

## EDUCATIONAL PLAN

Valid from the academic year 2023-2024

<b>Faculty:</b>	Physics
<b>The cycle of university studies:</b>	Master
<b>Name of the master's degree program:</b>	Metode avansate de cercetare în fizică/Advanced research methods in physics
<b>Name of the qualification<sup>1</sup> acquired after graduating from the study program:</b>	Specialist in physics
<b>Title awarded:</b>	Master's in physics
<b>Duration of studies (in years):</b>	2 years
<b>Number of credits (ECTS):</b>	120
<b>Form of education<sup>2</sup>:</b>	Full-time education
<b>Language of instruction:</b>	English
<b>Geographical location of studies:</b>	Timișoara
<b>The framing of the study program in science fields</b>	
<b>Fundamental field:</b>	Mathematics and natural sciences
<b>Science Branch:</b>	Physics
<b>The field of university master's studies:</b>	Physics
<b>Name of the broad field of study (according to DL-ISCED F-2013):</b>	Natural sciences, mathematics and statistics
<b>Name of the restricted field of studies (according to DR-ISCED F-2013):</b>	Physical sciences
<b>Name of the detailed field of study (according to DDS-ISCED F-2013):</b>	Physics

<sup>1</sup> *Calificarea (qualification)* este rezultatul formal al unui proces de evaluare și validare, care este obținut atunci când un organism/o autoritate competent/ă stabilește că o persoană a dobândit rezultate ale învățării corespunzătoare unor standarde prestabilite. Calificările dobândite de absolvenții programelor de studii din învățământul superior sunt atestate prin diplome, prin certificate și prin alte acte de studii eliberate numai de către instituțiile de învățământ superior acreditate.

<sup>2</sup> Învățământ cu frecvență (IF) sau învățământ cu frecvență redusă (IFR)

## GENERAL PRESENTATION OF THE PROGRAM OF UNIVERSITY STUDIES

### 1. The mission of the study program<sup>3</sup>

The mission of the master's studies in "Advanced research methods in physics" is to prepare qualified personnel for higher education and researchers in a field - closely related to condensed matter physics and theoretical physics. The master's program is open to students with a background in physics who are eager to expand their knowledge and experience in a modern physics research environment. Thanks to the experimental and theoretical skills acquired during the study, students will also have the ability to respond to the needs of the industrial community in areas such as materials technology, automotive industry, chemical engineering, IT and others.

Within the master's specialization two tracks could be chosen by students:

1. Theoretical physics: we will convey to students the current view (Standard Model) about the fundamental building blocks of Matter, about the elementary forces, about cosmic objects, about the future and the past of the Universe. As is known, the main research center in fundamental physics, CERN, is the largest civilian consumer of computing power in the world. We will talk about the modern technologies involved in these activities at the frontiers of Science.

2. Physics of advanced materials: a basic training is provided in the field of theoretical and experimental physics, the physics of crystallization processes, nanosystems, physical methods for characterizing materials, transport phenomena, technologies for obtaining advanced materials,

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<sup>3</sup> Misiunea și obiectivele programului de studii trebuie să fie în concordanță cu misiunea Universității de Vest din Timișoara și cu cerințele identificate pe piața muncii.

Conform *Cartei universitare* (articolul 5), **misiunea generală a UVT este de cercetare științifică avansată și educație, generând și transferând cunoaștere către societate** prin:

a) cercetare științifică, dezvoltare, inovare și transfer tehnologic, prin creație individuală și colectivă, în domeniul științelor, al științelor ingineresti, al literelor, al artelor, prin asigurarea performanțelor și dezvoltării fizice și sportive, precum și valorificarea și diseminarea rezultatelor acestora;

b) formare inițială și continuă, la nivel universitar, în scopul dezvoltării personale, a inserției profesionale a individului și a satisfacerii nevoilor de competențe ale mediului socio-economic.

UVT își asumă misiunea proprie de catalizator al dezvoltării societății românești prin crearea unui mediu inovativ și participativ de cercetare științifică, de învățare, de creație cultural-artistică și de performanță sportivă, transferând spre comunitate competențe și cunoștințe prin serviciile de educație, cercetare și de consultanță pe care le oferă partenerilor din mediul economic și socio-cultural.

