seminar and Excursions 4 Jan Drahokoupil, Petr Kolenko Jan Drahokoupil Jan Drahokoupil (Gar.)	Z	4		L	Р
11YVDM	Intrinsic Dynamics of Materials Hanuš Seiner Hanuš Seiner Hanuš Seiner (Gar.)	ZK	3	2+0	Z	Р

11DPIP1	of the courses of this group of Study Plan: Code=NMSPIPLAJ2 Name=MDP P_IPLNAJ 2nd y  Master Thesis 1	Z	10
On the basis of the as	signment and under the supervision of the supervisor, the student prepares an individually assigned topic for 2 semesters.	'	ı
11DPIP2	Master Thesis 2	Z	20
On the basis of the as	signment and under the supervision of the supervisor, the student prepares an individually assigned topic for 2 semesters.	'	
11YFPOR	Physics of Surfaces and Interfaces	ZK	2
Description is provide	d of basic thermodynamic properties, atomary and electronic structure of surfaces and interfaces. The physical models valid fo	r bulk sysstems a	re juxtaposed
with the changes due	to introduction of new surface/interface. The theoretical treatment is followed by overview of experimental techniques applied to	preparation of s	urface structures
and to study of chemi	cal composition and structural arrangement of the latter. In addition, brief overview is given of simulation approaches suitable for	or analysis and pr	rediction of
properties of selected	systems. All the subjects are demonstrated on praktical exaples of case studies.		
11YOPTX	Optical Properties of Solids	ZK	2
This course gives an	ntroductory into the optical properties of solids. The fundamental principles of absorption, reflection, luminescence and light pro	pagation are disc	ussed for a wide
range of materials, in	cluding crystalline insulators, semiconductors, and metals. Classical and quantum models are used as appropriate, and the obs	served phenomer	na are discussed
from point of their app	dication.		
11YSIK	Computer Simulation of Condensed Matter	Z.ZK	5
111011	Comparer Cimalation of Condenicod Matter	_,	

Computer simulation in condensed-matter physics is becoming an important tool used by both experimentalist and theorists to develop new materials and technologies. Thus, solution of many practical problems can be transferred from the real to a "virtual" laboratory. During the course, students will be introduced to the theoretical background of basic computation methods and let to test the acquired knowledge in practical exercises. Each lesson is organized as a tutorial where typical problems are solved with detailed explication of the computation methods used. The course is taking place in Computer classroom of the Department of Solid State Physics. Practical demonstration and exercises are using Material Studio simulation environment (Accelrys Software Inc.).

11YSAEX3 | Seminar and Excursions 3 | Z | 4 |
Excursions of students to selected departments of partner universities and institutes of Czech Academy of Sciences (CAS). Practical demonstrations and active participation of students on hot topics of solid state physics. Discussion of own research results and their presentation as a training for defenses of students theses.

11YSAEX4 | Seminar and Excursions 4 | Z | 4 |
Excursions of students to selected departments of partner universities and institutes of Czech Academy of Sciences (CAS). Practical demonstrations and active participation of students on hot topics of solid state physics. Discussion of own research results and their presentation as a training for defenses of students theses.

11YVDM | Intrinsic Dynamics of Materials | ZK | 3 |
The course gives an introductory overview of dynamical phenomena taking place in the materials, with the main focus laid on the elastic wave propagation (and its interaction with the microstructure), dynamic plasticity, phase transition fronts kinetics, and dynamic fracture mechanics.

Name of the block: Compulsory elective courses

Minimal number of credits of the block: 0

The role of the block: PV

Code of the group: NMSPIPLAJPV1

Name of the group: MDP P\_IPLNAJ Required optional courses 1st year

Requirement credits in the group: In this group you have to gain at least credits (at most 0) Requirement courses in the group: In this group you have to complete at least 1 course

Credits in the group: 0

Note on the group:

At least one course must be enrolled.

