PROGRAM OF STUDIES

PHYSICS

Specialization: Physics of Advanced Materials for Energy Processing (PAMEP)

(in Polish: "Fizyka zaawansowanych materiałów do przetwarzania energii")

GRADUATE DEGREE STUDIES

Basic information:

a) program: PHYSICS, specialization: Physics of Advanced Materials for Energy Processing
b) level of education: graduate studies
c) profile of studies: academic
d) the number of semesters and ECTS points required to complete the program: 4 semesters, 120 ECTS points
e) academic degree obtained by graduates: Master's

Additional information:

a) categorization of the program in relation to the National Qualifications Framework: Science

b) mission statement:

Adam Mickiewicz University's mission is to prepare adepts of science and educate students through research addressing the educational challenges of the modern society. There is no doubt that the prerequisite of today's world is a prompt development of scientific expertise. Physics should be viewed as the foundation of materials science. The Faculty of Physics at AMU, which boasts a great scientific potential (academic staff and infrastructure) and an equally impressive didactic potential (academic staff and infrastructure as well - labs, library, lecture halls), meets the highest education standards of students of Physics. It has to be pointed out that our education goals and our program, according with our University's strategy, go along with the subject matters and main research objectives of the Faculty of Physics.

PAMEP program will be conducted solely in **the English language** with emphasis on preparing its students for their future work as scientists or in science-related areas. The subject matter of the program is closely tied to Material Physics which currently has been applied or has its potential application in **energy generation, processing, storage and saving.** The goal of this program is to prepare a student for an academic career (postgraduate degree studies) or a career in private sector corporations which strictly rely on detailed knowledge of scientific research (for instance, companies involved in research, producing or servicing advanced measuring tools and companies which interact with both science and the industry). With the beginning of the second semester, students divided into research groups start working on their master's dissertations which are **expected to be based on the publication authored or coauthored by the students.** Completion of the dissertation will lead to a dissertation defense exam. The last semester is devoted to internship in **academic institutions other than the Faculty of Physics or in commercial companies**.

The graduate program offers classes strictly connected to Physics (for instance, solid state physics, thermodynamics, magnetism) but also combined Physics and Chemistry (for instance, photovoltaics, solar energy, soft matter, crystallography), Physics and Biology (for instance, artificial photosynthesis, bionanostructures) and Physics and Nanomaterial Engineering (for instance, conducting nanostructures, one- and two-dimensional materials). Our students get familiarized not only with theories but also with experimental methods of materials research. Additionally, they participate in specialized courses exploring the advanced modern material characterization techniques (for instance, electron and atomic force microscopy, optical spectroscopy, X-ray spectroscopy, Raman spectroscopy, NMR spectroscopy, time-resolved laser spectroscopy, neutron

scattering), material creation (for instance, lithography, thin film deposition, chemical methods) and theoretical computation and computer simulation methods applied in materials physics.

c) addressing job market demands, graduate students' career evaluation and international standards:

A Faculty of Physics graduate who holds a Master's of Science degree will be perfectly prepared both to continue his or her education during postgraduate program and to work in the private sector. Our program will enable our graduates to comply with the work requirements in numerous areas of the knowledge-based economy and will also enable them to keep up with modern day ever-changing job market, especially in relation to those fields relying on new material technologies and within companies applying the latest scientific findings into the industry. Material research, especially that exploring various aspects of energy, is currently among the most rapidly developing type of research in the world, as it has an immense impact on the world economy and technological advancements. Our education program meets the requirements of various international standards, for instance, The Physics Degree, Graduate Skill Base and the Core of Physics (IOP 2010) and Physics, Astronomy and Astrophysics QAA 2008.

d) employment opportunities:

scientific institutions, research and industrial labs, advanced technology companies, entrepreneurship, education

e) preliminary requirements (candidate's qualifications):

undergraduate degree in science, natural sciences or technology

Program characteristics:

a) total number of ECTS points, to be obtained by a student from courses led by academic teachers: 120
b) total number of ECTS points to be obtained by a student from basic sciences courses, to which education goals are set based on the specialization, level and education profile: 120
c) total number of ECTS points to be obtained by a student from practical courses, including labs and projects: 76
d) minimal number of ECTS points to be obtained by a student from general classes offered by institutions other than the Faculty of Physics or completed during other study programs: 4
e) minimal number of ECTS points to be obtained by a student from humanistic or social sciences courses: 5
f) minimal number of ECTS points to be obtained by a student from a foreign language class: 4
g) minimal number of ECTS points to be obtained by a student from physical education class: 0

Each student of PAMEP specialization is obliged to take a 10-weeks-long (approximately 500 credit hours of student's work) internship in a R&D company or a research group outside of the Faculty of Physics at AMU (including international companies and groups). Such internship takes place during the last (IV) semester of the program as part of "External practices" course. The internship program choice is the responsibility of a student although it has to be approved by the dissertation supervisor, who deems the internship completed on the basis of an appropriate document signed by an internship supervisor or a research group supervisor.