Realizarea misiunii UVT se concretizează în (*articolul 6 din Carta UVT*):

- promovarea cercetării științifice, a creației literar-artistice și a performanței sportive;
- formarea inițială și continuă a resurselor umane calificate și înalt calificate;
- dezvoltarea gândirii critice și a potențialului creativ al membrilor comunității universitare;
- crearea, tezurizarea și răspândirea valorilor culturii și civilizației umane;
- promovarea interferențelor multiculturale, plurilingvistice și interconfesionale;
- afirmarea culturii și științei românești în circuitul mondial de valori;
- dezvoltarea societății românești în cadrul unui stat de drept, liber și democrat.

and numerical modeling and simulation methods. Also, special attention is paid to current trends in scientific research and demand both nationally and internationally, such as obtaining new materials with improved properties, relaxation processes, nanosystems in electromagnetic fields, obtaining crystals with laser potential, control of the flow of a melt with the help of magnetic and electric fields.

## 2. Competencies and expected learning outcomes formed within the study program

### A. COMPETENCIES<sup>4</sup>

#### Key-Competences<sup>5</sup>:

- multilingual competences.
- competences in the field of science, technology, engineering and mathematics.
- digital competences.
- personal, social and learning competences.

#### Professional Competencies<sup>6</sup>:

##### Theoretical physics track:

- Competencies to develop and refine existing theories using calculations.
- Study currently accepted theories in the field of theoretical physics.
- Skills to perform mathematical calculations in an attempt to prove abstract theories.
- Develop theories based on observations and calculations.

##### Physics of advanced materials track:

- Competences in the field of obtaining materials;
- Competences in the field of characterizing the specific properties of some materials;
- Competences in the field of using computers and calculation programs for the numerical simulation of physical processes specific to obtaining materials;
- The acquisition of a coherent and functional system of fundamental knowledge in the

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<sup>4</sup> *Competența (competence)* reprezintă capacitatea dovedită de a selecta, combina și utiliza adecvat cunoștințe, aptitudini și abilități personale, sociale și/sau metodologice și alte achiziții constând în valori și atitudini, pentru rezolvarea cu succes a unei anumite categorii de situații de muncă sau de învățare, precum și pentru dezvoltarea profesională ori personală în condiții de eficacitate și eficiență.

<sup>5</sup> *Competențele-cheie pentru învățarea pe tot parcursul vieții* sunt acele competențe de care au nevoie toți cetățenii pentru împlinirea și dezvoltarea personală, ocuparea unui loc de muncă, incluziune socială și cetățenie activă, fiind dezvoltate în perspectiva învățării pe tot parcursul vieții, începând din copilăria mică și pe tot parcursul vieții adulte, prin intermediul învățării formale, non-formale și informale.

<sup>6</sup> *Competențele profesionale* reprezintă capacitatea de a realiza activitățile cerute la locul de muncă la nivelul calitativ specificat în standardul ocupațional. Acestea se dobândesc pe cale formală, respectiv prin parcurgerea unui program organizat de o instituție acreditată.

field of materials science;

**Transversal Competencies<sup>7</sup>:**

- The ability to filter information and establish its veracity.
- Active learning capacity.
- Ability to analyze, synthesize and make decisions responsibly.
- Ethics and integrity.
- Solving complex problems.

**EXPECTED LEARNING OUTCOMES<sup>8</sup>**

**a) Knowledge** - According to the European Qualifications Framework (EQF), the learning outcomes related to qualification level 7, corresponding to university master's studies, require highly specialized knowledge and their critical awareness, some of them being at the vanguard of the level of knowledge from a field of work or study, as a basis for original thinking and/or research:

- to know the advanced notions in the field of Physics, which involves a critical understanding of theories and principles;
- to know the working formulas for calculations with physical quantities using properly the principles and laws of physics;
- to know the language specific to the field;
- to know physical phenomena and interpret them by formulating hypotheses and operationalizing key concepts and the appropriate use of laboratory equipment;
- to know the constructive and operating principles of the equipment for obtaining and characterizing materials and to explain how to use it;