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
11EPR	Practical Training in Electronics Pavel Jiroušek Pavel Jiroušek (Gar.)	KZ	6		Z	PV
11PFPL	Practical Training of Semiconductors Petr Levinský Petr Levinský (Gar.)	KZ	6		L	PV
11PSP	Practical Exercises from Solid State Structure Analysis Ji í apek, Monika Ku eráková <b>Ji í apek</b> Ji í apek (Gar.)	KZ	6		Z	PV

## Characteristics of the courses of this group of Study Plan: Code=NMSPIPLAJPV1 Name=MDP P\_IPLNAJ Required optional courses 1st year

. or you.			
11PSP	Practical Exercises from Solid State Structure Analysis	KZ	6
The aim of this practical	I training is to introduce the students the fundamentals of X-ray and neutron diffraction methods for diagnostics of structure d	lependant proper	ties of solids.
11EPR	Practical Training in Electronics	KZ	6
Practical training in elec	ctronics gives practical experience in the design of selected electronic circuits. Students obtain basic skill in the circuit realisa	tion. Practical trai	ning includes
linear circuits, digital cir	cuits and exercise in the programming of microprocessor control system. Students are allowed to work on the electronic probl	lem concerning th	eir own scientific
activity.			
11PFPL	Practical Training of Semiconductors	KZ	6
The aim of this practical	training is to introduce the students to the fundamentals of semiconductors technology and solid-state physics and with pra-	ctical measureme	nts of basic
properties of materials	and devices		

Name of the block: Elective courses
Minimal number of credits of the block: 0

The role of the block: V

Code of the group: NMSPIPLAJV

Name of the group: MDP P\_IPLNAJ Optional courses

**Diffraction Analysis of Mechanical Stress** 

Nikolaj Ganev, Ivo Kraus Nikolaj Ganev Nikolaj Ganev (Gar.)

Requirement credits in the group: In this group you have to gain at least credits (at most 0)

Requirement courses in the group:

Credits in the group: 0 Note on the group:

11YDAN

Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their Code Credits Completion Scope Semester Role members) Tutors, authors and guarantors (gar.) Applied Neutron Diffractometry Monika Ku eráková, Stanislav Vratislav Monika Ku eráková Stanislav 11YAND ZK Ζ 2 2 Vratislav (Gar.) Chemical Aspects of Solids 11CHA 2 2 L ZK ٧ Karel Knížek Karel Knížek (Gar.)

ZK

2

Ζ

11YDMSX	Diffraction Methods of Structural Biology Jan Dohnálek Jan Dohnálek (Gar.)	Z,ZK	3	2P+1C	L	V
11YFPPL	Physics of Solid State Phase Transitions Ji í Hlinka Ji í Hlinka Ji í Hlinka (Gar.)	ZK	2	2	L	٧
12YFDD	Physics of Detection and Detectors of Optical Radiation Ladislav Pina Ladislav Pina (Gar.)	ZK	2	2+0	Z	V
02FG	Physics of graphene described by Dirac equation Vít Jakubský Vít Jakubský Vít Jakubský (Gar.)	Z	2	2P+0C	L	V
12YFOPT	Optical Physics Pavel Kwiecien, Ivan Richter Pavel Kwiecien Ivan Richter (Gar.)	Z,ZK	3	3+0	Z	V
11YKO	Metallic Oxides Ji í Hejtmánek Ji í Hejtmánek Ji í Hejtmánek (Gar.)	ZK	2	2	Z,L	V
12KOP	Quantum Optics Ivan Richter, Miroslav Dvo ák Miroslav Dvo ák Ivan Richter (Gar.)	Z,ZK	5	3+1	L	V
11YMAM	Magnetic Materials Oleg Heczko Oleg Heczko (Gar.)	ZK	2		Z	V
11YMONA	Molecular Nanosystems Irena Kratochvílová Irena Kratochvílová (Gar.)	ZK	2	2	Z	V
11YNAMA	Nanomaterials - Preparation and Characteristics	Z,ZK	2		L	V
11YNMV	Neutronography in Material Research	ZK	2		L	V
11YOSAL	Optical Spectroscopy of Inorganic Solids  Zden k Pot ek Zden k Pot ek Zden k Pot ek (Gar.)	ZK	2	2	L	V
11YPMK1	Macromolecular Crystallography Laboratory 1 Tomáš Kova Tomáš Kova (Gar.)	KZ	4		Z	V
11YPMK2	Macromolecular Crystallography Laboratory 2 Tomáš Kova Tomáš Kova (Gar.)	KZ	4		L	V
11YPOSPL	Practical course in optical spectroscopy of solids Kate ina Aubrechtová Dragounová, Zden k Pot ek Kate ina Aubrechtová Dragounová Kate ina Aubrechtová Dragounová (Gar.)	KZ	4	0P+52C	Z	V
11YPAO	Principles and Applications of Optical Sensors with Practical Trainings  Jan Aubrecht Jan Aubrecht (Gar.)	ZK	2		L	V
11RTSW	Real Time Software Pavel Jiroušek, Martin Dráb Martin Dráb Pavel Jiroušek (Gar.)	Z	3	2	L	V
11YSEM	Scanning Electron Microscopy and Microbeam Analysis Methods Jaromír Kope ek Jaromír Kope ek (Gar.)	ZK	2		Z	V
11YSMAM	Smart Materials and Their Applications Petr Sedlák, Zden k Pot ek Zden k Pot ek (Gar.)	ZK	2	2P+0C	L	V
)1SUP	Start-up Project Pemysl Rubeš Pemysl Rubeš (Gar.)	KZ	2	2P+0C		V
11YSUPR	Superconductivity and Low Temperature  Martin Ledinský, Zden k Jan Zden k Jan (Gar.)	ZK	4	4	Z	V
11YPCPC	Theory and Construction of Photovoltaic Cells Ji í Pfleger Ji í Pfleger (Gar.)	ZK	2	2	Z	V
I1VPSX	Selected Topics of Solid State Structure Jan Drahokoupil Jan Drahokoupil (Gar.)	Z,ZK	2	1P+1C	L	V
haracteristics of the	e courses of this group of Study Plan: Code=NMSPIPLAJV Nam	e=MDP P_IF	PLNAJ C	Optional co	ourses	
11YAND Ap	oplied Neutron Diffractometry neutron diffraction method as the method used in solid state physics research and the m				ZK	2 and magne
	n, as well as the comparative properties to the X-ray method. The basic concept of this n	nethod is illustra	ted by man	<del></del>		
11CHA Ch	nemical Aspects of Solids	culation is demo		2	ZK	2

