Programul de studii: Physics

Domeniul de studii: Fizică/Physics
Ciclul de studii: Licenţă

Discipline opţionale:

DOB.101.P Real analysis / Analiză reală
DOB.102.P Linear algebra / Algebră liniară
DOB.103.P Classical Mechanics I / Mecanică fizică I
DOB.104.P Molecular physics and heat I / Fizica moleculară şi căldură I
DOB.105.P Foreign language I / Limbă străină I
DOP.106.1.P Computer Programming (C/C++) / Programarea calculatoarelor (C/C++)
DOP.106.2.P Physical Chemistry / Chimie fizică
DOP.107.1.P Etică şi integritate academica
DOP.107.2.P Authoring and scientific dissemination / Autorat şi diseminarea cunoaşterii ştiinţifice
DOB.111.P Equations of mathematical physics / Ecuaţiile fizicii matematice
DOB.112.P Differential equations and Complex analysis / Ecuaţii diferenţiale şi analiză complexă
DOB.113.P Classical mechanics II / Mecanică fizică II
DOB.114.P Molecular physics and heat II / Fizică moleculară şi căldură II
DOB.115.P Electricity and magnetism / Electricity and magnetism
DOB.116.P Processing of physical data and numerical methods / Procesarea datelor fizice şi metode numerice
DOB.117.P Foreign language II
DOB.119.P Sports I / Educaţie fizică I
DOB.120.P Sports II / Educaţie fizică II
DOB.201.P Optics / Optică
DOB.202.P Analytical mechanics / Mecanica analitică
DOB.203.P Electrodynamics and theory of relativity I / Electrodinamica şi teoria relativităţii I
DOB.204.P Fundamentals of atomic physics / Bazele fizicii atomice
DOB.205.P Foreign language II / Limbă străină II
DOP.206.1.P Simulation methods in Physics / Metode de simulare în fizică
DOP.206.2.P Systems theory / Teoria sistemelor
DOP.207.1.P Python programming for physicists
DOP.207.2.P Scientific computing techniques in C++
DOB.211.P Electrodynamics and theory of relativity II / Electrodinamica şi teoria relativităţii II
DOB.212.P Quantum mechanics I / Mecanică cuantică I
DOB.213.P Electronics / Electronică
DOB.214.P Nuclear physics / Fizică nucleară
DOB.215.P Thermodynamics and statistical physics / Termodinamică şi fizică statistică
DOB.216.P Traineeship / Practica de specialitate (3 săpt. x 30 ore)
DOP.217.1.P Virtual instrumentation and data acquisition / Instrumentaţie virtuală şi achiziţie de date
DOP.217.2.P Physical methods for non-destructive testing / Metode fizice de control nedistructiv
DOB.223.P Sports III / Educaţie fizică III
DOB.301.P Quantum Mechanics II / Mecanică cuantică II
DOB.302.P Molecular physics / Fizica moleculei
DOB.303.P Solid state physics / Fizica solidului
DOB.304.P Particle physics / Fizica particulelor elementare
DOB.305.P Spectroscopy and lasers / Spectroscopie şi laseri
DOP.306.1.P Methods and techniques of presenting the results in physics / Metode şi tehnici de prezentare a rezultatelor în fizică
DOP.306.2.P History of Physics / Istoria fizicii
DOB.310.P Research Activity (2 weeks x 30 hours) / Practica de specialitate
DOP.312.1.P Numerical methods in quantum mechanics / Metode numerice în mecanica cuantică
DOP.312.2.P Elements of quantum optics / Elemente de optică cuantică
DOP.313.1.P Detectors dosimetry and radiation protection / Detectori, dozimetrie şi radioprotecţie

DOP.313.2.P Radiation sources. Natural and induced radioactivity / Surse de radiaţii. Radioactivitate naturală şi indusă

DOP.314.1.P Introduction to polymers physics / Introducere în fizica polimerilor

DOP.314.2.P Introduction to environmental physics / Introducere în fizica mediului

DOP.315.1.P Semiconductor physics / Fizica semiconductorilor

DOP.315.2.P Special topics in solid state physics / Capitole speciale de fizica solidului

DOP.316.1.P Electronic devices and circuits / Dispozitive şi circuite electronice

DOP.316.2.P Introduction to nanotechnologies / Introducere în nanotehnologii

Syllabus

Academic year 2026/2027
DOB.101.P Real analysis / Analiză reală

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Real analysis / Analiză reală				
2.2. Teacher			Prof. dr. Claudia Timofte				
2.3. Tutorials/Practicals instructor(s)			Prof. dr. Claudia Timofte				
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	6	3.2. Lectures	3	3.3. Tutorials/Practicals/Projects	3/0/0
3.4. Total hours per semester	84	3.5. Lectures	42	3.6. Tutorials/Practicals/Projects	42/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					33
Research in library, study of electronic resources, field research					17
Preparation for practicals/tutorials/projects/reports/homework					16
Tutorat					0
Other activities					0
3.7. Total hours of individual study					66
3.8. Total hours per semester					150
3.9. ECTS					6

4. Prerequisites (if necessary)

4.1. curriculum	High school mathematics courses: Algebra, Mathematical Analysis.
4.2. competences	Basic knowledge of using Microsoft 365 (Word, Excel, PowerPoint, Teams platform).

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia room (with video projector). Smart board. Lecture notes. Recommended bibliography.
5.2. for tutorials/practicals	Video projector. Computers. Smart board.

6. Learning outcomes

Knowledge	R11. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented.
Skills	R11. The student/graduate provides examples of the application of basic theoretical concepts and results to solve exercises and problems related to the topics covered in the curriculum subjects.
Responsibility and autonomy	R11. The student/graduate uses logical thinking, analyzes problem statements, and selects the specific method for solving problems from the topics covered in the curriculum subjects.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Metric spaces. Normed spaces. Spaces with scalar product. Real Euclidean spaces.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	2 Hours

Convergent and fundamental sequences. Complete spaces. Series in normed spaces. Number series. Convergence tests.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	3 Hours
Limits of functions. Continuous functions. Continuous functions on compact sets. Uniform continuity. Connected sets.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	3 Hours
Differentiable functions. Partial derivatives. Jacobi matrix. Differential operators: gradient, divergence, curl. Applications in Physics.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	6 Hours
Higher order differentials. Taylor's formula. Local extrema. Implicit functions and systems of implicit functions.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	4 Hours
Sequences and series of functions. Pointwise and uniform convergence. Power series. Taylor series. Fourier series. Applications.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	6 Hours
Integrable functions. Improper integrals. Parameter-dependent integrals. Improper integrals depending on parameters. Euler's functions.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	3 Hours
Line integrals. Paths. Line integrals of the first kind. Integration of differential forms of degree one.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	3 Hours
Multiple integrals. Change of variables in multiple integrals. Improper multiple integrals. Applications.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	4 Hours
Area of a smooth surface. Surface integrals. Oriented surfaces. Flux of a field through a surface.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	4 Hours
Integral formulas: Green-Riemann, Gauss-Ostrogradski, Stokes. Mechanical work. Path-independence of line integrals. Applications in Physics.	Systematic exposition. Interactive lecture. Critical analysis. Examplification. Use of digital resources.	4 Hours

References:

1. G. Arfken, H. Weber, "Mathematical Methods for Physicists", Elsevier Academic Press, 2005.
2. P. Bamberg, S. Sternberg, "A Course in Mathematics for Students of Physics", Cambridge University Press, 1990.
3. N. Cotfas, L. Cotfas, "Elements of Mathematical Analysis" (in Romanian), Editura Universităţii din Bucureşti, 2010.
4. R. Courant, "Differential and Integral Calculus", Wiley, New York, 1992.
5. A. Halanay, V. Olariu, S. Turbatu, "Mathematical Analysis" (in Romanian), Editura Didactică şi Pedagogică, 1983.
6. E. Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2011.
7. K. F. Riley, M. P. Hobson, S. J. Bence, "Mathematical Methods for Physics and Engineering", 3rd edition, Cambridge University Press, Cambridge, 2006.
8. W. Rudin, "Principles of Mathematical Analysis", McGraw-Hill, New York, 1964.
9. G. B. Thomas, M. D. Weir, J. Hass, "Thomas' Calculus", 13th edition, Pearson, 2014.
10. C. Timofte, "Differential Calculus", Editura Universităţii din Bucureşti, 2009.
11. C. Timofte, Lecture notes (pdf).

7.2 Tutorials	**Teaching techniques**	**Observations**

The seminar follows the course content. The issues to be discussed are meant to provide the student with a deep understanding of the theoretical concepts presented during the lectures, to develop computing skills and the appropriate use of the basic concepts of Real Analysis.	Exposition. The exercise. Problematization. Guided work. Team work. Solving individual tasks. Use of digital resources.	42 Hours

References:

1. L. Aramă, T. Morozan, "Problems of Differential and Integral Calculus" (in Romanian), Editura Tehnică, Bucureşti, 1978.
2. F. Ayres Jr., E. Mendelson, "Schaum's Outline of Calculus", 4th edition (Schaum's Outline Series), McGraw-Hill, New York, 1999.
3. Gh. Bucur, E. Câmpu, S. Găină, "Problems of Differential and Integral Calculus" (in Romanian), vol. I - III, Editura Tehnică, Bucureşti, 1978.
4. B. Demidovich, "Problems in Mathematical Analysis", Mir Publishers, Moscow, 1977.
5. N. Donciu, D. Flondor, "Mathematical Analysis. Problems" (in Romanian), Editura ALL, 1998.
6. D. Flondor, O. Stănăşilă, "Lessons of Mathematical Analysis and Solved Exercises" (in Romanian), Editura ALL, 1996.
7. Gh. Procopiuc, M. Ispas, "Problems of Mathematical Analysis" (in Romanian), Iaşi, 2002.
8. C. Timofte, "Real Analysis. Problems", Seminar notes (pdf).

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical and practical competences and abilities, which are important for an undergraduate student in the field of modern Physics, corresponding to national and international standards. The contents and the teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or from the European Union. The contents are in line with the requirements of the main employers of the graduates (industry, research, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	1. Clarity, coherence, and conciseness of the exam presentation. 2. Knowledge and understanding of the fundamental concepts of Real Analysis. 3. Correct use of mathematical methods and techniques. 4. The ability to demonstrate/justify theoretical results and to analyze specific examples.	Written and oral examination.	80%
Tutorial	1. The ability to apply specific results obtained in this course to solve given problems. 2. The ability to solve practical problems specific to the course and to correctly interpret, analyze, and present the obtained results.	Homework assignments (oral assessment), class engagement.	20%
Minimal requirements for passing the exam	Adequate knowledge and application of the fundamental notions of Real Analysis: convergence, series, limit, continuity, derivability, and integrability for real functions of several variables. Requirements for getting mark 5 (10 points scale) 1. Attendance of at least 50% of the lecture hours and at least 75% of the tutorial ones. 2. Fulfillment of at least 50% of each of the criteria that determine the final grade. Requirements for getting mark 10 (10 points scale) 1. Correct answer to all the subjects indicated for obtaining grade 10. 2. Skills, well-argued knowledge. 3. Demonstrated ability to analyze phenomena and processes. 4. Personal approach and interpretation.		

Date, 8.09.2026	Teacher's name and signature, Prof. dr. Claudia Timofte	Practicals/Tutorials/Project instructor(s), name and signature Prof. dr. Claudia Timofte
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.102.P Linear algebra / Algebră liniară

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Linear algebra / Algebră liniară				
2.2. Teacher			Conf. dr. Radu Slobodeanu				
2.3. Tutorials/Practicals instructor(s)			Conf. dr. Radu Slobodeanu				
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	6	3.2. Lectures	3	3.3. Tutorials/Practicals/Projects	3/0/0
3.4. Total hours per semester	84	3.5. Lectures	42	3.6. Tutorials/Practicals/Projects	42/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					30
Research in library, study of electronic resources, field research					16
Preparation for practicals/tutorials/projects/reports/homework					20
Tutorat					0
Other activities					0
3.7. Total hours of individual study					66
3.8. Total hours per semester					150
3.9. ECTS					6

4. Prerequisites (if necessary)

4.1. curriculum	High school mathematics
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom with blackboard, video projector, smartboard.
5.2. for tutorials/practicals	Classroom with blackboard, video projector, smartboard. Mathematica software.

6. Learning outcomes

Knowledge	R11. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented.
Skills	R11. The student/graduate provides examples of the application of basic theoretical concepts and results to solve exercises and problems related to the topics covered in the curriculum subjects.
Responsibility and autonomy	R11. The student/graduate uses logical thinking, analyzes problem statements, and selects the specific method for solving problems from the topics covered in the curriculum subjects.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
VECTOR SPACES. Linear independence. Subspaces. The span of a set of vectors. Basis and dimension of a vector space.	Systematic exposition. Interactive lecture. Critical analysis. Examplification.	6 Hours
The change of basis matrix. The change of coordinates of a vector at the change of basis. Sums and intersections of subspaces. Direct sums of subspaces. Complements of a subspace. Factor spaces. Lines, planes, hyperplanes.	Systematic exposition. Interactive lecture. Critical analysis. Examplification.	6 Hours

MATRICES. Linear maps (linear transformations). The image (range) and the kernel of a linear map. Isomorphism of vector spaces. The matrix associated to a linear map with respect to a pair of bases. Operations with matrices. The change of associated matrix at the change of bases. The algebra of matrices.	Systematic exposition. Interactive lecture. Critical analysis. Examplification.	6 Hours
LINEAR SYSTEMS. Gauss-Jordan elimination for finding the rank or the inverse of a matrix. Determinants. Solving linear systems.	Systematic exposition. Interactive lecture. Critical analysis. Examplification.	3 Hours
EUCLIDEAN SPACES. Inner product. Orthogonality. Orthogonal bases, orthonormal bases. The Gram-Schmidt orthogonalization method. The orthogonal complement of a subspace. Description of quantum system through finite dimensional Hilbert spaces	Systematic exposition. Interactive lecture. Critical analysis. Examplification.	3 Hours
COMPLEMENTS OF VECTOR CALCULUS. Cross product. Mixed product. Applications to physics. TENSOR PRODUCT. Linear forms and bilinear forms . The dual space. The bidual space. The dual basis and the canonical isomorphism. Multilinear maps and multilinear forms. Tensors. Operations with tensors. The change of coordinates of a tensor at a change of basis.	Systematic exposition. Interactive lecture. Critical analysis. Examplification.	6 Hours
MATRIX STRUCTURE. Eigenvalues and eigenvectors. The characteristic polynomial. Invariant subspaces. The structure of linear operators. Diagonalisation. The adjoint of a linear operator. Self-adjoint operators. Orthogonal and unitary operators.	Systematic exposition. Interactive lecture. Critical analysis. Examplification.	6 Hours
QUADRATIC FORMS. The Law of Inertia. The reduced (diagonal) form of a quadratic form.	Systematic exposition. Interactive lecture. Critical analysis. Examplification.	3 Hours
APPLICATIONS IN GEOMETRY. Affine spaces and transformations. Affine subspaces. Affine frames. Conics and quadrics. The reduced canonical equation. The classification of conics and quadrics.	Systematic exposition. Interactive lecture. Critical analysis. Examplification.	3 Hours

References:

N. Cotfas, Elemente de algebră liniară , Ed. Univ. Bucureşti, 2015.
M. I. Dillon, Linear algebra: vector spaces and linear transformations, Pure and applied undergraduate texts, AMS, 2023.
R. Freud, Linear algebra: a problem-centered approach, Pure and applied undergraduate texts, AMS, 2024
A. Givental, Linear Algebra and Differential Equations, Berkeley Mathematics Lecture Notes, vol. 11, AMS, 2001.
A. I. Kostrikin, Yu. I. Manin, Linear Algebra and Geometry, Gordon and Breach Science Publishers, 1989.
S. Lang, Linear Algebra, Springer, 2007.
E. B. Vinberg, A Course in Algebra, Graduate studies in Mathematics, vol. 56, AMS, 2003.

7.2 Tutorials	**Teaching techniques**	**Observations**
The seminar follows the course content. The issues to be discussed are meant to provide the student with a deep understanding of the theoretical concepts presented during the course, to develop computing skills and the appropriate use of the basic concepts presented during the course.	Exercises and problem solving. Guided work	42 Hours

References:

G. Arfken, H. Weber, F.E. Harris, Mathematical Methods for Physicists, 7th edition, Elsevier 2011.
D. Blideanu, I. Popescu, D. Ștefănescu, Probleme de algebră liniară, Ed. Univ. Bucureşti, 1986.
R. Freud, Linear algebra: a problem-centered approach, Pure and applied undergraduate texts, AMS, 2024.
S. Lipschutz, Lipson, M. Linear algebra, Schaum's outline, McGraw-Hill Education, 2018.
P.J. Olver, C. Shakiban, Applied Linear Algebra, 2nd edition, Springer 2018.
D. Ștefănescu, Modele matematice in fizică, Ed. Univ. Bucureşti 1984.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	1. Clarity, coherence, and conciseness of the exam presentation. 2. Knowledge and understanding of the fundamental concepts of Linear Algebra. 3. Correct use of mathematical methods and techniques. 4. The ability to demonstrate/justify theoretical results and to analyze specific examples.	Written and oral examination.	80%
Tutorial	1. The ability to apply specific results obtained in this course to solve given problems. 2. The ability to solve practical problems specific to the course and to correctly interpret, analyze, and present the obtained results.	Homework assignments (oral examination) Active classroom participation.	20%
Minimal requirements for passing the exam	Students must attend at least 50% of the lecture hours and at least 75% of the tutorial ones. Requirements for getting mark 5 (10 points scale): - Fulfillment of at least 50% of each of the criteria that determine the final grade. Requirements for getting mark 10 (10 points scale): - Correct answer to all the subjects indicated for obtaining grade 10 - Skills, well-argued knowledge - Demonstrated ability to analyze phenomena and processes - Personal approach and interpretation.		

Date, 8.09.2026	Teacher's name and signature, Conf. dr. Radu Slobodeanu	Practicals/Tutorials/Project instructor(s), name and signature Conf. dr. Radu Slobodeanu
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.103.P Classical Mechanics I / Mecanică fizică I

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Classical Mechanics I / Mecanică fizică I				
2.2. Teacher			Conf. Dr. Cătălin Berlic				
2.3. Tutorials/Practicals instructor(s)			Conf. Dr. Adriana Bălan, Prof. Dr. Valentin Barna				
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					35
Research in library, study of electronic resources, field research					17
Preparation for practicals/tutorials/projects/reports/homework					17
Tutorat					0
Other activities					0
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Not applicable
4.2. competences	The student demonstrates a good level of understanding of algebraic calculations, geometry, trigonometry, and elementary mathematical analysis.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room equipped with multimedia facilities (computer, video projector, and projection screen).
5.2. for tutorials/practicals	Laboratory equipped with the necessary facilities for conducting practical work. Computers, video projector, software packages for data analysis and processing.

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R9. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress.

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards. R9. The student/graduate deduces working formulas for calculations involving physical quantities , appropriately applying fundamental principles and laws.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python). R9. The student/graduate demonstrates autonomy in operating, maintaining, and repairing laboratory equipment (e.g., sensor calibration, instrument adjustment), adhering to safety and quality standards.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
1. Introduction. The place of mechanics among the classical branches of physics. Fundamental concepts: space, time, mass. Measurements and units. Dimensional analysis.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	1 Hour
2. Scalar and vector quantities. Addition and subtraction of vectors. Dot product, cross product, triple scalar product. Unit vectors. 3. Coordinate systems in the plane and in space. Cartesian coordinates. Unit vectors of the coordinate axes. Polar coordinates. Spherical coordinates. Cylindrical coordinates.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	1 Hour
4. Kinematics of a mass point. The concept of trajectory. Equation of motion. Velocity. Acceleration. Radius of curvature of the trajectory. Normal and tangential acceleration.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	1 Hour

5. Types of motion of a mass point. Curvilinear motion. Motion with constant acceleration vector. Uniform rectilinear motion. Uniformly accelerated rectilinear motion. Oblique projectile motion in a vacuum. Circular motion. Helical motion.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	1 Hour
6. Principles of mechanics. Statements and discussion. Definition of linear momentum. Inertial and non-inertial reference frames. Galilean transformations.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	2 Hours
7. Motion of a mass point under the influence of different types of forces. Constant force. Time-dependent force. Velocity-dependent force. Air resistance. Position-dependent force. Applications.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	4 Hours
8. Dynamics of the mass point. Theorem of the variation of the linear momentum of the mass point. Torque. Angular momentum. Theorem of the variation of the angular momentum of the mass point. Work. Power. Kinetic energy. Theorem of the variation of the kinetic energy of the mass point. Potential energy. Conservative forces. Total energy. Conservation of the energy. Friction and friction forces.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	4 Hours
9. Dynamics of a system of mass points. Definition of a system of mass points. Internal and external forces. Theorem of the variation of the linear momentum of a system of particles. Theorem of the variation of the angular momentum of a system of particles. Kinetic energy variation theorem for a system of mass points. Energy conservation for a system of particles.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	4 Hours
10. Center of mass of a system of particles. Motion in the center of mass reference frame and in the laboratory reference frame. Decomposition theorems.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	2 Hours
11. Collisions. Inelastic collision. Elastic collision. Collision with a wall. Coefficients of restitution. Rocket propulsion.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	2 Hours
12. Kinematics of the rigid body. The rigid body model. Translation and rotation. Composition of the positions, velocities, and accelerations of a rigid body. Poisson's formulas. Euler's formulas. Planar parallel motion.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	2 Hours
13. Dynamics of the rigid body. Rotational kinetic energy. Work. Power. Rotational angular momentum. Moment of inertia about an axis. Principal axes of inertia. Steiner's theorem (parallel axis theorem). Calculation of moments of inertia. Applications.	Systematic exposition– lecture, demonstration, discussion, case study. Examples.	4 Hours

References:

1. A. Hristev, Mecanică şi acustică, Editura Didactică şi Pedagogică, Bucureşti, 1984.
2. V. Dima, Mecanică medicală, Editura Universităţii din Bucureşti, 1999
3. D. Kleppner, R. Kolenkow, An Introduction to Mechanics, 2nd edition, Cambridge University Press, 2013
4. C. Kittel, W.D.Knight, M.A. Ruderman, Cursul de Fizică Berkeley, Volumul I, Mecanică, Editura Didactică şi Pedagogică, Bucureşti, 1981.
5. A.P. French, Newtonian Mechanics (M.I.T. Introductory Physics), 1st. Edition, W. W. Norton and Company, 1971.
6. D. Halliday, R. Resnik, J. Walker, Fundamentals of Physics, Extended: Extended 11-th Edition, Wiley 2018

7.3 Practicals	**Teaching techniques**	**Observations**
Presentation of the mechanics laboratory. Safety training. Use of measuring instruments.	Exposition, discussion, case study. Examples.	2 Hours
Dimensional analysis. Errors and error calculation. Presentation of physical measurement data: tables and graphs. Use of specialized software.	Exposition, discussion, case study. Examples.	2 Hours
The simple pendulum. Determination of gravitational acceleration.	Guided practical activity	2 Hours
Physical pendulum	Guided practical activity	2 Hours
Steiner theorem	Guided practical activity	2 Hours
Parallel axis theorem	Guided practical activity	2 Hours
Maxwell pendulum	Guided practical activity	2 Hours
Dynamic study of torsion	Guided practical activity	4 Hours
Mach pendulum	Guided practical activity	2 Hours
Determination of the elastic constant of a spring	Guided practical activity	2 Hours
Free fall	Guided practical activity	2 Hours
Advanced data analysis: curve fitting. Completion of missed laboratory works.	Discussion. Examples. Guided practical activity	2 Hours
Finalization of experimental data processing. Presentation of laboratory reports.	Discussion. Examples. Guided practical activity	2 Hours

References:

1. C. Ciucu, Cristina Miron, V. Barna, Lucrări practice. Mecanică Fizică şi Acustică (I), Ed. Universităţii din Bucureşti, Bucureşti, 2009.
2. E. Barna, C. Ciucu, Cristina Miron, V. Barna, C. Berlic, Lucrări practice. Mecanică Fizică şi Acustică (II), Ed. Universităţii din Bucureşti, Bucureşti, 2010.
3. Experiments in Mechanics, Wave Motion, and Heat Laboratory Manual for PHYS: 1511, PHYS: 1701, AND PHYS: 1611, University of Iova, 2024

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms/develops some theoretical and/or practical competences and abilities which are fundamental for an undergraduate student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	- Knowledge of the fundamental concepts of Mechanics; - Accurate understanding of the topics covered in the course; - Demonstration of theoretical concepts using correct computational relationships; - Clarity, coherence, and conciseness of the presentation; - Correct use of the studied physical models, formulas, and computational relationships; - Ability to provide relevant examples; - Ability to apply acquired knowledge to solve mechanics problems.	1. Midterm written exam on theoretical knowledge 35% 2. Final assessment. Written and oral exam on theoretical knowledge 35% For online evaluation, the exam topics will be sent electronically via email, Google Classroom, or Microsoft Teams. During the exam, students must keep their video cameras on, and the session will be recorded.	70%
Practical	- Knowledge of specific experimental techniques and laboratory infrastructure; - Application of specific problem-solving methods for a given task; - Interpretation of results.	1. Midterm written exam on theoretical knowledge 15% 2. Final written exam on theoretical knowledge 15%	30%
Minimal requirements for passing the exam	Requirements for Obtaining a Grade of 5 - Mandatory attendance at all practical activities (seminars and laboratory sessions) and at least 50% of the lectures. Completion of all laboratory experiments and presentation of the results in the form of scientific reports. - Obtaining a minimum grade of 5 in the laboratory assessment. - Correctly solving the examination questions designated as sufficient to obtain a grade of 5 in the final examination. Requirements for Obtaining a Grade of 10 - Demonstration of thoroughly substantiated knowledge and well-developed practical skills. - Demonstrated ability to analyse physical phenomena and processes, and correctly solve all examination questions.		

Date, 25.09.2026	Teacher's name and signature, Conf. Dr. Cătălin Berlic	Practicals/Tutorials/Project instructor(s), name and signature Conf. Dr. Adriana Bălan, Prof. Dr. Valentin Barna
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOB.104.P Molecular physics and heat I / Fizica moleculară şi căldură I

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Molecular physics and heat I / Fizica moleculară şi căldură I				
2.2. Teacher			Conf.Dr. Anca Dumitru				
2.3. Tutorials/Practicals instructor(s)			Conf. Dr. Anca Dumitru				
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					35
Research in library, study of electronic resources, field research					17
Preparation for practicals/tutorials/projects/reports/homework					17
Tutorat					0
Other activities					0
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia devices
5.2. for tutorials/practicals	Set of practical work illustrating the topics covered in the course; Consumables; Computers and software for data analysis

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods).

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Introduction: Macroscopic description of system. Fundamental concepts. Thermodynamic system. Surroundings, State variables, Boundaries. Classification of the thermodynamics systems. State variable. Classification of state variable. Use of partial derivate in thermodynamics.	Systematic exposition - lecture. Conversation. Examples	2 Hours
Thermal equilibrium and temperature. General law of thermodynamics. The zero law of thermodynamics. Temperature measurement. Temperature scales. Temperature measurement devices. Pressure. Pressure measurement. Dalton Law of partial pressure.	Systematic exposition - lecture. Conversation. Examples	4 Hours
Ideal gas laws. Thermal Equations of state. Thermal coefficients. General laws of thermal expansion. Applications of thermal coefficients. Cyclical relation. The relation between thermal coefficients. Equivalence between equation of state and the thermal coefficients for ideal gas.	Systematic exposition - lecture. Conversation. Examples	4 Hours
State and transfer variables. Reversible and irreversible processes. Heat. Mechanical work. Sign Conventions. The first law of thermodynamics (primary formulation and general statement). Caloric coefficients. Applications of the first law in the basic processes: adiabatic, isothermal, isochoric, isobaric and polytropic. Enthalpy. Phase changes. Latent Heat. Newton law of cooling. Caloric equation of state. Free expansion-Joule Experiment. Joule-Thomson Experiment.	Systematic exposition - lecture. Conversation. Examples	2 Hours
Primary statement of the second law of thermodynamics; Heat engine: monothermal and bithermal heat engine; Carnot Theorem; Absolute thermodynamics temperature; Clausius equality, Efficiency of the heat engine; Clausius' integral for reversible processes; Entropy and the general statement of the second law for reversible processes.	Systematic exposition - lecture. Conversation. Examples	4 Hours

Entropy in reversible processes. Clausius inequality. Clausius' integral for irreversible processes. The general statement of the second law for irreversible processes. The general statement of the second law of thermodynamics. Entropy and irreversibility. The principle of maximal entropy. Properties of the entropy. Equivalent statements of the second law.	Systematic exposition - lecture. Conversation. Examples	4 Hours
Partial derivate and Maxwell relations. Fundamental equation of thermodynamics. Differential relationships between state functions and state parameters: a) T,V independent variable; b) P,T independent variable and c) P,V independent variable. TdS equations.	Systematic exposition - lecture. Conversation. Examples	2 Hours
Heat engines: Stirling, Otto, Diesel and Brayton. Refrigerators. Heat pumps. Examples.	Systematic exposition - lecture. Conversation. Examples	2 Hours
Thermodynamic potentials	Systematic exposition - lecture. Conversation. Examples	2 Hours
Review of the concepts and notions introduced in the Molecular Physics I.	Systematic exposition - lecture. Conversation. Examples	2 Hours

References:

1. V. Filip, Introductory Thermal Physics, Ed. Univ. Buc., 2006.
2. Vlad Popa-Nita, Molecular physics(second part- Thermodynamics), Ed. Univ. Buc. (1994).M. W.
3. S.Stefan, Fizica Moleculara, Ed. Univ. Bucuresti, 2006
4. C.N. Plavitu, Fizica Fenomenelor Termice, Partea I, Ed. Hyperion, 1992
5. S. Turns, Thermodynamics. Concepts and Applications. Ed. Cambridge University Press, 2006
6. W. Greiner, L. Neise, H. Stocker, Thermodynamics and Statistical Mechanics, Ed. Springer, 2006
7. S. Stefan si V. Filip, Fizica Fenomenelor Termice. Culegere de Probleme, Ed. Univ. Buc., 2002.

7.3 Practicals	Teaching techniques	Observations
Presentation of the practical work. Training for laboratory work and safety	Systematic exposition - lecture. Conversation. Examples	2 Hours
Introduction to experimental errors. Representation and analysis of experimental data.	Systematic exposition - lecture. Conversation. Examples	4 Hours
Representation and analysis of experimental data. Graphical methods for analyzing experimental data	Systematic exposition - lecture. Conversation. Examples	4 Hours
Fortin barometer	Guided practical activity	2 Hours
Determination of specific heat of a solid body by calorimetric method.	Guided practical activity	2 Hours
Verifying the Dalton' law of partial pressure.	Guided practical activity	2 Hours
Determination of specific heat of a liquid by Hirn calorimeter.	Guided practical activity	2 Hours
Latent heat of crystallization.	Guided practical activity	2 Hours
Mechanical equivalent of heat	Guided practical activity	2 Hours
Thermal equation of state for ideal gases	Guided practical activity	2 Hours
Heat capacities of gases (isobaric and isochoric molar heat capacities)	Guided practical activity	2 Hours
Joule-Thomson process	Guided practical activity	2 Hours

References:

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of knowledge and theminology used in thermal physics - ability to indicate/analyse specific examples - correct use of equations/mathematical methods/physical models and theories	1. Partial examination. Written test examination of theoretical competences. (30%) 2. Final examination. Written and oral test examinations of theoretical competences (40%)	70%
Practical	- ability to use specific experimental methods/apparatus - ability to analyse and interpret the characterization data - ability to present and discuss the results	Examination of Lab reports	30%
Minimal requirements for passing the exam	Correct exposition of a theoretical subject. A minimum grade of 5 must be obtained in each component of the evaluation. Attendance: at least 50% of the course hours and mandatory attendance at all lab sessions. At least 50% achievement in each of the criteria that determine the final grade.		

Date, 25.09.2026	Teacher's name and signature, Conf.Dr. Anca Dumitru	Practicals/Tutorials/Project instructor(s), name and signature Conf. Dr. Anca Dumitru
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOB.105.P Foreign language I / Limbă străină I

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	
1.3. Department	Department of Modern Languages
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Foreign language I / Limbă străină I				
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Monica Oanca				
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	1/0/0
3.4. Total hours per semester	14	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	14/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					18
Research in library, study of electronic resources, field research					9
Preparation for practicals/tutorials/projects/reports/homework					9
Tutorat					0
Other activities					0
3.7. Total hours of individual study					36
3.8. Total hours per semester					50
3.9. ECTS					2

4. Prerequisites (if necessary)

4.1. curriculum	Basic English language skills - A2 level
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	Whiteboard and video projector

6. Learning outcomes

Knowledge	R16. The student/graduate acquires civic competences, especially knowledge of social and political concepts and structures for active and democratic participation of people
Skills	R16. The student/graduate develops communication skills in the mother tongue and/or an international language
Responsibility and autonomy	R16. Spirit of initiative and entrepreneurship – the ability to turn ideas into action

7. Contents

7.2 Tutorials	**Teaching techniques**	**Observations**

Motivation to become a physicist	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The concept of error	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The rhythm of our life	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The Present Tenses	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Education	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The Past Tenses	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour

Finding the perfect job	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Distance and displacement	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Speed and velocity	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Kinematic equations	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Passive voice	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Causative	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Contrasting ideas	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour

Student project presentations	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour

References:

1. McCarthy Michael, Felicity O' Dell, English Vocabulary in Use, (Upper Intermediate and Advanced), Cambridge University Press, 2002, 2005.
2. McCarthy Michael, Felicity O' Dell, Test your English V

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The seminars follow the format of foreign language seminars within the University of Bucharest and are in accordance with international standards regarding the level of language competences.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Tutorial	Knowledge, understanding, and correct use of the grammar and vocabulary concepts discussed during the seminars	• Assessment through written tests (40%) • Assessment through oral tests (40%) • Portfolio (20%)	100%
Minimal requirements for passing the exam	To obtain a grade of 5 (Passing grade): • Correct acquisition of minimal English language knowledge, B1 level • Correct use of the main grammar concepts • Correct use of specialized terminology • Completion of all homework assignments posted on Google Classroom To obtain a grade of 10 (Highest grade): • Correct resolution of all exam questions/topics • Solid reasoning to substantiate the acquired knowledge		

Date,

8.09.2026

Practicals/Tutorials/Project instructor(s), name and signature

Lect. dr. Monica Oanca

Date of approval

17.09.2026

Head of department name and signature

Syllabus

Academic year 2026/2027
DOP.106.1.P Computer Programming (C/C++) / Programarea calculatoarelor (C/C++)

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Computer Programming (C/C++) / Programarea calculatoarelor (C/C++)				
2.2. Teacher			Lect. Dr. Marius CĂLIN				
2.3. Tutorials/Practicals instructor(s)			Asist. Dr. Leonard GEBAC				
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					22
Research in library, study of electronic resources, field research					11
Preparation for practicals/tutorials/projects/reports/homework					11
Tutorat					0
Other activities					0
3.7. Total hours of individual study					44
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	High school mathematics, fundamental algorithms

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	lecture room with video projector
5.2. for tutorials/practicals	Computer room

6. Learning outcomes

Knowledge	R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R8. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R12. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R14. The student/graduate knows the basic vocabulary and specialized terminology in a foreign language in the field of physics, the structure of scientific texts and international academic communication formats.

Skills	R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R8. The student/graduate compares theoretical results from specialized literature (e.g., textbooks, indexed articles) with experimental ones, integrating the data into a professional report or project. R12. The student/graduate develops personal, interpersonal, and intercultural competencies through involvement in activities that promote self-awareness, empathy, effective communication, respect for diversity, and collaboration with individuals from different cultural backgrounds to achieve objectives. R14. The student/graduate is able to read, understand and translate specialized texts, extract relevant information from international scientific sources and communicate orally and in writing in an autonomous and professional manner.
Responsibility and autonomy	R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R8. The student/graduate critically analyzes a specialized paper or scientific communication of medium difficulty (e.g., peer-reviewed article, scientific report), assuming the conclusions and recommendations. R12. The student/graduate becomes aware of responsibly assuming risks by taking initiatives, making decisions in uncertain situations, and managing consequences in an ethical and constructive manner. R14. The student/graduate uses information sources responsibly, respecting the norms of academic ethics and demonstrating initiative in learning the scientific language of the specialty.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
- Hardware. Computer architecture. Binary system.- Software. Operation systems and programming languages. Short history. - Correlation between the scientific coding language and the solving problem type: model calculations, simulation, data acquisition and processing. Examples of complex codes. - Scientific languages mostly used in physics: evolution, general characteristics, distinctive features	Systematic exposition - lecture. Examples	2 Hours
- Programming stages: problem solving, developing algorithm, implementation, compilation, execution. - Structure of a C++ program - Preprocessor directives, headers, libraries - Input/output	Systematic exposition - lecture. Examples	2 Hours
- Variable types. Constants. - Operators: arithmetic, relational and comparison, logical, assignment, conditional, sizeof, dot (.), arrow (- >), increment and decrement, etc.	Systematic exposition - lecture. Examples	2 Hours

- Control structures * selection statements:: if – else, switch * iteration statements (loops): while, do – while, for jump statements: continue, break, goto, etc. - Functions: types, declaring, prototypes, calling	Systematic exposition - lecture. Examples	4 Hours
- Arrays: initializing, accessing the values using references and pointers - Reference and dereference operators - Strings, operations with strings	Systematic exposition - lecture. Examples	2 Hours
- Pointers: declaring pointers, operations, comparison - Ponters and references	Systematic exposition - lecture. Examples	4 Hours
- Dynamic memory: operators new, delete - Data structures	Systematic exposition - lecture. Examples	2 Hours
- Classes: definition, objects, constructors, deconstructors, initialization, access to members, copy and move constructors	Systematic exposition - lecture. Examples	4 Hours
- Object Oriented Programming (OOP). Characteristics: encapsulation, inheritance, polymorphism	Systematic exposition - lecture. Examples	4 Hours
- Analysis of complex codes written in C++: Root, GEANT4	Systematic exposition - lecture. Examples	2 Hours

References:

1. Bjarne Stroustrup – Principles and Practice Using C++ - Addison – Wesley Publishing Company, 2009
2 Bjarne Stroustrup – The Design and Evolution of C++, - Addison – Wesley Publishing Company, 1994
3. R. Andonie, I. Gârbacea – Algoritmi fundamentali, o perspectivă C++ - Editura Libris, Cluj –Napoca, 1995
4. M. Hjorth-Jensen – Computational Physics, Universitatea din Oslo, note de curs, 2012
5. https://isocpp.org
6. www.cplusplus.com
7. www.learncpp.com
8. http://www.stroustrup.com

7.3 Practicals	**Teaching techniques**	**Observations**
Basic statements in C and C++. Applying the sequence Edit-Compile- Link-Run for C++ codes in operation system Linux	Guided practical activity	2 Hours
Developing codes including different types of variables, operators, control structures, preprocessor directives, functions	Guided practical activity	4 Hours
Developing codes including arrays, strings, pointers	Guided practical activity	4 Hours
Developing codes which use dynamic memory and data structures,classes	Guided practical activity	4 Hours
Developing codes emphasizing the advanteges of OOP	Guided practical activity	4 Hours
Random number generation and applications	Guided practical activity	2 Hours
Plotting with GnuPlot. Input/output from files	Guided practical activity	2 Hours
Performance analysis and optimization	Guided practical activity	4 Hours
The structure of complex codes. Comparison between C++ and the other languages	Guided practical activity	2 Hours

References:
1. Bjarne Stroustrup, Programming, Principles and Practice Using C++, Addison-Wesley Publishing, 2008
2. Bjarne Stroustrup, The Design and Evolution of C++, Addison-Wesley Publishing Company, 1994
3. https://isocpp.org

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops practical competences and abilities which are fundamental for an undergraduate student in the
field of modern Physics, corresponding to national and European/international standards.
The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the
syllabus of other universities from Romania or the European Union.
The content

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- knowledge, understanding, coherence, logic and clarity of exposition	Written test	40%
Practical	- ability to model a problem, create an algorithm, implement it into a functional code	Functional computer code	60%
Minimal requirements for passing the exam	Participation to all practical activities and at least 7 lectures - Solving 25% of the written test. - Developing and presenting a code with a low degree of complexity but fully functional. Requirements for getting mark 10 (10 points scale) • Correct answer to all the subjects indicated for obtaining grade 10 • Skills, well-argued knowledge • Demonstrated ability to analyze phenomena and processes • Personal approach and interpretation.		