**b) Skills** - According to the European Qualifications Framework (EQF), the learning outcomes related to qualification level 7, corresponding to university master's studies, assume specialized skills for solving research and/or innovation problems, for the development of new knowledge and procedures and for the integration of knowledge from different fields:

- to compare the theoretical results provided by the specialized literature with those of an experiment carried out within a professional project;
- to deduce the working formulas for calculations with physical quantities, using appropriately the principles and laws of physics;

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<sup>7</sup> *Competențele transversale* reprezintă achizițiile valorice și atitudinale care depășesc un anumit domeniu/program de studii și se exprimă prin următorii descriptori: responsabilitate și autonomie, interacțiune socială, dezvoltare personală și profesională.

<sup>8</sup> *Rezultatele învățării (learning outcomes)* înseamnă enunțuri care se referă la ceea ce cunoaște, înțelege și este capabil să facă un cursant la terminarea unui proces de învățare și care sunt definite sub formă de cunoștințe, abilități, responsabilitate și autonomie.

- to describe physical systems using specific theories and tools (experimental and theoretical models, algorithms, schemes, etc.);
- to apply the principles and laws of physics in solving theoretical or practical problems, under conditions of qualified assistance;
- to use the computer and calculation programs for the numerical simulation of the physical processes.

#### **Specific for Theoretical physics track:**

- To describe and explain the fundamental principles of physics, including those of: Relativity and Quantum Mechanics, Standard Model, Quantum fields and particles, Cosmology.
- To use high-level mathematical skills to solve conceptual and quantitative problems in physics.
- To describe critical experiments in the history of physics and explain how they led to revisions of our theoretical descriptions of nature.
- To analyse physical systems and provide order-of-magnitude estimates of quantities. This includes a knowledge of basic physical constants and key equations.

#### **Specific for Physics of advanced materials track:**

- to use the computer to control some experiments or processes and to acquire data;
- to characterize the specific properties of some materials taking into account the field in which they are used;
- to use experimental techniques for obtaining and characterizing materials through optical and spectroscopic methods;
- to identify the most appropriate methods to develop new materials with well-defined properties.

**c) Responsibility and autonomy** - According to the European Qualifications Framework (EQF), the learning outcomes related to qualification level 7, corresponding to university master's studies, involve the management and transformation of work or study situations that are complex, unpredictable and require new strategic approaches, by taking responsibility to contribute to professional knowledge and practices and/or to review the strategic performance of teams:

- assume responsibility for managing professional development;
- participate in some concrete physics experiments;
- to present scientific seminars and to popularize some notions of physics;
- to critically analyze a specialized report, scientific communication with a medium degree of difficulty in the field of physics;
- to be autonomous in the context of handling laboratory equipment, including in situations requiring an interdisciplinary approach;

- to autonomously use information sources and resources for communication and assisted professional training (Internet portals, specialized software applications, databases, online courses, etc.) both in Romanian and in a language of international circulation;
- to carry out research internships in various production/research units in order to become familiar with and operate modern equipment, obtain interesting results and prepare reports on the activity carried out.

### 3. Occupations that can be practiced on the labor market

- **Code COR - 211101** physicist.
- **Code COR - 211103** research assistant in physics.
- **Code COR - 211105** research assistant in physics-chemistry.
- **Code COR - 211107** research assistant in technological physics.

### 4. Ensuring flexible learning paths within the study program

*The flexibility of the study program is ensured through optional subjects, optional subjects and complementary subjects.*

**The disciplines of choice (optional)** are proposed for semesters 1, 2, 3 and 4 and are grouped into optional packages, which complete the student's specialization path. The choice of the route is made by the student, before the start of each academic year.

**The non-compulsory disciplines** are proposed for semesters 1-4 by the Department of Physics or the Faculty of Physics, which manages the study program, but they can also be chosen from the packages offered by other faculties of UVT.