Jan Drahokoupil <b>Jan Drahokoupil</b> Jan Drahokoupil (Gar.)		
Characteristics of the courses of this group of Study Plan: Code=NMSPIPLAJV Name=MDP P_IPLNAJ Optio	nal courses	
11YAND Applied Neutron Diffractometry	ZK	2
This lecture introduces the neutron diffraction method as the method used in solid state physics research and the materials sciences. The basic princ	ciples of the nucle	ar and magnetic
neutron scattering are given, as well as the comparative properties to the X-ray method. The basic concept of this method is illustrated by many practice.	tical examples.	
11CHA Chemical Aspects of Solids	ZK	2
The purpose of this lecture is an interpretation of the chemical bonding in solids. The principle of band structure calculation is demonstrated with the relations between crystal and electronic structure are manifested for selected materials.	help of Tight-bind	ing method. The
11YDAN Diffraction Analysis of Mechanical Stress	ZK	2
Course description: The course contains the fundamentals of diffraction stress analysis with a strong emphasis on the illustrations of the capability of X-problems.	ray diffraction to so	olve engineering
11YDMSX Diffraction Methods of Structural Biology	Z,ZK	3
Determination of 3D structure of biological macromolecules, such as proteins, nucleic acids or their complexes, by the means of physical methods is	crucial for new tr	ends in
biotechnologies, biomedicine and also in basic molecular biology research. Individual methods of three-dimensional structure determination will be e	explained with a fo	cus on the
individual steps of single crystal diffraction analysis. Practical examples of application in biotechnologies and medicine will be discussed. The practic	als will cover seve	ral basic steps
leading to determination of a new molecular structure.		
11YFPPL Physics of Solid State Phase Transitions	ZK	2
A number of interesting properties of crystalline materials are directly related or significantly influenced by occurrence of specific phase transitions. I		s course is to
provide unifying view on various types phase transitions encountered in solid state physics, with the emphasize on continuous symmetry braking phase transitions encountered in solid state physics, with the emphasize on continuous symmetry braking phase transitions encountered in solid state physics, with the emphasize on continuous symmetry braking phase transitions encountered in solid state physics, with the emphasize on continuous symmetry braking phase transitions encountered in solid state physics, with the emphasize on continuous symmetry braking phase transitions encountered in solid state physics, with the emphasize on continuous symmetry braking phase transitions are continuous symmetry braking phase transitions.	ase transitions.	
12YFDD Physics of Detection and Detectors of Optical Radiation	ZK	2
Electromagnetic spectrum. Sources of electromagnetic radiation. Radiometric and photometric units. Ideal detector. External and internal photoefect.	Quantum fluctuati	ons of radiation.
Noise of detector and electronic circuits. Dynamic range. Detectors based on external photoefect. Photocathodes. Electron multipliers. Microchannel pl	•	
based on internal photoefect. Semiconductor detectors. Scintilators. Detectors of IR, VIS and UV radiation. X-ray detectors Pyroelectricity and pyroc	detectors. Detecto	r electronic
circuits. Human eye.		
02FG Physics of graphene described by Dirac equation	Z	2
General description of crystal. Tight-binding model of graphene and its approximation in terms of Dirac equation. Transport of Dirac fermions in graph	•	
and related phenomena. Bilayer graphene, its description and properties in the external magnetic field. Carbon nanotubes, their classification. Basic	description of gra	phene
nanoribbons,boundary conditions and energy. Dirac fermions in curved space, fullerenes. Other Dirac materials.		