Date, 25.09.2026	Teacher's name and signature, Lect. Dr. Marius CĂLIN	Practicals/Tutorials/Project instructor(s), name and signature Asist. Dr. Leonard GEBAC
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOP.106.2.P Physical Chemistry / Chimie fizică

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Physical Chemistry / Chimie fizică				
2.2. Teacher			Conf.dr. Marcela-Elisabeta Bărbînţă-Pătraşcu				
2.3. Tutorials/Practicals instructor(s)			Conf.dr. Marcela-Elisabeta Bărbînţă-Pătraşcu				
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					22
Research in library, study of electronic resources, field research					11
Preparation for practicals/tutorials/projects/reports/homework					11
Tutorat					0
Other activities					0
3.7. Total hours of individual study					44
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia infrastructure (videoprojector, PC), Internet access
5.2. for tutorials/practicals	Laboratory rooms equipped with: • Modern equipment, instruments and accessories: modern laboratory glassware; Sartorius analytical balance; Analytical balance Kern ABS 220-4N, 220g; Kern precision scales; pipettes; micropipettes; manual and electronic pipetting devices; manual and digital burettes; magnetic stirrers with and without heating; computers; mechanical stirrer (VIBRAX stirrer); pH-meters (stationary: Fisher Scientific; portable: pH 110 Exstik); Conductometer 3110 WTW; ovens with thermostat and electronic display; water purification system Milli-Q ; Titan probe sonicator Hielscher UP 100H; Ultrasonic bath BRANSON 1210; Water bath with electronic display and recirculation; SIGMA 2-16 K cooling centrifuge; spectrophotometers; UV-Vis single-beam spectrophotometer (model UV-20) ONDA; Temperature sensor with electronic display; Fisher Scientific Vortex Agitator, 1500 rpm; Ostwald viscometer; specific reagents; refrigerator; high-performance air conditioners, etc. • Interactive practical laboratory equipment - Phywe experimental set-up, computer assisted. • Computers with internet connection, tables, video projector, screen, blackboard.

6. Learning outcomes

Knowledge	R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R14. The student/graduate knows the basic vocabulary and specialized terminology in a foreign language in the field of physics, the structure of scientific texts and international academic communication formats.
Skills	R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R14. The student/graduate is able to read, understand and translate specialized texts, extract relevant information from international scientific sources and communicate orally and in writing in an autonomous and professional manner.
Responsibility and autonomy	R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R14. The student/graduate uses information sources responsibly, respecting the norms of academic ethics and demonstrating initiative in learning the scientific language of the specialty.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Introduction to physical chemistry (main physical chemistry subjects; tangent with other disciplines; general notions).	Systematic exposition – lecture; interactive presentation. Examples. Applications	2 Hours
Chemical Thermodynamics. (Types of systems. Thermodynamic parameters. The laws of thermodynamics. Thermochemistry. Equations Gibbs - Helmholtz. Chemical potentials.)	Systematic exposition – lecture; interactive presentation. Examples. Applications	4 Hours
Phase equilibrium (basics; phase diagram; ideal and real solutions)	Systematic exposition – lecture; interactive presentation. Examples. Applications	4 Hours
Chemical equilibrium (Law of mass action for chemically homogeneous and heterogeneous equilibrium. Equilibrium constants)	Systematic exposition – lecture; interactive presentation. Examples. Applications	4 Hours
Chemical kinetics (Fundamentals. Reaction rate. Reaction order. Reaction mechanisms. Arrhenius equation)	Systematic exposition – lecture; interactive presentation. Examples. Applications	4 Hours

Electrochemistry (Specific and equivalent electrical conductivity of electrolyte solutions and their dependence on solution dilution. Conductometric method for determining the degree and constant of ionization of weak electrolytes, and the conductivity coefficient of strong electrolytes. Electrode potentials. The mechanism of the appearance of the electric double layer. Nernst equation for electrode potential. Electrode classification. Standard hydrogen electrode. Galvanic cells. Dependence of electromotive force on the electrolyte concentration. Electrochemical cells. Potentiometry. pH. Electrolysis and its applications)	Systematic exposition – lecture; interactive presentation. Examples. Applications	10 Hours

References:

1. W. Schartl, Basic Physical Chemistry, 2014. https://www.kwcsangli.in/uploads/basic-physical-chemistry.pdf
2. M. E. Barbinta-Patrascu, N. Badea, A. Meghea, Oxidative stress studies on plant DNA exposed to ozone, Journal of Optoelectronics and Advanced Materials, 15 (5-6), 596 – 601, 2013.
3. P. W. Atkins, J. de Paula, Physical Chemistry, 8th Ed., Freeman, New York, NY, 2006. https://nowgonggirlscollege.co.in/attendence/classnotes/files/1621583343.pdf
4. V. S. BAGOTSKY, FUNDAMENTALS OF ELECTROCHEMISTRY, A JOHN WILEY and SONS, INC., PUBLICATION, USA, 2006, https://users.encs.concordia.ca/ tmg/images/9/9d/Fundamentals_of_Electrochemistry_2nd_Ed.pdf.

7.3 Practicals	**Teaching techniques**	**Observations**
Instructions for safety and health at work for activities in physical chemistry lab. Familiarization with laboratory equipment and accessories.	Systematic exposition - lecture. Conversations. Examples	2 Hours
Types of concentrations; measurement units. Solving problems. Preparation of solutions of a certain concentration. Successive dilutions.	Systematic exposition - lecture. Conversations. Examples. Applications. Guided practical activity	4 Hours
Determination of the viscosity of liquids	Guided practical activity	2 Hours
Acetic acid adsorption on activated carbon. Determination of the adsorption isotherm.	Guided practical activity	4 Hours
Determination of dissociation constant of electrolyte solutions	Guided practical activity	2 Hours
Chemical equilibrium. Le Chatelier's Principle	Guided practical activity	2 Hours
The reaction kinetics of the reduction of methylene blue with ascorbic acid	Guided practical activity	2 Hours
Determination of Activation Energy	Guided practical activity	2 Hours
Electromotive force of the Daniell-Jacobi cell	Guided practical activity	4 Hours
Discussing laboratory reports. Solving problems and tests of physical chemistry.	Systematic exposition - lecture. Conversations. Examples. Applications.	4 Hours

References:

1. Sarah Mowry and Paul J. Ogren, Kinetics of Methylene Blue Reduction by Ascorbic Acid, Journal of Chemical Education Vol. 76 No. 7 July 1999, https://personal.utdallas.edu/ son051000/chem4473/MBreductionJChemEd_1999.pdf
2. KINETICS OF THE REDUCTION OF METHYLENE BLUE BY ASCORBIC ACID, https://personal.utdallas.edu/ son051000/chem4473/MBkineticsLab.pdf
3. https://hcdescience.weebly.com/uploads/5/1/7/3/5173639/chemistry_eoc.pdf
4. https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu- and -Amit-Gurtu.pdf

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit aims at developing specific theoretical and practical competences and abilities in the field of Physical Chemistry, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania (Babes-Bolyai University, Cluj-Napoca) or from abroad (The University of British Columbia; University of Coimbra; University of California Los Angeles UCLA; Colby College; McGill University; University College London; Washington State University). The content of the discipline is in accordance with the requirements for employment in research institutes in physics, materials science and education (in accordance with the law).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of equations/and theories - ability to indicate/analyse specific examples	Written test	50%
Practical	- Ability to perform specific experiments; ability to handle equipment, chemical reagents and laboratory utensils; - Application of specific methods for solving problems and tests of physical chemistry; - Correct processing and interpretation of experimental results.	Continuous evaluation; Lab reports; practical evaluation.	50%
Minimal requirements for passing the exam	Requirements for obtaining score 5 (five): Attendance at least 50% of the number of lectures and compulsory attendance at all laboratory sessions. Completion of all work and laboratory reports. Correct solution for the subjects indicated to obtain score 5 at the final colloquium. Requirements for obtaining score 10 (ten): Skills and knowledge deeply argued. Demonstrated ability to analyze phenomena and processes, correctly solving all subjects. Personal way of approaching and interpreting.		

Date, 25.09.2026	Teacher's name and signature, Conf.dr. Marcela-Elisabeta Bărbînţă-Pătraşcu	Practicals/Tutorials/Project instructor(s), name and signature Conf.dr. Marcela-Elisabeta Bărbînţă-Pătraşcu
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOP.107.1.P Etică şi integritate academica

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Etică şi integritate academica				
2.2. Teacher			lector dr. Sanda Voinea				
2.3. Tutorials/Practicals instructor(s)							
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	14	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					18
Research in library, study of electronic resources, field research					9
Preparation for practicals/tutorials/projects/reports/homework					9
Tutorat					0
Other activities					0
3.7. Total hours of individual study					36
3.8. Total hours per semester					50
3.9. ECTS					2

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R15. The student understands and appropriates the professional ethics and ethical practices that characterize the scientific and academic community.
Skills	R15. The student applies ethical principles in professional work, and respects intellectual property rights
Responsibility and autonomy	R15. The student applies independently ethical behaviors and skills including critical thinking, methodological rigor, professional integrity and responsibility towards the environment and community

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Moral evaluation frameworks. Fundamental concepts of ethics. Ethics and the scientific community. Criteria for moral valuation: consequences / intentions, virtues.	Lecture. Example. Discussion.	2 Hours
Academic integrity: institutional tools. Codes and ethics commissions. The virtues of an integral academic organization. UB's ethical culture.	Lecture. Example. Discussion.	2 Hours

The specifics of academic ethics. Research ethics, professional ethics. Ethics and academic performance.	Lecture. Example. Discussion.	2 Hours
Academic freedom and disagreement in science. Access to resources (fairness and equity in academic organizations and research teams).Ethics of teamwork in scientific research. Implications and outcomes of collaboration.	Lecture. Example. Discussion.	2 Hours
Plagiarism and self-plagiarism. Falsification or fabrication of research results. Originality of results.	Lecture. Example. Discussion.	2 Hours
Publication ethics: authorship and co-authorship. Respect for intellectual property. Copyrights. Ethical use of AI.	Lecture. Example. Discussion.	2 Hours
Ethics of academic writing. How to write an academic paper.	Lecture. Example. Discussion.	2 Hours

References:

Julian Baggini, Peter S. Fosl, A Compendium of Ethical Concepts and Methods, Blackwell Publishing, 2014.

Blaxter, L, Hugh, C. Tight, L. How to research, New York, 2006

Angelo Corlett. " The Role of Philosophy in Academic Ethics", Journal of Academic Ethics, Volume 12, Issue 1, pp 1–14, 2014

Codul de etică al Universităţii din Bucureşti https://unibuc.ro/wp-content/uploads/2021/01/CODUL-DE-ETICA-SI-DEONTOLOGIE-AL-UNIVERSITATII-DIN-BUCURESTI-2020-1.pdf

Carta UNIBUC (https://unibuc.ro/wp-content/uploads/2018/12/CARTA-UB.pdf)

Joshua D. Greene, et. al. "An fMRI investigation of emotional engagement in moral judgment." Science, 2001.

Neil Hamilton. Academic Ethics, Westport: Praeger Publishers, 2002

Bruce Macfarlane. Researching with Integrity. The Ethics of Academic Enquiry, London: Routledge, 2009.

James Rachels, Introducere în Etică, traducere de Daniela Angelescu, Editura Punct, 2000.

Ebony Elizabeth Thomas and Kelly Sassi, "An Ethical Dilemma: Talking about Plagiarism and Academic Integrity in the Digital Age", English Journal 100.6, pp. 47–53, 2011

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course addresses the most discussed theoretical issues in the area of academic ethics, along with their practical impact implications. The content of the course is consistent with the content of similar courses taught at universities in the country (Babeş-Bolyai University, Cluj Napoca, "Alexandru Ioan Cuza" University of Iasi) and major universities abroad, providing students with tools for moral decision and ethics that can be used by students in their academic activity and in their professional life.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	Originality. Critical spirit. Academic writing. Knowledge of the rules of academic ethics.	written test	100%

Minimal requirements for passing the exam	Complete solving of the subjects indicated for obtaining the ADMITTED qualifier. Attending at least 50% courses.

Date, 25.09.2026	Teacher's name and signature, lector dr. Sanda Voinea

Date of approval 28.09.2026	Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOP.107.2.P Authoring and scientific dissemination / Autorat şi diseminarea cunoaşterii ştiinţifice

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Authoring and scientific dissemination / Autorat şi diseminarea cunoaşterii ştiinţifice				
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)							
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	14	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					18
Research in library, study of electronic resources, field research					9
Preparation for practicals/tutorials/projects/reports/homework					9
Tutorat					0
Other activities					0
3.7. Total hours of individual study					36
3.8. Total hours per semester					50
3.9. ECTS					2

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R14. The student/graduate knows the basic vocabulary and specialized terminology in a foreign language in the field of physics, the structure of scientific texts and international academic communication formats. R15. The student understands and appropriates the professional ethics and ethical practices that characterize the scientific and academic community.
Skills	R14. The student/graduate is able to read, understand and translate specialized texts, extract relevant information from international scientific sources and communicate orally and in writing in an autonomous and professional manner. R15. The student applies ethical principles in professional work, and respects intellectual property rights
Responsibility and autonomy	R14. The student/graduate uses information sources responsibly, respecting the norms of academic ethics and demonstrating initiative in learning the scientific language of the specialty. R15. The student applies independently ethical behaviors and skills including critical thinking, methodological rigor, professional integrity and responsibility towards the environment and community

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Introduction. Definition of scientific writing. The aim(s) for writing a scientific paper. How to plan a research and choose a paper topic. Literature search and state of the art.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Example	2 Hours
The standard structure of a scientific paper. Abstract, Introduction, Method, results and discussions, conclusions. Example of paper from Journal of Geophysical Research.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Example	2 Hours
Language and style of a scientific paper. Using abbreviations. Preparing the Figures and Tables. The quality of a figure. Examples of Figures and Tables.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Example	2 Hours
Preparing the Abstract and Title. References and citation of them in the main manuscript. Acknowledgments. Copyright considerations.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Example	2 Hours
Publication process. Choosing the appropriate journal. Submitting process. Cover letter. The review process. Accept, modify, reject letters.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Example	2 Hours
Authorship definition. Authors contributions. Author order. Acknowledgments again. Plagiarism. Authors responsibilities before publication, during peer review process and after publication.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Example	2 Hours
Other scientific writing. Writing a review paper. Writing a book chapter/ book. Writing a conference report. Preparing a poster. Presenting a work orally in a conference meeting.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Example	2 Hours

References:

1. Chris A. Mack, 2018, How to Write a Good Scientific Paper, SPIE PRESS, Bellingham, Washington USA, 124 pp.
2. Barbara Gastel and Robert A. Day, 2016, How to Write and Publish a Scientific Paper, Greenwood, Santa Barbara, California, USA, 346 pp.
3. S. R. N. Reis, A. I. Reis, 2013, How to Write Your First Scientific Paper, DOI: 10.1109/IEDEC.2013.6526784

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms/develops theoretical and practical competences and abilities which are important for an undergraduate student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	Coherence and clarity of exposition, correct use of scientific writing methods and concepts ability to apply to specific examples	oral examination	100%
Minimal requirements for passing the exam	Participating to minimum 50% of the lectures. Requirements for mark 5 (10 points scale)		

Date,
25.09.2026

Date of approval

28.09.2026

Head of department
name and signature
Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOB.111.P Equations of mathematical physics / Ecuaţiile fizicii matematice

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title	Equations of mathematical physics / Ecuaţiile fizicii matematice						
2.2. Teacher	Conf.dr.Radu Slobodeanu						
2.3. Tutorials/Practicals instructor(s)	Conf.dr.Radu Slobodeanu						
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	5	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	3/0/0
3.4. Total hours per semester	70	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	42/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					28
Research in library, study of electronic resources, field research					14
Preparation for practicals/tutorials/projects/reports/homework					9
Tutorat					0
Other activities					4
3.7. Total hours of individual study					55
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	The 1st year courses Real and Complex Analysis and Algebra, Geometry and Differential equations. High school mathematics
4.2. competences	Computational skills

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom with video projector. Access to the library and to internet resources (Moodle or Google Classroom)
5.2. for tutorials/practicals	Classroom with video projector. Mathematica software.

6. Learning outcomes

Knowledge	R10. The student/graduate deduces working formulas for calculations involving physical quantities, correctly applying fundamental principles and laws.
Skills	R10. Students/graduates prepare and present, in English, scientific or outreach reports and communications, using appropriate technical language and logical argumentation.
Responsibility and autonomy	R10. Students/graduates take responsibility for interacting, contributing, and integrating into multilingual work teams and professional communities, demonstrating autonomy in using information sources in English.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations

Elements of functional analysis. Hilbert spaces, Hilbert bases. Fourier trigonometric series. Linear and bounded operators on a Hilbert space. Linear functionals. Riesz theorem. The adjoint of a bounded linear operator on a Hilbert space. Compact operators. Eigenvalues and eigenvectors.Fredholm alternative. Applications to integral equations.	Lecturing. Demonstrating (Examples). Classroom discussions.	6 Hours
Sturm-Liouville theory and special functions. Regular Sturm-Liouville boundary value problems. Orthogonal polynomials. Bessel functions. Spherical harmonics. Applications to explicitly solvable quantum systems.	Lecturing. Demonstrating (Examples). Classroom discussions.	8 Hours
Problems in the theory of partial differential equations. Initial and boundary conditions. The classification and the reduction to canonical form for semilinear second-order PDE.	Lecturing. Demonstrating (Examples). Classroom discussions.	2 Hours
Elliptic equations. Green's identities and the integral representation formula with 3 potentials (Newtonian potential, simple layer and double layers potentials). Maximum principle, mean value theorem. Boundary value problems (Dirichlet and Neumann) for Laplace equation. Green's function for the interior Dirichlet problem. Applications in electrodynamics.	Lecturing. Demonstrating (Examples). Classroom discussions.	4 Hours
Hyperbolic equations. Solutions of the wave equation in the cases of n=1,2,3. Domain of dependence, region of influence. Huygens' principle. The finite vibrating string problem. Separation of variables method.	Lecturing. Demonstrating (Examples). Classroom discussions.	3 Hours
Parabolic equations. Maximum principle. The solution of the Cauchy's problem. Fourier's method of separation of variables for solving the mixed problem.	Lecturing. Demonstrating (Examples). Classroom discussions.	3 Hours
Integral transforms. Laplace and Fourier transform. Applications in spectroscopy and imaging.	Lecturing. Demonstrating (Examples). Classroom discussions.	2 Hours

References:

Bibliography:

G. Arfken, H. Weber, F.E. Harris, Mathematical Methods for Physicists, 7th edition, Elsevier 2011.

I. Armeanu, Functional Analysis (in Romanian), Ed.Universităţii din Bucureşti, 1998.

V. Barbu, Partial differential equations and boundary value problems, Springer, 2013.

V. Branzănescu, O. Stănăşilă, Special Topics in Mathematics (in Romanian), Editura ALL 1998.

R. Courant, D. Hilbert, Methods of Mathematical Physics, Vol. 2, Partial Differential Equations, Wiley, 1989.

M. Reed, B. Simon, Methods of Modern Mathematical Physics, vol I-IV, Academic Press, 1972-1978

N. Teodorescu, V. Olariu, Ordinary and Partial Differential Equations (in Romanian) vol. I-III, Ed. Tehnică, 1978-1980.

A. N. Tikhonov, A. A. Samarskii, Equations of Mathematical Physics, Dover Publications, Reprint edition 2011.

V.S. Vladimirov, Equations of mathematical physics, Marcel Dekker, New York, 1971.

P.J. Olver, Introduction to partial differential equations, Springer, 2014.

7.2 Tutorials	**Teaching techniques**	**Observations**
The seminar follows the course content. The problems arising in theoretical physics related to special functions, Fourier series expansion, Fourier transform will be supported with examples in MATHEMATICA.	Exercises and problem solving. Guided work	42 Hours

References:

Bibliography:

C. Constanda, Solution techniques for elementary partial differential equations, CRC Press, 2016.
P. DuChateau, D. W. Zachmann, Theory and problems of partial differential equations, Schaum's outline series, McGraw Hill, 1986.
N.N. Lebedev, Special Functions and Their Applications, Dover Publications, 1972
Gh. Mocică, Problems of Special Functions (in Romanian), Editura Didactica si Pedagogica, 1988
P.J. Olver, Introduction to partial differential equations, Springer, 2014
R. Slobodeanu, A. Stoica, Ecuaţiile Fizicii Matematice. Introducere prin probleme rezolvate (in Romanian), 2022.
T. Stanasila, V.Olariu, Ordinary and Partial Differential Equations (in Romanian), Editura Tehnica,1982
V.S. Vladimirov, A collection of problems on the equations of mathematical physics, Springer, 2013.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical competences and computational abilities that are mostly important for an undergraduate student in Physics, according to the (inter)national standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other Romanian as well as European universities.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - ability to apply theoretical results and the standard solving techniques in order to solve simple partial differential equations with initial/boundary value conditions. - ability to analyse specific examples	Written exam (alternatively: two partial evaluations)	80%
Tutorial	Correct identification and application of the method needed for problem solving	Homeworks	20%
Minimal requirements for passing the exam	Minimal requirements for passing the exam At least 50% of points at the exam and 50% of due homeworks. Being present at minimum 50% of the tutorials. Requirements for getting mark 5 (10 points scale) -Students must attend at least 50% of the lecture hours and at least 75% of the tutorial ones. -Fulfillment of at least 50% of each of the criteria that determine the final grade. Requirements for getting mark 10 (10 points scale) -Correct answer to all the subjects indicated for obtaining grade 10 -Skills, well-argued knowledge -Demonstrated ability to analyze phenomena and processes -Personal approach and interpretation.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
8.09.2026	Conf.dr.Radu Slobodeanu	Conf.dr.Radu Slobodeanu

Date of approval	Head of department name and signature
17.09.2026	Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.112.P Differential equations and Complex analysis / Ecuaţii diferenţiale şi analiză complexă

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Differential equations and Complex analysis / Ecuaţii diferenţiale şi analiză complexă				
2.2. Teacher			R.Slobodeanu				
2.3. Tutorials/Practicals instructor(s)			A.Stoica				
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	2/0/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	28/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					35
Research in library, study of electronic resources, field research					17
Preparation for practicals/tutorials/projects/reports/homework					17
Tutorat					0
Other activities					0
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	The 1st semester courses Real Analysis and Algebra, Geometry and Differential equations. High school mathematics
4.2. competences	Computational skills

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom with video projector. Access to the library and to internet resources (Moodle or Google Classroom)
5.2. for tutorials/practicals	Classroom with video projector.

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics).
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Complex numbers. Operations with complex numbers, trigonometric representation. Elementary point set topology.	Lecturing. Demonstrating (Examples). Classroom discussions.	3 Hours

Complex functions. Limits and continuity. Complex differentiability. Examples. Holomorphic functions. Cauchy-Riemann equations. Relation with harmonic functions.	Lecturing. Demonstrating (Examples). Classroom discussions.	4 Hours
Complex Integration. Complex line integral. Cauchy's Theorem. Cauchy's Integral Formula. Applications	Lecturing. Demonstrating (Examples). Classroom discussions.	4 Hours
Power Series. Taylor series and analyticity. Uniqueness and analytic continuation. Laurent series and singularities. Classification of isolated singularities. Meromorphic functions	Lecturing. Demonstrating (Examples). Classroom discussions.	6 Hours
The Calculus of Residues. Index of a point with respect to a closed curve. Residue of a holomorphic function at an isolated singularity. The Residue Theorem. Evaluation of real integrals using the Residue Theorem	Lecturing. Demonstrating (Examples). Classroom discussions.	4 Hours
Ordinary differential equations (ODE). Linear ODEs, existence and uniqueness results, solution techniques (for 1st order ODEs, 2nd and higher order ODEs with constant coefficients). Some classical nonlinear ODEs (Bernoulli, Riccati, Lagrange). Linear systems of differential equations with constant coefficients	Lecturing. Demonstrating (Examples). Classroom discussions.	5 Hours
Conformal mapping. Riemann Mapping Theorem. Linear fractional transformations. Applications to potential theory problems (planar fluid flows, Laplace equation with boundary conditions, Poisson integral formula)	Lecturing. Demonstrating (Examples). Classroom discussions.	2 Hours

References:

G. Arfken, H. Weber, Mathematical Methods for Physicists, Elsevier Academic Press, 2005.

N. Cotfas, L. Cotfas, Elemente de analiză matematică (in Romanian), Ed. Universităţii din Bucureşti, 2010.

Ch. Constanda, Differential Equations, A Primer for Scientists and Engineers, Springer 2013.

E. Kreyszig, Advanced Engineering Mathematics, 10th edition, Wiley, 2011.

W. Rudin, Real and Complex Analysis, McGraw-Hill, 1986.
C. Timofte, Complex Analysis, Ed. Universităţii din Bucureşti, 2014.

7.2 Tutorials	**Teaching techniques**	**Observations**
The seminar follows the course content. Some computation of power series and integrals will be supported with examples in Wolfram MATHEMATICA.	Exercises and problem solving. Guided work	28 Hours

References:

S. Lipschutz, J. Schiller, D. Spellman, M. Spiegel, Schaum's Outline of Complex Variables, 2nd ed. (Schaum's Outline Series), McGraw-Hill, New York, 2009.

K.F. Riley, M.P. Hobson, S.J. Bence, Mathematical Methods for Physics and Engineering, 3rd ed., Cambridge University Press, 2006.

P.J. Olver, Complex analysis and conformal mapping,University of Minnesota806, 2017.

P.J. Olver, C. Shakiban, Applied Linear Algebra, 2nd edition, Springer 2018.

C. Timofte, Special Topics in Mathematics, Ed. Universităţii din Bucureşti, 2016.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops theoretical and practical skills and abilities that are important for undergraduate Physics students, corresponding to national and international standards. The content and teaching methods were chosen after an in-depth analysis of the content of similar course units in the curriculum of other universities in Romania or in the European Union. The content of the discipline is in accordance with the requirements and expectations of the representatives of the epistemic communities, of the professional associations and of the main employers of the future graduates in the field related to the program.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of arguments, capacity to cite appropriate general results from the course - ability to manipulate complex functions and the associated notions of complex differentiability and integrability - ability to analyse specific examples, to compute contour integrals using residues, expansion in power serie	Written exam	80%
Tutorial	Ability to apply the specific results given in the course to problem solving. Ability to interpret correctly the results obtained.	Homeworks (oral assessment), seminar activity.	20%
Minimal requirements for passing the exam	At least 50% of points at the exam and 50% of due homeworks. Being present at minimum 50% of the tutorials and 50% of the lectures		

Date, 8.09.2026	Teacher's name and signature, R.Slobodeanu	Practicals/Tutorials/Project instructor(s), name and signature A.Stoica
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.113.P Classical mechanics II / Mecanică fizică II

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Classical mechanics II / Mecanică fizică II				
2.2. Teacher			Conf. Dr. Catalin Berlic				
2.3. Tutorials/Practicals instructor(s)			Conf. Dr. Adriana Balan, Prof. Dr. Valentin Barna, Conf Dr. Catalin Berlic				
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	1/1/0
3.4. Total hours per semester	42	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	14/14/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					29
Research in library, study of electronic resources, field research					15
Preparation for practicals/tutorials/projects/reports/homework					14
Tutorat					0
Other activities					0
3.7. Total hours of individual study					58
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	Attendance of the courses: Physical Mechanics I, Real Analysis, Algebra, Geometry, and Differential Equations.
4.2. competences	Laboratory equipped with the necessary facilities for conducting practical work. Computers, video projector, software packages for data analysis and processing. Internet connection. Seminar room.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room equipped with modern multimedia facilities, including a computer, video projector, and projection screen.
5.2. for tutorials/practicals	Laboratory fully equipped with the necessary facilities for conducting practical work, including computers, video projector, and software packages for data analysis and processing.

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R9. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress.
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards. R9. The student/graduate deduces working formulas for calculations involving physical quantities , appropriately applying fundamental principles and laws.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python). R9. The student/graduate demonstrates autonomy in operating, maintaining, and repairing laboratory equipment (e.g., sensor calibration, instrument adjustment), adhering to safety and quality standards.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Rigid body statics. Composition of parallel forces. Force couples. Reduction of a system of forces. Varignon's theorem. Equilibrium conditions. Center of gravity of a system of particles. Theorems of Guldin and Pappus.	Systematic exposition – lecture, demonstration, discussion, case study. Examples.	2 Hours
1. Gravitation. Kepler's laws. Law of gravitational attraction. Gravitational acceleration. Variation of gravitational acceleration with altitude. Orbital velocities. Gravitational field.	Systematic exposition – lecture, demonstration, discussion, case study. Examples.	2 Hours

2. Motion in a central field. The two-body problem. Velocity and acceleration. Angular momentum integral. Energy integral. Orbits and trajectories.	Systematic exposition – lecture, demonstration, discussion, case study. Examples.	2 Hours
3. Kinematics and dynamics of relative and absolute motion. Absolute motion, relative motion, and transport motion. Composition of displacements, velocities, and accelerations. Non-inertial reference frames. Inertial (fictitious) forces. Coriolis force. Applications.	Systematic exposition – lecture, demonstration, discussion, case study. Examples.	4 Hours
4. Fluid mechanics. Fluid statics. Hydrostatic pressure. Pascal's law. Archimedes' principle. Fluid dynamics. Continuity equation. Bernoulli's equation. Viscosity. Poiseuille's law. Stokes' law. Terminal velocity.	Systematic exposition – lecture, demonstration, discussion, case study. Examples.	4 Hours

References:

1. A. Hristev, Mecanică şi acustică, Editura Didactică şi Pedagogică, Bucureşti, 1984.
2. V. Dima, Mecanică medicală, Editura Universităţii din Bucureşti, 1999
3. D. Kleppner, R. Kolenkow, An Introduction to Mechanics, 2nd edition, Cambridge University Press, 2013
4. C. Kittel, W.D.Knight, M.A. Ruderman, Cursul de Fizică Berkeley, Volumul I, Mecanică, Editura Didactică şi Pedagogică, Bucureşti, 1981.
5. A.P. French, Newtonian Mechanics (M.I.T. Introductory Physics), 1st. Edition, W. W. Norton and Company, 1971.
6. D. Halliday, R. Resnik, J. Walker, Fundamentals of Physics, Extended: Extended 11-th Edition, Wiley 2018

7.2 Tutorials	**Teaching techniques**	**Observations**
The seminar topics follow the content of the course. The problems discussed aim at a deep understanding of the theoretical concepts presented in the lectures, the development of computational skills, and the proper use of the fundamental concepts of Physical Mechanics.	Presentation, conversation, exercises	14 Hours

References:

1. A. Hristev, Probleme rezolvate de mecanică şi acustică, Ed. APH, Bucureşti, 1999.
2. V. Dima, E. Barna, Mecanică şi acustică. Probleme rezolvate, Ed. Universităţii din Bucureşti, 2006.
3. C. Plăviţu, A. Hristev, L. Georgescu, D. Borşan, V. Dima, C. Stănescu, L. Ionescu, R. Moldovan, Probleme de mecanică fizică şi acustică, Ed. Didactică şi Pedagogică, Bucureşti, 1981
4. D. Morin, Introduction to Classical Mechanics: With Problems and Solutions, Cambridge University Press, 2008

7.3 Practicals	**Teaching techniques**	**Observations**
Acoustic resonators.	Guided practical activity	2 Hours
Konig tube.	Guided practical activity	2 Hours
Coupled pendula.	Guided practical activity	2 Hours
Free surface of a rotating liquid.	Guided practical activity	2 Hours
Coupled oscillations on a linear air track.	Guided practical activity	2 Hours
Rod's torsion	Guided practical activity	2 Hours
Finalization of experimental data processing. Completion of missed laboratory works.	Discussion. Examples. Guided practical activity	2 Hours

References:

1. C. Ciucu, Cristina Miron, V. Barna, Lucrări practice. Mecanică Fizică şi Acustică (I), Ed. Universităţii din Bucureşti, Bucureşti, 2009.
2. E. Barna, C. Ciucu, Cristina Miron, V. Barna, C. Berlic, Lucrări practice. Mecanică Fizică şi Acustică (II), Ed. Universităţii din Bucureşti, Bucureşti, 2010.
3. Experiments in Mechanics, Wave Motion, and Heat Laboratory Manual for PHYS: 1511, PHYS: 1701, AND PHYS: 1611, University of Iova, 2024

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms/develops some theoretical and/or practical competences and abilities which are fundamental for an undergraduate student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Knowledge of the fundamental concepts of Physical Mechanics; - Accurate acquisition and correct understanding of the topics covered in the course; - Demonstration of theoretical concepts using correct calculation relationships; - Clarity, coherence, and conciseness of the presentation; - Correct use of the studied physical models, formulas, and computational relationships; - Ability to provide relevant examples; - Ability to apply the acquired knowledge to solving mechanics problems.	Written and oral theoretical knowledge exam. For online evaluation, the exam topics will be sent electronically via email, Google Classroom, or Microsoft Teams. During the exam, students must have their video cameras turned on, and the session will be recorded.	60%
Tutorial	Ability to solve mechanics exercises.	Continuous assessment: ongoing evaluation based on active participation and problem-solving at the board during seminar classes.	20%
Practical	- Knowledge of the specific experimental techniques and infrastructure in the laboratory; - Application of specific problem-solving methods for a given task; - Interpretation of results.	Written evaluation	20%
Minimal requirements for passing the exam	Requirements for Obtaining a Grade of 5 - Mandatory attendance at all practical activities (seminars and laboratory sessions) and at least 50% of the lectures. Completion of all laboratory experiments and presentation of the results in the form of scientific reports. - Obtaining a minimum grade of 5 in the laboratory assessment. - Correctly solving the examination questions designated as sufficient to obtain a grade of 5 in the final examination. Requirements for Obtaining a Grade of 10 - Demonstration of thoroughly substantiated knowledge and well-developed practical skills. - Demonstrated ability to analyse physical phenomena and processes, and correctly solve all examination questions.		

Date, 25.09.2026	Teacher's name and signature, Conf. Dr. Catalin Berlic	Practicals/Tutorials/Project instructor(s), name and signature Conf. Dr. Adriana Balan, Prof. Dr. Valentin Barna, Conf Dr. Catalin Berlic
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOB.114.P Molecular physics and heat II / Fizică moleculară şi căldură II

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Molecular physics and heat II / Fizică moleculară şi căldură II				
2.2. Teacher			Conf.Dr. Anca Dumitru				
2.3. Tutorials/Practicals instructor(s)			Conf.Dr. Anca Dumitru				
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	1/1/0
3.4. Total hours per semester	42	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	14/14/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					29
Research in library, study of electronic resources, field research					15
Preparation for practicals/tutorials/projects/reports/homework					14
Tutorat					0
Other activities					0
3.7. Total hours of individual study					58
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia devices
5.2. for tutorials/practicals	Set of practical work illustrating the topics covered in the course; Consumables; Computers and software for data analysis

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods).