The Faculty offers additional lectures and courses held by visiting renowned scientists from overseas. Such courses will be announced ahead of time and student's participation might result in obtaining credit from another lecture or course from the basic curriculum of a similar subject matter.

Plan of studies

PHYSICS, Specialization: Physics of Advanced Materials for Energy Processing

GRADUATE DEGREE STUDIES

campus-based studies

No.	Name of the course	Lecture (number of hours)	Course/ Seminars (number of hours)	Lab/ Project (number of hours)	Type of credit	ECTS points
1	2	3	4	5	6	7
Year I - Semester I						
1.	Signal and energy processing in nanopatterned materials	30			as per syllabus	3
2.	Physical properties of 1D and 2D materials and their application in low energy consuming electronic devices	30			as per syllabus	3
3.	Students seminars 1		45		as per syllabus	4
4.	Molecular simulation of soft matter	30			as per syllabus	3
5.	Biophotovoltaic materials	30			as per syllabus	3
6.	Down- and up-conversion in nanomaterials doped with lanthanide ions	30			as per syllabus	3
7.	Methods of fabrication and analysis of conducting nanostructures	30			as per syllabus	3
8.	Thermodynamics of Electrolyte Solutions	30			as per syllabus	3
9.	Introduction to Computational Studies of Electronic Structure of Nanosystems	30			as per syllabus	3
10.	Bionanostructures	30			as per syllabus	3
11.	Magnetism, magnetic materials and magnetization dynamics	30			as per syllabus	3
12.	Introduction to neutron scattering	30			as per syllabus	3
13.	Liquids in Confinement; Quasi-high pressure effects in nanopores	30			as per syllabus	3
14.	Electric and thermoelectric transport at the nanoscale	30			as per syllabus	3
15.	Sunlight energy conversion	30			as per syllabus	3
17.	Health and Safety	4				0
Semester I total (319 h)		274	45			31
Year I - Semester II						
1.	Specialized English		30		as per syllabus	2
2.	Students seminars 2		20		as per syllabus	2
3.	Dissertation seminars and lab (diploma)		80	80	up to the supervisor	18
4.	Optical microscopy: from bright field to confocal fluorescence			15	as per syllabus	2
5.	Introduction to fluorescence spectroscopy			15	as per syllabus	2
6.	Spectroscopic characterization of down- and up-converting nanomaterials			15	as per syllabus	2
7.	Fundamentals of control engineering			15	as per syllabus	2
8.	Micromagnetic simulations			15	as per syllabus	2
9.	Nuclear magnetic resonance			15	as per syllabus	2
10.	Optical lattices as a quantum simulators			15	as per syllabus	2
11.	Fabrication and analysis of surface nanostructures I			15	as per syllabus	2
12.	Intellectual Property, Patents, and Entrepreneurship	15			as per syllabus	1
Semester II total (285 h)		15	130	140		31
Year I total (604 h)		289	175	140		62

1	2	3	4	5	6	7
Year II - Semester III						
1.	Humanistic lecture	30	15		as per syllabus	4
2.	Students seminars 3		20		as per syllabus	2
3.	Dissertation seminars and lab (diploma)		80	80	up to the supervisor	18
4.	Fabrication and analysis of surface nanostructures II			15	as per syllabus	2
5.	Introduction to polymer physics and lattice Monte Carlo simulations of polymers			15	as per syllabus	2
6.	Computational Studies of Electronic and Energy Transport in Nanosystems			15	as per syllabus	2
7.	Time-resolved laser spectroscopy			15	as per syllabus	2
8.	Electron Microscopy			15	as per syllabus	2
9.	Molecular dynamics simulations			15	as per syllabus	2
10.	Liquids in confinement; the novel phases in nanopores			15	as per syllabus	2
11.	Preparation and characterization of solar cells			15	as per syllabus	2
Semester III total (285 h)		30	115	140		32
Year II - Semester IV						
1.	Students seminars 4		20		as per syllabus	2
2.	External practices				up to the supervisor	18
3.	Modeling of self-organization in molecular systems			15	as per syllabus	2
4.	Atomic Layer Deposition technique			15	as per syllabus	2
5.	X-ray diffraction and Differential Scanning Calorimetry (DSC)			15	as per syllabus	2
6.	Brillouin scattering			15	as per syllabus	2
7.	Spectroscopic properties of photosynthetic pigments			15	as per syllabus	2
8.	Focused Ion Beam technique			15	as per syllabus	2
Semester IV total (65 h)			20	45		26
Year II total (350 h)		30	135	185		58
Entire program total: 954 h						**120**

Classes on yellow background are selective (7 lectures in semester I, 4 courses in semester II and III and 3 courses in semester IV). Classes on white background are obligatory for all the students.