12YFOPT	Optical Physics	Z,ZK	3
	pasics of optical physics. It systematically discusses the optical wave propagation in vacuum, in isotropic and anisotropic medi al waves. Next, it describes the polarization and its applications, statistical properties of polychromatic waves, fundamentals o		
11YKO	Metallic Oxides	ZK	2
-	nical composition and characteristic electronic properties of oxides is presented. Namely electronic and thermal transport, specif		_
-	nd long range magnetic order are discussed. Phase transitions as a consequence of mutual interplay of lattice, transport and magnetic order are discussed.	_	
	mical composition and temperature are documented. Orbital, spin and charge ordered (disordered) states are exemplified usi ance manganites, high temperature superconducting cuprates and cobalt oxide thermoelectrics.	ng the salient oxid	e families -
12KOP	Quantum Optics	Z,ZK	5
_	advanced topics in quantum optics, consequentially to the previous course of Quantum electronics. It systematically discusses e	· · · · · · · · · · · · · · · · · · ·	_
	tates of electromagnetic field, quantum description of optical radiation, special states of fields, with respect to quasi-probability		
	ention is given both to Dirac quantum theory of interaction of quantized electromagnetic field with a quantum system (including		-
	ering (Rayleigh, Thomson, Raman, resonance fluorescence). The attention is further given both to the quantum theory of cohere actions), in relation to classical theory. The course is further devoted to generalized higher-order coherence theory, coherent pro		-
=	damping (quantum damped harmonic oscillator, Heisenberg-Langevin approach). Finally, the attention is given to review of no	-	
·· -	y interferometry, Brown-Twiss effect, stellar correlation interferometer, correlation spectroscopy), possibilities of measuring the	quantum state of	light, and some
	rn quantum optics (squeezed states). The lectures are accompanied with practical example exercises.	71/	
11YMAM	Magnetic Materials   hand scale of magnetic materials with emphasis on their applications. A brief introduction (referring to the former, more general	ZK theoretical course	2 c of magnetism)
	broad scale of magnetic materials with emphasis on their applications. A brief introduction (referring to the former, more general on of individual effects and their usage in recent technics and technologies. We will manifest that existence of the contemporal		
•	Important part of the course is devoted to introduction into measurements of various magnetic properties of solids.	,	
11YMONA	Molecular Nanosystems	ZK	2
	cture is to show possibilities to use selected molecules properties in molecular nanodevices.		
11YNAMA	Nanomaterials - Preparation and Characteristics	Z,ZK	2
	nethods of preparation of nanomaterials, their structure, specific properties and applications. The properties of carbon and silic aim of the subject is to explain the relationships between physical / chemical properties of nanoparticulate materials and their		-
11YNMV	Neutronography in Material Research	ZK	2
	powerful method for a detailed understanding of the static and dynamic properties on atomic scale of materials in many field	l l	
	e fundamental principles of nuclear and magnetic scattering and penetration of thermal neutrons. From this point of view the following		
•	o industrial scaling, neutron penetration though machinable materials ( and consequent case of construction of environmental characteristics of the different polytop portrains to beginning and spirites.	nambers), neutron	atomic contrast
11YOSAL	g possibilities. Examples of the different neutron scattering techniques are given.  Optical Spectroscopy of Inorganic Solids	ZK	2
	experimental data and theoretical models that allow us elucidate and predict spectroscopic properties of optical centers in soli	l l	