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python). R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Applications of thermodynamic potentials. Spontaneity and Gibbs free enthalpy. Thermodynamic potentials for an open system. Chemical potential.	Systematic exposition - lecture. Conversation. Examples.	2 Hours
The third law of thermodynamics. Statement.Consequences. Equilibrium conditions for an isolated system. The principle of minimum of energy. Concept of phase. Phase Transition and chemical potential. Phase equilibrium and phase diagram. Gibbs phase rule. Clapeyron- Clausius Equation.	Systematic exposition - lecture. Conversation. Examples.	3 Hours
Van der Waals Equation of state. Critical temperature and associated constants. Compressibility Factor. Entropy and thermodynamic potential of van der Waals gas. Applications of van der Waals gas in isothermal and adiabatic process, Van der Waals gas equation for an adiabatic process. Carnot engine efficiency Relation between molar heat capacities of van der Waals gas.	Systematic exposition - lecture. Conversation. Examples.	2 Hours
Introduction on the kinetic molecular theory of ideal gases. Assumptions of kinetic theory. Relationship between pressure and molecular kinetic energy. Molecular interpretation of temperature. Theorem of equipartition of energy. Degree of freedom. Molar heat capacities (revised)	Systematic exposition - lecture. Conversation. Examples.	2 Hours
Random variables. Mean and Standard deviation. Microstate, macrostate and multiplicity. Statistical view of Entropy. Boltzmann relation. Statistical versus thermodynamics definition of entropy.	Systematic exposition - lecture. Conversation. Examples.	2 Hours

Introduction in statistical physics. Statistical distribution law by positions. Statistical distribution law by velocity vector. Maxwell Velocity Distribution. Mean Speed, Most Probable Speed and Root-Mean-Square Speed. Conversion of velocity distribution to energy distribution. Molecular collision. Mean free path. Effusion. Molecular current and flow. Transport phenomena: diffusion, viscosity and thermal conductivity.	Systematic exposition - lecture. Conversation. Examples.	3 Hours

References:

1. V. Filip, Introductory Thermal Physics, Ed. Univ. Buc., 2006.
2. Vlad Popa-Nita, Molecular physics (first part- Thermodynamics), Ed. Univ. Buc. (1994).
3. S.Stefan, Fizica Moleculara, Ed. Univ. Bucuresti, 2006
4. C.N. Plavitu, Fizica Fenomenelor Termice, Partea I, Ed. Hyperion, 1992
5. S. Turns, Thermodynamics. Concepts and Applications. Ed. Cambridge University Press, 2006
6. W. Greiner, L. Neise, H. Stocker, Thermodynamics and Statistical Mechanics, Ed. Springer, 2006
7. S. Stefan si V. Filip, Fizica Fenomenelor Termice. Culegere de Probleme, Ed. Univ. Buc., 2002.

7.2 Tutorials	**Teaching techniques**	**Observations**
Thermodynamic potentials and phase transition	Review theoretical notion. Example. Problems	4 Hours
van der Waals gas	Review theoretical notion. Example. Problems	4 Hours
kinetic molecular theory of ideal gases	Review theoretical notion. Example. Problems	2 Hours
Maxwel distribution. Energy distribution.	Review theoretical notion. Example. Problems	4 Hours

References:

7.3 Practicals	**Teaching techniques**	**Observations**
Determination of surface tension of a liquid	Guided practical activity	2 Hours
The viscosity of a liquid with Hoppler viscosimeter	Guided practical activity	2 Hours
Viscosity coefficient of air	Guided practical activity	2 Hours
Verification of Stefan-Boltzmann's law of radiation	Guided practical activity	2 Hours
Vapour pressure of water at high temperature	Guided practical activity	2 Hours
Maxwellian velocity distribution	Guided practical activity	2 Hours
Determination of specific heat of a liquid by cooling method	Guided practical activity	2 Hours

References:

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of knowledge and theminology used in thermal physics - ability to indicate/analyse specific examples - correct use of equations/mathematical methods/physical models and theories	Oral and written examination	50%

Tutorial	- ability to use theoretical knowledge to solve problem; ability to analyze the results; ability to present and discuss the results	Homework	20%
Practical	- ability to use specific experimental methods/apparatus - ability to analyse and interpret the characterization data - ability to present and discuss the results	Examination of Lab reports	30%
Minimal requirements for passing the exam	Correct exposition of a theoretical subject. A minimum grade of 5 must be obtained in each component of the evaluation. Attendance: at least 50% of the course hours and mandatory attendance at all lab sessions. At least 50% achievement in each of the criteria that determine the final grade.		

Date, 25.09.2026	Teacher's name and signature, Conf.Dr. Anca Dumitru	Practicals/Tutorials/Project instructor(s), name and signature Conf.Dr. Anca Dumitru
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOB.115.P Electricity and magnetism / Electricity and magnetism

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Electricity and magnetism / Electricity and magnetism				
2.2. Teacher			Lect. dr. Cezar Tăzlăoanu				
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Cezar Tăzlăoanu/Conf.dr. Sorina Iftimie				
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	7	3.2. Lectures	3	3.3. Tutorials/Practicals/Projects	1/3/0
3.4. Total hours per semester	98	3.5. Lectures	42	3.6. Tutorials/Practicals/Projects	14/42/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					39
Research in library, study of electronic resources, field research					19
Preparation for practicals/tutorials/projects/reports/homework					19
Tutorat					0
Other activities					0
3.7. Total hours of individual study					77
3.8. Total hours per semester					175
3.9. ECTS					7

4. Prerequisites (if necessary)

4.1. curriculum	Parcurgerea cursurilor: Analiză reală şi complexă; Algebră, Geometrie şi ecuaţii diferenţiale, Mecanică fizică
4.2. competences	Identificarea şi utilizarea adecvată a principalelor legi şi principii fizice într-un context dat

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Sală cu dotări multimedia (videoproiector)
5.2. for tutorials/practicals	Laborator specific şi montaje experimentale pentru efectuarea unor experimente de bază sau fundamentale în electricitate şi magnetism.

6. Learning outcomes

Knowledge	R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods).
Skills	R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics.
Responsibility and autonomy	R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
ELECTROSTATICA Interacţii fundamentale în natură. Forţe şi câmpuri asociate. Tăria relativă a interacţiunilor fundamentale. Domeniul spaţial de acţiune. Particule care mediază interacţiile fundamentale. Conceptul general de sarcină. Sarcini electrice. Conservarea şi cuantificarea sarcinii electrice. Consecinţe. Legea lui Coulomb. Principiul superpoziţiei liniare	Expunere sistematică. Exemple.	3 Hours
Formalismul câmpului electrostatic în vid. Intensitatea şi potenţialul câmpului. Linii de câmp. Principiul superpoziţiei liniare. Natura conservativă a câmpului electrostatic. Distribuţii statice de sarcini electrice punctuale şi densităţi de sarcină asociate. Teorema Earnshaw. Teorema Green de reciprocitate. Formalismul distribuţiilor continue de sarcină. Distribuţia Dirac. Distribuţii atomice şi moleculare de sarcină electrică.	Expunere sistematică. Exemple.	3 Hours
Momentele electrice ale distribuţiilor de sarcină. Dipolul electric. Molecule polare şi nepolare. Potenţialul şi câmpul dipolului. Energia electrostatică a sistemului dipol-câmp electrostatic. Interacţiunea dipolilor electrici. Legea lui Gauss. Fluxul intensităţii electrice. Formele integrală şi diferenţială.	Expunere sistematică. Exemple.	3 Hours
Ecuaţiile lui Poisson şi Laplace. Exemple şi aplicaţii la sisteme cu grad înalt de simetrie spaţială. Unicitatea soluţiilor ecuaţiilor câmpului electrostatic. Tipuri de condiţii pe frontieră şi la infinit. Energia electrostatică a sistemelor de sarcini. Energia stocată în câmpul electrostatic. Consecinţe.	Expunere sistematică. Exemple.	3 Hours
MATERIA ÎN CÂMP ELECTROSTATIC Conductori ideali la echilibru electrostatic. Comportarea câmpului şi potenţialului. Câmpul electric în vecinătatea suprafeţei conductorilor. Teorema lui Coulomb. Teorema Green de reciprocitate. Capacitatea electrică. Condensatorul electric. Coeficienţi de capacitate şi coeficienţi de potenţial. Condensatorul cu feţe planparalele. Conectarea în serie sau în paralel a condensatorilor electrici.	Expunere sistematică. Exemple.	3 Hours
Polarizarea materiei. Dielectrici. Mecanisme de polarizare. Câmpul electric în interiorul dielectricului. Vectorul inducţie electrică. Vectorul polarizare electrică. Constanta dielectrică. Densitatea volumică a sarcinii de polarizare. Medii liniare electric. Comportarea inducţiei şi intensităţii electrice la interfeţe. Ecuaţiile de trecere.	Expunere sistematică. Exemple.	3 Hours
ELECTROCINETICA Intensitatea curentului electric. Tipuri de curenţi electrici.Vectorul densitate de curent. Ecuaţia de continuitate. Consecinţele ecuaţiei de continuitate. Conducţia electrică. Specii de purtători de sarcină. Mecanisme de conducţie în diferite medii conductoare. Exemple şi aplicaţii. Viteza de drift. Mobilitatea electrică a purtătorilor, conductivitatea şi rezistivitatea electrică a mediului conductor. Medii conductoare şi clasificarea lor.	Expunere sistematică. Exemple.	3 Hours

Medii conductoare liniare. Legea lui Ohm. Forma locală a legii lui Ohm. Rezistenţa electrică. Rezistori electrici. Caracteristica IU a unui rezistor. Supraconductori. Dependenţa de temperatură a mecanismelor de conducţie. Tensiunea electromotoare. Pila electrică. Surse de tensiune şi surse de curent ideale sau reale. Principii de funcţionare şi caracteristicile I-U ale surselor.	Expunere sistematică. Exemple.	3 Hours
CIRCUITE LECTRICE DE CURENT CONTINUU Componentele unui circuit electric. Componente active şi componente pasive. Componente liniare şi neliniare. Reprezentarea componentelor prin simboluri. Reprezentarea circuitelor electrice prin scheme. Teoremele de echivalenţă Thévenin şi Norton. Calculul tensiunii şi al rezistenţei Thévenin. Curentul şi conductanţa Norton. Legile lui Kirchhoff. Elementele topologice ale cicuitelor electrice. Legea curenţilor şi legea tensiunilor. Conectarea rezistorilor electrici în serie sau în paralel. Rezistenţa echivalentă şi calculul ei.	Expunere sistematică. Exemple.	3 Hours
Regimul tranzitoriu. Circuite electrice serie RC. Încărcarea condensatorului prin rezistor cu o sursă de tensiune. Constanta de timp. Încărcarea condensatorului cu o sursă de curent. Circuite serie RLC. Analiza regimului oscilatoriu amortizat. Disiparea puterii în circuitele electrice. Efectul Joule. Legea lui Joule. Forma locală a legii şi densitatea volumică de putere electrică. Energia de interacţiune a unui curent electric cu câmpul electric local. Bilanţul energetic al circuitelor de curent continuu. Teorema transferului maxim de putere.	Expunere sistematică. Exemple.	3 Hours
MAGNETOSTATICA Câmpul magnetic al curentului continuu. Inducţia magnetică. Intensitatea câmpului magnetic. Exemple. Legea Biot-Savart. Teorema Ampère. Forţa electromagnetică. Aplicaţii Forţa Lorentz. Mişcarea clasică a particulelor încărcate electric în câmpuri magnetice şi electrice Potenţialul magnetic vector. Proprietăţi. Semnificaţie. Inductanţa electrică. Formulele lui Neumann. Inductanţa proprie, self-inductanţa, inductanţa mutuală. Energia stocată în câmpul magnetic. Momente magnetice. Energii de interacţie.Forţe şi momente exercitate asupra momentului dipolar magnetic. Precesia Larmor şi aplicaţiile ei.	Expunere sistematică. Exemple.	3 Hours

CÂMPUL ELECTROMAGNETIC Inducţia electromagnetică şi legea lui Faraday. Circuite electrice în câmpuri dependente de timp. Calculul tensiunii şi curentului indus. Conservarea energiei şi legea lui Lenz. CIRCUITE DE CURENT ALTERNATIV. Fazori. Bobina ideală şi condensatorul ideal parcurse de curent alternativ sinusoidal. Reactanţa inductivă şi reactanţa capacitivă. Impedanţa şi admitanţa unui circuit. Diagrama fazorială a circuitelor CA. Rezonanţa circuitelor serie şi paralel. Formula Thomson pentru frecvenţa proprie. Factorul de calitate. Comportarea circuitelor mixte. Exemple. Puterea şi bilanţul energetic în circuite de curent alternativ sinusoidal. Calculul valorilor efective ale tensiunii şi curentului. Puterea activă şi puterea reactivă. Factorul de putere.	Expunere sistematică. Exemple.	3 Hours
MATERIA ÎN CÂMP MAGNETIC Proprietăţi magnetice. Vectorul magnetizare. Curba de histerezis magnetic şi energia necesară magnetizării. Permeabilitatea magnetică a materialelor. Feromagnetism, paramagnetism şi diamagnetism.	Expunere sistematică. Exemple.	3 Hours
UNDE ELECTROMAGNETICE Ecuaţia undelor electromagnetice. Propagarea undelor. Transportul energiei electromagnetice. Vectorul Poynting. Energia şi impulsul stocate în stocată în câmp electromagnetic. Consecinţe.	Expunere sistematică. Exemple.	3 Hours

References:

Edward M. Purcell, Electricitate şi Magnetism, Berkeley Physics Course, Vol. II, Editura Didactică şi Pedagogică, Bucureşti, 1982.
R. P. Feynman, R. B. Leighton, M. Sands, The Feynman Lectures on Physics, Vol. 2, Addyson-Wesley, 1964.
S. Antohe, Electricitate şi Magnetism, Vol.1, Editura Universitatii din Bucureşti (1999); ISBN: 973-575- 326-X; S.
S. Antohe, Electricitate şi Magnetism, Vol.II, , Editura Universitatii din Bucureşti (2002), ISBN: 973-575-326-1 (2002)
Suporturi pentru curs:
P. Cristea, Electricitate şi magnetism, note de curs (pdf)
P. Cristea, cursuri de electricitate online (înregistrare video)

7.2 Tutorials	**Teaching techniques**	**Observations**
Calculul intensităţii electrice şi al potenţialului pentru distribuţii discrete de sarcină. Rezolvări de probleme.	Expunere şi activitate dirijată	1 Hour
Calculul intensităţii electrice şi al potenţialului pentru distribuţii continue de sarcină. Rezolvări de probleme	Expunere şi activitate dirijată	1 Hour
Legea lui Gauss. Aplicaţii la sisteme cu grad înalt de simetrie spaţială. Rezolvări de probleme.	Expunere şi activitate dirijată	2 Hours
Ecuaţiile lui Poisson şi Laplace. Aplicaţii la sisteme cu grad înalt de simetrie spaţială. Rezolvări de probleme.	Expunere şi activitate dirijată	1 Hour
Calculul momentelor dipolare şi interacţia dipolilor electrici. Rezolvări de probleme.	Expunere şi activitate dirijată	1 Hour
Transfigurări triunghi-stea şi stea-triunghi pentru calculul rezistenţei echivalente. Rezolvări de probleme.	Expunere şi activitate dirijată	1 Hour
Calculul coeficienţilor de capacitate şi al coeficienţilor de potenţial. Calculul capacităţilor echivalente. Rezolvări de probleme.	Expunere şi activitate dirijată	1 Hour
Calculul tensiunii şi al rezistenţei Thévenin. Calculul curentului şi conductanţei Norton. Rezolvări de probleme.	Expunere şi activitate dirijată	1 Hour
Aplicarea legilor lui Kirchhoff. Rezolvări de probleme	Expunere şi activitate dirijată	2 Hours

Aplicaţii ale legii Biot-Savart. Calculul inducţiei magnetice şi al potenţialului magnetic vector. Rezolvări de probleme	Expunere şi activitate dirijată	1 Hour
Calculul impedanţelor şi al diagramelor fazoriale pentru circuite CA. Rezolvări de probleme	Expunere şi activitate dirijată	2 Hours

References:

1. I. Secăreanu, V. Ruxandra, M. Logofătu, S. Antohe, Electricitate şi magnetism, Lucrări de laborator, Tipografia Universităţii din Bucureşti, 1988.
2. P. Cristea, Experimente de electricitate şi magnetism (pdf)

7.3 Practicals	Teaching techniques	Observations
Electrizarea prin frecare, influenţă şi contact. Principiul de funcţionare al electroscopului. Principiul de funcţionare al electrometrului.	Activitate practică dirijată	3 Hours
Măsurarea sarcinii electrice şi a potenţialelor cu electrometrul.	Activitate practică dirijată	3 Hours
Interacţiunea electrostatică a sarcinilor punctiforme. Verificarea legii lui Coulomb.	Activitate practică dirijată	3 Hours
Experimentul lui Millikan. Cuantificarea sarcinii electrice.	Activitate practică dirijată	3 Hours
Studiul condensatorului cu plăci plan-paralele. Capacitatea electrică a condensatoarelor. Măsurarea constantei dielectrice a diferitelor materiale (sticlă, plexiglas, plastic,ceramică).	Activitate practică dirijată	3 Hours
Utilizarea voltmetrelor şi ampermetrelor. Metodele amonte şi aval de măsurare a rezistenţei electrice.	Activitate practică dirijată	3 Hours
Măsurarea rezistivităţii electrice a metalelor (Al, Cu).	Activitate practică dirijată	3 Hours
Măsurători potenţiometrice. Măsurarea precisă a tensiunilor electromotoare.	Activitate practică dirijată	3 Hours
Efecte tranzitorii în circuite RC şi RLC	Activitate practică dirijată	3 Hours
Legea lui Biot şi Savart. Măsurarea inducţiei magnetice.	Activitate practică dirijată	3 Hours
Studiul câmpului magnetic terestru. Determinarea componentelor orizontală şi verticală a inducţiei magnetice terestre.	Activitate practică dirijată	3 Hours
Forţa Lorentz. Măsurarea sarcinii specifice e/m a electronului.	Activitate practică dirijată	3 Hours
Inducţia electromagnetică. Verificarea experimentală a legii inducţiei electromagnetice	Activitate practică dirijată	3 Hours
Fenomene de rezonanţă în circuite RLC serie şi paralel.	Activitate practică dirijată	3 Hours

References:

1. I. Secăreanu, V. Ruxandra, M. Logofătu, S. Antohe, Electricitate şi magnetism, Lucrări de laborator, Tipografia Universităţii din Bucureşti, 1988.
2. P. Cristea, Experimente de electricitate şi magnetism (pdf)

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

Cursul dezvoltă competenţe specifice teoretice şi practice în domeniul fenomenelor electrice şi al electromagnetismului. Conţinutul prelegerilor corespunde tuturor standardelor naţionale, europene sau din ţări cu tradiţie şi calitate recunoscută a instrucţiei în domeniu. De asemenea, metodele de predare şi conţinutul au fost alese în concordanţă cu prelegeri similare din universităţi cunoscute din Romania, Uniunea Europeană sau universităţi de top din Statele Unite ale Americii. Prelegerile şi experimentele propuse pentru formarea abilităţilor experimentale satisfac standarde de înaltă calitate educaţională şi corespund aşteptărilor şi cerinţelor principalilor angajatori ai absolvenţilor (industrie, sănătate, cercetare, – de exemplu Institutul Naţional pentru Fizica Materialelor, învăţământ-gimnaziu si colegii sau licee de specialitate).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	- Claritatea, coerenţa şi concizia expunerii teoretice; - Utilizarea corectă a relaţiilor de calcul; - Rezolvarea corectă a problemelor propuse;	Examen scris	60%
Tutorial	- Grad de participare - Capacitatea de aplicare a legilor electromagnetismului	Rezolvarea temelor pentru acasă	10%
Practical	- Cunoaşterea şi utilizarea tehnicilor experimentale; - Interpretarea consistentă a rezultatelor; - Redactarea corectă a referatelor asupra experimentelor	Colocviu de laborator	30%
Minimal requirements for passing the exam	Frecventarea obligatorie a 50% din cursuri, frecventarea obligatorie a tuturor activităţilor de laborator, seminar şi prezentarea tuturor referatelor finale. Obţinerea mediei 5 - Frecventarea tuturor activităţilor de laborator şi prezentarea referatelor finale cu prelucrarea datelor. - Tratarea completă şi corectă a unui subiect teoretic şi soluţii corecte la 2 dintre problemele propuse la examenul scris. Obţinerea notei 10: - Abilităţi, cunoştinţe profund argumentate - Capacitate demonstrată de analiză a fenomenelor şi proceselor, rezolvarea corecta a tuturor subiectelor		

Date,

25.09.2026

Teacher's
name and signature,
Lect. dr. Cezar Tăzlăoanu

Practicals/Tutorials/Project instructor(s),
name and signature
Lect. dr. Cezar Tăzlăoanu

Conf.dr. Sorina Iftimie

Date of approval

28.09.2026

Head of department
name and signature
Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOB.116.P Processing of physical data and numerical methods / Procesarea datelor fizice şi metode numerice

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Processing of physical data and numerical methods / Procesarea datelor fizice şi metode numerice				
2.2. Teacher			Lect.dr.Roxana Zus				
2.3. Tutorials/Practicals instructor(s)			Lect.dr.Cristian Iorga				
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	colocviu	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	42	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					14
Research in library, study of electronic resources, field research					8
Preparation for practicals/tutorials/projects/reports/homework					7
Tutorat					0
Other activities					4
3.7. Total hours of individual study					33
3.8. Total hours per semester					75
3.9. ECTS					3

4. Prerequisites (if necessary)

4.1. curriculum	Programming Languages, Algebra, Analysis, Differential Equations
4.2. competences	Knowledge of programming, linear algebra, analysis, differential equations

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Computer, Video projector Lecture notes Bibliography
5.2. for tutorials/practicals	Computer network Lecture notes Bibliography

6. Learning outcomes

Knowledge	R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations.
Skills	R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework.
Responsibility and autonomy	R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Solution of Linear Algebraic Equations Direct Methods: Gaussian Elimination, LU decomposition Iterative Methods: Jacobi, Gauss-Seidel, Singular value decomposition	Systematic exposition - lecture. Critical analysis. Examples	3 Hours

Non-linear Equations and Roots of Polynomials Fixed point method, Bisection method, Newton-Raphson method, False Positon Method Secant Method, Laguerre's method of calculating polynomial roots	Systematic exposition - lecture. Critical analysis. Examples	3 Hours
Function approximation Polynomial interpolation: Lagrange, Newton Continuous least squares approximation (orthogonal polynomials, trigonometric polynomials) Discrete least squares approximation (least squares approximations, discrete orthogonal polynomials, Chebyshev)	Systematic exposition - lecture. Critical analysis. Examples	3 Hours
Numerical Evaluation of Derivatives and integrals Direct derivation. Derivation by interpolation. Classical formulas (the rectangle method, the trapezoidal method, Simpson method etc) Gauss Integration (Legendre, Hermite, Laguerre, Chebyshev) Monte-Carlo methods	Systematic exposition - lecture. Critical analysis. Examples	3 Hours
6. Numerical Solution of Ordinary Differential Equations Direct Methods for Initial Value Problems Euler's Method of order I Euler's Method of order II Runge-Kutta Methods	Systematic exposition - lecture. Critical analysis. Examples	2 Hours

References:

-K. Atkinson, "An Introduction to Numerical Analysis", 2nd ed., John WileyPub., 1989
- William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", 3rd ed.,Cambridge University Press, 2007
-R. Burden, J. D. Faires, "Numerical Analysis", Thomson Brooks/Cole, 2010
-George W. Collins , "Fundamental Methods and Data Analysis", 2003
-Morten Hjorth-Jensen , "Computational Physics", University of Oslo, 2006
-C.Brebente, S.Mitran, S.Zancu, "Metode Numerice", Ed.Tehnică, 1997
-Roxana Zus, Lecture notes (pdf)

7.3 Practicals	**Teaching techniques**	**Observations**
Environment for programming the numerical methods exposed in the lecture	Systematic exposition. Heuristic conversation. Guided practical activity	2 Hours
Programming the methods for solving linear algebraic equations. Applications in physics.	Guided practical activity	6 Hours
Programming the methods for solving non-linear equations and finding roots of polynomials. Applications in physics.	Guided practical activity	6 Hours
Interpolation and extrapolation of data points. Function approximation.	Guided practical activity	4 Hours
Numerical derivation.	Guided practical activity	2 Hours
Programming the methods for numerical solution of integrals. Applications in physics.	Guided practical activity	6 Hours
Programming the methods for numerical solution of ordinary differential equations. Applications in physics.	Guided practical activity	2 Hours

References:

Bibliography:
- William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", 3rd ed.,Cambridge University Press, 2007
- R. Burden, J. D. Faires, "Numerical Analysis", Thomson Brooks/Cole, 2010
- George W. Collins , "Fundamental Methods and Data Analysis", 2003
- Morten Hjorth-Jensen , "Computational Physics", University of Oslo, 2006
- Roxana Zus, Adrian Stoica, laboratory notes in electronic format

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical and practical competences and abilities, which are important for an undergraduate student in the field of modern Physics, corresponding to national and international standards. The contents and the teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or from the European Union. The contents are in line with the requirements of the main employers of the graduates (industry, research, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	The understanding and correct use of the theoretical knowledge, clarity of exposition, logical coherence	Written test (final examination) Homework during the lecture	50%
Tutorial	- ability to apply specific methods for a given problem - ability to present and discuss the results	Evaluation through individual homework at the end of the semester	50%
Minimal requirements for passing the exam	Minimal requirements for passing the exam Frequency: 50% lecture attendance and attendance to all tutorials and practicals Requirements for mark 5 (10 points scale) Correct exposition of 50% from the theoretical topics at the final exam. Correct numerical solution of one problem at the final exam.		

Date, 8.09.2026	Teacher's name and signature, Lect.dr.Roxana Zus	Practicals/Tutorials/Project instructor(s), name and signature Lect.dr.Cristian Iorga
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.117.P Foreign language II

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Foreign language II				
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Monica Oanca				
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	colocviu	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	1/0/0
3.4. Total hours per semester	14	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	14/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					18
Research in library, study of electronic resources, field research					9
Preparation for practicals/tutorials/projects/reports/homework					9
Tutorat					0
Other activities					0
3.7. Total hours of individual study					36
3.8. Total hours per semester					50
3.9. ECTS					2

4. Prerequisites (if necessary)

4.1. curriculum	Basic English language skills - A2 level
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	Whiteboard and video projector

6. Learning outcomes

Knowledge	R16. The student/graduate acquires civic competences, especially knowledge of social and political concepts and structures for active and democratic participation of people
Skills	R16. The student/graduate develops communication skills in the mother tongue and/or an international language
Responsibility and autonomy	R16. Spirit of initiative and entrepreneurship – the ability to turn ideas into action

7. Contents

7.2 Tutorials	Teaching techniques	Observations
Motivation to become a physicist	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour

The concept of error	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The rhythm of our life	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The Present Tenses	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Education	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The Past Tenses	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Finding the perfect job	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Distance and displacement	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour

Speed and velocity	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Kinematic equations	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Passive voice	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Causative	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Contrasting ideas	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Student project presentations	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour

References:

1. McCarthy Michael, Felicity O' Dell, English Vocabulary in Use, (Upper Intermediate and Advanced), Cambridge University Press, 2002, 2005.
2. McCarthy Michael, Felicity O' Dell, Test your English V

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The seminars follow the format of foreign language seminars within the University of Bucharest and are in accordance with international standards regarding the level of language competences.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Tutorial	Knowledge, understanding, and correct use of the grammar and vocabulary concepts discussed during the seminars	• Assessment through written tests (40%) • Assessment through oral tests (40%) • Portfolio (20%)	100%
Minimal requirements for passing the exam	To obtain a grade of 5 (Passing grade): • Correct acquisition of minimal English language knowledge, B1 level • Correct use of the main grammar concepts • Correct use of specialized terminology • Completion of all homework assignments To obtain a grade of 10 (Highest grade): • Correct resolution of all exam questions/topics • Solid reasoning to substantiate the acquired knowledge		

Date,

25.09.2026

Practicals/Tutorials/Project instructor(s), name and signature

Lect. dr. Monica Oanca

Date of approval

28.09.2026

Head of department name and signature

Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOB.119.P Sports I / Educaţie fizică I

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	
1.3. Department	Department of Physical Education and Sports
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Sports I / Educaţie fizică I				
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)			Lector univ. dr. Cătălin Şerban				
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	verificare	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	1/0/0
3.4. Total hours per semester	14	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	14/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					2
Research in library, study of electronic resources, field research					3
Preparation for practicals/tutorials/projects/reports/homework					6
Tutorat					0
Other activities					0
3.7. Total hours of individual study					11
3.8. Total hours per semester					25
3.9. ECTS					1

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R16. The student/graduate acquires civic competences, especially knowledge of social and political concepts and structures for active and democratic participation of people
Skills	R16. The student/graduate develops communication skills in the mother tongue and/or an international language
Responsibility and autonomy	R16. Spirit of initiative and entrepreneurship – the ability to turn ideas into action

7. Contents

7.2 Tutorials	Teaching techniques	Observations
Introductory lecture	Lecture / Presentation. Practical exercises.	1 Hour
Initial assessment	Lecture / Presentation. Practical exercises.	1 Hour
Technique consolidation: aerobics and fitness	Lecture / Presentation. Practical exercises.	3 Hours
Consolidation of core ball-handling technical elements (volleyball, handball)	Lecture / Presentation. Practical exercises.	5 Hours

Consolidation of core collective offensive and defensive tactical actions (volleyball, handball)	Lecture / Presentation. Practical exercises.	4 Hours

References:

1. Ganciu, M., (coord), colectiv DEFS, 2013, Curs de educaţie fizică pentru studenţii Universităţii din Bucureşti, Editura Universităţii din Bucureşti, Bucureşti
2. Ganciu, M., Aducovschi, D., Gozu, B., Stoica, A.M., Stoicoviciu, A., Gulap, M., Cristea, M., 2010, Activitatea fizică independentă şi valorificarea prin mişcare a timpului liber – Vol.I, Editura Universităţii din Bucureşti, Bucureşti
3. Stoica, A., 2011, Curs practic de gimnastică aerobică pentru studenţii din Universitatea din Bucureşti. Editura Universităţii din Bucureşti

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

Physical education constitutes a social activity with outstanding contributions to the social and professional integration of youth. The formative function of physical education will contribute to the development of these qualities and capacities, enabling the future specialist to master their chosen profession as quickly and effectively as possible, to practice it with high efficiency, to engage in various social activities, and to act independently and creatively upon both the environment and themselves.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Tutorial	• Interest shown in the course through systematic participation in practical lessons • Initial and intermediate assessment through tests and control trials • Participation in sports competitions	Individual assessment	100%
Minimal requirements for passing the exam	• Participation in 50% of the total number of lessons • Passing the motor skill trials • Participation in a sports competition • Demonstrating a minimum mastery of the general concepts of physical education and sports		

Date,

8.09.2026

Practicals/Tutorials/Project instructor(s), name and signature

Lector univ. dr. Cătălin Şerban

Date of approval

17.09.2026

Head of department name and signature

Syllabus

Academic year 2026/2027
DOB.120.P Sports II / Educaţie fizică II

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	
1.3. Department	Department of Physical Education and Sports
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Sports II / Educaţie fizică II				
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)			Lector univ. dr. Cătălin Șerban				
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	verificare	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	1/0/0
3.4. Total hours per semester	14	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	14/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					2
Research in library, study of electronic resources, field research					3
Preparation for practicals/tutorials/projects/reports/homework					6
Tutorat					0
Other activities					0
3.7. Total hours of individual study					11
3.8. Total hours per semester					25
3.9. ECTS					1

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R16. The student/graduate acquires civic competences, especially knowledge of social and political concepts and structures for active and democratic participation of people
Skills	R16. The student/graduate develops communication skills in the mother tongue and/or an international language
Responsibility and autonomy	R16. Spirit of initiative and entrepreneurship – the ability to turn ideas into action

7. Contents

7.2 Tutorials	Teaching techniques	Observations
Introductory lecture	Lecture / Presentation. Practical exercises.	1 Hour
Initial assessment	Lecture / Presentation. Practical exercises.	1 Hour
Technique consolidation: aerobics and fitness	Lecture / Presentation. Practical exercises.	3 Hours
Consolidation of core ball-handling technical elements (volleyball, handball)	Lecture / Presentation. Practical exercises.	5 Hours

Consolidation of core collective offensive and defensive tactical actions (volleyball, handball)	Lecture / Presentation. Practical exercises.	4 Hours

References:

1. Ganciu, M., (coord), colectiv DEFS, 2013, Curs de educaţie fizică pentru studenţii Universităţii din Bucureşti, Editura Universităţii din Bucureşti, Bucureşti
2. Ganciu, M., Aducovschi, D., Gozu, B., Stoica, A.M., Stoicoviciu, A., Gulap, M., Cristea, M., 2010, Activitatea fizică independentă şi valorificarea prin mişcare a timpului liber – Vol.I, Editura Universităţii din Bucureşti, Bucureşti
3. Stoica, A., 2011, Curs practic de gimnastică aerobică pentru studenţii din Universitatea din Bucureşti. Editura Universităţii din Bucureşti

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

Physical education constitutes a social activity with outstanding contributions to the social and professional integration of youth. The formative function of physical education will contribute to the development of these qualities and capacities, enabling the future specialist to master their chosen profession as quickly and effectively as possible, to practice it with high efficiency, to engage in various social activities, and to act independently and creatively upon both the environment and themselves.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Tutorial	• Interest shown in the course through systematic participation in practical lessons • Initial and intermediate assessment through tests and control trials • Participation in sports competitions	Individual assessment	100%
Minimal requirements for passing the exam	• Participation in 50% of the total number of lessons • Passing the motor skill trials • Participation in a sports competition • Demonstrating a minimum mastery of the general concepts of physical education and sports		

Date,

8.09.2026

Practicals/Tutorials/Project instructor(s), name and signature

Lector univ. dr. Cătălin Șerban

Date of approval

17.09.2026

Head of department name and signature

Syllabus

Academic year 2026/2027
DOB.201.P Optics / Optică

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Optics / Optică				
2.2. Teacher			Conf. Dr. Ovidiu TOMA				
2.3. Tutorials/Practicals instructor(s)			Conf. Dr. Ovidiu TOMA				
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	7	3.2. Lectures	3	3.3. Tutorials/Practicals/Projects	1/3/0
3.4. Total hours per semester	98	3.5. Lectures	42	3.6. Tutorials/Practicals/Projects	14/42/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					39
Research in library, study of electronic resources, field research					19
Preparation for practicals/tutorials/projects/reports/homework					19
Tutorat					0
Other activities					0
3.7. Total hours of individual study					77
3.8. Total hours per semester					175
3.9. ECTS					7

4. Prerequisites (if necessary)

4.1. curriculum	Geometry, Trigonometry, Mathematical analysis, Classic mechanics, Equations of mathematical physics, Electricity
4.2. competences	Knowledge of the trigonometrical functions and relations. Knowledge and use of the harmonic oscillator equations and the mechanical waves equations. Capability of mathematical (computational) modelling of oscillating phenomenon.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia equipped class (videoprojector) Lecture notes Recommended bibliography.
5.2. for tutorials/practicals	Laboratory of optics with experimental works of geometrical optics, photometry, interference, diffraction, polarization, thermal radiation.