In accordance with the provisions of the Regulation on the development of education plans for the study programs at the University of West Timisoara, so that students can benefit from credits for volunteering activities based on the provisions of the National Education Law no. 1/2011, with subsequent amendments and additions (article 203, paragraph (9)), the Volunteering discipline is available every semester in the curricula of all bachelor's and master's degree programs, with optional subject status, with a number of 2 ECTS credits.

### 5. Professional activity and student assessment

The rights, obligations and conditions of the professional activity of students at the West University of Timisoara are regulated by the Code of Student Rights and Obligations and the Regulation on the professional activity of students from the bachelor's and master's study cycles of WUT, approved by the WUT Senate.

The form and assessment/examination methods for each subject in the curriculum are established by the subject sheets.

## 6. Final studies exam

In accordance with the Regulation on the organization and conduct of the final exams for bachelor's and master's university studies at the West University of Timisoara, approved by the WUT Senate, the final exam for master's university studies in any master's university study program organized at WUT it consists of a sample of elaboration and support of the dissertation work, for which 10 credits are awarded.

The topic and the bibliography corresponding to the final exam tests are published on each faculty's own website and/or on the WUT website before the beginning of each academic year.

Enrolment in the graduation exam is conditional on the student choosing the theme of the graduation thesis within 60 days at most from the beginning of the academic year of the final year of study.

The submission of the final version of the thesis on the e-learning platform is done at least 5 working days before the date scheduled for the start of the exam.

Each thesis will be accompanied, at the time of submission, by the Similarity Report resulting from the verification of the originality of the thesis through a specialized software, on the WUT e-learning platform.

According to the structure of the academic year, at WUT the exams for completing university studies can be organized in 3 sessions, usually in the months of July, September and February.

## 7. Preparation for the teaching profession (if applicable)

Students who wish to opt for a teaching career in pre-university education must complete (in addition to this study program) and complete the Psychopedagogical Training Program in order to certify the skills for the teaching profession and obtain the Certificate of Completion of this program. In the West University of Timisoara, this program is organized through the Department for the Training of Teaching Staff (DPPD) and can be followed in parallel with university studies or as a postgraduate. For more information, visit the link: <https://dppd.uvt.ro>.

## LIST OF DISCIPLINES STUDIED, GROUPED BY YEARS AND SEMESTER OF STUDY

### Study year I

#### Academic year 2024-2025

Nr. crt.	Discipline	C1	C2	Discipline Code	Semester I				Semester II					
					Number of hours/week				Number of credits	Number of hours/week				Number of credits
					C	S	L	P		C	S	L	P	
1.	Complements of Theoretical Physics	DF	DO	ARMP 1101	2	2	-	-	7	-	-	-	-	-
2.	Complements of Solid State Physics	DF	DO	ARMP 1102	2	2	-	-	7	-	-	-	-	-
3.	Complements of Atom and Molecule Physics	DF	DO	ARMP 1103	2	2	-	-	7	-	-	-	-	-
4.	Magnetic materials	DS	DOP	ARMP 1104	2	2	-	-	7	-	-	-	-	-
	Symmetries in physics			ARMP 1105										
	Complements of biophysics with applications in medicine			ARMP 1106										
5.	Ethics of the research. Methodology of scientific work	DC	DO	ARMP 1107	1	1	-	-	2	-	-	-	-	-
6.	Crystal growth methods	DS	DOP	ARMP 1201	-	-	-	-	-	2	1	-	-	5
	Gravitation and cosmology			ARMP 1202										
7.	X-ray characterization of materials	DS	DOP	ARMP 1203	-	-	-	-	-	2	2	-	-	6
	Statistical methods for data analyzing			ARMP 1204										
8.	Transport phenomena	DS	DOP	ARMP 1205	-	-	-	-	-	2	2	-	-	7
	Quantum fields			ARMP 1206										
9.	Standard model	DS	DO	ARMP 1207	-	-	-	-	-	2	2	-	-	6
10.	Microwaves and applications	DS	DO	ARMP 1208	-	-	-	-	-	2	-	1	-	6
<b>Total</b>					9	9	-	-	30	10	8	-	-	30
<b>Total teaching hours per week</b>					18				18					