· ·	lecay and efficiency of luminescence, is illustrated by an example of color centers, rare-earth ions, and transition metal ions in		· · · · ·
•	ttice symmetry and vibrations on spectroscopic properties of optically active centers. Attention is also paid to physical basis of	•	*
	al spectroscopy of solids, to non-radiative energy transfer between adjacent centers and formation of their aggregates with dissidently high concentrations of optical centers.	stinct spectroscop	oic properties
11YPMK1	Macromolecular Crystallography Laboratory 1	KZ	4
	the students to practical aspects of macromolecular crystallography.		
11YPMK2	Macromolecular Crystallography Laboratory 2	KZ	4
	lucha m zkušenosti z výpo etních metod makromolekulární krystalografie.		
	Practical course in optical spectroscopy of solids	KZ	4
· -	es an overview of experimental methods used in optical spectroscopy for the study of photoluminescence, optical absorption paid to the description of block arrangement of experimental set-ups and methods for measurement of chosen characteristics		-
	used and to the techniques of processing, graphical representation, and interpretation of measured data. The general approach		
	rements on model samples performed by students on appropriate equipment in the laboratory.		
11YPAO	Principles and Applications of Optical Sensors with Practical Trainings	ZK	2
	roductory into the optical sensors. The fundamental principles of absorption, luminescence and SPR sensors are discussed for a		II
	f this course gives an introductory into theory of the electromagnetic field. Second part describes the wave phenomena in me- introduction into atomic physics.	chanics and electr	omagnetism.
11RTSW	Real Time Software	Z	3
_	duction to the problematic of the real time software. It describes the specifics of RT software and shows commonly used solu		
11YSEM	Scanning Electron Microscopy and Microbeam Analysis Methods	ZK	2
	s to familiarize students with the work on scanning electron microscope (SEM) and the possibilities of bundle analytical method		
	iples, the display methods, analytical methods available on SEM and sampling techniques will be analyzed. The student should be appropriately training to propriate a propriate propriate the right technique for solving a appoint problem, but also to go		•
available experimental	e necessary practical training to prepare a sample and choose the right technique for solving a specific problem, but also to matechniques.	iake general onen	tation in the
11YSMAM	Smart Materials and Their Applications	ZK	2
	terials have one or more properties, such as shape, conductivity or color, that can be dramatically and reversibly altered by cha	nges in some exte	rnal conditions.
	ing to external stimuli (heat, stress, electric field, light) influences what types of applications the smart material can be used for		
	sive and active vibration damping, airbag sensors, acoustic transducers, precision positioners, miniature ultrasonic motors, va s, light sensitive glasses or photochromic and thermochromic clothes could serve as a few examples. Lectures are focused on		
•	n and possible application of color changing materials, light emitting materials, piezoelectric materials, conducting polymers, o		
<del>-</del>	emory materials. Attention is also paid to the effect of phase transitions on physical properties of smart materials and to their		
01SUP	Start-up Project	KZ	2
11YSUPR	Superconductivity and Low Temperature	ZK	4
=	s: low temperature physics, including cooling methods, low temperature technique, and measurement of low temperatures; ma		•
in quantum fluids (supe single electron transisto	rfluidity and superconductivity), quantum crystals and diffusion, mesoscopic phenomena in electron systems, quantum Hall e or	rrects, Coulomb bl	ockade and
Jangio Siconori Italiaisi	···		