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics).
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Evolution of optics knowledge. Induction and deduction in knowledge. Foundamentals of geometrical optics. Eikonal equation. Lagrange integral invariant. Fermat principle. Lagrangian formulation of optics. Ray equation.	Systematic exposition - lecture. Heuristic conversation. Experiment. Examples.	3 Hours

LAWS AND PRINCIPLES OF GEOMETRICAL OPTICS - Law of reflection; Law of refraction; Total reflection; Laws and principles of geometrical optics APPLICATIONS OF TOTAL REFLECTION - Evanescent waves; Guided waves, optical waveguide, end coupling, guided modes; Total reflection prisms	Systematic exposition - lecture. Heuristic conversation. Experiment. Examples.	3 Hours
LIGHT RAYS AND IMAGINES - Graphical ray-trace method; PLANE SURFACES - Plane mirror; Plane-parallel plate; Prism SPHERICAL SURFACES- Parabolic mirrors; Spherical mirrors; Mirror aberrations; Spherical transmission surfaces (diopters)	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples.	3 Hours
Thin lenses, types of lenses. Graphical ray-trace method. Lens makers formula. Conjugate point formula. Cardinal point formula. Linear systems - point spread function. Optical transfer function.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples.	3 Hours
OPTICAL ABERRATIONS - Geometric aberrations of point images MATRIX FORMULATION OF GEOMETRICAL OPTICS - Basic formula; Spherical surfaces; Thick lens; Optical systems	Systematic exposition - lecture. Heuristic conversation. Examples.	3 Hours
IDEAL OPTICAL SYSTEMS - Fundamental relations for ideal systems OPTICAL INSTRUMENTS - Basic characteristics; Fundamental optical instruments: Magnifying glass: Optical microscope; Refracting telescope; Photo camera; Human eye	Systematic exposition - lecture. Heuristic conversation. Examples.	3 Hours
PHOTOMETRY- Physical quantities, measurements and units of measure; Reflection, transmission and absorption coefficients. COLORIMETRY - CIE standard; Additive color model; Subtractive color model; Color space, additive color mixing	Systematic exposition - lecture. Examples.	3 Hours
Light as electromagnetic wave. Maxwell equations in optical media. Wave equation. Plane waves and spherical waves.	Systematic exposition - lecture. Heuristic conversation. Modelling (TIC). Case studies. Examples	2 Hours
Phase speed and group speed. Rayleigh relation. Theory of light dispersion. Complex refractive index. Optical constants (refractive index and extinction coefficient).	Systematic exposition - lecture. Heuristic conversation. Modelling (TIC). Case studies. Examples	2 Hours
Light interference. Coherent waves. Young double slit experiment. Fringe spacing calculus. Interference in white light. Interference by wave-front division. Young-Fresnel devices.	Systematic exposition - lecture. Heuristic conversation. Modelling (TIC). Examples	2 Hours
Interference by amplitude division. Interference devices. Fringes classification (equal thickness, equal inclination). Newton rings. Two beams interferometry. Michelson interferometer.	Systematic exposition - lecture. Heuristic conversation. Modelling (TIC). Examples	3 Hours

Light diffraction. Fresnel diffraction (divergent light). Fresnel zones. Fraunhofer diffraction (parallel light) on filiform slit, circular slit, double slit and plane diffraction gratings. Resolution of optical instruments (Abbe's relation).	Systematic exposition - lecture. Heuristic conversation. Critical analyzes. Examples	5 Hours
Light polarization. Light polarization by reflection and refraction. Malus and Brewster experiments. Light polarization by double refraction (birefringence). Polarizing prisms. Light polarization by dichroism and light scattering.	Systematic exposition - lecture. Heuristic conversation. Modelling (TIC). Critical analyzes. Examples	3 Hours
Elliptically polarized light (interference in polarized light). Artificial birefringence. Optical activity (rotatory polarization) in optical media (solids and liquids). Light propagation in isotropic media. Fresnel relations. Thermal radiation. Photometric study of black-body as a Lambert surface. Deduction of Wien displacement law and Stefan-Boltzmann law.	Systematic exposition - lecture. Heuristic conversation. Modelling (TIC). Critical analyzes. Examples	4 Hours

References:

Geometrical Optics, Mircea Bulinski , Editura Universitatii Bucuresti (2014);
I.I. Popescu, "Optica geometrica" Vol. I Tipografia Universitatii din Bucuresti (1988). St.Levai, M.Bulinski, O.Toma, "Optica", Editura Universitatii din Bucuresti (2005)
Iulian Ionita – Optica ondulatorie, http://www.fizica.unibuc.ro/Fizica/Studenti/Cursuri/Main.php-
F. Pedrotti, L. Pedrotti, Introduction to Optics, Prentice Hall, New Jersey, 1993
E. Hecht, Optics, Addison-Wesley, 2002
M. Born, E.Wolf, "Principles of Optics", Cambridge University Press (1998)
M. Giurgea, L.Nasta, Optica Editura Academiei Române, Bucuresti, 1998.
G. Bratescu, Optica, Editura Didactica si Pedagogica, Bucuresti, 1982
I. Iova, Elemente de optica aplicata, Editura stiintifica si enciclopedica, Bucureşti, 1977

7.2 Tutorials	Teaching techniques	Observations
Centered optical systems. Exercises and problems.	Tutorials	3 Hours
Photometry and radiometry. Exercises and problems.	Tutorials	2 Hours
Optical instruments. Exercises and problems.	Tutorials	2 Hours
Interference of light. Exercises and problems.	Tutorials	3 Hours
Diffraction of light. Exercises and problems.	Tutorials	2 Hours
Polarization of light. Exercises and problems.	Tutorials	2 Hours

References:

Ovidiu Toma, Doina Bejan, Marian Bazavan, Iulian Ionita, Mircea Bulinski, "Geometrical Optics, Practical Works, Exercises and Problems" Editura Universitatii Bucuresti (2021);
D.Bejan, M.Bazavan, I.Ionita, O.Toma, M.Bulinski, I.Gruia, "Lucrari practice de optica geometrica", Editura Universitatii din Bucuresti (2013).
D Bejan, M. Bazavan, I. Ionita, O. Toma - Lucrari Practice de Optica Ondulatorie, Ed. Unibuc. Buc, Bucuresti, 2013.
St.Levai, A.Ioan, L.Nasta, Optica. Exercitii si probleme, Tipografia Universitatii din Bucuresti (1984)

7.3 Practicals	Teaching techniques	Observations
Reflection and refraction laws.	Guided practical activity	2 Hours
Measurement of focal distance at converging lenses, diverging lense and concave mirrors.	Guided practical activity	4 Hours
The determination of cardinal elements of centered optical systems. Spherical aberration. Measurement of focal distance at a lens with high convergence.	Guided practical activity	4 Hours

The study of optical prism; measurement of refractive index by minimum deviation method. Measurement of the refractive index at liquids with Abbe refractometer.	Guided practical activity	4 Hours
Laws of photometry. Measurement of integral light flux of a light source using Ulbricht integrating sphere.	Guided practical activity	3 Hours
Determination of transmission curve with Pulfrich spectrophotometer.	Guided practical activity	2 Hours
Optical microscope – measurement of angular Magnification (grosissment). Refracting telescope – measurement of grosisment.	Guided practical activity	2 Hours
Interference of light. Young-Fresnel devices (Billet double-lens, Fresnel biprism).	Guided practical activity	3 Hours
Michelson interferometer.	Guided practical activity	2 Hours
Diffraction on filiform slit. Experimental verification of Fraunhofer intensity distribution. Plane diffraction grating. Determining the grating's frequency.	Guided practical activity	4 Hours
Malus law. Determination of the polarization degree at a laser diode. Photoelasticity	Guided practical activity	4 Hours
The study of rotatory polarization at solids.	Guided practical activity	2 Hours
The study of rotatory polarization at liquids. Laurent polarimeter.	Guided practical activity	2 Hours
Thermal radiation; Stefan-Boltzmann law. Wien's displacement law.	Guided practical activity	4 Hours

References:

Ovidiu Toma, Doina Bejan, Marian Bazavan, Iulian Ionita, Mircea Bulinski, "Geometrical Optics, Practical Works, Exercises and Problems" Editura Universitatii Bucuresti (2021);
D.Bejan, M.Bazavan, I.Ionita, O.Toma, M.Bulinski, I.Gruia, "Lucrari practice de optica geometrica", Editura Universitatii din Bucuresti (2013).
D Bejan, M. Bazavan, I. Ionita, O. Toma - Lucrari Practice de Optica Ondulatorie, Ed. Unibuc. Buc, Bucuresti, 2013.
St.Levai, A.Ioan, L.Nasta, Optica. Exercitii si probleme, Tipografia Universitatii din Bucuresti (1984)

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The discipline content is based on a tradition of over 150 years of teaching Optics at University of Bucharest, improved and correlated with todays directions of development in optics as presented in the papers and conferences of international societies OSA and SPIE. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union (Rochester Institute of Optics, Rochester University). The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, secondary school teaching – INFLPR, INFM, INOE, IOR as the main employers of our graduates with competences in Optics).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition correct use of equations/mathematical methods/physical models and theories ability to indicate/analyse specific examples	Final written evaluation: Test of theoretical knowledges and applied problems.	70%
Practical	- Applying specific methods of solving the given problem; - Results interpretation;	Evaluation by practical test	30%

Minimal requirements for passing the exam	Mandatory attendance: 50% from lectures and all practicals completed. • At least mark 5 at the end of evaluation.

Date, 8.09.2026	Teacher's name and signature, Conf. Dr. Ovidiu TOMA	Practicals/Tutorials/Project instructor(s), name and signature Conf. Dr. Ovidiu TOMA
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.202.P Analytical mechanics / Mecanica analitică

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Analytical mechanics / Mecanica analitică				
2.2. Teacher			Prof. Iulia Ghiu				
2.3. Tutorials/Practicals instructor(s)			Lect. Andreea Croitoru				
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	2/0/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	28/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					35
Research in library, study of electronic resources, field research					17
Preparation for practicals/tutorials/projects/reports/homework					17
Tutorat					0
Other activities					0
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Mechanics, Electricity and magnetism, Algebra, Real and complex analysis, Equations of mathematical physics
4.2. competences	A good level of algebra, geometry, trigonometry, real and complex analysis

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia infrastructure (video projector, PC).
5.2. for tutorials/practicals	Multimedia infrastructure (video projector, PC).

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R14. The student/graduate knows the basic vocabulary and specialized terminology in a foreign language in the field of physics, the structure of scientific texts and international academic communication formats.

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R14. The student/graduate is able to read, understand and translate specialized texts, extract relevant information from international scientific sources and communicate orally and in writing in an autonomous and professional manner.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R14. The student/graduate uses information sources responsibly, respecting the norms of academic ethics and demonstrating initiative in learning the scientific language of the specialty.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Constraints. The d'Alembert principle. Generalized forces	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Lagrange equations. Lagrange equations for systems with potential applied forces. The Lagrange function. The analytic structure of the kinetic energy. Generalized momenta and cyclic coordinates. Conservation of energy	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
Modification of the Lagrange function leaving the Lagrange equations unchanged. Plane pendulum: the Lagrange function, the Lagrange equation, the tension force in the cord, the period of oscillation	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	3 Hours
Equilibrium configuration. Small oscillations: Lagrange equations, normal frequencies	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
The Hamilton function. Hamilton equations. Modification of the Hamilton function induced by a physically irrelevant change of the Lagrange function. Variation of a dynamical variable. The Poisson bracket	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	3 Hours
Properties of the Poisson brackets. The fundamental Poisson brackets. Poisson's theorem. The Hamilton function expressed using the spherical coordinates	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
The electromagnetic potentials. The Lorentz force expressed in terms of the electromagnetic potentials	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
The Lagrange function for a charged particle in an electromagnetic field. The Hamilton function for a charged particle in an electromagnetic field. Modification of the Lagrange function and Hamilton function induced by a gauge transformation	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Two-body problem. Central field of force: general feature of the trajectory. Central field: the Lagrange function. Conservation laws	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	2 Hours

The radial equation. The Binet's equation. The effective potential energy of a particle in a repulsive Coulomb field. The effective potential energy of a particle in an attractive Coulomb field. The equation of the trajectory for a particle in a Coulomb field. Analysis of the trajectory. The study of the elliptic motion of a particle in a Coulomb field	Systematic exposition – lecture. Heuristic conversation. Critical analysis. Examples	4 Hours

References:

1. H. Goldstein, C. Poole, J. Safko, Classical Mechanics, 3rd Edition, Addison-Wesley, 2001.
2. I. Merches , L. Burlacu, Applied analytical mechanics, "The Voice of Bucovina" Press, 1995.
3. T. Kibble, F. Berkshire, Classical Mechanics, 5th Edition, Imperial College Press, 2004.

7.2 Tutorials	**Teaching techniques**	**Observations**
Lagrange formalism	Problem solving. Guided work	8 Hours
Small oscillations	Problem solving. Guided work	4 Hours
Hamilton formalism	Problem solving. Guided work	8 Hours
The motion of a particle in a central field	Problem solving. Guided work	8 Hours

References:

I. Merches , L. Burlacu, Applied analytical mechanics, "The Voice of Bucovina" Press, 1995.
2. Burlacu, D. David, Probleme de mecanica analitica, Editura Universitatii din Bucuresti, 1988.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical competences and abilities which are important for an undergraduate student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Understanding the basic concepts of Analytical Mechanics - Correct use of equations and physical models	Written examination	100%
Minimal requirements for passing the exam	Attending minimum 50 % of the lectures and 50 % of the tutorials. Requirements for getting mark 5 Minimum 50 % of the requirements for the final mark. Requirements for getting mark 10 Correct answer to all the subjects, skills, well-argued knowledge.		

Date, 8.09.2026	Teacher's name and signature, Prof. Iulia Ghiu	Practicals/Tutorials/Project instructor(s), name and signature Lect. Andreea Croitoru
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.203.P Electrodynamics and theory of relativity I / Electrodinamica şi teoria relativităţii I

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Electrodynamics and theory of relativity I / Electrodinamica şi teoria relativităţii I				
2.2. Teacher			Conf. Madalina Boca				
2.3. Tutorials/Practicals instructor(s)			Lector Virgil V. Baran				
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	2/0/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	28/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					35
Research in library, study of electronic resources, field research					17
Preparation for practicals/tutorials/projects/reports/homework					17
Tutorat					0
Other activities					0
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R12. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R14. The student/graduate knows the basic vocabulary and specialized terminology in a foreign language in the field of physics, the structure of scientific texts and international academic communication formats. R15. The student understands and appropriates the professional ethics and ethical practices that characterize the scientific and academic community.
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards. R12. The student/graduate develops personal, interpersonal, and intercultural competencies through involvement in activities that promote self-awareness, empathy, effective communication, respect for diversity, and collaboration with individuals from different cultural backgrounds to achieve objectives. R14. The student/graduate is able to read, understand and translate specialized texts, extract relevant information from international scientific sources and communicate orally and in writing in an autonomous and professional manner. R15. The student applies ethical principles in professional work, and respects intellectual property rights

Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python). R12. The student/graduate becomes aware of responsibly assuming risks by taking initiatives, making decisions in uncertain situations, and managing consequences in an ethical and constructive manner. R14. The student/graduate uses information sources responsibly, respecting the norms of academic ethics and demonstrating initiative in learning the scientific language of the specialty. R15. The student applies independently ethical behaviors and skills including critical thinking, methodological rigor, professional integrity and responsibility towards the environment and community

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
1. The fundamental laws of electromagnetism. Generalization of the equations of the stationary field to the time-dependent case. The Maxwell equations for the electromagnetic field in vacuum. The local and integral form of electromagnetism lows.	Systematic exposition - lecture. Examples	5 Hours
2. Electric field of volume charge distributions. The Poisson equation for the electric potential. Green's Theorem. The boundary value problems for the Poisson equation; Dirichlet and Neumann boundary conditions. The uniqueness theorem. General methods for solving the Poisson equation. Conservation of the electric charge; continuity equation.	Systematic exposition - lecture. Examples	2 Hours
3. The magnetic field of current distributions. The equations of the magnetic field in vacuum in the stationary regime. Volume distribution of currents. Integral representation of the vector potential.	Systematic exposition - lecture. Examples	2 Hours
4. Electrodynamics potentials. Gauge transformations, equations of the potentials, retarded and advanced potentials.	Systematic exposition - lecture. Examples	2 Hours
5. General theorems of the electromagnetic field. Theorem of the energy of the electromagnetic field in vacuum (Poynting). Theorems of the kinetic and angular momentum of the electromagnetic field in vacuum.	Systematic exposition - lecture. Examples	3 Hours
6. Multipole analysis of the electromagnetic field. Multipole expansion of retarded potentials. Electric and magnetic multipoles. Averaging of the microscopic electromagnetic field equations. Maxwell's equations in polarizable / magnetizable media. P, D, M, H, vectors. The discontinuity of the electromagnetic field at the interface between two different media. Energy, force and torque exerted by an external field on a localized system of charges and currents	Systematic exposition - lecture. Examples	7 Hours

7. Radiation of localized systems of charges and currents. The field and radiation of simple charge and current distributions. Dipole approximation. Types of antennas.	Systematic exposition - lecture. Examples	2 Hours
8. Propagation of the electromagnetic field. Properties of plane electromagnetic waves; the monochromatic case (phase, wavelength, frequency, polarization). The laws of reflection and refraction. Snell's law. Total internal reflection. Fresnel's relations for an arbitrary angle. Polarization by reflection. Reflection and transmission coefficients.	Systematic exposition - lecture. Examples	5 Hours

References:

M. Maggiore, A Modern Introduction to Classical Electrodynamics, Oxford University Press, 2023
W. Nolting, Electrodynamics, Springer International Publishing, 2016
A. Zangwill, Modern Electrodynamics, Cambridge university press, 2013
D. Griffiths, Introduction to electrodynamics, Pearson, 2013
J. D. Jackson, Classical Electrodynamics, Wiley, 2009
C. Vrejoiu, Editura Universitatii din Bucuresti, Electrodinamica si teoria relativitatii, 1993

7.2 Tutorials	**Teaching techniques**	**Observations**
1. Elements of field theory and vector and differential calculus (grad, div, rot and curl). Curvilinear orthogonal coordinates. Differential operators in curvilinear coordinates (spherical, cylindrical, polar).	Problem solving. Guided work. Case study. Examples.	2 Hours
2. Point-like, linear, surface charge distributions written as generalized volume densities. The Dirac distribution and its properties	Problem solving. Guided work. Case study. Examples.	2 Hours
3. Calculation of the electric potenţial in the presence of a conductor using the expansion of the solution in the basis of complete sets of special functions and orthogonal polynomials. Spherical functions, Legendre polynomials, Bessel functions. The solutions of the Sturm Liouville problem for the Legendre and Bessel equations. Completeness, orthogonality, integral representations, generating functions, recurrence relations. Green function method.	Problem solving. Guided work. Case study. Examples.	4 Hours
4. Multipole expansion of the electric and magnetic potential. Electric and magnetic multipoles. The energy, force and torque exerted by an external field on multipole systems. Spherical multipoles	Problem solving. Guided work. Case study. Examples.	4 Hours
5. Computation of the magnetic field of given current distributions using the method of the scalar and vector potential. The magnetic field of linear, surface and volume current distributions (in the volume and on the surface of a sphere/cylinder).	Problem solving. Guided work. Case study. Examples.	4 Hours
6. Conservation laws in electrodynamics. Computation of the energy, momentum and angular momentum of various electromagnetic field configurations with spherical, planar and cylindrical symmetries in vacuum.	Problem solving. Guided work. Case study. Examples.	4 Hours
7. Electrostatic problems with dielectric bodies. Polarization of a spherical dielectric in an external homogeneous field or in the field of a point-like charge. Polarization surface charge. A point-like electric charge near the plane interface of two adjacent dielectrics. Screening of the electric and magnetic field by a dielectric. Spherical screen.	Problem solving. Guided work. Case study. Examples.	4 Hours
8. Study of the properties of the monochromatic waves. Polarization. Stokes parameters	Problem solving. Guided work. Case study. Examples.	2 Hours

9. The dipole radiation. Linear and circular antenna. The radiation field, angular distribution and total radiated power. Polarization of the radiated field.	Problem solving. Guided work. Case study. Examples.	2 Hours

References:

M. Maggiore, A Modern Introduction to Classical Electrodynamics, Oxford University Press, 2023
W. Nolting, Electrodynamics, Springer International Publishing, 2016
A. Zangwill, Modern Electrodynamics, Cambridge university press, 2013
D. Griffiths, Introduction to electrodynamics, Pearson, 2013
J. D. Jackson, Classical Electrodynamics, Wiley, 2009
C. Vrejoiu, Editura Universitatii din Bucuresti, Electrodinamica si teoria relativitatii, 1993

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical competences and abilities which are fundamental for an undergraduate student in the field of modern physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, academic, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Knowledge of fundamental topics - Assimilation and correct understanding of concepts taught throughout the lectures - Ability to construct mathematically sound theories using the methods taught - Ability to solve problems	Written test and oral examination	75%
Tutorial	- Ability to solve problems	Homeworks	25%
Minimal requirements for passing the exam	Criteria for obtaining mark 5 on a 10 points scale (passing the course): - At least 50% lecture and 70% seminar attendance - Correct solutions for the indicated subjects for obtaining mark 5. Criteria for obtaining mark 10 on a 10 points scale (maximum grade): - Skills, well-argued knowledge - Proven ability to analyze phenomena and processes, correct solutions to all indicated subjects		

Date, 8.09.2026	Teacher's name and signature, Conf. Madalina Boca	Practicals/Tutorials/Project instructor(s), name and signature Lector Virgil V. Baran
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.204.P Fundamentals of atomic physics / Bazele fizicii atomice

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Fundamentals of atomic physics / Bazele fizicii atomice				
2.2. Teacher			Conf.univ.dr. Vasile Bercu				
2.3. Tutorials/Practicals instructor(s)			Asist.univ.dr. Leonard Gebac				
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	1/1/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	14/14/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					35
Research in library, study of electronic resources, field research					17
Preparation for practicals/tutorials/projects/reports/homework					17
Tutorat					0
Other activities					0
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Classical mechanics I,II; Molecular physics and heat I, II; Electricity and magnetism; Real analysis; Optics
4.2. competences	Knowledge of mathematics, classical mechanics, molecular physics and heat

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Amphitheater equipped with multimedia devices (video)
5.2. for tutorials/practicals	Laboratory with experimental set up for atomic experiments computers

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications).
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects).

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Particle-like behavior of radiation - electromagnetic radiation – basic elements - laws of blackbody radiation - rayleigh-Jeans formula for blackbody radiation – the "ultraviolet catastrophe" - Planck's theory of blackbody radiation – Wien's displacement law, Stefan-Boltzmann law	Systematic exposition through lectures	5 Hours
Photons – particle-like properties of radiation - photoelectric effect - Compton effect - continuous spectrum of X-rays - pair production	Systematic exposition, lectures. Critical analysis	4 Hours
Wave properties of particles - de Broglie's hypothesis - electron diffraction - wave-particle duality: wave packets, dispersion of wave packets, uncertainty principle - statistical interpretation of wave packets	Systematic exposition, lecture. Case study.	5 Hours
Structure of atoms - Thomson's model - study of atoms through scattering experiments: scattering cross sections - Rutherford's experiment – probing atoms using alpha particles - Rutherford's atomic model - emission and/or absorption experiments of radiation by atoms	Systematic exposition, lecture. Case study.	5 Hours
Atomic models - Bohr's model for the hydrogen-like atom - Franck-Hertz experiment - correspondence principle - characteristic X-ray spectrum - Wilson–Sommerfeld quantization rules - Bohr–Sommerfeld model	Systematic exposition – lecture. Case study. Critical analyses.	5 Hours
Magnetic properties of atoms - magnetic dipole moment - Stern–Gerlach experiment - electron spin - spin-orbit interaction - total angular momentum - vector model of the atom	Systematic exposition – lecture.	4 Hours

References:

Basics of atomic physics: lecture notes, Vasile Bercu, https:moodle.fizica.unibuc.ro
Atomic and molecular physics, B. H. Bransden si C. J. Joachain, Bucuresti, 1998
Atkins' physical chemistry - Peter Atkins, Julio de Paula, Oxford University Press, 2010
Atoms, Molecules and Photons: An Introduction to Atomic-, Molecular- and Quantum Physics -Wolfgang Demtröder Springer; 2nd ed. 2010
Quantum physics of atoms, molecules, solids, nuclei and particlesRobert Martin Eisberg and Robert Resnick, New York ; John Wiley and Sons, 1974

7.2 Tutorials	Teaching techniques	Observations
Introduction to laboratory work: radiation-matter interaction and detection methods	Combined lecture	2 Hours

Analysis of uncertainties and error calculation. Data processing and reporting of results.	Combined lecture	2 Hours
Blackbody radiation, the photoelectric effect, and the Compton effect. Problems.	Combined lecture	2 Hours
Broglie's hypothesis. Electron diffraction — the wave nature of matter and wave-particle duality. The uncertainty principle. Problems.	Combined lecture	2 Hours
Atomic structure and atomic models. Problems.	Combined lecture	2 Hours
Atoms in a magnetic field. Problems.	Combined lecture	2 Hours
Synthesis problems in atomic physics	Combined lecture	2 Hours

References:

Basics of atomic physics: lecture notes, Vasile Bercu, https:moodle.fizica.unibuc.ro
Atomic and molecular physics, B. H. Bransden si C. J. Joachain, Bucuresti, 1998
Atkins' physical chemistry - Peter Atkins, Julio de Paula, Oxford University Press, 2010
Atoms, Molecules and Photons: An Introduction to Atomic-, Molecular- and Quantum Physics -Wolfgang Demtröder Springer; 2nd ed. 2010
Quantum physics of atoms, molecules, solids, nuclei and particlesRobert Martin Eisberg and Robert Resnick, New York ; John Wiley and Sons, 1974

7.3 Practicals	**Teaching techniques**	**Observations**
Determination of the specific charge of the electron	Supervised practical activity	2 Hours
Photoelectric effect – Determination of Planck's constant	Supervised practical activity	2 Hours
Continuous spectrum emitted by the X-Ray tube. Determination of Planck's constant	Supervised practical activity	2 Hours
The Compton effect	Supervised practical activity	4 Hours
Electron diffraction	Supervised practical activity	2 Hours
The Balmer series. Determination of the Rydberg constant	Supervised practical activity	2 Hours

References:

Fizica atomica:lucrari practice, colectiv de autori: Elena Borca, et al.; Tipografia Universitatii din Bucuresti, 1984
Lucrari practice de fizica atomica; htttp:brahms.fizica.unibuc.ro/atom/atom/LabAtom.php
Atomic and molecular physics, B. H. Bransden si C. J. Joachain, Bucuresti, 1998
Atkins' physical chemistry - Peter Atkins, Julio de Paula, Oxford University Press, 2010
Atoms, Molecules and Photons: An Introduction to Atomic-, Molecular- and Quantum Physics -Wolfgang Demtröder Springer; 2nd ed. 2010
Quantum physics of atoms, molecules, solids, nuclei and particles Robert Martin Eisberg and Robert Resnick, New York ; John Wiley and Sons, 1974

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course content is in accordance with those of similar subjects at other universities in the country and abroad, being oriented towards the acquisition of concepts and physical processes associated with atoms.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	Fundamental knowledge: ability to demonstrate correct knowledge and understanding of basic concepts, notions, and results in atomic physics. Theoretical skills: ability to rigorously justify and demonstrate theoretical results and principles specific to the field. Scientific communication skills: capacity to clearly and argumentatively defend orally, in writing, one's solutions and reasoning. Application of knowledge: capacity to effectively apply the concepts and results acquired during lectures to solve specific problems and practical exercises.	Continuous assessment: quiz-type tests during lectures (Microsoft Teams platform): 5% Midterm exam: written test followed by an oral exam. The grade for the midterm exam is calculated as follows: 2/3 from the written test (20% of the final course grade) and 1/3 from the oral exam (10% of the final course grade). The written paper is corrected and discussed during the oral examination; in addition to the written solutions, the oral exam may cover other topics from the syllabus covered up to that point: 30% Final exam: written test followed by an oral exam, with the same grading structure as the midterm exam (2/3 written test – 20%, 1/3 oral exam – 10%), covering the exam syllabus: 30%	65%
Tutorial	Correct and efficient application of specific problem-solving methods. Coherent presentation, written and oral, of the solution. Understanding and ownership of one's own solutions in the homework portfolio.	• Portofoliu de teme rezolvate pe parcursul semestrului. Evaluarea portofoliului nu se limitează la verificarea existenţei şi completitudinii temelor; studentul poate fi întrebat asupra conţinutului acestuia şi trebuie să demonstreze că înţelege şi cunoaşte propriile rezolvări: 8% • Prezentarea/rezolvarea unei probleme la tablă, prin rotaţie, cel puţin o dată pe semestru: 7%	15%

Practical	Preparation and execution of the experiment: acquisition of experimental procedures, correct and safe use of equipment, precise and systematic data collection. Data processing and analysis: error calculation, graphical representations, curve fitting of experimental data. Interpretation of results and conclusions: interpretation within theoretical context, identification and discussion of error sources or limitations. Presentation of results: clarity, structure, and accuracy of laboratory reports.	Written colloquium: taken based on the laboratory reports: 20%	20%
Minimal requirements for passing the exam	Obtaining a grade of 5 (Passing grade): • Compulsory attendance at all practical activities (seminar and laboratory) and at 75% of the lectures. • Completion of all laboratory work and submission of the results in the form of scientific reports. • Obtaining at least a grade of 5 on the laboratory colloquium. • Correct resolution of the topics required to score 5 points on the final exam. Obtaining a grade of 10 (Maximum grade): • Deeply argued abilities and knowledge. • Demonstrated capacity for analyzing phenomena and processes, alongside the correct resolution of all exam topics.		

Date, 25.09.2026	Teacher's name and signature, Conf.univ.dr. Vasile Bercu	Practicals/Tutorials/Project instructor(s), name and signature Asist.univ.dr. Leonard Gebac
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOB.205.P Foreign language II / Limbă străină II

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	
1.3. Department	Department of Modern Languages
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Foreign language II / Limbă străină II				
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Monica Oanca				
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	1/0/0
3.4. Total hours per semester	14	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	14/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					18
Research in library, study of electronic resources, field research					9
Preparation for practicals/tutorials/projects/reports/homework					9
Tutorat					0
Other activities					0
3.7. Total hours of individual study					36
3.8. Total hours per semester					50
3.9. ECTS					2

4. Prerequisites (if necessary)

4.1. curriculum	Basic English language skills - A2 level
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	Whiteboard and video projector

6. Learning outcomes

Knowledge	R16. The student/graduate acquires civic competences, especially knowledge of social and political concepts and structures for active and democratic participation of people
Skills	R16. The student/graduate develops communication skills in the mother tongue and/or an international language
Responsibility and autonomy	R16. Spirit of initiative and entrepreneurship – the ability to turn ideas into action

7. Contents

7.2 Tutorials	**Teaching techniques**	**Observations**

Motivation to become a physicist	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The concept of error	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The rhythm of our life	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The Present Tenses	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Education	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
The Past Tenses	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension..	1 Hour

Finding the perfect job	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Distance and displacement	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Speed and velocity	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Kinematic equations	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Passive voice	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Causative	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour
Contrasting ideas	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour

Student project presentations	• Audiovisual techniques (PowerPoint presentations, educational films, audio materials) • Practical exercises - vocabulary, grammar structures, reading comprehension.	1 Hour

References:

1. McCarthy Michael, Felicity O' Dell, English Vocabulary in Use, (Upper Intermediate and Advanced), Cambridge University Press, 2002, 2005.
2. McCarthy Michael, Felicity O' Dell, Test your English V

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The seminars follow the format of foreign language seminars within the University of Bucharest and are in accordance with international standards regarding the level of language competences.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Tutorial	Knowledge, understanding, and correct use of the grammar and vocabulary concepts discussed during the seminars	• Assessment through written tests (40%) • Assessment through oral tests (40%) • Portfolio (20%)	100%
Minimal requirements for passing the exam	To obtain a grade of 5 (Passing grade): • Correct acquisition of minimal English language knowledge, B1 level • Correct use of the main grammar concepts • Correct use of specialized terminology • Completion of all homework assignments posted on Google Classroom To obtain a grade of 10 (Highest grade): • Correct resolution of all exam questions/topics • Solid reasoning to substantiate the acquired knowledge		

Date,

8.09.2026

Practicals/Tutorials/Project instructor(s), name and signature

Lect. dr. Monica Oanca

Date of approval

17.09.2026

Head of department name and signature

Syllabus

Academic year 2026/2027
DOP.206.1.P Simulation methods in Physics / Metode de simulare în fizică

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title	Simulation methods in Physics / Metode de simulare în fizică						
2.2. Teacher	Lect.dr. Roxana ZUS						
2.3. Tutorials/Practicals instructor(s)	Asist. Vasile SEVESTREAN, Asist. Ioana DUMINICĂ						
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					10
Research in library, study of electronic resources, field research					5
Preparation for practicals/tutorials/projects/reports/homework					4
Tutorat					0
Other activities					0
3.7. Total hours of individual study					19
3.8. Total hours per semester					75
3.9. ECTS					3

4. Prerequisites (if necessary)

4.1. curriculum	Programming Languages, Algebra, Analysis, Differential Equationsce
4.2. competences	Knowledge of programming, linear algebra, analysis, differential equations

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Computer, Video projector Lecture notes Bibliography
5.2. for tutorials/practicals	Computer network Lecture notes Bibliography

6. Learning outcomes

Knowledge	R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R8. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R13. The student/graduate describes physical systems (e.g., thermodynamic systems, electrical circuits), using specific theories and tools to characterize them.

Skills	R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R8. The student/graduate compares theoretical results from specialized literature (e.g., textbooks, indexed articles) with experimental ones, integrating the data into a professional report or project. R13. The student/graduate is able to read, understand, and translate specialized texts, extract relevant information from international scientific sources, and communicate orally and in writing in an autonomous and professional manner.
Responsibility and autonomy	R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R8. The student/graduate critically analyzes a specialized paper or scientific communication of medium difficulty (e.g., peer-reviewed article, scientific report), assuming the conclusions and recommendations. R13. The student/graduate responsibly uses international information sources, respecting academic ethics standards and demonstrating initiative in learning specialized scientific language.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
1.Modeling and simulation of physical systems Fundamental concepts - system; the structure of systems modeling and simulation; measurement and experimental data processing. Linear systems in physics - OTF and PSF. Linear prediction - Fourier transform, convolution and de-convolution signals. Modeling and simulation in contemporary knowledge.	Systematic exposition - lecture. Critical analysis. Examples	2 Hours
2. Theory of modeling and simulation Basic concepts; specification systems formalism. Formalisms of modelling and their simulators: DT (Discrete Time); DEQ (Differential Equation); DEV (Discrete Event); Verification, Validation, Approximate morphisms. Complexity theory.	Systematic exposition - lecture. Critical analysis. Examples	4 Hours
3. Ordinary Differential Equations (ODE) Modeling with ODE. Geometric meaning of the solutions of differential equations. Solutions of differential equations. Finite differences. Cellular automata. Nonlinear physical systems - Phase space, maps and flows, autonomous and non-autonomous systems; deterministic chaotic systems. Applications in physics.	Systematic exposition - lecture. Critical analysis. Examples	4 Hours
4. Monte Carlo simulation methods Applications in physics.	Systematic exposition - lecture. Critical analysis. Examples	4 Hours
5. Partial Differential Equations Finite difference methods; Spectral methods; Relaxation methods; Applications in physics: heat equation, diffusion, Navier-Stokes etc.	Systematic exposition - lecture. Critical analysis. Examples	6 Hours
6. Integral Equations	Systematic exposition - lecture. Critical analysis. Examples	2 Hours
7. Introductory Applications of Artificial Intelligence	Systematic exposition - lecture. Critical analysis. Examples	4 Hours
8. Presenting sample problems from physics for project	Systematic exposition - lecture. Critical analysis. Examples	2 Hours

References:

- Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, "Theory of Modeling and Simulation", Academic Press (2000);
- William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", 3rd ed.,Cambridge University Press, 2007
- R. Burden, J. D. Faires, "Numerical Analysis", Thomson Brooks/Cole, 2010- George W. Collins , "Fundamental Methods and Data Analysis", 2003
- Morten Hjorth-Jensen , "Computational Physics", University of Oslo, 2006
- Sheldon M. Ross, "Simulation", Academic Press (2002)
-Kendall Atkinson, "The Numerical Solution of Integral Equations of the Second Kind ", Cambridge Univ. Press, 1997
-P.K. Kythe and M.R. Shaferkotter, "Handbook of Computational Methods for Integration", Chapman and Hall, CRC Press, 2005
- Stephen Wolfram, A New Kind of Science (http://www.wolframscience.com/nksonline/toc.html)
- Mircea Bulinski, "Modelare si simulare – Aplicatii in OSPL", Ed. Universitatii Bucuresti, 2011

7.3 Practicals	**Teaching techniques**	**Observations**
Environment for programming the numerical and simulation methods exposed in the lecture	Systematic exposition. Heuristic conversation. Guided practical activity	2 Hours
Modeling, simulation and prediction of physical systems: DES (Differential Equation System); DTS (Discrete Time System); Devs (Discrete Event System). Applications in physics.	Guided practical activity	4 Hours
Programming the methods for numerical solution of ordinary differential equations. Applications in physics.	Guided practical activity. Critical analysis. Examples	4 Hours
Programming the methods for numerical solution of partial differential equations. Applications in physics.	SGuided practical activity. Critical analysis. Examples	4 Hours
Programming the methods for numerical solution of integral equations. Applications in physics.	Guided practical activity. Critical analysis. Examples	2 Hours
Monte-Carlo simulation. Applications in physics.	Guided practical activity	4 Hours
Linear systems in physics. Linear prediction. Applications in physics.	Guided practical activity	2 Hours
Nonlinear systems in physics. Time-series analysis. Analysis of phase space. Applications in physics.	Guided practical activity	2 Hours
Stochastic and deterministic modeling of complex systems. Applications in physics.	Guided practical activity	2 Hours
Project	Guided practical activity	2 Hours

References:

- Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, "Theory of Modeling and Simulation", Academic Press (2000);
- William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", 3rd ed.,Cambridge University Press, 2007
- R. Burden, J. D. Faires, "Numerical Analysis", Thomson Brooks/Cole, 2010- George W. Collins , "Fundamental Methods and Data Analysis", 2003
- Morten Hjorth-Jensen , "Computational Physics", University of Oslo, 2006
- Sheldon M. Ross, "Simulation", Academic Press (2002)
- Stephen Wolfram, A New Kind of Science (http://www.wolframscience.com/nksonline/toc.html)
-Kendall Atkinson, "The Numerical Solution of Integral Equations of the Second Kind ", Cambridge Univ. Press, 1997
-P.K. Kythe , M.R. Shaferkotter, "Handbook of Computational Methods for Integration", Chapman and Hall, CRC Press,
2005
- Mircea Bulinski, "Modelare si simulare – Aplicatii in OSPL", Ed. Universitatii Bucuresti, 2011
- Roxana Zus, Note de curs in format electronic - barutu.fizica.unibuc.ro/ ftmopl
- Roxana Zus, Adrian Stoica, Mihai Marciu Note de laborator in format electronic - barutu.fizica.unibuc.ro/ ftmopl

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

For the elaboration of the contents, of the teaching and learning methods, the teachers have consulted the corresponding lectures from national and international universities. The content is in agreement with the research topics of the R&D institutes that use numerical methods for solving specific problems, simulations and/or processing of physical data.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of methods - ability to indicate/analyse specific examples	Written test and oral examination	25%
Practical	- ability to apply specific methods for given problems - ability to present and discuss the results - ability to apply the redactation techniques in solving the given physics problem - ability to present the methods and techniques used - the project presentation	Evaluation of project and through practical activity.	75%
Minimal requirements for passing the exam	Achieving grade 5: Minimum attendance: 50% lecture, 75% applied activities (practicals and project). Correct exposition of 50% from the theoretical topics at the final exam. Correct numerical solution of one problem at the final exam. Achieving grade 10: - Correct answers to all assigned questions/topics; - In-depth, well-reasoned skills and knowledge; - Demonstrated ability to analyze simulated physical phenomena; - Personal approach and interpretation.		

Date, 8.09.2026	Teacher's name and signature, Lect.dr. Roxana ZUS	Practicals/Tutorials/Project instructor(s), name and signature Asist. Vasile SEVESTREAN, Asist. Ioana DUMINICĂ
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOP.206.2.P Systems theory / Teoria sistemelor

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Systems theory / Teoria sistemelor				
2.2. Teacher			Lect. Dr. Ing. Lucian-Nicolae COJOCARIU				
2.3. Tutorials/Practicals instructor(s)			Lect. Dr. Ing. Lucian-Nicolae COJOCARIU				
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					10
Research in library, study of electronic resources, field research					5
Preparation for practicals/tutorials/projects/reports/homework					4
Tutorat					0
Other activities					0
3.7. Total hours of individual study					19
3.8. Total hours per semester					75
3.9. ECTS					3

4. Prerequisites (if necessary)

4.1. curriculum	Completion of the following courses: Computer Programming and Programming Languages, Algebra, Calculus, Differential Equations, Applied Informatics I and II.
4.2. competences	Programming knowledge, knowledge of linear algebra, calculus, and differential equations

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia facilities (video projector)
5.2. for tutorials/practicals	Video projector, computer network

6. Learning outcomes

Knowledge	R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications).
Skills	R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented.
Responsibility and autonomy	R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects).

