

University of Maribor
Faculty of Natural Sciences and Mathematics

Information on the Master programme
Physics

QUALIFICATION AWARDED

- **Postgraduate programme on Physics**

Qualification rewarded: M. Sc. Degree in Physics

Duration of studies: 2 years

ADMISSION REQUIREMENTS

Postgraduate programme: a successfully completed undergraduate university programme; the undergraduate university programme on Physics is recommended but not obligatory.

EDUCATIONAL AND PROFESSIONAL GOALS

The main educational and professional goal is to educate the students in the following fields: analysis of dynamics of complex systems, econophysics, computational physics in combination with measurements in science and technology, biophysics (also related to medicine) and environmental physics. All the fields are in accordance with the current employment needs and the envisioned future needs of experts.

The graduates of the undergraduate and the postgraduate study are able to perform their work with the support of up-to-date communicational, informational and computer systems in different fields like economy, informatics, biophysics and technology. So the new possible areas, that can be covered by the graduates of the program Physics of complex system, lie in industry, telecommunications, biotechnology and economy.

The graduates at the postgraduate level additionally achieve the following competences:

- the ability of advanced system thinking, which enables the graduate to organize and lead the interdisciplinary groups that study complex systems in different fields in science, insurance business, solution of environmental problems,
- the ability to analyze complex systems qualitatively and quantitatively, in order to predict the future development of the system and foresee the impact of different effects on the system, thus being able to solve the real problems in nature, environment and society,
- thorough knowledge of the structure and functioning of the physical systems and the transfer of knowledge to other fields,
- professional criticism, responsibility, initiative and self sufficient work at making decisions and the leading of complicated tasks,
- the ability to work in international groups,
- knowledge of experimental and theoretical methods for testing scientific theories,
- detailed knowledge and understanding of physical systems,
- understanding of advanced physical problems and the ability to study and solve them on the quantitative level,
- the organizing and leading of project, group and lab work.

ACCESS TO FURTHER STUDIES

Graduates of the undergraduate university programme Physics and graduates of any other undergraduate university programme of Physics can continue their studies at the postgraduate level leading to the M. Sc. degree. Graduates of the postgraduate level will be able to continue the studies at a higher level leading to the Doctor degree (the doctoral programme is in preparation).

COURSE STRUCTURE DIGRAM WITH CREDITS

Complete curricula of the post graduate programme of the Physics is given in the following pages. All the courses (obligatory and elective) are given together with the semester of study, the amount and type of the contact hours and the assigned number of the ECTS credits. The abbreviations in the curriculum have the following meaning:

L – lectures

EL – experimental lectures

S – seminar

T – tutorial

LW – lab work

FW – field work

The programme consists of 60 ECTS of obligatory courses and 60 ECTS of elective courses, which are grouped into three basic modules (each 30 ECTS) and four advanced modules (each 30 ECTS).

In the first semester the student has 30 ECTS of obligatory courses.

In the second semester one basic module (30 ECTS) has to be chosen.

In the third semester the student chooses an advanced module (30 ECTS). The selection of this module is in general independent of the chosen basic module.

In the fourth semester the student has one obligatory course (10 ECTS). 20 ECTS in this semester are devoted to the master thesis.

Obligatory courses and the master thesis: 60 ECTS

Course title	ECTS
Statistical Thermodynamics	8
Physics of Complex Systems	7
Physics Modelling	10
Physical Applications	5
Introduction to the scientific research	10
MASTER THESIS	20
	60

Modules:

basic module Soft Matter	
Course Title	ECTS
Physics of Materials	5
Selected Topics from Quantum Mechanics	5
Modern Optics	5
Soft Matter	5
Electromagnetic Field	5
Elective course	5
	30

advanced module Biophysics	
Course Title	ECTS
Molecular Biophysics	5
Experimental Methods in Physics and Biophysics	10
Theoretical Biophysics	10
Elective Course	5
	30

basic module Dynamical Systems	
Course Title	ECTS
Nonlinear Dynamical Systems	5
Stochastic Processes	10
Game Theory	5
Graph Theory and Networks	5
Economic Dynamics	5
	30