11YPCPC	Theory and Construction of Photovoltaic Cells	ZK	2
	d to provide a theoretical background of the photovoltaic solar energy conversion. It is focused not only on the classical crystalline si		
	xploiting new materials, including polymers, and new physical principles. The students will learn mathematical and theoretical backgr Il structures and materials. The part of the course will be dedicated to the practical and economical aspects of the application of sola		
	ycle assessment will provide students with better understanding of the relation between the photovoltaic cells application and enviro		
11VPSX	Selected Topics of Solid State Structure	Z,ZK	2
_	cuses on the structure of solids from the point of view of the arrangement of atoms. The first part focuses on application-interesting str	· .	
to molecular crystal	ls. In the second part we will look at the possibilities of observing the atomic structure using X-rays, both from the point of view of the a	verage and the loc	al structure.
Objective of the cou	urse is also the use of special programs designed to study and analyze the structure and microstructure of solids.		
	List of courses of this pass:		
Code	Name of the course	Completion	Credits
01SUP	Start-up Project	KZ	2
02FG	Physics of graphene described by Dirac equation	Z	2
•	of crystal. Tight-binding model of graphene and its approximation in terms of Dirac equation. Transport of Dirac fermions in graphen		
and related ph	enomena. Bilayer graphene, its description and properties in the external magnetic field. Carbon nanotubes, their classification. Basi	c description of gra	aphene
440114	nanoribbons,boundary conditions and energy. Dirac fermions in curved space, fullerenes. Other Dirac materials.	71/	
11CHA	Chemical Aspects of Solids electure is an interpretation of the chemical bonding in solids. The principle of band structure calculation is demonstrated with the hel	ZK	2
The purpose of this	relations between crystal and electronic structure are manifested for selected materials.	p or right-billding i	nethod. The
11DPIP1	Master Thesis 1	Z	10
	On the basis of the assignment and under the supervision of the supervisor, the student prepares an individually assigned topic for 2	l	
11DPIP2	Master Thesis 2	Z	20
	On the basis of the assignment and under the supervision of the supervisor, the student prepares an individually assigned topic for 2	semesters.	'
11EPR	Practical Training in Electronics	KZ	6
Practical training	in electronics gives practical experience in the design of selected electronic circuits. Students obtain basic skill in the circuit realisation	n. Practical trainin	g includes
linear circuits, digita	al circuits and exercise in the programming of microprocessor control system. Students are allowed to work on the electronic problem	concerning their or	wn scientific
	activity.	<b>-</b> 1.6	
11FDEL	Physics of Dielectrics	ZK	2
Electrical, trierma	I, and mechanical properties of dielectrics and switching of polarization in ferroelectrics are described in details. Interaction of electromaterials is studied in a wide frequency range from point of view of classical and quantum physics.	inagnetic neid witi	i dielectric
11FKOV	Physics of Metals	ZK	2
111101	The purpose of this lecture is to introduce the undergraduate students to the study of the physical properties of metals and al		_
11FMGL	Physics of Magnetic Solids	ZK	2
The origin of the r	magnetic moment. Fundamental magnetic interactions. Magnetic susceptibility. Diamagnetism and paramagnetism. Substances with	1	
ferromagne	tic, antiferromagnetic, ferrimagnetic ordering. Domain structure and magnetization processes. Magnetic relaxation and resonance ph	enomena. Spintro	nics.
11PFPL	Practical Training of Semiconductors	KZ	6
The aim of this p	ractical training is to introduce the students to the fundamentals of semiconductors technology and solid-state physics and with prac-	tical measurement	s of basic
440010	properties of materials and devices.	71/	4
11POLO	Physics of Semiconductors  n overview of fundamental physical phenomena used for design and operation of semiconductor elements. Physics of electric, galvar	ZK	4
_	notoelectric and optical properties of intrinsic and doped semiconductors is explained in detail with respect to possibilities of their effective	_	
, р.	Considerable attention is also paid to explanation of the properties of P-N junction and metal-semiconductor contact.		,
11PSP	Practical Exercises from Solid State Structure Analysis	KZ	6
The aim of this pr	ractical training is to introduce the students the fundamentals of X-ray and neutron diffraction methods for diagnostics of structure de	pendant properties	of solids.
11RTSW	Real Time Software	Z	3
	seminar is the introduction to the problematic of the real time software. It describes the specifics of RT software and shows commonly		
11SAEX1	Seminar and Excursions 1	Z	4
	ct is recommended for preparation of the diploma thesis solution. It consists of lectures of research workers, advisors, postgraduates		
11SAEX2	Seminar and Excursions 2	Z	4
Excursions of stude	ents to selected departments of partner universities and institutes of Czech Academy of Sciences (CAS). Practical demonstrations and on hot topics of solid state physics. Discussion of own research results and their presentation as a training for defenses of student		n of students
11STPL	Seminar in Solid State Theory	KZ	2
IIOIFL	The purpose of this lecture is to solve numerical problems of theory of solids and physics of condensed state.	114	
11TPL1	Solid State Theory 1	ZK	6
	n solids. Symmetry of crystalline solids. Vibrations of crystalline lattice and its thermal properties. Band electron structure of crystalline	l .	'
	electrons in nonideal solids.		
11TPL2	Solid State Theory 2	ZK	3