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Mathematical preliminaries: Laplace and Z-transforms, linear algebra. Dynamical systems. Definitions, characterizations, classifications.	Systematic presentation, lecture. Examples	4 Hours
Continuous-time linear systems. Discrete-time linear systems. Discretization of continuous-time linear systems	Systematic presentation, lecture. Examples	4 Hours

Frequency representations of linear systems. Interconnection of linear systems. Stability analysis of automatic control systems.	Systematic presentation, lecture. Examples	4 Hours
Structural properties of linear systems: controllability and observability	Systematic presentation, lecture. Examples	4 Hours
Controllable and observable decomposition. Structural decomposition. Kalman's structure theorem.	Systematic presentation, lecture. Examples	4 Hours
Control law. Pole and eigenvalue placement.	Systematic presentation, lecture. Examples	4 Hours
Stabilizability and detectability. State estimator theory: Kalman and Luenberger. Elementary synthesis. Design of stabilizing dynamic compensators.	Systematic presentation, lecture. Examples	4 Hours

References:

F. Stratulat - Teoria Sistemelor. Analiza si sinteza asistata de calculator a sistemelor liniare, Printech, 502 pg. 2008.
F. Stratulat - Teoria Sistemelor.Analiza asistata de calculator a sistemelor liniare, Matrixrom, 294 pg.

7.3 Practicals	Teaching techniques	Observations
The Laplace transform. The Z-transform.	Supervised practical activity	4 Hours
Determining the response of continuous-time linear systems. Determining the response of discrete-time linear systems.	Supervised practical activity	4 Hours
Discretization of continuous-time signals and continuous-time linear systems. Plotting semi-logarithmic frequency characteristics (Bode plots) for a continuous-time linear system.	Supervised practical activity	4 Hours
Plotting the Nyquist plot of the transfer function. Transfer function algebra (linear systems interconnection). Stability analysis of systems in a negative feedback connection.	Supervised practical activity	4 Hours
Analysis of structural properties: controllability and observability. Controllable and observable decomposition. Structural decomposition. Kalman's structure theorem.	Supervised practical activity	4 Hours
Control law. Pole and eigenvalue placement. Stabilizability and detectability.	Supervised practical activity	4 Hours
Elementary synthesis. Design of stabilizing dynamic compensators with Kalman or Luenberger-type state estimators.	Supervised practical activity	4 Hours

References:

F. Stratulat - Teoria Sistemelor. Analiza si sinteza asistata de calculator a sistemelor liniare, Printech, 502 pg. 2008.
F. Stratulat - Teoria Sistemelor.Analiza asistata de calculator a sistemelor liniare, Matrixrom, 294 pg., 2000

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

In order to outline the content and choose the teaching/learning methods, given the particular importance of the course for applications in modern technology, the course coordinator has consulted the content of similar courses taught at universities both domestically and abroad. The content is aligned with the topics addressed within research and development institutes in the field, which utilize numerical methods for solving specific problems, simulations, and/or relevant data processing.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	• Clarity, coherence, and conciseness of the presentation; • Correct use of calculation formulas; • Capacity to provide examples;	Written test and oral examination	50%
Practical	• Application of specific problem-solving methods for given problems; • Interpretation of results.	Assessment through a practical exam	50%

Minimal requirements for passing the exam	To obtain a final grade of 5 (Passing grade): • Mandatory attendance at all practical activities (seminars and laboratories) and at 50% of the lectures. Completion of all laboratory works and submission of the results in the form of scientific reports. • Obtaining a grade of 5 on the laboratory colloquium. • Correct resolution of the questions/topics designated for a score of 5 on the final exam. To obtain a grade of 10 (Highest grade): • Deeply substantiated skills and knowledge. • Demonstrated capacity to analyze phenomena and processes, and correct resolution of all exam questions/topics.

Date, 25.09.2026	Teacher's name and signature, Lect. Dr. Ing. Lucian-Nicolae COJOCARIU	Practicals/Tutorials/Project instructor(s), name and signature Lect. Dr. Ing. Lucian-Nicolae COJOCARIU
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOP.207.1.P Python programming for physicists

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Python programming for physicists				
2.2. Teacher			Lect. dr. Mihai Marciu				
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Mihai Marciu				
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	2	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	28	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/14/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					24
Research in library, study of electronic resources, field research					12
Preparation for practicals/tutorials/projects/reports/homework					11
Tutorat					0
Other activities					0
3.7. Total hours of individual study					47
3.8. Total hours per semester					75
3.9. ECTS					3

4. Prerequisites (if necessary)

4.1. curriculum	Completion of the following courses: Computer programming I (C/C++); English for science;
4.2. competences	Computational physics skills

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia facilities (video projector)
5.2. for tutorials/practicals	Laboratory room with specific infrastructure

6. Learning outcomes

Knowledge	R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R10. The student/graduate deduces working formulas for calculations involving physical quantities, correctly applying fundamental principles and laws.
Skills	R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards. R10. Students/graduates prepare and present, in English, scientific or outreach reports and communications, using appropriate technical language and logical argumentation.

Responsibility and autonomy	R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python). R10. Students/graduates take responsibility for interacting, contributing, and integrating into multilingual work teams and professional communities, demonstrating autonomy in using information sources in English.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Introduction to object-oriented programming. Types of object-oriented languages.	Systematic presentation – lecture. Examples.	2 Hours
Object-oriented programming in Python. Fundamental concepts and the evolution of the Python language.	Systematic presentation – lecture. Examples.	2 Hours
General design of software applications in Python.	Systematic presentation – lecture. Examples.	2 Hours
Exception handling in Python. Exception types and error propagation.	Systematic presentation – lecture. Examples.	1 Hour
Input/output streams in Python. Application examples.	Systematic presentation – lecture. Examples.	1 Hour
Creating plots in Python. Drawing methods.	Systematic presentation – lecture. Examples.	1 Hour
Introduction to parallel programming. Creating and using threads in Python.	Systematic presentation – lecture. Examples.	1 Hour
Using SQL and NoSQL databases in Python. Executing SQL and NoSQL queries.	Systematic presentation – lecture. Examples.	1 Hour
Using graphical interfaces in Python applications.	Systematic presentation – lecture. Examples.	1 Hour
Network programming for Python applications. Using TCP and UDP protocols.	Systematic presentation – lecture. Examples.	2 Hours

References:

[1] Python Crash Course, A Hands-On, Project-Based Introduction to Programming, 3rd Edition, Eric Matthes, No Starch Press, 2023
[2] Luciano Ramalho, Fluent Python. Clear, Concise, and Effective Programming, O'Reilly Media, August 2015.
[3] Rance D. Necaise, Data Structures and Algorithms Using Python, Ed. JOHN WILEY and SONS, 2011.
[4] Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, John Wiley and Sons, 2013.

7.3 Practicals	**Teaching techniques**	**Observations**
Introduction to Python. Structure of Python programs.	Guided practical activity.	3 Hours
Data types in Python. Variables and types of statements. Practical applications. Examples.	Guided practical activity.	3 Hours
Vectors and multi-dimensional arrays. Character strings.	Guided practical activity.	2 Hours
Object-oriented programming in Python. Creating and using objects. Using constructors.	Guided practical activity.	2 Hours
Class methods. The concept of overloading and overriding. Application examples.	Guided practical activity.	1 Hour
Access modifiers and exception handling in Python.	Guided practical activity.	1 Hour
Development of physics applications in Python.	Guided practical activity.	1 Hour
Creating applications in Python.	Guided practical activity.	1 Hour

References:
[1] Python Crash Course, A Hands-On, Project-Based Introduction to Programming, 3rd Edition, Eric Matthes, No Starch Press, 2023
[2] Luciano Ramalho, Fluent Python. Clear, Concise, and Effective Programming, O'Reilly Media, August 2015.
[3] Rance D. Necaise, Data Structures and Algorithms Using Python, Ed. JOHN WILEY and SONS, 2011.
[4] Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, John Wiley and Sons, 2013.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

In order to outline the content and choose the teaching/learning methods, the course coordinators have consulted the content of similar courses taught at universities both domestically and abroad. The content is aligned with the requirements of the University of Bucharest, as well as national and international standards for writing and presenting scientific papers.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	• Clarity, coherence, and conciseness of the presentation; • Correct use of calculation formulas; • Capacity to provide examples;	Written exam and oral evaluation.	80%
Practical	• Application of specific problem-solving methods for the given problem; • Interpretation of results;	Laboratory colloquium.	20%
Minimal requirements for passing the exam	To obtain a final grade of 5 (Passing grade): • Mandatory attendance at all practical activities (laboratories) and at 50% of the lectures. Completion of all laboratory works and submission of the results in the form of scientific reports. • Obtaining a grade of 5 on the laboratory colloquium. • Correct resolution of the questions/topics designated for a score of 5 on the final exam. To obtain a grade of 10 (Highest grade): • Deeply substantiated skills and knowledge. • Demonstrated capacity to analyze phenomena and processes, and correct resolution of all exam questions/topics.		

Date, 25.09.2026	Teacher's name and signature, Lect. dr. Mihai Marciu	Practicals/Tutorials/Project instructor(s), name and signature Lect. dr. Mihai Marciu
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOP.207.2.P Scientific computing techniques in C++

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Scientific computing techniques in C++				
2.2. Teacher			Prof. dr. Lucian Ion				
2.3. Tutorials/Practicals instructor(s)			Prof. dr. Lucian Ion				
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	COLOCVIU	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	2	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	28	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/14/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					24
Research in library, study of electronic resources, field research					12
Preparation for practicals/tutorials/projects/reports/homework					11
Tutorat					0
Other activities					0
3.7. Total hours of individual study					47
3.8. Total hours per semester					75
3.9. ECTS					3

4. Prerequisites (if necessary)

4.1. curriculum	Computer programming C/C++
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia-equipped room
5.2. for tutorials/practicals	Computer laboratory

6. Learning outcomes

Knowledge	R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R10. The student/graduate deduces working formulas for calculations involving physical quantities, correctly applying fundamental principles and laws.
Skills	R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards. R10. Students/graduates prepare and present, in English, scientific or outreach reports and communications, using appropriate technical language and logical argumentation.
Responsibility and autonomy	R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python). R10. Students/graduates take responsibility for interacting, contributing, and integrating into multilingual work teams and professional communities, demonstrating autonomy in using information sources in English.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations

Classes. Inheritance and derived classes. Polymorphism.	Systematic exposition - lecture. Example	2 Hours
Templates in C++. Exceptions and testing.	Systematic exposition - lecture. Example	2 Hours
Classes for linear algebra; operators for vector operations.	Systematic exposition - lecture. Example	4 Hours
Object-oriented numerical libraries. Libraries for solving ordinary differential equations. Libraries for solving boundary value problems.	Systematic exposition - lecture. Example	4 Hours
C++/MPI applications.	Systematic exposition - lecture. Example	2 Hours

References:

1. J. Pitt-Francis, J. Whiteley, Guide to Scientific Computing in C++ (2nd edition) (Springer International Publishing AG, Cham, Switzerland, 2017)
2. B. Stroustrup, The C++ Programming Language (3rd edition) (Addison-Wesley, Reading, Massachusetts, USA, 1997).

7.3 Practicals	**Teaching techniques**	**Observations**
Classes - inheritance, and polymorphism.	Practical work	2 Hours
Templates. Vectors and sets in STL (Standard Template Library).	Practical work	2 Hours
Constructors, destructors, operators for vector operations	Practical work	2 Hours
Classes and functions for ODE. Examples.	Practical work	2 Hours
Classes and functions for solving boundary value problems.	Practical work	4 Hours
MPI/C++ applications.	Practical work	2 Hours

References:

1. J. Pitt-Francis, J. Whiteley, Guide to Scientific Computing in C++ (2nd edition) (Springer International Publishing AG, Cham, Switzerland, 2017)
2. B. Stroustrup, The C++ Programming Language (3rd edition) (Addison-Wesley, Reading, Massachusetts, USA, 1997).

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	Correct use of the studied programming models and techniques; Ability to provide examples; Ability to apply acquired knowledge to problem-solving.	Practical applications colloquium	60%
Practical	Knowledge of programming and testing techniques; Ability to provide examples;	Continuous assessment - solving assignments on specific topics;	40%
Minimal requirements for passing the exam	Obtaining a passing grade of 5: Mandatory attendance at all practical activities (seminars and laboratories) and at 50% of the lectures. Completion of all laboratory works and presentation of the results in the form of scientific reports. Obtaining a minimum grade of 5 on the laboratory colloquium. Correctly solving the designated topics to obtain a score of 5 on the final exam Obtaining a grade of 10: Advanced, deeply reasoned skills and knowledge. Demonstrated ability to analyze phenomena and processes, and correct solution of all topics.		

Date, 25.09.2026	Teacher's name and signature, Prof. dr. Lucian Ion	Practicals/Tutorials/Project instructor(s), name and signature Prof. dr. Lucian Ion
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOB.211.P Electrodynamics and theory of relativity II / Electrodinamica şi teoria relativităţii II

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Electrodynamics and theory of relativity II / Electrodinamica şi teoria relativităţii II				
2.2. Teacher			Conf. Madalina Boca				
2.3. Tutorials/Practicals instructor(s)			Lector Virgil V. Baran				
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	2/0/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	28/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					22
Research in library, study of electronic resources, field research					11
Preparation for practicals/tutorials/projects/reports/homework					11
Tutorat					0
Other activities					0
3.7. Total hours of individual study					44
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R12. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R14. The student/graduate knows the basic vocabulary and specialized terminology in a foreign language in the field of physics, the structure of scientific texts and international academic communication formats. R15. The student understands and appropriates the professional ethics and ethical practices that characterize the scientific and academic community.
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards. R12. The student/graduate develops personal, interpersonal, and intercultural competencies through involvement in activities that promote self-awareness, empathy, effective communication, respect for diversity, and collaboration with individuals from different cultural backgrounds to achieve objectives. R14. The student/graduate is able to read, understand and translate specialized texts, extract relevant information from international scientific sources and communicate orally and in writing in an autonomous and professional manner. R15. The student applies ethical principles in professional work, and respects intellectual property rights

Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python). R12. The student/graduate becomes aware of responsibly assuming risks by taking initiatives, making decisions in uncertain situations, and managing consequences in an ethical and constructive manner. R14. The student/graduate uses information sources responsibly, respecting the norms of academic ethics and demonstrating initiative in learning the scientific language of the specialty. R15. The student applies independently ethical behaviors and skills including critical thinking, methodological rigor, professional integrity and responsibility towards the environment and community

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Physical basis of the Theory of Relativity (TR). Relativity principles. Frames of reference. Space and time. Time dilation and length contraction in Special Relativity. Lorentz transformations and their consequences. Relativistic formula of velocity addition	Systematic exposition - lecture. Examples	2 Hours
Minkowski space. Lorentz transformations as orthogonal transformations in Minkowski space. The matrix of a special Lorentz transformation (boost) and its properties. Scalars, 4- vectors and 4-tensors. Scalar product and norm of 4-vectors. Differential 4-vector operators	Systematic exposition - lecture. Examples	4 Hours
The relativistic invariant interval, classification and properties. Geometrical representation of Lorentz transformations.	Systematic exposition - lecture. Examples	1 Hour
Elements of relativistic kinematics. Proper time. 4-velocity, 4- acceleration and their properties. Norms and relativistic transformations.	Systematic exposition - lecture. Examples	2 Hours
Covariant dynamics of the relativistic particle. 4-force and 4-momentum. Covariant formulation of momentum and energy theorems. Energy-momentum relativistic relation. Relativistic transformations relations for momentum and energy. Relativistic Lagrange and Hamilton functions of the free particle and for the particle in an external field. Motion of a relativistic particle in an external EMF. Special cases	Systematic exposition - lecture. Examples	4 Hours
Relativistic kinematics of relativistic collisions (interactions). Center of mass frame of two particles, total mass and the center of mass velocity. Energy, momentum and velocity of one particle in the proper frame of one other and in the Center of mass frame. Applications. Laboratory frame. Independent invariant parameters of binary elastic collisions.	Systematic exposition - lecture. Examples	3 Hours

Covariant formulation of the laws of EMF. Covariant formulation of electric charge conservation (continuity eq.) . 4-current of electric charge. Covariant formulation of the EM potentials in Lorenz gauge. 4-potential. Relativistic transformations of the 4-current and 4- potential. Covariant formulation of Lorenz condition. The 4-tensor of the EMF. Covariant formulation of Maxwell equations in vacuum. Relativistic invariants of the EMF. Relativistic transformations of electric and magnetic field.	Systematic exposition - lecture. Examples	4 Hours
Covariant formulation of the EMF equations in media (laws of macroscopic field). Average of eqs. of microscopic field. Polarization and excitation 4-tensors. Relativistic transformations of the P, D, M, H vectors. Covariant formulation of the EMF energy and momentum theorems. Energy-momentum tensor of the EMF.	Systematic exposition - lecture. Examples	4 Hours
EMF of a point charge in arbitrary motion. LienardWiechert potentials. Electric and magnetic field vectors. The field of the charge in uniform motion. Radiation field. Intensity (angular distribution) and total radiated power	Systematic exposition - lecture. Examples	4 Hours

References:

M. Maggiore, A Modern Introduction to Classical Electrodynamics, Oxford University Press, 2023
W. Nolting, Electrodynamics, Springer International Publishing, 2016
A. Zangwill, Modern Electrodynamics, Cambridge university press, 2013
D. Griffiths, Introduction to electrodynamics, Pearson, 2013
J. D. Jackson, Classical Electrodynamics, Wiley, 2009
C. Vrejoiu, Editura Universitatii din Bucuresti, Electrodinamica si teoria relativitatii, 1993
C. Moller, The Theory of Relativity, Clarendon Press, 1955
R. Hagedorn, Relativistic Kinematics, W.A. Benjamin, 1964
J.L. Synge, Relativity: The Special Theory, Elsevier Science Ltd; 2nd ed. 1980

7.2 Tutorials	**Teaching techniques**	**Observations**
1. Description of the Michelson-Morley and Fizeau experiments. Applications of the Lorentz transformation relations and the relativistic formula for the composition of velocities. Lorentz contraction. Aberration of starlight	Problem solving. Guided work. Case study. Examples.	5 Hours
2. Light cone, proper time, time dilation. Applications of relativistic formulas for composing velocities. Relativistic formula for composing accelerations	Problem solving. Guided work. Case study. Examples.	4 Hours
3. Motion of a particle under the action of a constant and quasielastic force. Motion of a point charge in homogeneous constant electric and magnetic fields (various cases).	Problem solving. Guided work. Case study. Examples.	4 Hours
Study of relativistic collisions / decays of particles. Conservation laws in Special Relativity: the energymomentum four-vector. The Compton effect and the inverse Compton effect.	Problem solving. Guided work. Case study. Examples.	5 Hours
Applications of relativistic formulas of EMF transformations in vacuum and in material media. Transformation relations of the dipole electric and magnetic moments.	Problem solving. Guided work. Case study. Examples.	6 Hours
The field of the uniform moving charge. Cherenkov effect. Bremsstrahlung. Angular distribution and the total radiated power of a point charge in arbitrary motion. The cases of uniform linear acceleration and of circular uniform motion (synchrotron radiation).	Problem solving. Guided work. Case study. Examples.	4 Hours

References:
M. Maggiore, A Modern Introduction to Classical Electrodynamics, Oxford University Press, 2023
W. Nolting, Electrodynamics, Springer International Publishing, 2016
A. Zangwill, Modern Electrodynamics, Cambridge university press, 2013
D. Griffiths, Introduction to electrodynamics, Pearson, 2013
J. D. Jackson, Classical Electrodynamics, Wiley, 2009
C. Vrejoiu, Editura Universitatii din Bucuresti, Electrodinamica si teoria relativitatii, 1993
C. Moller, The Theory of Relativity, Clarendon Press, 1955
R. Hagedorn, Relativistic Kinematics, W.A. Benjamin, 1964
J.L. Synge, Relativity: The Special Theory, Elsevier Science Ltd; 2nd ed. 1980

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical competences and abilities which are fundamental for an undergraduate student in the field of modern physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, academic, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Knowledge of fundamental topics - Assimilation and correct understanding of concepts taught throughout the lectures - Ability to construct mathematically sound theories using the methods taught - Ability to solve problems	Written test and oral examination	75%
Tutorial	- Ability to solve problems	Homeworks	25%
Minimal requirements for passing the exam	Criteria for obtaining mark 5 on a 10 points scale (passing the course): - At least 50% lecture and 70% seminar attendance - Correct solutions for the indicated subjects for obtaining mark 5. Criteria for obtaining mark 10 on a 10 points scale (maximum grade): - Skills, well-argued knowledge - Proven ability to analyze phenomena and processes, correct solutions to all indicated subjects		

Date, 8.09.2026	Teacher's name and signature, Conf. Madalina Boca	Practicals/Tutorials/Project instructor(s), name and signature Lector Virgil V. Baran
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.212.P Quantum mechanics I / Mecanică cuantică I

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Quantum mechanics I / Mecanică cuantică I				
2.2. Teacher			Prof.dr. Virgil Băran				
2.3. Tutorials/Practicals instructor(s)			Lect.dr. Virgil V. Băran				
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	2/0/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	28/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					15
Research in library, study of electronic resources, field research					10
Preparation for practicals/tutorials/projects/reports/homework					15
Tutorat					0
Other activities					4
3.7. Total hours of individual study					44
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	Real and Complex Analysis, Algebra, Differential Equations, Equations of Mathematical Physics, Classical mechanics, Fundamentals of Atomic Physics
4.2. competences	Knowledge about : - Phenomenology of microscopic behaviour of physical systems - Differential and integral calculus, partial differential equations, special functions, orthogonal polynomials - Analytical formalism of classical mechanics; classical electrodynamics

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Computer, Video projector, Lecture notes, Bibliography
5.2. for tutorials/practicals	Lecture notes, Bibliography

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics).
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations

1. The principles of quantum mechanics The superposition principle of the states in quantum mechanics The state concept in quantum mechanics. Hilbert space. Dirac bra-ket formalism. The physical observables in quantum mechanics. Hermitian operators. Eigenvalues and eigenvectors of Hermitian operators (discrete case). The spectral theorem. Eigenvalues and eigenvectors of Hermitian operators (continuous case). The measurement postulate in quantum mechanics. Compatible observables. Physical interpretation of the transition amplitude. Incompatible observables. Heisenberg uncertainty relation. Interpretation. Position observable and position measurement. Linear momentum and momentum measurement. Fundamental quantum relations. Dirac approach. The commutator in quantum mechanics. The spatial translation in quantum mechanics. Translation operator. The generator of the translations: the linear momentum. Interpretation of the results of Stern-Gerlach experiment. The Hilbert space of the spin one-half systems. The spin one-half operator components. Commutation relations. Pauli Matrices. The dynamical evolution in quantum mechanics. Time evolution operator: properties. The Hamiltonian of a quantum system. Eigenvalues and eigenvectors of the Hamiltonian. Stationary states. Schrodinger equation for the evolution operator. Schrodinger equation for ket vectors.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	12 Hours
2. Coordinates representation of quantum mechanics Position representation of quantum mechanics: quantum wave mechanics. Physical interpretation of the wave function. Position and linear momentum operators in coordinate representation. The time-dependent Schrodinger equation for the wave function. The continuity equation of the density of probability in quantum mechanics. Time independent Schrodinger equation for the wave function. Physical boundary conditions and energy quantization for a system in a potential well.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
3. Harmonic oscillator in quantum mechanics The harmonic oscillator in quantum mechanics. The Hamiltonian. The creation and annihilation operators (ladder operators) for harmonic oscillator. The eigenvalues and eigenvectors of the harmonic oscillator Hamiltonian. Coherent states. Definition. Basic properties. The harmonic oscillator in coordinate representation. Polynomial method	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
4. The time-independent perturbation theory General discussion and setting of the problem: non-degenerate case. Zero-order approximation and first order approximation for the state ket and energy The second order correction to the ket vector and energy.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	3 Hours

5. Angular momentum in quantum mechanics The orbital angular momentum. Basic definitions, commutation relations, a set of compatible observables. The ladder operators in the algebra of angular momentum. Eigenvalues and eigenvectors of the orbital angular momentum. General angular momentum: definition, commutation relations. Ladder operators: definition and properties. Eigenvalues and eigenvectors of the general angular momentum.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	5 Hours

References:

J.J. Sakurai, J.J. Napolitano, Modern quantum mechanics, Addison-Wesley, 2011
D . H . McIntyre , Quantum mechanics. A paradigms approach, Pearson Education Ltd , 2014
L . D . Landau , E .M. Lifshitz , Quantum mechanics, Butterworth -Heinemann, 2003
PAM Dirac, Principles of Quantum Mechanics, Oxford, 1982
W. Greiner, Quantum mechanics: an introduction, Springer, 2001
L.E. Ballentine, Quantum Mechanics : A Modern Development (2nd Edition), World Scientific Publishing Company; 2014
V. Baran, R. Zus, Lecture notes on quantum mechanics
S. Titeica, Mecanica Cuantica, Editura Academiei, 1984

7.2 Tutorials	**Teaching techniques**	**Observations**
Hermitian operators. Eigenvalues and eigenvectors of Hermitian operators (discrete case). The spectral theorem. Eigenvalues and eigenvectors of Hermitian operators (continuous case).	Problem solving. Guided work. Case study. Examples.	4 Hours
The principles of quantum mechanics – applications	Problem solving. Guided work. Case study. Examples.	6 Hours
Applications in coordinate's representation of quantum mechanics. Infinite and finite potential well. Potential barrier. Tunneling effect.	Problem solving. Guided work. Case study. Examples.	8 Hours
Harmonic oscillator in quantum mechanics – statistics of position and momentum - applications	Problem solving. Guided work. Case study. Examples.	4 Hours
The time-independent perturbation theory – nondegenrate case. Applications: anharmonic oscillator, etc.	Problem solving. Guided work. Case study. Examples.	2 Hours
Quantum theory of the orbital and general angular momentum - applications	Problem solving. Guided work. Case study. Examples.	4 Hours

References:

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical competences and abilities which are fundamental for an undergraduate student in the field of modern physics, corresponding to national and European/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, academic, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	- coherence and clarity of exposition - correct use of equations/mathematical methods/physical models and theories - ability to indicate/analyze specific examples	Written test/oral examination	70%
Tutorial	- ability to use specific problem solving methods - ability to analyse the results	Homeworks/written tests	30%
Minimal requirements for passing the exam	Attendance of at least 50% for the lectures and at least 70% for the tutorials. Correct solutions to the indicated subjects for obtaining the grade 5 from all activities, part of the continuous evaluation. Correct solutions to the indicated subjects for obtaining the grade 5 within the final exam.		

Date, 8.09.2026	Teacher's name and signature, Prof.dr. Virgil Băran	Practicals/Tutorials/Project instructor(s), name and signature Lect.dr. Virgil V. Băran
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.213.P Electronics / Electronică

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Electronics / Electronică				
2.2. Teacher			Prof. dr. Andrei Barborică				
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Bogdan Biţă				
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					20
Research in library, study of electronic resources, field research					12
Preparation for practicals/tutorials/projects/reports/homework					12
Tutorat					0
Other activities					0
3.7. Total hours of individual study					44
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods).
Skills	R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics.

Responsibility and autonomy	R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python). R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Physical properties of semiconductors. Fermi-Dirac Distribution, Density of charge carriers in intrinsic semicondactors, Physical Phenomena in semiconductors, P and N tipe semiconductors, P-N Junction.		2 Hours
Physical Phenomena in semiconductors. Continuity equation		2 Hours
P-N Junction. Physical phenomena at the P-N junction. Diodes. I-V characteristic of a diode		4 Hours
Applications of P-N Junction. Zener diode. Varicap diode, Photodiode, LED, Tunnel Diode, Multi Junctions Devices (Diac, Triac, Thiristor)		4 Hours
Bipolar transistor Currents of bipolar transistor, Static characteristics (Common emitter(CE), Common Base (CB)), Temperature Sensitivity, Static working point of CE and CB connections for bipolar transistor , Ebers-Moll equations.		4 Hours
Field effect transistor JFET, MOSFET. Amplifier circuits using FETs.		4 Hours
Feedback Amplifiers.		4 Hours
Operational Amplifiers.		4 Hours

References:

Razvan BOBULESCU, Andrei BARBORICA Introduction to Electronics, Editura Universitatii din Bucuresti, 2002.
P. Horowitz and W. Hill, "The art of electronics", 2nd edition, Cambridge Unversity Press,1994
Mihai P Dinca, "Electronica - Manualul studentului", vol1, Editura Universitatii din Bucuresti, 2003.
J. COX, Fundamentals of Linear Electronics, Ed. Delmar, 2001

7.3 Practicals	**Teaching techniques**	**Observations**
Static characteristics of semiconductor diodes (Si, Ge, LED, Zener)		2 Hours
Static characteristics of bipolar transistor in common emitter configuration		2 Hours
Static characteristics of bipolar transistor in common base configuration		2 Hours
The oscilloscope		2 Hours
Rectifiers, unregulated and regulated power supplies. Voltage multiplier.		4 Hours
Static characteristics of JFET		3 Hours
Static characteristics of MOSFET		3 Hours
Constant current, constant voltage sources		2 Hours
Diac, Triac, Thiristor		4 Hours
Temperature dependence of semiconductor diode and bipolar transistor		4 Hours

References:

Razvan BOBULESCU, Andrei BARBORICA Introduction to Electronics, Editura Universitatii din Bucuresti, 2002.
P. Horowitz and W. Hill, "The art of electronics", 2nd edition, Cambridge Unversity Press,1994
Mihai P Dinca, "Electronica - Manualul studentului", vol1, Editura Universitatii din Bucuresti, 2003.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of equations/mathematical methods/physical models and theories - ability to indicate/analyze specific examples	Written test/oral examination	80%
Practical	- ability to use specific experimental methods/apparatus - ability to perform/design specific experiments - ability to present and discuss the results	Lab reports	20%
Minimal requirements for passing the exam	Minimal requirements for passing the exam 80% of the practical activities must be finalized, mark 5 for the lab examination Requirements for mark 5 (10 points scale) A mimimum grade of 5 for the lab examination Answering the theoretical exam questions and solving the exercises with grade 5		

Date, 25.09.2026	Teacher's name and signature, Prof. dr. Andrei Barborică	Practicals/Tutorials/Project instructor(s), name and signature Lect. dr. Bogdan Biţă
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOB.214.P Nuclear physics / Fizică nucleară

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Nuclear physics / Fizică nucleară				
2.2. Teacher			Mihaela Parvu, Oana Ristea				
2.3. Tutorials/Practicals instructor(s)			Mihaela Parvu, Oana Ristea				
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					35
Research in library, study of electronic resources, field research					10
Preparation for practicals/tutorials/projects/reports/homework					25
Tutorat					0
Other activities					-1
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	The equations of mathematical physics, physics of the atom and molecule
4.2. competences	Knowledge of mathematics, atomic physics, programming languages and numerical methods, etc.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia devices (video)
5.2. for tutorials/practicals	Nuclear Physics Laboratory equipped with radioactive isotopic sources, radiation detectors (gas, scintillators, semiconductors detectors), spectroscopic chains, multichannel analyzers, radiation monitors

6. Learning outcomes

Knowledge	R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R10. The student/graduate deduces working formulas for calculations involving physical quantities, correctly applying fundamental principles and laws.
Skills	R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R10. Students/graduates prepare and present, in English, scientific or outreach reports and communications, using appropriate technical language and logical argumentation.

Responsibility and autonomy	R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R10. Students/graduates take responsibility for interacting, contributing, and integrating into multilingual work teams and professional communities, demonstrating autonomy in using information sources in English.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Introduction: purpose and role of subatomic physics; historic steps in discovering the structure of matter and the fundamental constituents.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
The intrinsic properties of the atomic nucleus: size, radius, density, binding energy, mass, electric charge, spin, parity, magnetic moment and quadrupole moments	Systematic exposition - lecture. Examples	8 Hours
Nuclear stability: binding energy, separation energy, the liquid drop model and semi-empirical mass formula.	Systematic exposition - lecture. Heuristic conversation. Examples	4 Hours
Radioactive decay: activity, half-time, the law of radioactive decay.	Systematic exposition - lecture. Heuristic conversation. Examples	4 Hours
Disintegration processes: alpha, beta, gamma decay; emitting nuclei, decay heat, energy spectra, decay series; applications.	Systematic exposition - lecture. Heuristic conversation.. Critical analysis. Examples	8 Hours

References:

1. A Das and T. Ferbel, Introduction to Nuclear and Particle Physics, World Scientific, Second edition, 2005
2. Raymond Serway, Clement Moses, Curt Moyer, Modern Physics, Third Edition, Thomson Books/Cole, 2005 (13 Nuclear structure, 14 Nuclear physics applications, 15 Elementary particles; other only by selection)
3. http://hyperphysics.phy-astr.gsu.edu/hbase/HFrame.html
4. http://ocw.mit.edu/OcwWeb/Nuclear-Engineering/22-101Fall-2006/LectureNotes/index.htm
5. K Heyde, Basic Ideas and Concepts in Nuclear Physics (An Introduction approach) (Graduate student series in physics, Series Editor: Douglas F Brewer), IOP Publishing Ltd, Second edition 1999
6. K. Gottfried, V. Weisskopf Concepts of particle physics Clarendon Press, 1984
7. Brian R Martin, Nuclear and Particle Physics – An Introduction, 2nd_Edition, 2009
8. WR Leo, Techniques for nuclear and particle physics experiments, 2nd Edition Springer-Verlag , 1994
9. http://ocw.mit.edu/courses/nuclear-engineering/22-55j-principles-of-radiation-interactions-fall-2004/lecture-notes/

10. Electronic support of the course
10. Manuale scrise de membrii Catedrei de Fizica atomica si nucleara, autori diferiti, diferite editii
11. Fizica nucleara – Culegere de probleme (Catedra de fizica atomica si nucleara), Editura All, 1994
12. Îndrumător de laborator, Catedra de Fizică atomică şi nucleară, Ed.Univ. Bucureşti, diverse ediţii

7.3 Practicals	**Teaching techniques**	**Observations**
1.Dosimetry 2. Experimental study of the probabilistic nature of the processes of radioactive decays 3. The study of the interactions of alpha particles in air 4. The absorption of the beta particles in various materials 5. Bakscattering of the beta particles 6. Gamma atenuation in different materials 7. Gamma spectroscopy 8. Determination of the activity of a gamma ray source	Guided practical activities	16 Hours
Statistical analysis of experimental data in nuclear physics Nuclear electronic elements and set-ups used in nuclear physics lab	Guided work	6 Hours

Problems	Guided work	4 Hours
Examination		2 Hours

References:
1.Electronic Lab Guide
2. Fizica nucleara – Culegere de probleme (Catedra de fizica atomica si nucleara), Editura All, 1994
3. Lucrari practice de Fizica nucleara, Îndrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară, Ed. Univ. Bucureşti, 1987
4. Bazele Fizicii nucleare, Lucrari practice, Indrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară, Ed. Univ. Bucureşti, 2003
5. 1000 solved problems in Modern Physics, A. Kamal, Springer-Verlag, 2010
6. Problems and solutions on Atomic, Nuclear and Particle Physics, Y.-K. Lim, World Scientific, 2000

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops theoretical and practical competences and abilities which are fundamentalfor an undergraduate student in the field of modern Physics, corresponding to national and international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union (University of Oxford https://www.ox.ac.uk/admissions/undergraduate/courses-listing?wssl=1, Universityof Parma http://www.difest.unipr.it/it/didattica/laurea-triennale-fisica/calendario-didattico, Universitatea Padova, http://en.didattica.unipd.it/didattica/2015/SC1158/2014). The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of equations/mathematical methods/physical models and theories - ability to indicate/analyse specific examples	Oral examination	60%
Practical	- ability to use specific experimental methods/apparatus - ability to perform/design specific experiments - ability to present and discuss the results - ability to use specific problem solving methods - ability to analyse the results	Lab reports and oral examination	40%
Minimal requirements for passing the exam	Minimum requirements for passing (grade 5): Mandatory attendance at all applied activities (tutorials and laboratory) and at 75% of the lectures. Completion of all laboratory work and presentation of the results as scientific reports. A grade of at least 5 in the laboratory colloquium. Correct solution of the exam questions designated for a grade of 5 in the final exam. Requirements for the maximum grade (grade 10): Thorough, well-argued knowledge and skills. Demonstrated ability to analyse phenomena and processes; correct solution of all exam questions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
25.09.2026	Mihaela Parvu, Oana Ristea	Mihaela Parvu, Oana Ristea

Date of approval	Head of department name and signature
28.09.2026	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOB.215.P Thermodynamics and statistical physics / Termodinamică şi fizică statistică

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Thermodynamics and statistical physics / Termodinamică şi fizică statistică				
2.2. Teacher			Lect. dr. Stefan-Alexandru Ghinescu				
2.3. Tutorials/Practicals instructor(s)			Asist. Univ. dr. Cristian-Valer Vraciu				
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	6	3.2. Lectures	3	3.3. Tutorials/Practicals/Projects	3/0/0
3.4. Total hours per semester	84	3.5. Lectures	42	3.6. Tutorials/Practicals/Projects	42/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					21
Research in library, study of electronic resources, field research					10
Preparation for practicals/tutorials/projects/reports/homework					10
Tutorat					0
Other activities					0
3.7. Total hours of individual study					41
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Real and complex analysis; Algebra, geometry and differential equations; Molecular Physics
4.2. competences	Basic notions regarding integrals and derivatives. Molecular physics: elementary notions specific to thermodynamics (heat, work, entropy, simple transformations).

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Videoprojector.
5.2. for tutorials/practicals	Videoprojector.

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations.