Noncompulsory Disciplines														
Nr. crt.	Disciplina	C1	C2	Discipline Code	Semester I				Number of credits	Semester II				
					Number of hours/ week					C	S	L	P	
					C	S	L	P						
1.	Introduction to Econophysics: from Statistical Physics to Risk Management	DC	DFAC	ARMP 1209						1	1			4
2.	Relativistic Fluid Dynamics	DS	DFAC	ARMP 1210						2	2			6
3.	Volunteering activity 1	DC	DFAC	ARMP 1108	60 de ore				2	-	-	-	-	-
4.	Volunteering activity 2	DC	DFAC	ARMP 1211	-	-	-	-	-	60 de ore				2

**Legend**

<b>C1</b>	content criterion
<b>C2</b>	the obligation criterion
<b>DF</b>	fundamental disciplines
<b>DD</b>	field disciplines (where applicable)
<b>DS</b>	specialized disciplines
<b>DC</b>	complementary disciplines
<b>DO</b>	compulsory (imposed) disciplines
<b>DOP</b>	optional disciplines (of your choice)
<b>DFAC</b>	Noncompulsory disciplines
<b>CP</b>	professional competency
<b>CT</b>	transversal competence
<b>C</b>	course-type didactic activity
<b>S</b>	seminar-type didactic activity
<b>L</b>	didactic activity of practical laboratory type
<b>P</b>	didactic activity of the internship type

**Discipline code:** <faculty><department><no. discipline>

## Study year II

Academic year 2025-2026

Nr. crt.	Discipline	C1	C2	Discipline Code	Semester I				Semester II					
					Number of hours/ week				Number of credits	Number of hours/ week				Number of credits
					C	S	L	P		C	S	L	P	
1.	Advanced methods in Optical Spectroscopy	DS	DO	ARMP 2301	2		2		6	-	-	-	-	-
2.	Solar energy conversion	DS	DO	ARMP 2302	2	2	-		6	-	-	-	-	-
3.	Rheological characterization of materials	DS	DOP	ARMP 2303	2	1	-		6	-	-	-	-	-
	Advanced methods in computational physics			ARMP 2304										
4.	Synthesis and characterization of nano/micromaterials	DS	DOP	ARMP 2305	2		2		6	-	-	-	-	-
	Fields in interaction			ARMP 2306										
5.	Defects in crystal	DS	DOP	ARMP 2307	2	-	2		6	-	-	-	-	-
	Stellar astrophysics			ARMP 2308										
6.	Specialization practice (projects, etc)	DS	DO	ARMP 2401	-	-	-	-	-	-	-	5	8	
7.	Scientific research internship	DS	DO	ARMP 2402	-	-	-	-	-	-	-	4	8	
8.	Practice for elaboration of dissertation	DS	DO	ARMP 2403	-	-	-	-	-	-	-	4	8	
9.	Practical Course	DS	DOP	ARMP 2404								3	6	
<b>Total</b>					10	9	-		30	-	-	16	30	
<b>Total teaching hours per week</b>					19					16				

### Noncompulsory Disciplines

Nr. crt.	Discipline	C1	C2	Discipline Code	Semester I				Semester II					
					Number of hours/ week				Number of credits	Number of hours/ week				Number of credits
					C	S	L	P		C	S	L	P	
1.	Volunteering activity 3	DC	DFAC	ARMP 2309	-	1	-	-	2	-	-	-	-	-
2.	Volunteering activity 4	DC	DFAC	ARMP 2405	-	-	-	-	-	-	1	-	-	2
3.	Effective Models in Quantum Chromodynamics	DS	DFAC	ARMP 2406	2	2								6
4.	Numerical Relativity	DS	DFAC	ARMP 2407	2	2								6