Electric, magnetic and thermal properties of itinerant electrons in solids, Bolzmann kinetic equation, transport and optical phenomena in solids

The lecture cycle focuses on the structure of solids from the point of view of the arrangement of atoms. The first part focuses on application-interesting structures from metallic materials to molecular crystals. In the second part we will look at the possibilities of observing the atomic structure using X-rays, both from the point of view of the average and the local structure.

Objective of the course is also the use of special programs designed to study and analyze the structure and microstructure of solids.

2

Selected Topics of Solid State Structure

Research Project 1

11VPSX

11VUIP1

11VUIP2	Research Project 2	KZ	8
11YAND	·	ZK	2
	Applied Neutron Diffractometry  uces the neutron diffraction method as the method used in solid state physics research and the materials sciences. The basic principle		_
	scattering are given, as well as the comparative properties to the X-ray method. The basic concept of this method is illustrated by many		•
11YDAN	Diffraction Analysis of Mechanical Stress	ZK	2
	n: The course contains the fundamentals of diffraction stress analysis with a strong emphasis on the illustrations of the capability of X-ray of		1
	problems.		
11YDMSX	Diffraction Methods of Structural Biology	Z,ZK	3
	n of 3D structure of biological macromolecules, such as proteins, nucleic acids or their complexes, by the means of physical methods is	•	ı
	s, biomedicine and also in basic molecular biology research. Individual methods of three-dimensional structure determination will be ex		
dividual steps of	f single crystal diffraction analysis. Practical examples of application in biotechnologies and medicine will be discussed. The practicals	will cover severa	l basic ste
	leading to determination of a new molecular structure.		
11YFPOR	Physics of Surfaces and Interfaces	ZK	2
Description is pro	ovided of basic thermodynamic properties, atomary and electronic structure of surfaces and interfaces. The physical models valid for b	ulk sysstems are	juxtapose
•	due to introduction of new surface/interface. The theoretical treatment is followed by overview of experimental techniques applied to pre	•	
and to study of	chemical composition and structural arrangement of the latter. In addition, brief overview is given of simulation approaches suitable fo	r analysis and pr	ediction of
	properties of selected systems. All the subjects are demonstrated on praktical exaples of case studies.		
11YFPPL	Physics of Solid State Phase Transitions	ZK	2
	resting properties of crystalline materials are directly related or significantly influenced by occurrence of specific phase transitions. The		
	unifying view on various types phase transitions encountered in solid state physics, with the emphasize on continuous symmetry braking		
11YKO	Metallic Oxides	ZK	2
=	chemical composition and characteristic electronic properties of oxides is presented. Namely electronic and thermal transport, specific h		
	ons and long range magnetic order are discussed. Phase transitions as a consequence of mutual interplay of lattice, transport and magne via chemical composition and temperature are documented. Orbital, spin and charge ordered (disordered) states are exemplified usin		
transition tuneu	colossal magnetoresistance manganites, high temperature superconducting cuprates and cobalt oxide thermoelectrics.	g trie Sallerit Oxic	e iaiiiiles
11YMAM	Magnetic Materials	ZK	2
	with a broad scale of magnetic materials with emphasis on their applications. A brief introduction (referring to the former, more general the		_
	scription of individual effects and their usage in recent technics and technologies. We will manifest that existence of the contemporary		_
o lonowou by do	materials is impossible. Important part of the course is devoted to introduction into measurements of various magnetic properties of		at magnot
11YMONA	Molecular Nanosystems	ZK	2
11111101111		211	_
	The main goal of the lecture is to show possibilities to use selected molecules properties in molecular nanodevices.		
11YNAMA	The main goal of the lecture is to show possibilities to use selected molecules properties in molecular nanodevices.  Nanomaterials - Preparation and Characteristics	7 7K	2
11YNAMA	Nanomaterials - Preparation and Characteristics	Z,ZK	2
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11YSAEX4	Seminar and Excursions 4	Z	4
Excursions of stud	ents to selected departments of partner universities and institutes of Czech Academy of Sciences (CAS). Practical demonstrations and		n of students
	on hot topics of solid state physics. Discussion of own research results and their presentation as a training for defenses of students	s theses.	
11YSEM	Scanning Electron Microscopy and Microbeam Analysis Methods	ZK	2
The aim of the lect	ure is to familiarize students with the work on scanning electron microscope (SEM) and the possibilities of bundle analytical methods a	vailable on such o	levices. With
regard to physic	al principles, the display methods, analytical methods available on SEM and sampling techniques will be analyzed. The student shoul	d be able to easily	train on a