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Fundamental problems of neo-gibbsian thermodynamics	Systematic exposition - lecture. Examples	3 Hours
Thermodynamic representations	Systematic exposition - lecture. Examples	3 Hours
Thermodynamic coefficients and thermodynamic equilibrium conditions Condiţii de echilibru termodinamic	Systematic exposition - lecture. Examples	3 Hours
First order phase transitions, macroscopic models	Systematic exposition - lecture. Examples	3 Hours
Fundamental problems of classical statistical mechanics	Systematic exposition - lecture. Examples	3 Hours
Equilibrium statistical ensembles	Systematic exposition - lecture. Examples	9 Hours
Special topics in classical statistical mechanics: the Ising models	Systematic exposition - lecture. Examples	6 Hours
Special topics in classical statistical mechanics: the Van der Waals gas	Systematic exposition - lecture. Examples	6 Hours
Landau theory of phase transitions (mean field approximation)	Systematic exposition - lecture. Examples	6 Hours

References:

1. TERMODINAMICĂ ŞI FIZICĂ STATISTICĂ. NOTE DE CURS ŞI SEMINAR, Editura Universittatii din Bucuresti, 2017, 978-606-16-0898-0
2. K. Huang, Introduction to statistical physics, CRC Press, 2013
3. K. Huang, Lectures on statistical physics and protein folding, World Scientific 2005
4. D. Tong, Lectures on Statistical Physics, University of Cambridge, 2012, https://www.damtp.cam.ac.uk/user/tong/statphys.html
5. Harald J.W. Müller-Kirsten, Basics of Statistical Physics, 3rd ed. World Scientific, 2022.

7.2 Tutorials	**Teaching techniques**	**Observations**
Mathematical complements for thermodynamics	Theoretical presentation and problem solving probleme	3 Hours

Fundamental problems of neo-gibbsian thermodynamics	Theoretical presentation and problem solving	3 Hours
Thermodynamic representations	Theoretical presentation and problem solving	3 Hours
Thermodynamic coefficients and thermodynamic equilibrium conditions	Theoretical presentation and problem solving	3 Hours
First order phase transitions, macroscopic models	Theoretical presentation and problem solving	6 Hours
Mathematical complements for classical statistical mechanics	Theoretical presentation and problem solving	3 Hours
Equilibrium statistical ensembles	Theoretical presentation and problem solving	9 Hours
Landau theory of phase transitions (mean field approximation)	Theoretical presentation and problem solving	6 Hours
Special topics in classical statistical mechanics: the Ising models	Theoretical presentation and problem solving	6 Hours

References:

1. D.A.R. Dalvit, J. Frastai, I. Lawrie, Problems on statistical mechanics, CRC Press, 1999
2. Y.-K. Lim, Problems and solutions on thermodynamics and statistical mechanics, World Scientific, 1990
3. J.M. Yeomans, Statistical mechanics of phase transitions, Clarendon Press, 1992
4. K. Huang, Introduction to statistical physics, CRC Press, 2013

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical competences and abilities which are fundamental for an undergraduate student in the field of modern physics, corresponding to national and European/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the equirements/expectations of the main employers of the graduates (industry, research, academic, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	The evaluation criteria are: - Knowledge of fundamental concepts taught throughout the semester; - Ability to apply the fundamental concepts in solving simple problems; - Ability to model medium-complexity systems through reasoning developed on the basis of fundamental concepts; - Active participation in the lecture and seminar sessions.	Written exam	100%

Minimal requirements for passing the exam	Active participation in lecture and seminar sessions is rewarded with at most two bouns points. The final mark is computed as the sum between the mark obtained in the written exam and the bonus points; the final mark cannot exceed 10.00. Criteria for obtaining mark 5 on a 10 points scale (passing the course): - Minimum attendance: 50% for lectures and 70% for seminars. - Without bonus points: Correctly solving half of the items of the written exam problems. - In case the student was awarded bonus points for active participation: the bonus points sum up with the written exam mark. The exam is passed if the sum is at greater than or equal to 5.00. Criteria for obtaining mark 10 on a 10 points scale: - Without bonus points: Correctly solving all items of the written exam problems. - In case the student was awarded bonus points for active participation: the bonus points sum up with the written exam mark. The final mark is 10 if the sum is greater than or equal to 9.50.

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
8.09.2026	Lect. dr. Stefan-Alexandru Ghinescu	Asist. Univ. dr. Cristian-Valer Vraciu

Date of approval	Head of department name and signature
17.09.2026	Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.216.P Traineeship / Practica de specialitate (3 săpt. x 30 ore)

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Traineeship / Practica de specialitate (3 săpt. x 30 ore)				
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)			Conf. dr. Vasile Bercu				
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	verificare	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	30	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	0/30/0
3.4. Total hours per semester	90	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	0/90/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					5
Research in library, study of electronic resources, field research					3
Preparation for practicals/tutorials/projects/reports/homework					2
Tutorat					0
Other activities					0
3.7. Total hours of individual study					10
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	Knowledge from related disciplines acquired previously
4.2. competences	Skills in solving theoretical and experimental problems under qualified supervision

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R16. The student/graduate acquires civic competences, especially knowledge of social and political concepts and structures for active and democratic participation of people
Skills	R16. The student/graduate develops communication skills in the mother tongue and/or an international language
Responsibility and autonomy	R16. Spirit of initiative and entrepreneurship – the ability to turn ideas into action

7. Contents

7.3 Practicals	**Teaching techniques**	**Observations**

Physics-specific internship within a research center/institute/company with which the Faculty of Physics has concluded internship agreements. Theoretical methods and techniques specific to the field of Physics. Experimental approaches specific to the field of Physics: • Experimental techniques specific to the field; • Methods for processing/designing devices/systems specific to the field; • Characterization techniques specific to the field. Specific occupational health and safety regulations will be presented at the beginning, and initial training seminars will be organized for the use of laboratory equipment and computer systems.	Guided activity	90 Hours

References:
To be specified for the chosen topic by the supervising faculty member and the internship coordinator; it includes occupational health and safety regulations and training courses/seminars.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course responds to current demands for practical skills development in higher education, both nationally and internationally. The internships will be carried out within the institutes/companies with which the Faculty of Physics has concluded internship agreements. The target fields of activity are diverse, with potential employers spanning both the research and development sector and other domains.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Practical	• Evaluation of theoretical/experimental skills acquired during laboratory activity • Evaluation of the capacity to analyze and interpret theoretical/experimental results	Internship/Activity report	100%
Minimal requirements for passing the exam	To obtain a final grade of 5 (passing grade) • Mandatory attendance at all activities included in the internship portfolio • Preparation of the activity report following the internship • Mastery of the main concepts, methods, and techniques. To obtain a grade of 10 (Highest grade) • Deeply substantiated skills and knowledge • Demonstrated capacity to analyze phenomena and processes • Personal approach to problem-solving and interpretation		

Date,

25.09.2026

Practicals/Tutorials/Project instructor(s),
name and signature
Conf. dr. Vasile Bercu

Date of approval

28.09.2026

Head of department
name and signature
Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOP.217.1.P Virtual instrumentation and data acquisition / Instrumentaţie virtuală şi achiziţie de date

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Virtual instrumentation and data acquisition / Instrumentaţie virtuală şi achiziţie de date				
2.2. Teacher			Lect. dr. Bogdan Biţă				
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Bogdan Biţă				
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					22
Research in library, study of electronic resources, field research					11
Preparation for practicals/tutorials/projects/reports/homework					11
Tutorat					0
Other activities					0
3.7. Total hours of individual study					44
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	Completion of the following courses: Programming, Numerical Methods
4.2. competences	Skills in computational Physics

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia facilities (video projector)
5.2. for tutorials/practicals	Seminar/laboratory room with specific infrastructure

6. Learning outcomes

Knowledge	R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R9. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress.

Skills	R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R9. The student/graduate deduces working formulas for calculations involving physical quantities , appropriately applying fundamental principles and laws.
Responsibility and autonomy	R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R9. The student/graduate demonstrates autonomy in operating, maintaining, and repairing laboratory equipment (e.g., sensor calibration, instrument adjustment), adhering to safety and quality standards.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Experimental techniques in modern physics. Transducers and automatic data acquisition.	Systematic presentation, lecture. Examples	4 Hours
Software applications – the LabVIEW programming environment. Virtual instruments.	Systematic presentation, lecture. Examples	6 Hours
The G programming language: data types, language elements, structures, subprograms, working with files, interfacing with other programming languages.	Systematic presentation, lecture. Examples	6 Hours
The VISA architecture. Configuring and controlling a GPIB bus. Configuring and controlling an RS485 bus. Electrical signal conditioning and data processing.	Systematic presentation, lecture. Examples	6 Hours
Computer connectivity to sensors and actuators. Signal acquisition. Personal computer and external devices. Hardware configurations. Data communication and storage.	Systematic presentation, lecture. Examples	6 Hours

References:

1. G Programming Reference Manual, National Instruments
2. Data Acquisition Basics Manual, National Instruments
3. R.Baican, D.S. Necsulescu, Applied Virtual Instrumentation (WIT Press, Southampton, UK, 2000)

7.3 Practicals	**Teaching techniques**	**Observations**
Introduction to graphical programming. The front panel. Block diagrams.	Practical works	4 Hours
Virtual instruments. The VI editor. Menus and tools.	Practical works	4 Hours
Graphics and text. VI files and libraries. Hierarchy in virtual instrumentation.	Practical works	8 Hours
Modeling of physical systems. Data acquisition modules.	Practical works	12 Hours

References:

1. G Programming Reference Manual, National Instruments
2. Data Acquisition Basics Manual, National Instruments
3. R.Baican, D.S. Necsulescu, Applied Virtual Instrumentation (WIT Press, Southampton, UK, 2000).

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

In order to outline the content and choose the teaching/learning methods, the course coordinators have consulted the content of similar courses taught at universities both domestically and abroad. The content of the course complies with the standards used in research and industry.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	• Knowledge of specific programming techniques; • Interpretation of results.	Development of an application on a given topic	60%
Practical	- Aplicarea metodelor specifice de rezolvare pentru problema dată;	Laboratory colloquium	40%
Minimal requirements for passing the exam	To obtain a final grade of 5 (Passing grade): • Mandatory attendance at all practical activities (seminars and laboratories) and at 50% of the lectures. Completion of all laboratory works and submission of the results in the form of scientific reports. • Obtaining a grade of 5 on the laboratory colloquium. • Correct resolution of the questions/topics designated for a score of 5 on the final exam. To obtain a grade of 10 (Highest grade): • Deeply substantiated skills and knowledge. • Demonstrated capacity to analyze phenomena and processes, and correct resolution of all exam questions/topics.		

Date, 25.09.2026	Teacher's name and signature, Lect. dr. Bogdan Biţă	Practicals/Tutorials/Project instructor(s), name and signature Lect. dr. Bogdan Biţă
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOP.217.2.P Physical methods for non-destructive testing / Metode fizice de control nedistructiv

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title	Physical methods for non-destructive testing / Metode fizice de control nedistructiv						
2.2. Teacher	Lect. dr. Bogdan Biţă						
2.3. Tutorials/Practicals instructor(s)	Lect. dr. Bogdan Biţă						
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					22
Research in library, study of electronic resources, field research					11
Preparation for practicals/tutorials/projects/reports/homework					11
Tutorat					0
Other activities					0
3.7. Total hours of individual study					44
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	Fundamental and specialized disciplines: analysis and algebra; mechanics; molecular physics and heat; electricity; electronics; optics; atomic physics
4.2. competences	Skills in operating standard laboratory equipment

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia-equipped room (video projector)
5.2. for tutorials/practicals	Laboratory room with specific infrastructure

6. Learning outcomes

Knowledge	R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R13. The student/graduate describes physical systems (e.g., thermodynamic systems, electrical circuits), using specific theories and tools to characterize them.
Skills	R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards. R13. The student/graduate is able to read, understand, and translate specialized texts, extract relevant information from international scientific sources, and communicate orally and in writing in an autonomous and professional manner.
Responsibility and autonomy	R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python). R13. The student/graduate responsibly uses international information sources, respecting academic ethics standards and demonstrating initiative in learning specialized scientific language.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
DEFECTOSCOPY – a discipline at the interface between physics and engineering. General presentation of the principles of Defectoscopy, its role, main non-destructive testing methods, history, and trends.	Systematic exposition - lecture. Case studies. Examples. Critical analyses.	2 Hours
VISUAL TESTING METHOD - VT. Physical principles, methods and equipment, interpretation and evaluation criteria, scope of application / limitations, advantages / disadvantages.	Systematic exposition - lecture. Case studies. Examples. Critical analyses.	2 Hours
LIQUID PENETRANT TESTING METHOD - PT. Physical principles / capillarity, methods, testing procedures and stages, equipment, interpretation and evaluation criteria, scope of application / limitations, advantages / disadvantages.	Systematic exposition - lecture. Case studies. Examples. Critical analyses.	4 Hours
MAGNETIC PARTICLE TESTING METHOD - MT. Physical principles / magnetism, methods, testing procedures and stages, equipment, interpretation and evaluation criteria, scope of application / limitations, advantages / disadvantages.	Systematic exposition - lecture. Case studies. Examples. Critical analyses.	4 Hours
RADIOGRAPHIC TESTING METHOD - RT. Physical principles / radiation sources / radiation interaction with matter, methods, testing procedures and stages, equipment, interpretation and evaluation criteria, scope of application / limitations, advantages / disadvantages.	Systematic exposition - lecture. Case studies. Examples. Critical analyses.	4 Hours
ULTRASONIC TESTING METHOD – UT – Conventional Technique. Physical principles / waves / ultrasound / propagation / attenuation / generation, methods, testing procedures and stages, equipment, interpretation and evaluation criteria, scope of application / limitations, advantages / disadvantages.	Systematic exposition - lecture. Case studies. Examples. Critical analyses.	4 Hours
ULTRASONIC TESTING METHOD – PA and TOFD – Phased Array and Time-of-Flight Diffraction Technique. Physical principles / waves / ultrasound / propagation / attenuation / generation, methods, testing procedures and stages, equipment, interpretation and evaluation criteria, scope of application / limitations, advantages / disadvantages.	Systematic exposition - lecture. Case studies. Examples. Critical analyses.	4 Hours
ADVANCED TESTING METHODS – Eddy Current, Acoustic Emission, Guided Waves, IR Thermography, X-ray Fluorescence. Physical principles, methods, testing procedures and stages, equipment, scopes of application / limitations, advantages / disadvantages.	Systematic exposition - lecture. Case studies. Examples. Critical analyses.	4 Hours

References:

[1] Patrick O. Moore (editor) – Liquid Penetrant Testing, ASNT, Columbus OH, USA, 1999.
[2] Patrick O. Moore (editor) – Magnetic Testing, ASNT, Columbus OH, USA, 1999.
[3] Patrick O. Moore (editor) – Radiographic Testing, ASNT, Columbus OH, USA, 1999.
[4] Patrick O. Moore (editor) – Ultrasonic Testing, ASNT, Columbus OH, USA, 1999.
[5] D. R. Mocanu, ş.a. – Încercarea materialelor, vol. 3, Editura Tehnică, Bucureşti, 1986.
[6] V. Deutsch, M. Platte, M. Vogt – Controlul ultrasonic, Principii şi aplicaţii industriale, Editura ARoENd, Bucureşti, 1998.
[7] V. Safta – Controlul îmbinărilor şi produselor sudate, Editura Facla, Timişoara, 1984.
[8] J. Krautkrämer, H. Krautkrämer – Ultrasonic Testing of Materials, 2-nd Edition, Springer - Verlag, Berlin, 1977.

7.3 Practicals	Teaching techniques	Observations
Visual testing methods – digital videoendoscopy	Guided practical activity	2 Hours

Liquid penetrant testing method – stages / applications	Guided practical activity	2 Hours
Magnetic particle testing method – stages / applications	Guided practical activity	2 Hours
Radiographic method – interpretation of radiographic films	Guided practical activity	2 Hours
Ultrasonic testing method – calibration of ultrasonic flaw detectors	Guided practical activity	2 Hours
Ultrasonic testing method – normal incidence / single-crystal and dual-crystal transducers	Guided practical activity	2 Hours
Ultrasonic testing method – oblique incidence / angle beam transducers	Guided practical activity	4 Hours
Ultrasonic testing method – size evaluation of discontinuities	Guided practical activity	4 Hours
Ultrasonic testing method – A/B/C-scan presentations	Guided practical activity	4 Hours
Ultrasonic testing methods – Phased Array (PA) and Time-of-Flight Diffraction (TOFD) techniques	Guided practical activity	4 Hours
References:		

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

-The discipline meets the current national and international development and evolution requirements of higher education in the field of non-destructive testing techniques;
-The course syllabus is integrated into the study programs associated with the field of applied engineering sciences at UB, being correlated with similar study programs from European universities implementing the Bologna system;
-In the current context of industrial development, the targeted fields of activity are virtually unlimited, with potential employers spanning the educational sector, industry, commerce, and research & development, as well as national, international, or multinational organizations, associations, societies, and companies involved in the production and distribution of measuring instruments;
-Students are provided with competences tailored to current qualification needs, along with a scientific and technical training corresponding to the Bachelor‘s level, enabling rapid integration into the labor market after graduation, as well as the opportunity to continue their studies through Master‘s and PhD programs;
-The study program is aligned with the policy and strategy of the University of Bucharest, both in terms of content and structure, and with regard to the aptitude and international openness offered to students.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	Clarity, coherence, and conciseness of the exposition; Correct use of calculation formulas; Ability to provide examples;	Theoretical knowledge test	60%
Practical	Application of specific problem-solving methods for the given problem	Assessment through a practical exam	40%
Minimal requirements for passing the exam	Obtaining a passing grade of 5: -Mandatory attendance at all practical activities (seminars and laboratories) and at 50% of the lectures. Completion of all laboratory works and presentation of the results in the form of scientific reports. -Obtaining a minimum grade of 5 on the laboratory colloquium. -Correctly solving the designated topics to obtain a score of 5 on the final exam. Obtaining a grade of 10: -Advanced, deeply reasoned skills and knowledge. -Demonstrated ability to analyze phenomena and processes, and correct solution of all topics.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
8.09.2026	Lect. dr. Bogdan Biţă	Lect. dr. Bogdan Biţă

Date of approval	Head of department name and signature
17.09.2026	Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.223.P Sports III / Educaţie fizică III

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	
1.3. Department	Department of Physical Education and Sports
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Sports III / Educaţie fizică III				
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)			Lector univ. dr. Cătălin Șerban				
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	verificare	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	1/0/0
3.4. Total hours per semester	14	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	14/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					6
Research in library, study of electronic resources, field research					3
Preparation for practicals/tutorials/projects/reports/homework					2
Tutorat					0
Other activities					0
3.7. Total hours of individual study					11
3.8. Total hours per semester					25
3.9. ECTS					1

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R16. The student/graduate acquires civic competences, especially knowledge of social and political concepts and structures for active and democratic participation of people
Skills	R16. The student/graduate develops communication skills in the mother tongue and/or an international language
Responsibility and autonomy	R16. Spirit of initiative and entrepreneurship – the ability to turn ideas into action

7. Contents

7.2 Tutorials	Teaching techniques	Observations
Introductory lecture	Lecture / Presentation. Practical exercises.	1 Hour
Initial assessment	Lecture / Presentation. Practical exercises.	1 Hour
Technique consolidation: aerobics and fitness	Lecture / Presentation. Practical exercises.	3 Hours
Consolidation of core ball-handling technical elements (volleyball, handball)	Lecture / Presentation. Practical exercises.	5 Hours

Consolidation of core collective offensive and defensive tactical actions (volleyball, handball)	Lecture / Presentation. Practical exercises.	4 Hours

References:

1. Ganciu, M., (coord), colectiv DEFS, 2013, Curs de educaţie fizică pentru studenţii Universităţii din Bucureşti, Editura Universităţii din Bucureşti, Bucureşti
2. Ganciu, M., Aducovschi, D., Gozu, B., Stoica, A.M., Stoicoviciu, A., Gulap, M., Cristea, M., 2010, Activitatea fizică independentă şi valorificarea prin mişcare a timpului liber – Vol.I, Editura Universităţii din Bucureşti, Bucureşti
3. Stoica, A., 2011, Curs practic de gimnastică aerobică pentru studenţii din Universitatea din Bucureşti. Editura Universităţii din Bucureşti

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

Physical education constitutes a social activity with outstanding contributions to the social and professional integration of youth. The formative function of physical education will contribute to the development of these qualities and capacities, enabling the future specialist to master their chosen profession as quickly and effectively as possible, to practice it with high efficiency, to engage in various social activities, and to act independently and creatively upon both the environment and themselves.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Tutorial	• Interest shown in the course through systematic participation in practical lessons • Initial and intermediate assessment through tests and control trials • Participation in sports competitions	Individual assessment	100%
Minimal requirements for passing the exam	• Participation in 50% of the total number of lessons • Passing the motor skill trials • Participation in a sports competition • Demonstrating a minimum mastery of the general concepts of physical education and sports		

Date,

8.09.2026

Practicals/Tutorials/Project instructor(s), name and signature

Lector univ. dr. Cătălin Șerban

Date of approval

17.09.2026

Head of department name and signature

Syllabus

Academic year 2026/2027
DOB.301.P Quantum Mechanics II / Mecanică cuantică II

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Quantum Mechanics II / Mecanică cuantică II				
2.2. Teacher			Prof. Univ. Dr. Virgil Băran				
2.3. Tutorials/Practicals instructor(s)			Lect. Univ. Dr. Virgil V. Băran				
2.4 Year of study	3	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	2/0/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	28/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					20
Research in library, study of electronic resources, field research					15
Preparation for practicals/tutorials/projects/reports/homework					30
Tutorat					0
Other activities					4
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Real and Complex Analysis, Algebra, Differential Equations, Equations of Mathematical Physics, Classical mechanics, Fundamentals of Atomic Physics, Quantum Mechanics I
4.2. competences	Knowledge about : - Phenomenology of microscopic behaviour of physical systems - Differential and integral calculus, partial differential equations, special functions, orthogonal polynomials - Analytical formalism of classical mechanics; classical electrodynamics -Principles of quantum mechanics, representations of Quantum Mechanics, angular momentum in Quantum Mechanics

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Computer, Video projector, Lecture notes, Bibliography
5.2. for tutorials/practicals	Lecture notes, Bibliography

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics).
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations

1. Theory of rotations in Quantum Mechanics The rotation operator. The angular momentum operator as the generator of rotations. Wigner functions: physical interpretation. Systems of spin 1/2 particles. The Pauli formalism.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
2. The addition of angular momenta The quantum mechanical description of combination of two physical systems. Two spin one-half systems. General discussion. Maximal sets of mutually compatible observables. Possible bases in the Hilbert space of total system. The formal theory of angular momentum addition. Clebsch-Gordan coefficients. Interpretation. Basic properties of Clebsch- Gordan coefficients. Recursion relations for Clebsch-Gordan coefficients. Clebsch- Gordan series. Addition of orbital angular momentum with the spin one-half angular momentum. Spherical tensors. Definition. Products of spherical tensor operators. Wigner-Eckart theorem.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	5 Hours
3. Kepler problem in quantum mechanics Formulation of the problem. System of compatible observables. Coordinates representation of time independent Schrodinger equation. Coulomb potential. Eigenvalues and eigenvectors for hydrogen atom.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
4. The time-independent perturbation theory – degenerate case Perturbation theory for the degenerate case. Variational method for ground state and excited states. Ritz approach.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	3 Hours
5. Particle motion in a magnetic field. The Pauli equation The Hamiltonian of a charged particle in the electromagnetic field. The Schrodinger equation. The Bohr-Procopiu magneton. The Pauli equation. The vector potential in quantum mechanics. The gauge invariance in quantum mechanics. Bohm-Aharonov effect. Modern Applications: Landau levels and integral quantum Hall effect.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
6. Systems of identical particles in quantum mechanics The principle of identity of like-particles in microscopic world; exchange degeneracy. Permutation operator; symmetrization and antisymmetrization operators for systems of two identical particles.The symmetrisation postulate: bosons and fermions.The state ket for a system of three bosons. Slater determinants. Systems of two electrons. Fock space.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours

7.Theory of time-dependent perturbations Schrödinger, Heisenberg and interaction (Dirac) pictures of quantum mechanics. Time evolution operator: definition, properties, Dyson perturbative expansion for time evolution operator. Transition amplitude. Transition probability. Step pertubation and Fermi's golden rule for transition rate. The case of a periodic perturbation:stimulated electromagnetic transitions. Dipole approximation. The scattering theory. The scattering amplitude and cross section. The perturbative approach and the relation with time-dependent perturbation theory.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours

References:

J.J. Sakurai, J.J. Napolitano, Modern quantum mechanics, Addison-Wesley, 2011
D . H . McIntyre , Quantum mechanics. A paradigms approach, Pearson Education Ltd , 2014
L . D . Landau , E .M. Lifshitz , Quantum mechanics, Butterworth -Heinemann, 2003
PAM Dirac, Principles of Quantum Mechanics, Oxford, 1982
W. Greiner, Quantum mechanics: an introduction, Springer, 2001
L.E. Ballentine, Quantum Mechanics : A Modern Development (2nd Edition), World Scientific Publishing Company; 2014
V. Baran, R. Zus, Lecture notes on quantum mechanics
A. Messiah, Quantum Mechanics, Dover Publications 1999
S. Titeica, Mecanica Cuantica, Editura Academiei, 1984

7.2 Tutorials	**Teaching techniques**	**Observations**
General theory of angular momentum (commutation relations, rotations, etc.)	Problem solving. Guided work. Case study. Examples	2 Hours
Systems of spin 1/2 particles - applications	Problem solving. Guided work. Case study. Examples	2 Hours
The addition of angular momenta – applications for particles with spin 1/2 and 1. Addition of orbital angular momentum with the spin one-half angular momentum.	Problem solving. Guided work. Case study. Examples	6 Hours
Hydrogen atom. Applications	Problem solving. Guided work. Case study. Examples	4 Hours
The time-independent perturbation theory – degenerate case. Applications: Stark effect etc.	Problem solving. Guided work. Case study. Examples	3 Hours
Quantum dynamics of particles in the electromagnetic field. Pauli equation – applications: Landau levels, Zeeman effect and Quantum Hall effect.	Problem solving. Guided work. Case study. Examples	4 Hours
Systems of identical particles in quantum mechanics – problems and applications.	Problem solving. Guided work. Case study. Examples	3 Hours
Theory of time-dependent perturbations – applications.	Problem solving. Guided work. Case study. Examples	4 Hours

References:

J.J. Sakurai, J.J. Napolitano, Modern quantum mechanics, Addison-Wesley, 2011
D . H . McIntyre , Quantum mechanics. A paradigms approach, Pearson Education Ltd , 2014
L . D . Landau , E .M. Lifshitz , Quantum mechanics, Butterworth -Heinemann, 2003
PAM Dirac, Principles of Quantum Mechanics, Oxford, 1982
W. Greiner, Quantum mechanics: an introduction, Springer, 2001
N. Zettili, Quantum Mechanics Concepts and Applications, second edition, John Wiley and Sons, 2009
V. Baran, R. Zus, Lecture notes on quantum mechanics
R. Zus, V. Băran, V.V. Băran, A.M. Croitoru, C.Iorga, D.I. Palade, Quantum Mechanics – Applications – seminar notes (pdf)

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical competences and abilities which are fundamental for an undergraduate student in the field of modern physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, academic, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of equations/mathematical methods/physical models and theories - ability to indicate/analyze specific examples - ability to apply the gained knowledge to solve specific problems (angular momentum coupling, Hydrogen atom, Stark effect, Zeeman effect, etc.)	Written test/oral examination	70%
Tutorial	- ability to use specific problem solving methods - ability to analyze the results	Homework/written tests	30%
Minimal requirements for passing the exam	Attendance of at least 50% for the lectures and at least 70% for the tutorials. Correct solutions to the indicated subjects for obtaining the grade 5 from all activities, part of the continuous evaluation. Correct solutions to the indicated subjects for obtaining the grade 5 within the final exam. Requirements for getting mark 10 (10 points scale) Correct answer to all the subjects indicated for obtaining grade 10 Skills, well-argued knowledge Demonstrated ability to analyze phenomena and processes Personal approach and interpretation.		

Date, 25.09.2026	Teacher's name and signature, Prof. Univ. Dr. Virgil Băran	Practicals/Tutorials/Project instructor(s), name and signature Lect. Univ. Dr. Virgil V. Băran
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOB.302.P Molecular physics / Fizica moleculei

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Molecular physics / Fizica moleculei				
2.2. Teacher			Conf.univ.dr. Vasile Bercu				
2.3. Tutorials/Practicals instructor(s)			Asist.univ.dr. Leonard Gebac				
2.4 Year of study	3	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	1/1/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	14/14/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					35
Research in library, study of electronic resources, field research					5
Preparation for practicals/tutorials/projects/reports/homework					29
Tutorat					0
Other activities					0
3.7. Total hours of individual study					69
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Fundamentals of atomic physics, Physical mechanics, Electricity and magnetism, Quantum ,echanics I, Equations of mathematical physics, Optics
4.2. competences	Cunoştinţe de matematică şi mecanică cuantică

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Sală cu dotări multimedia (videoproiector); Bibliografie recomandata
5.2. for tutorials/practicals	Laborator; Videoproiector; Calculatoare

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods).

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Single-electron atom – hydrogen-like atom - single-electron atom model - Hamiltonian of a single-electron atom - time-dependent Schrödinger equation - solving the Schrödinger equation - orbitals of hydrogen-like atoms - expectation values in the hydrogen-like atom	Systematic exposition – lecture.	4 Hours
Alkali metal atoms - Schrödinger equation in the dipole approximation of the atomic core potential - energy levels	Systematic exposition – lecture.	2 Hours
Hydrogenic atoms in an external magnetic field - Schrödinger equation for a particle in an external magnetic field - normal Zeeman effect - electron spin in the hydrogen-like atom - fine structure of hydrogen-like atoms - anomalous Zeeman effect	Systematic exposition – lecture.	3 Hours
Multi-electron atom – Helium atom - energy degeneracy in a system of two identical particles - helium atom – two-electron atom: calculation of ground state energy; excited states; Pauli principle; singlet and triplet states of the He atom; total wave functions of the two-electron atom; coupling of angular momenta: L-S and jj coupling	Systematic exposition – lecture. Critical analyses	6 Hours

Multi-electron atom - Hartree self-consistent field method: Hartree procedure for obtaining wave functions - calculation of atomic energy in the self-consistent field approximation - Hartree-Fock self-consistent field method: Slater rules; electron-electron repulsion and screening effect; electronic configurations and the Mendeleev table; terms for light atoms – L-S coupling; Hund's rules	Systematic exposition – lecture. Critical analyses	6 Hours
Molecules – structure and properties - mechanisms of atomic bonding in molecules - rotation and vibration of molecules - electronic structure of diatomic molecules: Born-Oppenheimer approximation - electronic motion and covalent bonding: valence bond method – hydrogen molecule; molecular orbital method – molecular ion H2+; molecular configuration	Systematic exposition – lecture. Case study	7 Hours

References:

Molecular physics: lecture notes, Vasile Bercu; https:moodle.fizica.unibuc.ro
Atomic and molecular physics B. H. Bransden si C. J. Joachain, Bucuresti, 1998
Molecular Quantum Mechanics, Peter W. Atkins, Ronald S. Friedman, Oxford University Press, 2010
Atkins' physical chemistry - Peter Atkins, Julio de Paula, Oxford University Press, 2010
Quantum chemistry – Ira N. Levine, Pearson, 2013
Introduction to quantum mechanics : with applications to chemistry, Linus Pauling and E. Bright Wilson, Dover Publications, 1985
Quantum physics of atoms, molecules, solids, nuclei and particles Robert Martin Eisberg and Robert Resnick, John Wiley and Sons, 1974

7.2 Tutorials	**Teaching techniques**	**Observations**
Introduction and review of quantum mechanics. Principles of molecular spectrometry and data processing: architecture and principles of optical spectrometers, spectral lines, and the physical significance of associated parameters.	Presentation. Discussions	2 Hours
Hydrogen-like atom — problems	Combined lecture	2 Hours
Computational methods for polyatomic molecules: HF method, DFT method	Presentation. Discussions	2 Hours
Applications of group theory in molecular physics. Molecular symmetry. Point symmetry groups. Symmetry elements and operations. Photon absorption processes, selection rules. Identification of spectral signatures and atomic configuration for AB3 molecules (such as the CO3 group in carbonates) from IR spectra using irreducible representations of symmetry groups.	Combined lecture	4 Hours
Spectral terms, multi-electron atoms. Determination of the configuration of C6H6 molecules from raman spectra using the theory of point symmetry groups.	Combined lecture	2 Hours
Synthesis problems in molecular physics	Combined lecture	2 Hours

References:

Molecular physics: lecture notes, Vasile Bercu; https:moodle.fizica.unibuc.ro
Atomic and molecular physics B. H. Bransden si C. J. Joachain, Bucuresti, 1998
Molecular Quantum Mechanics, Peter W. Atkins, Ronald S. Friedman, Oxford University Press, 2010
Atkins' physical chemistry - Peter Atkins, Julio de Paula, Oxford University Press, 2010
Quantum chemistry – Ira N. Levine, Pearson, 2013
Introduction to quantum mechanics : with applications to chemistry, Linus Pauling and E. Bright Wilson, Dover Publications, 1985
Quantum physics of atoms, molecules, solids, nuclei and particles Robert Martin Eisberg and Robert Resnick, John Wiley and Sons, 1974

7.3 Practicals	Teaching techniques	Observations
The spectrum of the sodium atom	Guided practical activity	2 Hours
The spectrum of two-electron atoms: He and Hg	Guided practical activity	4 Hours
IR spectroscopy technique; the HCl molecule	Guided practical activity	4 Hours
Numerical calculation of IR spectra, normal modes of vibration	Guided practical activity	4 Hours

References:

Fizica atomica:lucrari practice, colectiv de autori: Elena Borca, et al.; Tipografia Universitatii din Bucuresti, 1984
Lucrari practice de fizica atomica; htttp:brahms.fizica.unibuc.ro/atom/atom/LabAtom.php
Atomic and molecular physics, B. H. Bransden si C. J. Joachain, Bucuresti, 1998
Fizica atomică - Vol I, V. Spolschi, Editura Tehnica, 1953
Atkins' physical chemistry - Peter Atkins, Julio de Paula, Oxford University Press, 2010
Atoms, Molecules and Photons: An Introduction to Atomic-, Molecular- and Quantum Physics -Wolfgang Demtroder, Springer; 2nd ed. 2010
Quantum physics of atoms, molecules, solids, nuclei and particlesRobert Martin Eisberg and Robert Resnick, New York ; John Wiley and Sons, 1974

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course content is aligned with similar courses offered at other universities both nationally and internationally, being focused on the acquisition of concepts and physical processes associated with atoms and molecules.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	Student evaluation will focus on the following essential aspects: Understanding atomic and molecular phenomena: The ability to demonstrate a solid understanding of the structure and properties of atoms: from hydrogenic atoms to multielectronic atoms, including their behavior in external fields. Knowledge and understanding of the structure and properties of molecules: bonding, rotation, vibration, and electronic structure. Understanding the physical mechanisms underlying electron-electron interactions, coupling of angular momenta, and screening effects. Application of quantum mechanics formalism: The ability to efficiently apply the formalism of quantum mechanics to describe and explain atomic and molecular phenomena and properties. The capacity to use quantum concepts and methods, e.g., Hamiltonian, Schrödinger equation, wave functions, expectation values, in the context of problems specific to atoms and molecules. Understanding the quantum foundations of structure, e.g., atomic and molecular orbitals, electronic configurations, and atomic and molecular spectra. Problem solving and interpretation of results: The ability to solve conceptual and numerical problems specific to Atomic and Molecular Physics, using the mathematical apparatus of quantum mechanics. The skill to interpret obtained results, e.g., energies, energy levels, probabilities, and correlate them with experimental data or physical observations. Demonstration of the capacity to physically justify solutions and conclusions, not merely calculate them.	1. Ongoing Assessment: a) Mid-term written exam of theoretical knowledge: 30% b) Participation and responses during lectures: 5% c) Mid-term oral exam of theoretical knowledge: 10% 2. Final Assessment: Written exam of theoretical knowledge: 30%	75%
Tutorial	Correct and efficient application of specific problem-solving methods, including coherent presentation of the solution.	Assignments during the course For evaluation, the platforms Google Classroom / Microsoft Teams will be used.	5%

Practical	Preparation and execution of the experiment: Mastery of experimental procedures and adequate preparation for the laboratory work. Correct and safe use of apparatus and equipment. Precise and systematic collection of experimental data. Data processing and analysis: Application of specific methods for data processing and analysis. Interpretation of results and experimental conclusions: Ability to interpret obtained results in the context of theory and to formulate relevant conclusions. Identification and discussion of error sources or limitations of the experiment. Presentation of results – laboratory reports: Clarity, structure, and accuracy in presenting data and conclusions in the laboratory reports.	Evaluation by colloquium Reports will be submitted electronically via Google Classroom / Microsoft Teams	20%
Minimal requirements for passing the exam	Obtaining a grade of 5 (Passing grade): • Compulsory attendance at all practical activities (seminar and laboratory) and at 75% of the lectures. • Completion of all laboratory work and submission of the results in the form of scientific reports. • Obtaining at least a grade of 5 on the laboratory colloquium. • Correct resolution of the topics required to score 5 points on the final exam. Obtaining a grade of 10 (Maximum grade): • Deeply argued abilities and knowledge. • Demonstrated capacity for analyzing phenomena and processes, alongside the correct resolution of all exam topics.		