**Legend**

<b>C1</b>	content criterion
<b>C2</b>	the obligation criterion
<b>DF</b>	fundamental disciplines
<b>DD</b>	field disciplines (where applicable)
<b>DS</b>	specialized disciplines
<b>DC</b>	complementary disciplines
<b>DO</b>	compulsory (imposed) disciplines
<b>DOP</b>	optional disciplines (of your choice)
<b>DFAC</b>	Noncompulsory disciplines
<b>CP</b>	professional competency
<b>CT</b>	transversal competence
<b>C</b>	course-type didactic activity
<b>S</b>	seminar-type didactic activity
<b>L</b>	didactic activity of practical laboratory type
<b>P</b>	didactic activity of the internship type

**Discipline code:** <faculty><department><no. discipline>

Lista cursuri practice

1 Curs practic Continental

2 Curs practice Vitesco

3 Curs practic de norme CNCAN

## GENERAL ASSESSMENT I (by content criterion)

Nr. crt.	Tip disciplină	Număr total de ore								Prevedere standard specific ARACIS
		Anul I		Anul II		Întreg programul de studii		% din total		
		Curs	S/L/P	Curs	S/L/P	Curs	S/L/P		Total	
1.	Fundamentale	84	84	-	-	84	84	168	16,9%	-
2.	De domeniu (dacă există)	-	-	-	-	-	-	-	-	-
3.	De specialitate	168	140	140	350	308	490	798	80,3%	-
4.	Complementare	14	14	-	-	14	14	28	2,8%	-
<b>TOTAL</b>		<b>266</b>	<b>238</b>	<b>140</b>	<b>350</b>	<b>406</b>	<b>588</b>	<b>994</b>	<b>100%</b>	-

## GENERAL ASSESSMENT II (according to the mandatory criterion)

Nr. crt.	Tip disciplină	Număr total de ore								Prevedere standard specific ARACIS
		Anul I		Anul II		Întreg programul de studii		% din total		
		Curs	S/L/P	Curs	S/L/P	Curs	S/L/P		Total	
1.	Obligatorie	154	140	56	280	210	420	630	63,4%	-
2.	Opțională	112	98	84	70	196	168	364	36,6%	-
<b>TOTAL</b>		<b>266</b>	<b>238</b>	<b>140</b>	<b>350</b>	<b>406</b>	<b>588</b>	<b>994</b>	100%	-
3.	-	120	-	120	-	240	240	-	-	<i>Nu intră în calculul totalurilor</i>
<b>Raport total ore de seminar/laborator/practică / ore de curs</b>						1,37			<b>1&lt;R&lt;2</b>	

Responsabil program de studii,  
Prof. univ. dr. Daniel Vizman

Director de departament,  
Conf. univ. dr. Nicoleta Stefu

Decan  
Prof. univ. dr. Daniel Vizman

Rector,  
Prof. univ. dr. Marilen Gabriel PIRTEA

## CORELAREA DINTRE COMPETENȚE, REZULTATELE AȘTEPTATE ALE ÎNVĂȚĂRII ȘI DISCIPLINELE STUDIATE

### Corelarea rezultatelor așteptate ale învățării cu disciplinele studiate

Rezultate așteptate ale învățării	Complements of Theoretical Physics	Complements of Solid State Physics	Complements of Atom and Molecule Physics	Magnetic materials	Symmetries in physics	Complements of biophysics with applications in medicine	Ethics of the research. Methodology of scientific work	Crystal growth methods	Gravitation and cosmology	X-ray characterization of materials	Statistical methods for data analyzing	Transport phenomena	Quantum fields	Standard model	Microwaves and applications	Advanced methods in Optical Spectroscopy	Solar energy conversion	Rheological characterization of materials	Advanced methods in computational physics	Synthesis and characterization of nano/micromaterials	Fields in interaction	Defects in crystal	Stellar astrophysics	Specialization practice (projects, etc)	Scientific research internship	Practice for elaboration of dissertation
<b>Cunoștințe</b>																										
to know the advanced notions in the field of Physics, which involves a critical understanding of theories and principles	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
to know the working formulas for calculations with physical quantities using properly the principles and laws of physics	X	X	X		X				X		X	X	X	X							X		X			
to know the language specific to the field	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
to know physical phenomena and interpret them by formulating hypotheses and operationalizing key concepts and the appropriate use of laboratory equipment		X	X	X				X		X					X	X		X		X		X				
to know the constructive and operating principles of the equipment for obtaining and characterizing materials and to explain how to use it				X				X		X					X	X		X	X	X		X				
<b>Abilități</b>																										
to compare the theoretical results provided by the specialized literature with those of an experiment carried out within a professional project				X				X		X					X	X	X	X		X		X		X	X	X
to deduce the working formulas for calculations with physical quantities, using appropriately the principles and laws of physics	X	X	X		X				X		X	X	X	X							X		X			
To describe physical systems using specific theories and tools (experimental and theoretical models, algorithms, schemes, etc.)	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
to apply the principles and laws of physics in solving theoretical or practical problems, under conditions of qualified assistance	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
to use the computer and calculation programs for the numerical simulation of the physical processes												X							X				X			
To describe and explain the fundamental principles of physics, including those of: Relativity and Quantum Mechanics, Standard Model, Quantum fields and particles, Cosmology	X				X				X		X		X	X							X		X			
To use high-level mathematical skills to solve conceptual and quantitative problems in physics	X				X				X		X		X	X					X		X		X			
To describe critical experiments in the history of physics and explain how they led to revisions of our theoretical descriptions of nature	X				X				X		X		X	X							X		X			