advanced module Econophysics	
Course Title	ECTS
Econometrics	5
Time Series Analysis	5
Foundation of Financial Engineering	5
Actuarial Mathematics	5
Industrial Organization	5
Stock Market Trends and Strategies	5
	30

basic module Computer Physics	
Course Title	ECTS
Advanced Numerical Methods in Physics	10
Computer Statistical Methods	5
Computer Measurements and Control	5
Elective course*	5
Elective course*	5
	30

advanced module Multimedia and Informatics	
Course Title	ECTS
Multimedia Systems in Physics	5
Information System Development	5
Software engineering project management	5
Elective course*	5
Elective course*	5
Elective course*	5
Elective course	5
	30

*instead of two elective courses with 5 ECTS each, a student can choose one elective course with 10 ECTS.

Advanced module: Individual selection:

Student selects elective courses in total of 30 ECTS. The appropriate selection of the courses is approved by the Department of Physics.

ELECTIVE COURSES:

Some of the elective courses are the same as at the undergraduate study Physics of Complex systems. A student can select among the courses that were not taken at the undergraduate study and among those courses that are not a part of the chosen basic and advanced module.

Course title	ECTS
Acoustic	5
Actuarial Mathematics	5
Advanced Numerical Methods in Physics	10
Analytical Mechanics	5
Bioelectromagnetism	5
Characterisation of Molecular Structures	5
Communication Human – Machine	5
Computer Communications and Networks	5
Computer Measurements and Control	5
Computer Statistical Methods	5
Dynamical Systems in the Environment	5
Dynamics of Games	5
Econometrics	5
Economic Dynamics	5
Electromagnetic Field	5
Embedded Systems	5
Energy for Human Use	5
Experimental Methods in Physics and Biophysics	10
Fluid Physics	5
Foundation of Financial Engineering	5
Game Theory	5
Graph Theory and Networks	5
Industrial Organization	5
Information System Development	5
Liquid Crystals	5
Mechanics of Continuous Media	5
Modelling and Simulations in Medicine and Biology	5
Modern Optics	5
Molecular Biophysics	5
Multimedia Systems in Physics	5
Nonlinear Dynamical Systems	5
Photonics	5
Physical Processes in the Environment	5
Physics in Medicine	5
Physics of Colloids and Macromolecules	5
Physics of Fluids	5
Physics of Materials	5
Selected Topics from Quantum Mechanics	5
Soft Matter	5
Software engineering project management	5
Solid State	5
Stochastic Processes	10
Stock Market Trends and Strategies	5
Theoretical Biophysics	10
Time Series Analysis	5

1st year, 1st semester

Course title	L	S	T	LW	FW	Total contact hours	Individual work	Total hours/ECTS
Statistical Thermodynamics	30		45			75	165	240/8
Physics of Complex Systems	30		30			60	150	210/7
Physics Modelling	30		30	30		90	210	300/10
Physical Applications	30				30	60	90	150/5
						285	615	900/30

1st year, 2nd semester

Each student selects one of the basic elective modules: Soft Matter Dynamical Systems or Computational Physics.

Module Soft Matter

Course title	L	S	T	LW	FW	Total contact hours	Individual work	Total hours/ECTS
Physics of Materials	30		30			60	90	150/5
Electromagnetic Field	45		15			60	90	150/5
Modern Optics	30		30			60	90	150/5
Soft Matter	45		30			75	75	150/5
Selected Topics from Quantum Mechanics	45		15			60	90	150/5
Elective Course						60	90	150/5
						375	525	900/30

Module Dynamical Systems:

Course title	L	S	T	LW	FW	Total contact hours	Individual work	Total hours/ECTS
Nonlinear Dynamical Systems	30		30			60	90	150/5
Stochastic Processes	60		60			120	180	300/10
Graph Theory and Networks	30	15	15			60	90	150/5
Game Theory	30			30		60	90	150/5
Economic Dynamics	45		15			60		
						360	540	900/30

Module Computational Physics

Course title	L	S	T	LW	FW	Total contact hours	Individual work	Total hours /ECTS
Advanced Numerical Methods	45		15	60		120	180	300/10
Computer Statistical Methods	30			30		60	90	150/5
Computer Measurements and Control	30			30		60	90	150/5
Elective course*						60	90	150/5
Elective course*						60	90	150/5
						360	540	900/30

*instead of two elective courses with 5 ECTS each, a student can choose one elective course with 10 ECTS.