specific device, a	after the necessary practical training to prepare a sample and choose the right technique for solving a specific problem, but also to ma	ike general orienta	ation in the
	available experimental techniques.		
11YSIK	Computer Simulation of Condensed Matter	Z,ZK	5
Computer simulation	on in condensed-matter physics is becoming an important tool used by both experimentalist and theorists to develop new materials ar	d technologies. T	hus, solution
of many practical	problems can be transferred from the real to a "virtual" laboratory. During the course, students will be introduced to the theoretical bac	kground of basic	computation
methods and let to	test the acquired knowledge in practical exercises. Each lesson is organized as a tutorial where typical problems are solved with detailed	explication of the	computation
methods used. The	e course is taking place in Computer classroom of the Department of Solid State Physics. Practical demonstration and exercises are us	sing Material Stud	io simulation
	environment (Accelrys Software Inc.).		
11YSMAM	Smart Materials and Their Applications	ZK	2
Smart or responsiv	ve materials have one or more properties, such as shape, conductivity or color, that can be dramatically and reversibly altered by change	es in some externa	d conditions.
The properties res	ponding to external stimuli (heat, stress, electric field, light) influences what types of applications the smart material can be used for. The	ne number of their	applications
is growing steadil	y. Passive and active vibration damping, airbag sensors, acoustic transducers, precision positioners, miniature ultrasonic motors, vasc	cular stents, eyegl	ass frames,
cellular phone ante	ennas, light sensitive glasses or photochromic and thermochromic clothes could serve as a few examples. Lectures are focused on ph	sical properties,	experimenta
methods of investi	gation and possible application of color changing materials, light emitting materials, piezoelectric materials, conducting polymers, diel	ectric elastomers,	ferroelectric
materials and	d shape-memory materials. Attention is also paid to the effect of phase transitions on physical properties of smart materials and to the	ir numerical simul	ations.
11YSUPR	Superconductivity and Low Temperature	ZK	4
	urse is: low temperature physics, including cooling methods, low temperature technique, and measurement of low temperatures; macr	oscopic quantum	n phenomena
•	s (superfluidity and superconductivity), quantum crystals and diffusion, mesoscopic phenomena in electron systems, quantum Hall eff		
·	single electron transistor.		
11YVDM	Intrinsic Dynamics of Materials	ZK	3
	an introductory overview of dynamical phenomena taking place in the materials, with the main focus laid on the elastic wave propagati		_
3	microstructure), dynamic plasticity, phase transition fronts kinetics, and dynamic fracture mechanics.	(4)	
12KOP	Quantum Optics	Z,ZK	5
	the advanced topics in quantum optics, consequentially to the previous course of Quantum electronics. It systematically discusses espe	•	_
	erent states of electromagnetic field, quantum description of optical radiation, special states of fields, with respect to quasi-probability	•	
	the attention is given both to Dirac quantum theory of interaction of quantized electromagnetic field with a quantum system (including		
	scattering (Rayleigh, Thomson, Raman, resonance fluorescence). The attention is further given both to the quantum theory of coherence	•	,
	on functions), in relation to classical theory. The course is further devoted to generalized higher-order coherence theory, coherent prope		
•	ry of damping (quantum damped harmonic oscillator, Heisenberg-Langevin approach). Finally, the attention is given to review of nonc	•	
	tensity interferometry, Brown-Twiss effect, stellar correlation interferometer, correlation spectroscopy), possibilities of measuring the qu		
()	selected parts of modern quantum optics (squeezed states). The lectures are accompanied with practical example exercise	•	,
12YFDD	Physics of Detection and Detectors of Optical Radiation	ZK	2
	pectrum. Sources of electromagnetic radiation. Radiometric and photometric units. Ideal detector. External and internal photoefect. Qua		_
	and electronic circuits. Dynamic range. Detectors based on external photoefect. Photocathodes. Electron multipliers. Microchannel plate:		
	al photoefect. Semiconductor detectors. Scintilators. Detectors of IR, VIS and UV radiation. X-ray detectors Pyroelectricity and pyrodi	_	
Sacoa on mient	circuits. Human eye.	2.00.0.0.00.00.00	J.5501 01 110
12YFOPT	Optical Physics	Z,ZK	3
	ptical Filysics the basics of optical physics. It systematically discusses the optical wave propagation in vacuum, in isotropic and anisotropic media, a	,	_
THE IECIGIE COVERS	o the pasies of optical physics, it systematically discusses the optical wave propagation in yactum. In isotropic and anisotropic media, a	ana on anen boulic	
classifies types of	optical waves. Next, it describes the polarization and its applications, statistical properties of polychromatic waves, fundamentals of tv		

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