<b>Rezultate așteptate ale învățării</b>	Complements of Theoretical Physics	Complements of Solid State Physics	Complements of Atom and Molecule Physics	Magnetic materials	Symmetries in physics	Complements of biophysics with applications	Ethics of the research. Methodology of scientific work	Crystal growth methods	Gravitation and cosmology	X-ray characterization of materials	Statistical methods for data analyzing	Transport phenomena	Quantum fields	Standard model	Microwaves and applications	Advanced methods in Optical Spectroscopy	Solar energy conversion	Rheological characterization of materials	Advanced methods in computational physics	Synthesis and characterization of nano/micromaterials	Fields in interaction	Defects in crystal	Stellar astrophysics	Specialization practice (projects, etc)	Scientific research internship	Practice for elaboration of dissertation
To analyse physical systems and provide order-of-magnitude estimates of quantities. This includes a knowledge of basic physical constants and key equations	X				X				X		X		X	X							X		X			
to use the computer to control some experiments or processes and to acquire data												X						X					X			
to characterize the specific properties of some materials taking into account the field in which they are used				X				X		X					X	X		X		X		X				
to use experimental techniques for obtaining and characterizing materials								X		X						X		X		X		X				
to identify the most appropriate methods to develop new materials with well-defined properties				X				X		X		X			X	X		X		X		X				
<b>Responsabilitate și autonomie</b>																										
assume responsibility for managing professional development							X																	X	X	X
participate in some concrete physics experiments		X	X	X				X		X					X	X			X					X	X	X
to present scientific seminars and to popularize some notions of physics							X																	X	X	X
to critically analyze a specialized report, scientific communication with a medium degree of difficulty in the field of physics				X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
to be autonomous in the context of handling laboratory equipment, including in situations requiring an interdisciplinary approach		X	X	X				X		X					X	X			X							
to autonomously use information sources and resources for communication and assisted professional training (Internet portals, specialized software applications, databases, online courses, etc.) both in Romanian and in a language of international circulation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
to carry out research internships in various production/research units in order to become familiar with and operate modern equipment, obtain interesting results and prepare reports on the activity carried out.																								X	X	X