2nd year, 3rd semester

Each student chooses one advanced module: Biophysic, Econophysics, Multimedia and Informatics in Physics or Individual Selection.

Module Biophysics:

Course title	L	S	T	LW	FW	Total contact hours	Individual work	Total hours /ECTS
Molecular Biophysics	45		30			75	75	150/5
Experimental Methods in Physics and Biophysics	60		30	30		120	180	300/10
Theoretical Biophysics	75	15		30		120	180	300/10
Elective course						60	90	150/5
						375	525	900/30

Module Econophysics:

Course title	L	S	T	LW	FW	Total contact hours	Individual work	Total hours /ECTS
Econometrics	45		15			60	90	150/5
Foundations of Financial Engineering	45		15			60	90	150/5
Time Series Analysis	45		15			60	90	150/5
Actuary Mathematics	45		15			60	90	150/5
Stock Market Trends and Strategies	45		15			60	90	150/5
Industrial Organization	45		15			60	90	150/5
						360	540	900/30

Module Multimedia and Informatics in Physics:

Course title	L	S	T	LW	FW	Total contact hours	Individual work	Total hours /ECTS
Multimedia systems in Physics	30			30		60	90	150/5
Information System Development	30			30		60	90	150/5
Software Engineering Project Management	30			30		60	90	150/5
Elective course*						60	90	150/5
Elective course*						60	90	150/5
Elective course						60	90	150/5
						360	540	900/30

*instead of two elective courses with 5 ECTS each, a student can choose one elective course with 10 ECTS.

Module Individual selection: (e.g. 6 courses, each 5 ECTS, are chosen)

Course title	L	S	T	LW	FW	Total contact hours	Individual work	Total hours /ECTS
Elective course						60	90	150/5
Elective course						60	90	150/5
Elective course						60	90	150/5
Elective course						60	90	150/5
Elective course						60	90	150/5
Elective course						60	90	150/5
						360	540	900/30

2nd year, 4th semester

Course title	L	S	T	LW	FW	Total contact hours	Individual work	Total hours /ECTS
Introduction to Scientific Research	15	20				35	265	300/10
Master Thesis*							600	600/20
						35	865	900/30

*Master Thesis is defended when all other student's commitments in the programme are successfully done.

Elective courses:

Course title	L	S	T	L W	F W	Total contact hours	Individual work	Total hours /ECTS
Acoustics	50			10		60	90	150/5
Actuarial Mathematics	45		15			60	90	150/5
Advanced Numerical Methods in Physics	45		15	60		120	180	300/10
Analytical Mechanics	45		15			60	90	150/5
Bioelectromagnetism	45	15				60	90	150/5
Characterisation of Molecular Structures	30		30			60	90	150/5
Communication Human – Machine	30			30		60	90	150/5
Computer Communications and Networks	30			30		60	90	150/5
Computer Measurements and Control	30			30		60	90	150/5
Computer Statistical Methods	30			30		60	90	150/5
Dynamical Systems in the Environment	30			30		60	90	150/5
Dynamics of Games	30		30			60	90	150/5
Econometrics	45		15			60	90	150/5
Economic Dynamics	45		15			60	90	150/5
Electromagnetic Field	45		15			60	90	150/5
Embedded Systems	30			30		60	90	150/5
Energy for Human Use	30			15	15	60	90	150/5
Experimental Methods in Physics and Biophysics	60		30	30		120	180	300/10
Foundation of Financial Engineering	45		15			60	90	150/5
Game Theory	30			30		60	90	150/5
Graph Theory and Networks	30	15	15			60	90	150/5
Industrial Organization	45		15			60	90	150/5
Information System Development	30			30		60	90	150/5
Liquid Crystals	45	15				60	90	150/5
Mechanics of Continuous Media	45		15			60	90	150/5
Modelling and Simulations in Medicine and Biology	30	15		15		60	90	150/5
Modern Optics	30		30			60	90	150/5
Molecular Biophysics	30	15	30			75	75	150/5
Multimedia Systems in Physics	30			30		60	90	150/5
Nonlinear Dynamical Systems	30		30			60	90	150/5
Photonics	30	15	15			60	90	150/5
Physical Processes in the Environment	45			30	15	90	60	150/5
Physics in Medicine	30	15		15		60	90	150/5
Physics of Colloids and Macromolecules	45	15				60	90	150/5
Physics of Fluids	45		15			60	90	150/5
Physics of Materials	30		30			60	90	150/5
Selected Topics from Quantum Mechanics	45		15			60	90	150/5
Soft Matter	45		30			75	75	150/5
Software Engineering Project Management	30			30		60	90	150/5
Solid State	30		30			60	90	150/5
Stochastic Processes	60		60			120	180	300/10
Stock Market Trends and Strategies	45		15			60	90	150/5
Theoretical Biophysics	75	15		30		120	180	300/10
Time Series Analysis	45		15			60	90	150/5