Date, 25.09.2026	Teacher's name and signature, Conf.univ.dr. Vasile Bercu	Practicals/Tutorials/Project instructor(s), name and signature Asist.univ.dr. Leonard Gebac
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOB.303.P Solid state physics / Fizica solidului

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Solid state physics / Fizica solidului				
2.2. Teacher			Prof. dr. Daniela Dragoman				
2.3. Tutorials/Practicals instructor(s)			Prof. dr. Daniela Dragoman				
2.4 Year of study	3	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	5	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	1/2/0
3.4. Total hours per semester	70	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	14/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					50
Research in library, study of electronic resources, field research					25
Preparation for practicals/tutorials/projects/reports/homework					30
Tutorat					0
Other activities					0
3.7. Total hours of individual study					105
3.8. Total hours per semester					175
3.9. ECTS					7

4. Prerequisites (if necessary)

4.1. curriculum	Courses: Electricity and magnetism, Quantum Mechanics I, Equations of mathematical physics, Electrodynamics and Relativity theory, Thermodynamics and Statistical mechanics
4.2. competences	Abilities of Computational Physics

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia infrastructure (videoprojector, PC)
5.2. for tutorials/practicals	Seminar room/specific laboratory infrastructure

6. Learning outcomes

Knowledge	R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R11. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R13. The student/graduate describes physical systems (e.g., thermodynamic systems, electrical circuits), using specific theories and tools to characterize them.

Skills	R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R11. The student/graduate provides examples of the application of basic theoretical concepts and results to solve exercises and problems related to the topics covered in the curriculum subjects. R13. The student/graduate is able to read, understand, and translate specialized texts, extract relevant information from international scientific sources, and communicate orally and in writing in an autonomous and professional manner.
Responsibility and autonomy	R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R11. The student/graduate uses logical thinking, analyzes problem statements, and selects the specific method for solving problems from the topics covered in the curriculum subjects. R13. The student/graduate responsibly uses international information sources, respecting academic ethics standards and demonstrating initiative in learning specialized scientific language.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Crystalline structures. Symmetry elements. Reciprocal lattice. X-ray diffraction	Systematic exposition - lecture. Examples	6 Hours
Basic notions of crystal binding	Systematic exposition - lecture. Examples	2 Hours
Lattice oscillations. Acoustical and optical phonons. Phononic heat capacity	Systematic exposition - lecture. Examples	6 Hours
Electron dynamics. Tight-binding model. Electronic band structure. Classification of solids	Systematic exposition - lecture. Examples	4 Hours
Statistics of charge carriers in metals, intrinsic and extrinsic semiconductors. Electronic specific heat	Systematic exposition - lecture. Examples	4 Hours
Kinetics of charge carriers in solids. Boltzmann formalism. Relaxation time approximation. Electrical conductivity	Systematic exposition - lecture. Examples	4 Hours
Charge transport in magnetic field. Hall effect. Magnetoresistance	Systematic exposition - lecture. Examples	2 Hours

References:

1. I. Licea, Fizica corpului solid (Editura Universităţii din Bucureşti, Bucureşti, 1991).
2. Ch. Kittel, Introduction to Solid State Physics (8th ed., John Wiley and Sons, New York, 2004).
3. Y.M. Galperin, Introduction to Modern Solid State Physics (CreateSpace Publishing Platform, 2014), https://folk.uio.no/yurig/fys448/f448pdf.pdf.
4. N.W. Ashcroft, N.D. Mermin, Solid State Physics (Harcourt College, Fort Worth, USA, 1976)
5. D. Dragoman, Lecture notes (pdf)

7.2 Tutorials	**Teaching techniques**	**Observations**
Crystalline structures. Symmetry properties, X-ray diffraction	Theoretical exposition. Problem solving	3 Hours
Lattice vibrations. Dispersion laws. Density of oscillations	Theoretical exposition. Problem solving	3 Hours
Electronic structure of crystalline solids. Density of states; dimensionality effects	Theoretical exposition. Problem solving	3 Hours
Electrical conductivity in the relaxation time approximation. Applications	Theoretical exposition. Problem solving	2 Hours
Electrical conductivity in the relaxation time approximation in magnetic fields. Applications	Theoretical exposition. Problem solving	3 Hours

References:

1. F. Han, Problems in solid state physics with solutions, World Scientific, 2012
2. Ch. Kittel, Introduction to Solid State Physics (8th ed., John Wiley and Sons, New York, 2004).
3. Y.M. Galperin, Introduction to Modern Solid State Physics (CreateSpace Publishing Platform, 2014), https://folk.uio.no/yurig/fys448/f448pdf.pdf.
4. J. Cazaux, Understanding solid state physics. Problems and solutions, CRC Press, 2016
5. L. Mihaly, M.C. Martin, Solid state physics. Problems and solutions, J. Wiley and Sons, 1996
5. D. Dragoman, Lecture notes (pdf)

7.3 Practicals	**Teaching techniques**	**Observations**
Laboratory presentation. Safety instruction	Guided practical activity	2 Hours
Crystallography	Guided practical activity	4 Hours
X-ray diffraction	Guided practical activity	2 Hours
Electrical conduction in metals. Temperature dependence of resistivity	Guided practical activity	2 Hours
Electrical conduction in semiconductors. Bandgap determination	Guided practical activity	2 Hours
Hopping mechanism of electrical conduction	Guided practical activity	2 Hours
Optical absorption in semiconductors	Guided practical activity	2 Hours
Magnetoresistive effect	Guided practical activity	2 Hours
Seebeck effect	Guided practical activity	4 Hours
Statistics of charge carriers	Guided activity	2 Hours
Recovery of missed laboratory works	Guided practical activity	2 Hours
Laboratory colloquium	Guided activity	2 Hours

References:

1. C. Berbecaru, L. Ion, Fizica solidului – Caiet de lucrări de laborator
2. C. Kittel, Introduction to Solid State Physics (8th ed., John Wiley and Sons, New York, 2004).
3. D. Dragoman, Lecture notes (pdf)

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course content is in agreement with the content of similar courses taught at national and international universities, such as University Babeş-Bolyai, Cluj Napoca, University "Alexandru Ioan Cuza", Iaşi and, respectively, University of Groningen, Netherlands, Warwick University, UK, University of Tubingen, Germany, Technical University Wien, Austria, etc. The course forms abilities and competences to analyze specific phenomena of condensed matter physics, to plan and execute specific experiments, and toidentify applications of acquired knowledge. These competences and abilities are in line with the requirements/expectations of the main employers of graduate students (research institutes in material physics, industry, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	Clarity, coherence and concision of exposition; Proper use of physical models and mathematical formalism; Capacity of exemplification; Capacity to apply the acquired knowledge to problem solving.	Written exam (final exam)	34%
Tutorial	Application of specific solving methods for a given problem	On-going evaluation; solving of given problems (partial exam)	33%
Practical	Proper use of physical models and mathematical formalism; Knowledge of specific experimental techniques and instrumentation	Lab colloquium	33%

Minimal requirements for passing the exam	For mark 5: Attendance at all practical activities and finalization of lab works through scientific reports. 50% attendance at course Mark 5 at the corresponding lab colloquium Correct solving of subjects required to obtain an average mark of 5 from the partial exam and the final written exam For mark 10: Capacity of analysis of physical phenomena and processes demonstrated by solving correctly all the subjects at the lab colloquium as well as at the partial and final exams

Date, 25.09.2026	Teacher's name and signature, Prof. dr. Daniela Dragoman	Practicals/Tutorials/Project instructor(s), name and signature Prof. dr. Daniela Dragoman
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOB.304.P Particle physics / Fizica particulelor elementare

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Particle physics / Fizica particulelor elementare				
2.2. Teacher			Mihaela Parvu, Oana Ristea				
2.3. Tutorials/Practicals instructor(s)			Mihaela Parvu, Oana Ristea				
2.4 Year of study	3	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	1/1/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	14/14/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					55
Research in library, study of electronic resources, field research					15
Preparation for practicals/tutorials/projects/reports/homework					20
Tutorat					0
Other activities					4
3.7. Total hours of individual study					94
3.8. Total hours per semester					150
3.9. ECTS					6

4. Prerequisites (if necessary)

4.1. curriculum	The equations of mathematical physics, physics of the atom and molecule
4.2. competences	Knowledge of mathematics, physics atomic, programming languages and numerical methods, etc.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Amphytheatre equipped with multimedia devices (video)
5.2. for tutorials/practicals	Radioactive isotopic sources, experimental set up for nuclear spectroscopy, radiation detectors (gas, scintillators, semiconductors detectors), multichannel analyzers, radiation monitors

6. Learning outcomes

Knowledge	R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R8. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information.
Skills	R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R8. The student/graduate compares theoretical results from specialized literature (e.g., textbooks, indexed articles) with experimental ones, integrating the data into a professional report or project.

Responsibility and autonomy	R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R8. The student/graduate critically analyzes a specialized paper or scientific communication of medium difficulty (e.g., peer-reviewed article, scientific report), assuming the conclusions and recommendations.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Revision on the static properties of nuclei; the need for modeling of nuclear structure.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Classes of models for the nuclear structure: collective models, models of independent particles, unified models. Illustrations: the nuclear Fermi gas model, nuclear shell models, Bohr model Mottelshon; Comparing the predictions of the nuclear models with the experimental results; defficiences of the models of the nuclear structure; ways of developing the nuclear structure models.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	6 Hours
Nuclear forces: experimental basis; types of interactions, properties; properties of nuclear forces.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
Models for nuclear decays	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	6 Hours
Nuclear reactions: definitions, classification criteria; conservation laws; kinematics of the nuclear reactions. Mechanisms of reaction.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
Elementary particles: classification criteria, specific quantum numbers. Experimental methods for determining the mass and the life time. Elementarity concept. Fundamental Interactions. Symmetries. Naive quark model and color concept. The standard model. Higgs boson.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
Applications of Nuclear Physics in different areas of life. Perspective directions in elementary particle physics.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours

References:

1. A Das and T. Ferbel, Introduction to Nuclear and Particle Physics, World Scientific, Second edition, 2005
2. Raymond Serway, Clement Moses, Curt Moyer, Modern Physics, Third Edition, Thomson Books/Cole, 2005 (13 Nuclear structure, 14 Nuclear physics applications, 15 Elementary particles; other only by selection)
3. http://hyperphysics.phy-astr.gsu.edu/hbase/HFrame.html
4. http://ocw.mit.edu/OcwWeb/Nuclear-Engineering/22-101Fall-2006/LectureNotes/index.htm
5. K Heyde, Basic Ideas and Concepts in Nuclear Physics (An Introduction approach) (Graduate student series in physics, Series Editor: Douglas F Brewer), IOP Publishing Ltd, Second edition 1999
6. K. Gottfried, V. Weisskopf Concepts of particle physics Clarendon Press, 1984
7. Brian R Martin, Nuclear and Particle Physics – An Introduction, 2nd_Edition, 2009
8. WR Leo, Techniques for nuclear and particle physics experiments, 2nd Edition Springer-Verlag , 1994
9. http://ocw.mit.edu/courses/nuclear-engineering/22-55j-principles-of-radiation-interactions-fall-2004/lecture-notes/

10. Fizica nucleara – Culegere de probleme (Catedra de fizica atomica si nucleara), Editura All, 1994
11. Gh.Vlăducă – Elemente de Fizică nucleară – vol.I, II, Tipografia (Editura) Universităţii din Bucureşti, 1988, 1990
12. K.N.Muhin – Fizică nucleară experimentală – vol.I, II, Editura Tehnică, Bucureşti, 1981, 1982
13. R.Ion-Mihai, M.L.Ion – Introducere în Fizica nucleară – Editura Universităţii din Bucureşti, 2003
14. Colectiv catedră – Fizică nucleară. Lucrări de laborator – Tipografia Universităţii din Bucureşti, 1982, 1986
15. M.Sin (editor) – Bazele Fizicii nucleare. Lucrări de laborator – Editura Universităţii din Bucureşti, 2003
16. C. Beşliu, Al.Jipa – Modele de structură nucleară şi mecanisme de recaţie – Editura Universităţii din Bucureşti, 2002

7.2 Tutorials	**Teaching techniques**	**Observations**
Elements of electronic used in nuclear physics lab; temporal coincidences in nuclear experiments		6 Hours
Detectors. General Properties. Detector types. Methods for processing the signal.		4 Hours
Problems		4 Hours

References:

1. Fizica nucleara – Culegere de probleme (Catedra de fizica atomica si nucleara), Editura All, 1994
2. Lucrari practice de Fizica nucleara, Îndrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară, Ed. Univ. Bucureşti, 1987
3. Bazele Fizicii nucleare, Lucrari practice, Indrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară, Ed. Univ. Bucureşti, 2003
4. 1000 solved problems in Modern Physics, A. Kamal, Springer-Verlag, 2010
5. Problems and solutions on Atomic, Nuclear and Particle Physics, Y.-K. Lim, World Scientific, 2000

7.3 Practicals	**Teaching techniques**	**Observations**
1. Activation law 2. Moderation of neutrons 3. Determination of half-life of radionuclides from beta decay curves 4. Beta spectroscopy and internal conversion 5. The method of gamma-gamma delayed coincidence for activity measurements. Determination of life time for excited nuclear states. 6. Moessbauer Effect. Determination of some parameters of nuclear structure 7. Identification of elementary particles and their interactions		14 Hours

References:

1. Fizica nucleara – Culegere de probleme (Catedra de fizica atomica si nucleara), Editura All, 1994
2. Lucrari practice de Fizica nucleara, Îndrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară, Ed. Univ. Bucureşti, 1987
3. Bazele Fizicii nucleare, Lucrari practice, Indrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară, Ed. Univ. Bucureşti, 2003
4. 1000 solved problems in Modern Physics, A. Kamal, Springer-Verlag, 2010
5. Problems and solutions on Atomic, Nuclear and Particle Physics, Y.-K. Lim, World Scientific, 2000

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms/develops some theoretical and/or practical competences and abilities which are important/fundamental/something else for an undergraduate student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union străinătate (University of Oxford https://www.ox.ac.uk/admissions/undergraduate/courses-listing?wssl=1, Universityof Parma http://www.difest.unipr.it/it/didattica/laurea-triennale-fisica/calendario-didattico, Universitatea Padova, http://en.didattica.unipd.it/didattica/2015/SC1158/2014). The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of equations/mathematical methods/physical models and theories - ability to indicate/analyse specific examples	Written examination	60%
Tutorial	- ability to use specific problem solving methods - ability to analyse the results	Homeworks/written tests	10%
Practical	- ability to use specific experimental methods/apparatus - ability to perform/design specific experiments - ability to present and discuss the results	Lab reports and oral examination	30%
Minimal requirements for passing the exam	Minimum requirements for passing (grade 5): Mandatory attendance at all applied activities (tutorials and laboratory) and at 75% of the lectures. Completion of all laboratory work and presentation of the results as scientific reports. A grade of at least 5 in the laboratory colloquium. Correct solution of the exam questions designated for a grade of 5 in the final exam. Requirements for the maximum grade (grade 10): Thorough, well-argued knowledge and skills. Demonstrated ability to analyse phenomena and processes; correct solution of all exam questions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
25.09.2026	Mihaela Parvu, Oana Ristea	Mihaela Parvu, Oana Ristea

Date of approval	Head of department name and signature
28.09.2026	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOB.305.P Spectroscopy and lasers / Spectroscopie şi laseri

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title	Spectroscopy and lasers / Spectroscopie şi laseri						
2.2. Teacher	Associate Professor Doinita Bejan / CS1 Dr. Marian ZAMFIRESCU						
2.3. Tutorials/Practicals instructor(s)	Associate Professor Doinita Bejan / CS1 Dr. Marian ZAMFIRESCU						
2.4 Year of study	3	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					22
Research in library, study of electronic resources, field research					11
Preparation for practicals/tutorials/projects/reports/homework					11
Tutorat					0
Other activities					0
3.7. Total hours of individual study					44
3.8. Total hours per semester					100
3.9. ECTS					4

4. Prerequisites (if necessary)

4.1. curriculum	Mathematical Analysis, Optics, Electricity, Molecular Physics, Fundamentals of Atomic Physics, Quantum mechanics
4.2. competences	Physical data processing and numerical methods

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia equipped class (videoprojector) Lecture notes Recommended bibliography
5.2. for tutorials/practicals	Laboratory of Atomic Spectroscopy with spectral instruments and computers. Laboratory of Lasers.

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R14. The student/graduate knows the basic vocabulary and specialized terminology in a foreign language in the field of physics, the structure of scientific texts and international academic communication formats.
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R14. The student/graduate is able to read, understand and translate specialized texts, extract relevant information from international scientific sources and communicate orally and in writing in an autonomous and professional manner.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R14. The student/graduate uses information sources responsibly, respecting the norms of academic ethics and demonstrating initiative in learning the scientific language of the specialty.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Prism and diffraction grating spectral apparatus	Systematic exposition - lecture. Critical analysis. Examples	3 Hours
The spectral term of the fundamental state of atoms. Spectral terms of monovalent and bivalent excited atoms. Grotrian diagrams.	Systematic exposition - lecture. Examples	2 Hours
Fine structure of spectral lines. Relativistic displacement. Spin-orbit interaction. Total correction. Lamb displacement.	Systematic exposition - lecture. Critical analysis. Examples	3 Hours
Interaction of electromagnetic radiation with atoms. The dipole approximation. Einstein coefficients. Intensity of spectral lines. Selection rules.	Systematic exposition - lecture. Examples	4 Hours
Spectral series of alkali metals.	Systematic exposition - lecture. Examples	2 Hours
Laser radiation and its properties. Electromagnetic radiation in matter. Properties of laser radiation (monochromaticity, directionality, coherence).	Systematic exposition - lecture. Examples	2 Hours
Laser mechanisms. (Photons and energy diagrams; Absorption of electromagnetic radiation; Spontaneous emission of electromagnetic radiation; Thermodynamic equilibrium; Population inversion; Stimulated emission; Spontaneous emission rate equations; Stimulated transitions: Absorption rate equations, Stimulated emission rate equations, Constant of proportionality; Amplification)	Systematic exposition - lecture. Critical analysis. Examples	2 Hours
The laser system (Active medium, Excitation mechanism, Laser resonator). Optical cavity and oscillation modes. Longitudinal modes in a laser. Gain curve of the active medium. Transverse electromagnetic modes (TEM)	Systematic exposition - lecture. Examples	2 Hours
Optical cavity and oscillation modes. Specific laser optical cavities. Cavity stability criterion. Stability diagram of an optical cavity.	Systematic exposition - lecture. Examples	2 Hours
Laser amplification. The shape of the laser fluorescence line. The width of the fluorescence line. Laser gain curve. Fluorescence line broadening (Natural broadening. Doppler broadening. Pressure broadening). Laser gain Loop gain (Lossless loop gain (GL) calculation. Lossy loop gain (GL) calculation. Threshold gain (GL)th calculation)	Systematic exposition - lecture. Examples	2 Hours
Types of lasers and their characteristics. Gas lasers. Metal vapor laser. Ionized gas lasers. Molecular gas lasers. Excimer laser. Chemical laser. Far Infrared Lasers. Solid state lasers.	Systematic exposition - lecture. Examples	2 Hours
Applications of lasers.	Systematic exposition - lecture. Examples	2 Hours

References:

1. Bejan Doina, "Atomic Spectroscopy. Course Notes" 2025
2. H. E. White, "Introduction to atomic spectra", McGraw-Hill Book Company, New York and London, 1934.
3. E. Chpolski, "Physique atomique", Ed. Mir, Moscova, 1977.
5. B. H. Bransden and C. J. Joachain, "Physics of atoms and molecules" Longman Scientific and Technical, 1990.
4. Ath. Truţia, "Spectroscopie atomică şi moleculară", Ed. Univ. Bucureşti, 1975.
5. F. Iova, "Spectroscopie atomică şi moleculară", Ed. Univ. Bucureşti, 2002.
6. Jonathan Tennyson, "Astronomical Spectroscopy: An Introduction To The Atomic And Molecular Physics Of Astronomical Spectroscopy", 3rd edition, World Scientific Publishing Europe Ltd. 2019.
7. M. Csele, "Fundamentals of light sources and lasers" (Wiley, 2004)
8. W. Koechner, "Solid-State Laser Engineering", Springer Series in Optical Sciences, ed. 2006.
9. Anthony E. Siegman, "Lasers" University Science Books, 1986.
10. Ursula Keller, "Ultrafast Lasers. A comprehensive introduction to fundamental principles with practical applications" Springer Nature Switzerland AG 2021.

7.3 Practicals	**Teaching techniques**	**Observations**
Laboratory presentation	Guided activity	2 Hours
Prism based spectral instruments	Guided practical activity	2 Hours
Diffraction grating based spectral instruments	Guided practical activity	2 Hours
Zeeman effect of Cadmium ion	Guided practical activity	2 Hours
Spectrum of Ne and He atoms. The He-Ne laser	Guided practical activity	2 Hours
Spectrophotometer with optical fiber	Guided practical activity	2 Hours
Fine structure of the Balmer Hα line of hydrogen. Study of Grotrian diagrams for He, Ne, Hg, Cd, Na. Diagram of the energy levels of the He-Ne laser.	Exposure. Conversations	2 Hours
Study and alignement of a He-Ne laser	Guided practical activity	2 Hours
Analyses and characterization of active media of lasers.	Guided practical activity	2 Hours
Study and characterization of diode lasers (808.5 nm)	Guided practical activity	2 Hours
Study of Ti:Sapphire solid state laser	Guided practical activity	2 Hours
Study of CO2 laser	Guided practical activity	2 Hours
Analyses of longitudinal modes	Guided practical activity	2 Hours
Colloquy	Knowledge testing	2 Hours

References:

Laboratory Guides
Bejan Doina, "Atomic Spectroscopy. Course Notes" 2025

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some practical competences and abilities which are important for an undergraduate student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research, secondary school teaching – National Institute for Laser, Plasma and Radiation Physics., National Institute of Materials Physics, National Institute for Opto-Electronics, IOR, Apel Laser SRL).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	coherence and clarity of exposition - correct use of equations, spectral and laser methods, physical models and theories - ability to indicate/analyse specific examples of practical applications of spectrometry and lasers.	Final written evaluation: Test of theoretical knowledge and applied problems	70%

Tutorial	- Application of specific methods for solving for the given problem;	Continuous evaluation	10%
Practical	- ability to use specific experimental methods/apparatus (spectrometer, laser, spectral lamp) -Results interpretation;	Laboratory colloquium	20%
Minimal requirements for passing the exam	• Mandatory attendance: 50% of classes, seminars and 100% of laboratory work. • The correct presentation of the subjects indicated for obtaining a score of 5 in the final exam both in the Spectroscopy discipline and in the Lasers discipline. Failure to obtain score 5 in one of these subjects means that the student has not passed the Spectroscopy and Lasers exam. The final score will be the average of the grades obtained in the two subjects if the student obtained a score greater than or equal to 5 in each of the two subjects.		

Date, 8.09.2026	Teacher's name and signature, Associate Professor Doinita Bejan CS1 Dr. Marian ZAMFIRESCU	Practicals/Tutorials/Project instructor(s), name and signature Associate Professor Doinita Bejan CS1 Dr. Marian ZAMFIRESCU
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027

DOP.306.1.P Methods and techniques of presenting the results in physics / Metode şi tehnici de prezentare a rezultatelor în fizică

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Methods and techniques of presenting the results in physics / Metode şi tehnici de prezentare a rezultatelor în fizică				
2.2. Teacher			Lect. dr. Roxana ZUS				
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Andreea Mihaela CROITORU				
2.4 Year of study	3	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	14	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					31
Research in library, study of electronic resources, field research					15
Preparation for practicals/tutorials/projects/reports/homework					15
Tutorat					0
Other activities					0
3.7. Total hours of individual study					61
3.8. Total hours per semester					75
3.9. ECTS					3

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia equipment (video projector); Lecture notes; Recommended bibliography
5.2. for tutorials/practicals	Video projector; Computer network; Recommended bibliography;

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations.
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python).

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
1. Structure of a scientific paper Scientific report – characteristics and defining elements Extended scientific papers Characteristics and defining elements of a bachelor's thesis, dissertation, etc. Scientific article – characteristics and defining elements	Systematic exposition – lecture. Critical analyses. Examples	3 Hours
2. Presentation of examples of physics topics for project development	Systematic exposition – lecture. Critical analyses. Examples	1 Hour
3. Writing techniques Presentation of software packages for writing scientific papers	Systematic exposition – lecture. Critical analyses. Examples	1 Hour
4. Introduction to LaTeX Fundamental notions of writing Mathematical formulas, tables, graphs Packages, document classes	Systematic exposition – lecture. Critical analyses. Examples	4 Hours
5. Graphic representations, animations. Applications in physics	Systematic exposition – lecture. Critical analyses. Examples	3 Hours
6. Structure of a scientific presentation Characteristics and defining elements – oral/poster presentations, software packages Beamertex	Systematic exposition – lecture. Critical analyses. Examples	2 Hours

References:

1. Helmut Kopka, Patrick W. Daly, "A Guide to LATEX" (Fourth edition), Addison-Wesley, 2003
2. Donald Knuth, "The TEXbook", Addison-Wesley, Reading MA, 1984
3. Tobias Oetiker, Hubert Partl, Irene Hyna, Elisabeth Schlegl, "The Not So Short Introduction to LATEX"
4. Harold Rabinowitz; Suzanne Vogel "The manual of scientific style : a guide for authors, editors, and researchers" Academic Press/Elsevier 2009
5. Michael Alley The Craft of Scientific Presentations Springer 2007
6. John M. Swales, Christine B. Feak, Academic Writing for Graduate Students: Essential Tasks and Skills
7. A Course for Nonnative Speakers of English University of Michigan Press, 1994

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

In order to outline the content and choose teaching/learning methods, the course instructors consulted the content of similar courses offered at universities in the country and abroad. The content is in accordance with the requirements of the University of Bucharest as well as national and international standards for writing and presenting scientific papers.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Clarity, coherence, and conciseness of the presentation; - Ability to provide examples;	Oral evaluation	100%
Minimal requirements for passing the exam	Achieving an average grade of 5 Minimum attendance of 50% in lectures. Oral presentation to obtain the final grade of 5. Achieving an average grade of 10 Correct answers to all indicated topics for obtaining the grade of 10; Well-argued skills and knowledge; demonstrated analytical ability; personal approach and interpretation.		

Date, 8.09.2026	Teacher's name and signature, Lect. dr. Roxana ZUS	Practicals/Tutorials/Project instructor(s), name and signature Lect. dr. Andreea Mihaela CROITORU
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOP.306.2.P History of Physics / Istoria fizicii

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			History of Physics / Istoria fizicii				
2.2. Teacher			Prof. univ. dr. Virgil BĂRAN				
2.3. Tutorials/Practicals instructor(s)			Prof. univ. dr. Virgil BĂRAN				
2.4 Year of study	3	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	14	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					31
Research in library, study of electronic resources, field research					15
Preparation for practicals/tutorials/projects/reports/homework					15
Tutorat					0
Other activities					0
3.7. Total hours of individual study					61
3.8. Total hours per semester					75
3.9. ECTS					3

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia equipment (video projector); Recommended bibliography
5.2. for tutorials/practicals	Room with multimedia equipment (video projector); Recommended bibliography

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations.
Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python).

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations

1. Introductory course: why physics is a key science – the connection of physics with other sciences and areas of human knowledge.	Systematic exposition – lecture. Critical analyses. Examples	2 Hours
2. History of mechanics: main stages from antiquity to the present; the transition from classical mechanics to Einstein's relativistic mechanics.	Systematic exposition – lecture. Critical analyses. Examples	2 Hours
3. Evolution of optics: stages towards understanding light – from geometric optics through wave optics and electromagnetic phenomena to the photon. Applications of optics and the evolution of knowledge.	Systematic exposition – lecture. Critical analyses. Examples	2 Hours
4. History of electrodynamics: main stages in the evolution of electromagnetism up to Maxwell's theory. Light as an electromagnetic wave and the transition to the theory of relativity.	Systematic exposition – lecture. Critical analyses. Examples	2 Hours
5. History of quantum mechanics: the experimental revolution at the beginning of the 20th century; phases of development toward the rigorous theory of quantum phenomena. The relationship between quantum mechanics and the theory of relativity: concepts of physical field, particle/antiparticle.	Systematic exposition – lecture. Critical analyses. Examples	2 Hours
6. Development of thermodynamics and statistical mechanics: thermal phenomena and the crystallization of thermodynamic principles; classical statistical mechanics versus quantum statistical mechanics; phase transitions from Andrews' experiments to K. Wilson's renormalization group theory. Statistical physics, information, and phenomena of life.	Systematic exposition – lecture. Critical analyses. Examples	2 Hours
7. 20th-century physics: physics of fundamental interactions and elementary particles, condensed matter physics, nuclear physics, cosmology and astrophysics, geophysics, biophysics, and medical physics.	Systematic exposition – lecture. Critical analyses. Examples	2 Hours

References:

1. The Cambridge Companion to Galileo Galilei, Isaac Newton, G. Leibniz, Cambridge University Press
2. P. Mittelstaedt, P. A. Weingartner, Laws of Nature, Springer Verlag, Berlin Heidelberg, 2005
3. E. Mach, Mecanica. Expunere istorică şi critică a dezvoltării ei, Editura All
4. C. Cercignani, Ludwig Boltzmann, Editura Tehnica
5. F. Wilczek, The lightness of being: mass, ether and the unification of forces, Perseus, 2008
6. M. von Laue, History of Physics, Pergamonn Press
7. J. Baggott, The quantum story, Oxford University Press, 2011
8.W. Applebaum, The scientific revolution and the foundations of modern science, Greenwood Press, 2005
9. T.S. Kuhn, Structura Revolutiilor Stiintifice, Editura Humanitas
10. M. Born, Physics in my generation, Springer-Verlag New York Inc.
11. K. Simony, A cultural history of physics
12. Virgil Baran – Istoria Fizicii-Note de curs in format electronic (2019)

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

In order to outline the content and choose teaching/learning methods, the course instructors consulted the content of similar courses offered at universities in the country and Europe. The content is in accordance with the requirements of major employers in the field (research and development institutes, higher education, and pre-university education).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	- Clarity, coherence, and conciseness of the presentation; - Correct use/application of the principles of quantum mechanics, studied physical models, formulas, and calculation relations; - Ability to provide examples; - Ability to apply acquired knowledge to understanding the evolution of concepts in physics	Evaluation of the oral presentation.	100%
Minimal requirements for passing the exam	Achieving an average grade of 5 Minimum attendance of 50% in lectures. Oral presentation to obtain the final grade of 5. Achieving an average grade of 10 Correct answers to all indicated topics for obtaining the grade of 10; Well-argued skills and knowledge; demonstrated analytical ability; personal approach and interpretation.		

Date, 8.09.2026	Teacher's name and signature, Prof. univ. dr. Virgil BĂRAN	Practicals/Tutorials/Project instructor(s), name and signature Prof. univ. dr. Virgil BĂRAN
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOB.310.P Research Activity (2 weeks x 30 hours) / Practica de specialitate

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Research Activity (2 weeks x 30 hours) / Practica de specialitate				
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)			Conf. dr. Vasile Bercu				
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	verificare	2.7.Classification	DOB

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	0/3/0
3.4. Total hours per semester	30	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	0/30/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					23
Research in library, study of electronic resources, field research					11
Preparation for practicals/tutorials/projects/reports/homework					11
Tutorat					0
Other activities					0
3.7. Total hours of individual study					45
3.8. Total hours per semester					75
3.9. ECTS					3

4. Prerequisites (if necessary)

4.1. curriculum	Knowledge from related disciplines acquired previously
4.2. competences	Skills in solving theoretical and experimental problems under qualified supervision

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R16. The student/graduate acquires civic competences, especially knowledge of social and political concepts and structures for active and democratic participation of people
Skills	R16. The student/graduate develops communication skills in the mother tongue and/or an international language
Responsibility and autonomy	R16. Spirit of initiative and entrepreneurship – the ability to turn ideas into action

7. Contents

7.3 Practicals	**Teaching techniques**	**Observations**

Physics-specific internship within a research center/institute/company with which the Faculty of Physics has concluded internship agreements Theoretical methods and experimental techniques specific to Physics: • Experimental methods and techniques specific to optics, plasma physics, and lasers; • Methods for processing/designing semiconductor devices/structures; • Analysis and experimental methods and techniques specific to solid-state physics; • Analysis and experimental methods and techniques specific to atomic and nuclear physics; • Theoretical and computational methods and techniques specific to Physics; • Analysis and experimental methods and techniques specific to the environment and renewable energy sources;	Guided activity	30 Hours

References:
To be specified for the chosen topic by the supervising faculty member and the internship coordinator; it includes occupational health and safety regulations and training courses/seminars.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course responds to current demands for practical skills development in higher education, both nationally and internationally. The internships will be carried out within the institutes/companies with which the Faculty of Physics has concluded internship agreements. The target fields of activity are diverse, with potential employers spanning both the research and development sector and other domains.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Practical	• Evaluation of experimental skills acquired during laboratory activity • Evaluation of the capacity to analyze and interpret experimental results	Continuous assessment	100%
Minimal requirements for passing the exam	To obtain a grade of 5 (Passing grade) • Mandatory attendance at all activities included in the internship portfolio • Mastery of the main concepts, methods, and techniques. To obtain a grade of 10 (Highest grade) • Deeply substantiated skills and knowledge • Demonstrated capacity to analyze phenomena and processes • Personal approach to problem-solving and interpretation		

Date,

25.09.2026

Practicals/Tutorials/Project instructor(s),
name and signature
Conf. dr. Vasile Bercu

Date of approval

28.09.2026

Head of department
name and signature
Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOP.312.1.P Numerical methods in quantum mechanics / Metode numerice în mecanica cuantică

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Numerical methods in quantum mechanics / Metode numerice în mecanica cuantică				
2.2. Teacher			Lect. univ. dr. Roxana Zus				
2.3. Tutorials/Practicals instructor(s)			Lect. univ. dr. Roxana Zus				
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	30	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					48
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					23
Tutorat					0
Other activities					0
3.7. Total hours of individual study					95
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Having passed the courses: Quantum Mechanics I, Quantum Mechanics II, Computer Programming, Processing of Physical Data and Numerical Methods
4.2. competences	Knowledge of differential and integral calculus, numerical methods for solving ordinary differential equations

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia room
5.2. for tutorials/practicals	Laboratory with the necessary equipment for carrying out practical works. Computers, Video projector, software packages for data analysis and processing.

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R10. The student/graduate deduces working formulas for calculations involving physical quantities, correctly applying fundamental principles and laws. R14. The student/graduate knows the basic vocabulary and specialized terminology in a foreign language in the field of physics, the structure of scientific texts and international academic communication formats.

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R10. Students/graduates prepare and present, in English, scientific or outreach reports and communications, using appropriate technical language and logical argumentation. R14. The student/graduate is able to read, understand and translate specialized texts, extract relevant information from international scientific sources and communicate orally and in writing in an autonomous and professional manner.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R10. Students/graduates take responsibility for interacting, contributing, and integrating into multilingual work teams and professional communities, demonstrating autonomy in using information sources in English. R14. The student/graduate uses information sources responsibly, respecting the norms of academic ethics and demonstrating initiative in learning the scientific language of the specialty.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Numerical solution of the time independent Schrodinger equation (TISE) for 1D systems. Finding of bound, antibound and resonances states	Systematic exposition - lecture, demonstration, discussion, case study. Examples	2 Hours
Numerical study of the time evolution of a wavepacket in 1D under the influence of a potential field; numerical calculation of the transmission and reflection coefficients	Systematic exposition - lecture, demonstration, discussion, case study. Examples	3 Hours
The stationary and nonstationary states of the harmonic linear oscillator; coherent states	Systematic exposition - lecture, demonstration, discussion, case study. Examples	3 Hours
The eigenvalue problem of the perturbed harmonic linear oscillator; numerical solution of the TISE vs. perturbation method.	Systematic exposition - lecture, demonstration, discussion, case study. Examples	3 Hours
The stationary and nonstationary states of the hydrogen atom; graphical representation	Systematic exposition - lecture, demonstration, discussion, case study. Examples	3 Hours
The stationary perturbation theory for the case of the Hydrogen atom in an external field; the Dalgarno-Lewis method	Systematic exposition - lecture, demonstration, discussion, case study. Examples	4 Hours
Generation of random numbers according to a given statistical law.	Systematic exposition - lecture, demonstration, discussion, case study. Examples	2 Hours

References:

1. D. H. McIntyre, Quantum mechanics. A paradigms approach, Pearson Education Ltd, 2014
2. N. Zettili, Quantum Mechanics Concepts and Applications, second edition, John Wiley and Sons, 2009
3. Bernd Thaller, "Advanced Visual Quantum Mechanics", Springer 2005
4. William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", 3rd ed.,Cambridge University Press, 2007
5. George W. Collins , "Fundamental Methods and Data Analysis", 2003
6. Morten Hjorth-Jensen , "Computational Physics", University of Oslo, 2006
7. William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", 3rd ed.,Cambridge University Press, 2007
8. Robert L. Zimmerman, Fredrick I. Olness, "Mathematica For Physics: 2nd Edition", Addison-Wesley Publishing Company, 2002

7.3 Practicals	Teaching techniques	Observations
Numerical codes for solving the time independent Schrodinger equation (TISE) for 1D systems.	Systematic exposition. Heuristic conversation. Guided practical activity	2 Hours
Numerical codes for integration of the time dependent Schrodinger equation for a particle in 1D motion under the influence of a potential field; numerical calculation of the transmission and reflection coefficients	Systematic exposition. Heuristic conversation. Guided practical activity	1 Hour
Graphical representation (animation/movies) of the stationary and nonstationary states of the harmonic linear oscillator	Systematic exposition. Heuristic conversation. Guided practical activity	1 Hour
Numerical codes for solving the eigenvalue problem of the perturbed harmonic linear oscillator	Systematic exposition. Heuristic conversation. Guided practical activity	2 Hours
Graphical representation (animation/movies) of the stationary and nonstationary states of the hydrogen atom	Systematic exposition. Heuristic conversation. Guided practical activity	1 Hour
Numerical codes for the stationary perturbation theory for the case of the Hydrogen atom in an external field	Systematic exposition. Heuristic conversation. Guided practical activity	2 Hours
Numerical codes for generation of random numbers according to a given statistical law.	Systematic exposition. Heuristic conversation. Guided practical activity	1 Hour

References:

1. D. H. McIntyre, Quantum mechanics. A paradigms approach, Pearson Education Ltd, 2014
2. N. Zettili, Quantum Mechanics Concepts and Applications, second edition, John Wiley and Sons, 2009
3. Bernd Thaller, "Advanced Visual Quantum Mechanics", Springer 2005
4. William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", 3rd ed.,Cambridge University Press, 2007
5. George W. Collins , "Fundamental Methods and Data Analysis", 2003
6. Morten Hjorth-Jensen , "Computational Physics", University of Oslo, 2006
7. William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", 3rd ed.,Cambridge University Press, 2007
8. Robert L. Zimmerman, Fredrick I. Olness, "Mathematica For Physics: 2nd Edition", Addison-Wesley Publishing Company, 2002

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	The understanding and correct use of the theoretical knowledge, clarity of exposition, logical coherence	Written test (final examination) Homework during the lecture	50%
Practical	- ability to apply specific methods for a given problem - ability to present and discuss the results	Evaluation through individual homework at the end of the semester	50%
Minimal requirements for passing the exam	Achieving grade 5: Minimum attendance: 50% lecture, 75% applied activities. Correct exposition of 50% from the theoretical topics at the final exam. Correct numerical solution of one problem at the final exam. Achieving grade 10: - Correct answers to all assigned questions/topics; - In-depth, well-reasoned skills and knowledge; - Demonstrated ability to analyze simulated physical phenomena; - Personal approach and interpretation.		