**Corelarea rezultatelor așteptate ale învățării cu competențele-cheie, profesionale și transversale**

Rezultate așteptate ale învățării	Competențe-cheie				Competențe profesionale								Competențe transversale				
	Science, technology, engineering and mathematics skills	Digital skills	Personal, social and learning to learn skills	Multilingual skills	Competences in the field of obtaining materials	Competencies in the field of characterizing the specific properties of some materials	Competencies in the field of using computers and calculation programs for the numerical simulation of physical processes specific to obtaining materials	The acquisition of a coherent and functional system of fundamental knowledge in the field of materials science	Competencies to develop and refine existing theories using calculations	Study currently accepted theories in the field of theoretical physics	Skills to perform mathematical calculations in an attempt to prove abstract theories	Develop theories based on observations and calculations	Capacitatea de a filtra informații și de a stabili veridicitatea acestora	Capacitatea de învățare activă	Capacitatea de analiză, sinteză și de luare a deciziilor în mod responsabil	Etică și integritate complexe	Rezolvarea de probleme complexe
<b>Cunoștințe</b>																	
to know the advanced notions in the field of Physics, which involves a critical understanding of theories and principles	X		X	X	X	X		X	X	X		X		X			
to know the working formulas for calculations with physical quantities using properly the principles and laws of physics	X										X						
to know the language specific to the field	X		X	X				X	X				X				
to know physical phenomena and interpret them by formulating hypotheses and operationalizing key concepts and the appropriate use of laboratory equipment	X				X	X		X				X					
to know the constructive and operating principles of the equipment for obtaining and characterizing materials and to explain how to use it	X				X	X		X						X			X
<b>Abilități</b>																	
to compare the theoretical results provided by the specialized literature with those of an experiment carried out within a professional project						X				X			X	X	X		
to deduce the working formulas for calculations with physical quantities, using appropriately the principles and laws of physics	X							X	X								X
To describe physical systems using specific theories and tools (experimental and theoretical models, algorithms, schemes, etc.)	X	X						X									X
to apply the principles and laws of physics in solving theoretical or practical problems, under conditions of qualified assistance	X							X		X	X	X		X			X
to use the computer and calculation programs for the numerical simulation of the physical processes		X						X						X			X
To describe and explain the fundamental principles of physics, including those of: Relativity and Quantum Mechanics, Standard Model, Quantum fields and particles, Cosmology	X			X						X		X					
To use high-level mathematical skills to solve conceptual and quantitative problems in physics	X								X	X	X	X					X

Rezultate așteptate ale învățării	Competențe-cheie				Competențe profesionale								Competențe transversale				
	Science, technology, engineering and mathematics skills	Digital skills	Personal, social and learning to learn skills	Multilingual skills	Competences in the field of obtaining materials	Competencies in the field of characterizing the specific properties of some materials	Competencies in the field of using computers and calculation programs for the numerical simulation of physical processes specific to obtaining materials	The acquisition of a coherent and functional system of fundamental knowledge in the field of materials science	Competencies to develop and refine existing theories using calculations	Study currently accepted theories in the field of theoretical physics	Skills to perform mathematical calculations in an attempt to prove abstract theories	Develop theories based on observations and calculations	Capacitatea de a filtra informații și de a stabili veridicitatea acestora	Capacitatea de învățare activă	Capacitatea de analiză, sinteză și de luare a deciziilor în mod responsabil	Etică și integritate complexe	Rezolvarea de probleme complexe
To describe critical experiments in the history of physics and explain how they led to revisions of our theoretical descriptions of nature	X			X								X					
To analyse physical systems and provide order-of-magnitude estimates of quantities. This includes a knowledge of basic physical constants and key equations	X							X	X			X					
to use the computer to control some experiments or processes and to acquire data		X				X	X										
to characterize the specific properties of some materials taking into account the field in which they are used	X					X											X
to use experimental techniques for obtaining and characterizing materials	X				X	X		X					X				X
to identify the most appropriate methods to develop new materials with well-defined properties	X		X					X					X				
<b>Responsabilitate și autonomie</b>																	
assume responsibility for managing professional development													X		X	X	X
participate in some concrete physics experiments	X				X	X		X				X	X				X
to present scientific seminars and to popularize some notions of physics			X	X				X				X			X	X	
to critically analyze a specialized report, scientific communication with a medium degree of difficulty in the field of physics			X					X				X	X		X	X	
to be autonomous in the context of handling laboratory equipment, including in situations requiring an interdisciplinary approach								X			X		X			X	
to autonomously use information sources and resources for communication and assisted professional training (Internet portals, specialized software applications, databases, online courses, etc.) both in Romanian and in a language of international circulation			X					X							X	X	
to carry out research internships in various production/research units in order to become familiar with and operate modern equipment, obtain interesting results and prepare reports on the activity carried out.			X										X				X