FINAL EXAMINATION

There is no final examination other than the defence of the bachelor or master thesis.

EXAMINATION AND ASSESMENT REGULATIONS

The examinations are usually written and oral. Some of the courses involve the preparation of a seminar work which is usually defended by an oral presentation. The oral examination is usually preconditioned by laboratory attendance, the successful completion of the written exam and the seminar work where required.

Timetables of examinations are issued yearly by the Faculty senate at the beginning of the academic year and are published on the faculty web page and on the notice boards. There are at least 6 examinations for each course per academic year and students are free to choose the date of examination. The students need to register for examination 7 days before the examination date. The examination can be cancelled no later than 3 days before the examination date. The use of calculators, literature and other items during the examination is determined by the lecturer and may vary from course to course.

The M. Sc. thesis is publicly presented and defended before an examination board, chaired by an internationally recognized academician, who is an expert in the field. The members of the board are also the Dean of the Faculty, the mentor, co-mentor and one or two internationally recognized academicians, who are experts in the field.

ECTS DEPARTMENTAL CO-ORDINATOR

ECTS departmental co-ordinator is the actual head of the department.

Graduate Master Study Programme Physics

Code	Course title	Type	ECTS
	Acoustic	E	5
	Actuarial Mathematics	E	5
	Advanced Numerical Methods	E	10
	Analytical Mechanics	E	5
	Bioelectromagnetism	E	5
	Characterisation of Molecular Structures	E	5
	Communication Human – Machine	E	5
	Computer Communications and Networks	E	5
	Computer Measurements and Control	E	5
	Computer Statistical Methods	E	5
	Dynamical Systems in the Environment	E	5
	Dynamics of Games	E	5
	Economic Dynamics	E	5
	Econometrics	E	5
	Electromagnetic Field	E	5
	Embedded Systems	E	5
	Energy for Human Use	E	5
	Experimental Methods in Physics and Biophysics	E	10
	Fluid Physics	E	5
	Foundation of Financial Engineering	E	5
	Game Theory	E	5
	Graph Theory and Networks	E	5
	Industrial Organization	E	5
	Information System Development	E	5
	Introduction to Scientific Research	O	10
	Liquid Crystals	E	5
	MASTER THESIS	O	20
	Mechanics of Continuous Media	E	5
	Modelling and Simulations in Medicine and Biology	E	5
	Modern Optics	E	5
	Molecular Biophysics	E	5
	Multimedia Systems in Physics	E	5
	Nonlinear Dynamical Systems	E	5
	Photonics	E	5
	Physics Applications	O	5
	Physical Processes in the Environment	E	5
	Physics in Medicine	E	5
	Physics Modelling	O	10
	Physics of Colloids and Macromolecules	E	5
	Physics of Complex Systems	O	7
	Physics of Fluids	E	5
	Physics of Materials	E	5
	Selected Topics from Quantum Mechanics	E	5
	Soft Matter	E	5
	Software Engineering Project Management	E	5
	Solid State	E	5
	Statistical Thermodynamics	O	8
	Stochastic Processes	E	10
	Stock Market Trends and Strategies	E	5
	Theoretical Biophysics	E	10
	Time Series Analysis	E	5

O ... obligatory course E ... elective course