Date, 8.09.2026	Teacher's name and signature, Lect. univ. dr. Roxana Zus	Practicals/Tutorials/Project instructor(s), name and signature Lect. univ. dr. Roxana Zus
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOP.312.2.P Elements of quantum optics / Elemente de optică cuantică

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Theoretical Physics, Mathematics, Optics, Plasma and Lasers
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title	Elements of quantum optics / Elemente de optică cuantică						
2.2. Teacher	Lect. dr. Andreea Mihaela Croitoru						
2.3. Tutorials/Practicals instructor(s)	Lect. dr. Andreea Mihaela Croitoru						
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	30	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					48
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					23
Tutorat					0
Other activities					0
3.7. Total hours of individual study					95
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Completion of the courses: Quantum Mechanics, Optics, and Algebra.
4.2. competences	Good understanding of algebraic calculations, geometry, trigonometry, and mathematical analysis.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia facilities (computer, video projector, and projection screen), and a whiteboard.
5.2. for tutorials/practicals	Laboratory

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications).

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects).

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Definition of a quantum bit (qubit). Jones vectors and Jones matrices. Two-particle systems. Quantum entanglement.	Systematic presentation – lecture, demonstration, discussion, case study, and examples.	4 Hours
Quantum key distribution. The BB84 protocol and the B92 protocol.	Systematic presentation – lecture, demonstration, discussion, case study, and examples.	2 Hours
Quantum logic gates. Entanglement encoding. Superdense coding.	Systematic presentation – lecture, demonstration, discussion, case study, and examples.	2 Hours
The quantum information processor. The phase oracle. Phase kickback. Deutsch's algorithm. Overview of the IBM Quantum Composer online platform.	Systematic presentation – lecture, demonstration, discussion, case study, and examples.	2 Hours
Quantization of the electromagnetic field.	Systematic presentation – lecture, demonstration, discussion, case study, and examples.	4 Hours
Quantum description of the beam splitter. Applications.	Systematic presentation – lecture, demonstration, discussion, case study, and examples.	2 Hours
Coherent states. Quantum correlation functions. Quantum description of the Hanbury Brown–Twiss experiment.	Systematic presentation – lecture, demonstration, discussion, case study, and examples.	4 Hours

References:

1. C. Gerry, P. Knight, Introductory Quantum Optics, Cambridge University Press, 2005.
2. M. O. Scully, M. S. Zubairy, Quantum Optics, Cambridge University Press, 2002.
3. Cohen-Tannoudji, Dupont-Roc, and Grynberg, Atom-Photon Interactions, Wiley, 1998.
4. D. F. Walls, G. J. Milburn, Quantum Optics, Springer Verlag, 1994.
5. C. W. Gardiner, Quantum Noise, Springer Verlag, 1991.
6. M. D. Al-Amri, M. M. El-Gomati, M. S. Zubairy (Editors), Optics in Our Time, Springer Open, 2016.
7. A. M. Fox: Quantum optics: an introduction, Oxford University Press, 2006.
8. P. Meystre, M. Sargent III, Elements of Quantum Optics, Springer-Verlag Berlin Heidelberg, 2007.
9. P. Lambropoulos, D. Petrosyan, Fundamentals of Quantum Optics and Quantum Information, Springer-Verlag Berlin Heidelberg, 2007

7.3 Practicals	**Teaching techniques**	**Observations**

Experimental generation of two-photon entanglement.	Research. Case study. Supervised practical activity.	2 Hours
Quantum key distribution.	Research. Case study. Supervised practical activity.	2 Hours
The Michelson interferometer using a single photon.	Research. Case study. Supervised practical activity.	2 Hours
Optical implementation of quantum gates. Quantum information erasure.	Research. Case study. Supervised practical activity.	2 Hours
The Hanbury Brown–Twiss experiment.	Research. Case study. Supervised practical activity.	2 Hours

References:

1. C. Gerry, P. Knight, Introductory Quantum Optics, Cambridge University Press, 2005.
2. M. O. Scully, M. S. Zubairy, Quantum Optics, Cambridge University Press, 2002.
3. D. F. Walls, G. J. Milburn, Quantum Optics, Springer Verlag, 1994.
4. quED - Entanglement Demonstrator - A Science Kit for Quantum Physics, www.qutools.com.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

În vederea schiţării conţinuturilor, alegerii metodelor de predare/învăţare, titularul disciplinei a consultat conţinutul unor discipline similare predate la universitati din ţară şi străinătate. Conţinutul este în acord cu cerinţele principalilor angajatori din domeniu (industrie, institute de cercetare şi dezvoltare, învăţământ superior şi preuniversitar).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Knowledge of the fundamental concepts of quantum optics. - Acquisition and proper understanding of the topics covered in the course. - Demonstration of theoretical concepts through the correct application of mathematical formulas.	Written examination.	50%
Practical	- Interpretation of experimental results.	Written examination.	50%
Minimal requirements for passing the exam	Requirements for obtaining a grade 5: - Correctly solving the indicated topics required to achieve a grade of 5 on the final exam. Requirements for obtaining a grade 10: - Profoundly reasoned skills and knowledge - Demonstrated ability to analyze phenomena and processes, correct solution of all topics		

Date, 8.09.2026	Teacher's name and signature, Lect. dr. Andreea Mihaela Croitoru	Practicals/Tutorials/Project instructor(s), name and signature Lect. dr. Andreea Mihaela Croitoru
Date of approval 17.09.2026		Head of department name and signature Lect. dr. Rozana ZUS

Syllabus

Academic year 2026/2027
DOP.313.1.P Detectors dosimetry and radiation protection / Detectori, dozimetrie şi radioprotecţie

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Detectors dosimetry and radiation protection / Detectori, dozimetrie şi radioprotecţie				
2.2. Teacher			Conf. dr. Oana Ristea				
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Mihaela Pavu				
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	30	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					48
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					23
Tutorat					0
Other activities					0
3.7. Total hours of individual study					95
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Pre-requirements: The equations of mathematical physics, Physics of the atom and molecule, Nuclear and particle physics, Electronics
4.2. competences	Knowledge of Mathematics, Atomic and Nuclear Physics, Quantum mechanics, Programming languages and numerical methods etc.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia devices (video)
5.2. for tutorials/practicals	Radioactive isotopic sources, experimental set up for nuclear spectroscopy, radiation detectors (scintillators, semiconductors), multichannel analyzers, radiation monitors

6. Learning outcomes

Knowledge	R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R9. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress.

Skills	R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R9. The student/graduate deduces working formulas for calculations involving physical quantities , appropriately applying fundamental principles and laws.
Responsibility and autonomy	R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R9. The student/graduate demonstrates autonomy in operating, maintaining, and repairing laboratory equipment (e.g., sensor calibration, instrument adjustment), adhering to safety and quality standards.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
1. Fundamental processes of the interaction of radiation with substance: (a) energy losses by ionization and excitation of the heavy charged particles, ions and electrons; (b) interactions of photons; (c) neutrons; (d) muons	Systematic exposition - lecture. Examples	4 Hours
2. Radiation Sources: Isotopic sources, particle accelerators, nuclear reactors, cosmic rays	Systematic exposition - lecture. Examples	2 Hours
3. General properties of detectors. The main physical phenomena used to detect particles. Different types of detectors. Operating Principles	Systematic exposition - lecture. Examples	10 Hours
4. Dosimetry. Basic quantities and units. Dosimetric calculation depending on the type of radiation source (external / internal) and on the spatial dimension of the source.	Systematic exposition - lecture. Examples	2 Hours
5. Dosimetric measurement. Dosimetry methods. Radioprotection. Dosimetry and radiation protection standards.	Systematic exposition - lecture. Examples	2 Hours

References:

1. F. Attix, Introduction to radiological physics and radiation dosimetry, John Whiley and Sons, 1986
2. Brian R Martin, Nuclear and Particle Physics – An Introduction, 2nd_Edition, 2009
3. WR Leo, Techniques for nuclear and particle physics experiments, 2nd Edition Springer-Verlag , 1994
4. Manuale scrise de membrii Catedrei de Fizica atomica si nucleara, autori diferiti, diferite editii
5. Fizica nucleara – Culegere de probleme (Catedra de fizica atomica si nucleara), Editura All, 1994
6. G.F. Knoll, Radiation Detection and Measurement, Wiley, 2000
7. C. Grupen, B. A. Swartz, Particle Detectors, Cambridge University Press 2008

7.3 Practicals	**Teaching techniques**	**Observations**
Energy calibration of detection systems. Spectrum processing and extraction of relevant information	Guided practical activities	2 Hours

Study of the sensitivity of scintillation detectors	Guided practical activities	2 Hours
Determination of the dead time for scintillation detectors	Guided practical activities	2 Hours
Information processing at visualization detectors	Guided practical activities	2 Hours
Study of the detection efficacity of different types of detectors	Guided practical activities	2 Hours

References:

1. Fizica nucleara – Culegere de probleme (Catedra de fizica atomica si nucleara), Editura All, 1994
2. Lucrari practice de Fizica nucleara, Îndrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară, Ed. Univ. Bucureşti, 1987
3. Bazele Fizicii nucleare, Lucrari practice, Indrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară (editor Mihaela Sin), Ed. Univ. Bucureşti, 2003
4. 1000 solved problems in Modern Physics, A. Kamal, Springer-Verlag, 2010
5. Problems and solutions on Atomic, Nuclear and Particle Physics, Y.-K. Lim, World Scientific, 2000
6. https://geant4.web.cern.ch/
7. http://www.srim.org/

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical and/or practical competences and abilities which are important and fundamental for an undergraduate student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or from the EU (University of Oxford https://www.ox.ac.uk/admissions/undergraduate/courses-listing?wssl=1, University of Parma http://www.difest.unipr.it/it/didattica/laurea-triennale-fisica/calendario-didattico, Universitatea Padova, http://en.didattica.unipd.it/didattica/2015/SC1158/2014).
The contents are in line with the requirements of the main employers of the graduates (industry, research, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of equations/mathematical methods/physical models and theories - ability to indicate/analyse specific examples	Oral examination	60%
Practical	- ability to use specific experimental methods/apparatus - ability to perform/design specific experiments - ability to present, analyze and discuss the results - ability to use specific problem solving methods	Lab reports	40%
Minimal requirements for passing the exam	Minimum requirements for passing (grade 5): Mandatory attendance at all applied activities (tutorials and laboratory) and at 50% of the lectures. Completion of all laboratory work and presentation of the results as scientific reports. A grade of at least 5 in the laboratory colloquium. Correct solution of the exam questions designated for a grade of 5 in the final exam. Requirements for the maximum grade (grade 10) Thorough, well-argued knowledge and skills. Demonstrated ability to analyse phenomena and processes; correct solution of all exam questions.		

Date, 25.09.2026	Teacher's name and signature, Conf. dr. Oana Ristea	Practicals/Tutorials/Project instructor(s), name and signature Lect. dr. Mihaela Pavu
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOP.313.2.P Radiation sources. Natural and induced radioactivity / Surse de radiaţii. Radioactivitate naturală şi indusă

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Radiation sources. Natural and induced radioactivity / Surse de radiaţii. Radioactivitate naturală şi indusă				
2.2. Teacher			Conf. dr. Oana Ristea, Lect. dr. Radu Vasilache				
2.3. Tutorials/Practicals instructor(s)			Conf. dr. Oana Ristea, Lect. dr. Radu Vasilache				
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	30	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					48
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					23
Tutorat					0
Other activities					0
3.7. Total hours of individual study					95
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Pre-requirements: The equations of mathematical physics, Physics of the atom and molecule, Nuclear and particle physics, Electronics
4.2. competences	Knowledge of Mathematics, Atomic and Nuclear Physics, Quantum mechanics, Programming languages and numerical methods etc.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia devices (video)
5.2. for tutorials/practicals	Radioactive isotopic sources, experimental set up for nuclear spectroscopy, radiation detectors (scintillators, semiconductors), multichannel analyzers, radiation monitors

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R9. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress.

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R9. The student/graduate deduces working formulas for calculations involving physical quantities , appropriately applying fundamental principles and laws.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R9. The student/graduate demonstrates autonomy in operating, maintaining, and repairing laboratory equipment (e.g., sensor calibration, instrument adjustment), adhering to safety and quality standards.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
1. Fundamental processes of interaction of the radiation with matter. Effects of radiation on the population and environment.	Systematic exposition - lecture. Examples	4 Hours
2. Radiation sources. Cosmic radiation. Primary and secondary sources. Cosmogenic radionuclides. Radioactive series. Their distributions in nature. Analysis of the Ra-226 and K-40 . Air radioactivity (Rn-222, R-220 and their descendants). Distribution of radon in the atmosphere and housing.	Systematic exposition - lecture. Examples	6 Hours
3. Artificial radioactivity. Particle accelerators, nuclear reactors, neutron sources (spallation), medical and industrial sources, high power lasers, nuclear weapons.	Systematic exposition - lecture. Examples	4 Hours
4. The nuclear reactor as a source of radioactivity.	Systematic exposition - lecture. Examples	2 Hours
5. Elements of the dosimetry. Basic quantities and units. Dosimetric measurement. Dosimetry methods. The principles of radiation protection. Dosimetry and radiation protection standards.	Systematic exposition - lecture. Examples	4 Hours

References:

1. F. Attix, Introduction to radiological physics and radiation dosimetry, John Whiley and Sons, 1986
2. Brian R Martin, Nuclear and Particle Physics – An Introduction, 2nd_Edition, 2009
3. WR Leo, Techniques for nuclear and particle physics experiments, 2nd Edition Springer-Verlag , 1994
4. M. L. Anunziata, Handbook of radioactivity analysis, Academic Press 2012
5. O. Sima, Note de curs Radioactivitatea mediului
6. G.F. Knoll, Radiation Detection and Measurement, Wiley, 2000

7.3 Practicals	**Teaching techniques**	**Observations**
Gamma spectrometry using scintillation and semiconductor detectors		2 Hours

Calibration of germanium spectrometer for environmental samples measurements (matrix effects and coincidence effects are considered)		4 Hours
Radon flux measurements of ambient concentration and dose calculations		2 Hours
Numerical applications in dosimetry and radioprotection		2 Hours

References:

1. Fizica nucleara – Culegere de probleme (Catedra de fizica atomica si nucleara), Editura All, 1994
2. Lucrari practice de Fizica nucleara, Îndrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară, Ed. Univ. Bucureşti, 1987
3. Bazele Fizicii nucleare, Lucrari practice, Indrumător de laborator, Colectivul Catedrei de Fizică atomică şi nucleară, Ed. Univ. Bucureşti, 2003
4. 1000 solved problems in Modern Physics, A. Kamal, Springer-Verlag, 2010
5. Problems and solutions on Atomic, Nuclear and Particle Physics, Y.-K. Lim, World Scientific, 2000

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit develops some theoretical and/or practical competences and abilities which are important and fundamental for an undergraduate student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or from the EU (University of Oxford https://www.ox.ac.uk/admissions/undergraduate/courses-listing?wssl=1, University of Parma http://www.difest.unipr.it/it/didattica/laurea-triennale-fisica/calendario-didattico, Universitatea Padova, http://en.didattica.unipd.it/didattica/2015/SC1158/2014).
The contents are in line with the requirements of the main employers of the graduates (industry, research, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of equations/mathematical methods/physical models and theories - ability to indicate/analyse specific examples	Oral examination	60%
Practical	- ability to use specific experimental methods/apparatus - ability to perform/design specific experiments - ability to present, analyze and discuss the results - ability to use specific problem solving methods	Lab reports	40%
Minimal requirements for passing the exam	Minimum requirements for passing (grade 5): Mandatory attendance at all applied activities (tutorials and laboratory) and at 50% of the lectures. Completion of all laboratory work and presentation of the results as scientific reports. A grade of at least 5 in the laboratory colloquium. Correct solution of the exam questions designated for a grade of 5 in the final exam. Requirements for the maximum grade (grade 10) Thorough, well-argued knowledge and skills. Demonstrated ability to analyse phenomena and processes; correct solution of all exam questions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
25.09.2026	Conf. dr. Oana Ristea, Lect. dr. Radu Vasilache	Conf. dr. Oana Ristea, Lect. dr. Radu Vasilache

Date of approval	Head of department name and signature
28.09.2026	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOP.314.1.P Introduction to polymers physics / Introducere în fizica polimerilor

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Introduction to polymers physics / Introducere în fizica polimerilor				
2.2. Teacher			Conf.Dr. Anca Dumitru				
2.3. Tutorials/Practicals instructor(s)			Conf.Dr. Anca Dumitru				
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	40	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/20/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					43
Research in library, study of electronic resources, field research					21
Preparation for practicals/tutorials/projects/reports/homework					21
Tutorat					0
Other activities					0
3.7. Total hours of individual study					85
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia devices
5.2. for tutorials/practicals	Set of practical work illustrating the topics covered in the course; Consumables; Computers and software for data analysis

6. Learning outcomes

Knowledge	R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R9. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress.

Skills	R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R9. The student/graduate deduces working formulas for calculations involving physical quantities , appropriately applying fundamental principles and laws.
Responsibility and autonomy	R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R9. The student/graduate demonstrates autonomy in operating, maintaining, and repairing laboratory equipment (e.g., sensor calibration, instrument adjustment), adhering to safety and quality standards.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
History, Definition and Concept of Polymers. Introduction to the history of polymer science. Definition of the concept of polymer, by describing the types of polymers based on chemical structure and origins.	Systematic exposition - lecture. Conversation. Examples	2 Hours
Classification of polymers. Classification of polymers based on: origin, chemical composition of monomer, chemical composition of polymers, nature of polymer chain, degree of polymerization, type of polymerization reactions, polymer configuration, thermo- mechanical behavior, microscopic arrangement of molecules and applications	Systematic exposition - lecture. Conversation. Examples	2 Hours
Molecular weight of polymers. Description of the concepts of average molecular weights of polymer and of molecular weight distribution and principles and methods for measuring them.	Systematic exposition - lecture. Conversation. Examples	4 Hours
Polymerization Reactions and Polymerization Processes. Description of polymerization reactions: addition polymerization and step growth polymerization; Description of polymerization processes: bulk polymerization, suspension polymerization, emulsion polymerization and special processes.	Systematic exposition - lecture. Conversation. Examples	4 Hours
Electrical properties of polymers. Dielectrics properties of polymers. Relaxation and dielectric losses in polymers. Applications of dielectric polymers. Semiconducting properties of polymers. Description of synthesis methods and applications of semiconducting polymers.	Systematic exposition - lecture. Conversation. Examples	2 Hours

Methods of characterization. Brief presentation of characterization methods particularly used for polymers materials including Infrared and Raman Spectroscopy, X-ray photoelectron Spectroscopy, X-ray Diffraction and Thermal Analysis.	Systematic exposition - lecture. Conversation. Examples	6 Hours

References:

1. Nicholson J.W., The Chemistry of Polymer, RSC Publishing, Cambridge, UK, 2012.
2. L. H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley and Sons (2005)
3. David I. Bower, An introduction to Polymer Physics, Cambridge University Press (June 5, 2012), ISBN: 9780521637213;
4. Chanda M., Introduction to Polymer Science and Chemistry, CRC Press, Taylor and Francis Group, FL, USA, 2006.
5. Stanley R. Sandler, Wolf Karo, Jo-Anne Bonesteel, Eli M. Pearce, Polymer Synthesis and Characterization, 1998
6. Handbook of conducting polymers, vol. I. New York: Marcel Dekker; 1986. p. 265–91.
7. L.Constantinescu, C.Berlic, "Metode experimentale in fizica polimerilor" Ed. Univ. Din Bucuresti, 1999
8. L.Constantinescu, C.Berlic, "Structura polimerilor. Metode de studiu" Ed. Univ. Din Bucuresti, 2003
9. R J Young and P A Lovell, Introduction to Polymers, Chapman and Hall, 1992.
10. R Moore, D E Kline, Properties and Processing of Polymers for Engineers, Prentice-Hall, 1984
11. D H Morton-Jones, Polymer Processing, Chapman and Hall, 1989.
12. C.D. Wagner, W.M. Riggs, L.E. Davis, J.F. Moulter, G.E. Muilenberg, Handbook of X-ray Photoelectron Spectroscopy, Perkin-Elmer Corporation (1978).
13. http://www.pslc.ws/mactest/maindir.htm
14. "X-ray Diffraction Procedures for Polycrystalline and Amorphous Materials", Harold P. Klug and L. R. Alexander, Wiley-Interscience, 1974

7.3 Practicals	**Teaching techniques**	**Observations**
Oxidative polymerization of aniline	guided practical activity	4 Hours
Oxidative polymerization of aniline with metallic nano-oxides	guided practical activity	4 Hours
Oxidative polymerization of pyrrole	guided practical activity	4 Hours
Oxidative polymerization of pyrrole with metallic nano-oxides	guided practical activity	4 Hours
Analysis and interpretation of FTIR and XRD spectra of polyaniline and composite materials	guided practical activity	2 Hours
Analysis and interpretation of FTIR and XRD spectra of polypyrrole and composite materials	guided practical activity	2 Hours

References:

1. Handbook of conducting polymers, vol. I. New York: Marcel Dekker; 1986. p. 265–91.
2. L.Constantinescu, C.Berlic, "Metode experimentale in fizica polimerilor" Ed. Univ. Din Bucuresti, 1999
3. C.D. Wagner, W.M. Riggs, L.E. Davis, J.F. Moulter, G.E. Muilenberg, Handbook of X-ray Photoelectron Spectroscopy, Perkin-Elmer Corporation (1978).
4. "X-ray Diffraction Procedures for Polycrystalline and Amorphous Materials", Harold P. Klug and L. R. Alexander, Wiley-Interscience, 1974

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of knowledge and theminology used in polymer physics - ability to indicate/analyse specific examples	oral examination	70%

Practical	- ability to use specific experimental methods/apparatus - ability to analyse and interpret the characterization data - ability to present and discuss the results	Examination of Lab reports	30%
Minimal requirements for passing the exam	Correct exposition of a theoretical subject. A minimum grade of 5 must be obtained in each component of the evaluation. Attendance: at least 50% of the course hours and mandatory attendance at all lab sessions. At least 50% achievement in each of the criteria that determine the final grade. Requirements for Achieving Grade 10 (Excellent): Ability to clearly explain the physical principles underlying polymer behavior and properties. Capacity for critical analysis, interpretation, and discussion of the scientific concepts presented, including their application to relevant examples.		

Date, 25.09.2026	Teacher's name and signature, Conf.Dr. Anca Dumitru	Practicals/Tutorials/Project instructor(s), name and signature Conf.Dr. Anca Dumitru
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOP.314.2.P Introduction to environmental physics / Introducere în fizica mediului

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title				Introduction to environmental physics / Introducere în fizica mediului			
2.2. Teacher				Prof. dr. Mihai Dima			
2.3. Tutorials/Practicals instructor(s)				Prof. dr. Mihai Dima			
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	40	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/20/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					43
Research in library, study of electronic resources, field research					21
Preparation for practicals/tutorials/projects/reports/homework					21
Tutorat					0
Other activities					0
3.7. Total hours of individual study					85
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R6. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations.

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R6. The student/graduate writes and presents a scientific or professional report (e.g., laboratory or research paper, scientific or academic poster), adhering to ethical requirements and quality standards.
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R6. The student/graduate independently uses information sources (e.g., databases, software applications in MATLAB or Python).

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Actual environmental problems: global warming and climate change, distruction of the Ozone layer, pollution. The global warming: manifestation, causes and severity. Perception of climate change.	Systematic exposition - lecture. Conversation. Examples	2 Hours
Extended temporal perspective on the actual climate change – Paleoclimatology.	Systematic exposition - lecture. Conversation. Examples	4 Hours
Climate models. Design and scientific utility. Weather prediction, climate prediction and climate projections.	Systematic exposition - lecture. Conversation. Examples	4 Hours
General circulation of atmosphere and ocean.	Systematic exposition - lecture. Conversation. Examples	4 Hours
Critical components of the climate system.	Systematic exposition - lecture. Conversation. Examples	2 Hours
Thermohaline circulation. Socio-economic implications of climate change.	Systematic exposition - lecture. Conversation. Examples	2 Hours
Review of the concepts and notions presented during the course.	Systematic exposition - lecture. Conversation. Examples	2 Hours

References:

Holton J., R., Hakim, K. J., 2004: An Introduction to dynamic meteorology, Academic Press.
Peixoto J and Oort K.,J., 1998: Physics of Climate, Ed New York, pp. 650.

7.3 Practicals	**Teaching techniques**	**Observations**
Common structures of climate data files	Guided practical activity	2 Hours

Basic concepts of the GRADS application, used to plot global climate data	Guided practical activity	2 Hours
Types of plots in GRADS	Guided practical activity	2 Hours
Computing with GRADS	Guided practical activity	2 Hours
Analyzing data with GRADS	Guided practical activity	4 Hours
Visualizing global warming in GRADS	Guided practical activity	2 Hours
Constructing climate indices with GRADS	Guided practical activity	2 Hours
Statistical methods used in climate science.	Guided practical activity	4 Hours

References:

Climate Explorer (http://climexp.knmi.nl/start.cgi)
GRADS (http://cola.gmu.edu/grads/)
Wilks, D. S., Statistical Methods in the Atmospheric Sciences, Academic Press (2006).
Raportul IPCC 2021 (https://www.ipcc.ch/report/ar6/wg1/).

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms competences and abilities which are important for an undergraduate student in the field of modern Physics, corresponding to national and international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of knowledge and theminology used in thermal physics - ability to indicate/analyse specific examples - correct use of equations/mathematical methods/physical models and theories	Written examination	70%
Practical	- ability to use specific experimental methods/apparatus - ability to analyse and interpret the characterization data - ability to present and discuss the results	Examination of lab projects	30%
Minimal requirements for passing the exam	Requirements for mark 5 Completion of 80% of laboratory and mark 5 to written examination		

Date, 25.09.2026	Teacher's name and signature, Prof. dr. Mihai Dima	Practicals/Tutorials/Project instructor(s), name and signature Prof. dr. Mihai Dima
Date of approval 28.09.2026		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2026/2027
DOP.315.1.P Semiconductor physics / Fizica semiconductorilor

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Semiconductor physics / Fizica semiconductorilor				
2.2. Teacher			Prof. George Alexandru Nemnes				
2.3. Tutorials/Practicals instructor(s)			Prof. George Alexandru Nemnes				
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	1/1/0
3.4. Total hours per semester	40	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	10/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					43
Research in library, study of electronic resources, field research					21
Preparation for practicals/tutorials/projects/reports/homework					17
Tutorat					0
Other activities					4
3.7. Total hours of individual study					85
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Courses: Electricity and magnetism, Quantum Mechanics I, Equations of mathematical physics, Electrodynamics and Relativity theory, Thermodynamics and Statistical mechanics, Solid state physics, Equations of Mathematical Physics
4.2. competences	Abilities of Computational Physics

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia infrastructure (videoprojector, PC)
5.2. for tutorials/practicals	Seminar room/specific laboratory infrastructure

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R15. The student understands and appropriates the professional ethics and ethical practices that characterize the scientific and academic community.

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R15. The student applies ethical principles in professional work, and respects intellectual property rights
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R15. The student applies independently ethical behaviors and skills including critical thinking, methodological rigor, professional integrity and responsibility towards the environment and community

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Kinetic phenomena. Fundamental coefficients of transport in semiconductors.	Systematic exposition - lecture. Examples	6 Hours
Hall effect. Magnetoresistant effect.	Systematic exposition - lecture. Examples	4 Hours
The fundamental transport equations.	Systematic exposition - lecture. Examples	2 Hours
Shockley-Read statistics. Recombination rate associated with the deep levels.	Systematic exposition - lecture. Examples	4 Hours
The optical properties of semiconductors.	Systematic exposition - lecture. Examples	4 Hours

References:

[1] P.S. Kireev, Fizica semiconductorilor (Editura Ştiinţifică şi Enciclopedică, Bucureşti, 1977).
[2] K.W. Boer, U.W Pohl, Semiconductor Physics (Springer, Berlin, Germany, 2018).
[3] P.Y. Yu, M. Cardona, Fundamentals of Semiconductors – Physics and Materials Properties Introduction to Modern Solid State Physics, (Springer, Berlin, Germany, 2010)
[4] I. Munteanu, Fizica solidului, (Editura Universităţii din Bucureşti, Bucureşti, 2003).
[5] L. Ion, Note de curs (pdf)
[6] Simon M. Sze, Yiming Li, and Kwok K. Ng, Physics of Semiconductor Devices, 4th Edition, (John Wiley and Sons, 2021)

7.2 Tutorials	**Teaching techniques**	**Observations**
Electronic semiconductor structure. Doped semiconductors.	Theoretical exposition. Problem solving	2 Hours
Hall effect, temperature dependence. The mobility of load carriers.	Theoretical exposition. Problem solving	2 Hours

Recombination rate in the presence of deep-level impurities.	Theoretical exposition. Problem solving	2 Hours
The fundamental optical absorption.	Theoretical exposition. Problem solving	2 Hours
Hall effect. Magnetoresistant effect.	Theoretical exposition. Problem solving	2 Hours

References:

[1] K.W. Boer, U.W Pohl, Semiconductor Physics (Springer, Berlin, Germany, 2018).
[2] P.Y. Yu, M. Cardona, Fundamentals of Semiconductors – Physics and Materials Properties Introduction to Modern Solid State Physics, (Springer, Berlin, Germany, 2010)
[3] I. Munteanu, L. Ion, N. Tomozeiu, "Fizica semiconductorilor în probleme şi exerciţii" (Ed. Universităţii din Bucureşti, Bucureşti, 1994)
[4] D. Dragoman, Note de curs (pdf)
[5] Simon M. Sze, Yiming Li, and Kwok K. Ng, Physics of Semiconductor Devices, 4th Edition, (John Wiley and Sons, 2021)

7.3 Practicals	**Teaching techniques**	**Observations**
The Seebeck effect.	Guided practical activity	2 Hours
The Peltier effect.	Guided practical activity	2 Hours
The optical absorption spectroscopy - determination of the bandwidth of the prohibited semiconductor band.	Guided practical activity	2 Hours
Study of centers of impurity by electronic spin resonance.	Guided practical activity	2 Hours
The I-V characteristic of the p-n junction.	Guided practical activity	2 Hours

References:

[1] C. Berbecaru, L. Ion, Fizica solidului – Caiet de lucrări de laborator
[2] C. Kittel, Introduction to Solid State Physics (8th ed., John Wiley and Sons, New York, 2004).
[3] K.W. Boer, U.W Pohl, Semiconductor Physics (Springer, Berlin, Germany, 2018).
[4] P.Y. Yu, M. Cardona, Fundamentals of Semiconductors – Physics and Materials Properties Introduction to Modern Solid State Physics, (Springer, Berlin, Germany, 2010)
[5] I. Munteanu, L. Ion, N. Tomozeiu, "Fizica semiconductorilor în probleme şi exerciţii" (Ed. Universităţii din Bucureşti, Bucureşti, 1994)
[6] D. Dragoman, Note de curs (pdf)
[7] Simon M. Sze, Yiming Li, and Kwok K. Ng, Physics of Semiconductor Devices, 4th Edition, (John Wiley and Sons, 2021)

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course content is in agreement with the content of similar courses taught at national and international universities, such as University Babeş-Bolyai, Cluj Napoca, University "Alexandru Ioan Cuza", Iaşi and, respectively, University of Groningen, Netherlands, Warwick University, UK, University of Tubingen, Germany, Technical University Wien, Austria, etc. The course forms abilities and competences to analyze the physical phenomena specific to semiconductors, to plan and carry out specific experiments and to identify applications, skills and abilities of interest for companies and research institutes with activity in Materials Physics as well as in secondary school teaching.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	Clarity, coherence and concision of exposition; Proper use of physical models and mathematical formalism; Capacity of exemplification; Capacity to apply the acquired knowledge to problem solving.	Written exam	60%
Tutorial	Application of specific solving methods for a given problem	On-going evaluation; solving of given homeworks	20%
Practical	Proper use of physical models and mathematical formalism; Knowledge of specific experimental techniques and instrumentation	Lab colloquium	20%
Minimal requirements for passing the exam	Attendance at all practical and tutorial activities and mark 5 at the corresponding evaluations. Solving of selected subjects for mark 5 at the final written exam Obtaining a grade of 5 at the laboratory colloquium. Requirements for getting mark 10 (10 points scale): Skills, well-argued knowledge. Demonstrated ability to analyze phenomena and processes.		

Date, 25.09.2026	Teacher's name and signature, Prof. George Alexandru Nemnes	Practicals/Tutorials/Project instructor(s), name and signature Prof. George Alexandru Nemnes
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOP.315.2.P Special topics in solid state physics / Capitole speciale de fizica solidului

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Special topics in solid state physics / Capitole speciale de fizica solidului				
2.2. Teacher			Prof. George Alexandru Nemnes				
2.3. Tutorials/Practicals instructor(s)			Prof. George Alexandru Nemnes				
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	1/1/0
3.4. Total hours per semester	40	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	10/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					20
Research in library, study of electronic resources, field research					10
Preparation for practicals/tutorials/projects/reports/homework					13
Tutorat					0
Other activities					42
3.7. Total hours of individual study					85
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Lectures: Solid state physics, Quantum mechanics, Electricity and magnetism, Optics
4.2. competences	Use of software packages for data analysis

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia infrastructure (videoprojector, PC)
5.2. for tutorials/practicals	Equipments for electrical, optical and magnetic characterizations. Workstations with Linux operating system.

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R15. The student understands and appropriates the professional ethics and ethical practices that characterize the scientific and academic community.

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R15. The student applies ethical principles in professional work, and respects intellectual property rights
Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R15. The student applies independently ethical behaviors and skills including critical thinking, methodological rigor, professional integrity and responsibility towards the environment and community

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Physics of nanostructures. Introduction. Specific electrical and optical properties.	Systematic exposition - lecture. Examples.	4 Hours
Magnetic properties of solids. Applications. Spintronics.	Systematic exposition - lecture. Examples.	4 Hours
Introduction to fractional exclusion statistics. Applications.	Systematic exposition - lecture. Examples.	4 Hours
Atomistic methods for electronic properties of materials.	Systematic exposition - lecture. Examples.	4 Hours
Machine learning techniques in condensed matter physics.	Systematic exposition - lecture. Examples.	4 Hours

References:

[1] D.K. Ferry, S.M. Goodnick, Transport in Nanostructures (Cambridge Univ. Press, 2009, 2nd ed)
[2] S. Datta Electronic transport in Mesoscopic systems (Cambridge Univ. Press, Reprinted 1999)
[3] Electronic Structure – Basic Properties and Practical Methods (Cambridge Univ. Press, 2020)
[4] Quantum Transport in Nanostructures and Molecules, Colin John Lambert, (IOP Publishing, 2021)

7.2 Tutorials	**Teaching techniques**	**Observations**
Determination of electron transmission coefficients in low-dimensional structures [Examples]	Seminar	2 Hours
Rashba effect. Spin filters. [Examples]	Seminar	2 Hours
Applications of fractional exclusion statistics to interacting fermion and boson systems. [theoretical aspects]	Seminar	2 Hours
Atomistic calculation of semiconductor band structures [theoretical aspects]	Seminar	2 Hours
Artificial neural networks for predicting electronic properties. [Usage of specialized libraries]	Seminar	2 Hours

References:

[1] D.K. Ferry, S.M. Goodnick, Transport in Nanostructures (Cambridge Univ. Press, 2009, 2nd ed)
[2] S. Datta Electronic transport in Mesoscopic systems (Cambridge Univ. Press, Reprinted 1999)
[3] Electronic Structure – Basic Properties and Practical Methods (Cambridge Univ. Press, 2020)
[4] Quantum Transport in Nanostructures and Molecules, Colin John Lambert, (IOP Publishing, 2021)
[5] TensorFlow: https://www.tensorflow.org/

7.3 Practicals	**Teaching techniques**	**Observations**
Determination of electron transmission coefficients in low-dimensional structures. [Applied scattering theory]	Guided practical activity	2 Hours
Rashba effect. Spin filters. [Applied scattering theory]	Guided practical activity	2 Hours
Applications of fractional exclusion statistics to interacting fermion and boson systems. [Metropolis algorithm for transition rates]	Guided practical activity	2 Hours
Atomistic calculation of semiconductor band structures. [SIESTA code]	Guided practical activity	2 Hours
Artificial neural networks for predicting electronic properties. [TensorFlow, SciKit Learn applications]	Guided practical activity	2 Hours

References:

[1] D.K. Ferry, S.M. Goodnick, Transport in Nanostructures (Cambridge Univ. Press, 2009, 2nd ed)
[2] S. Datta Electronic transport in Mesoscopic systems (Cambridge Univ. Press, Reprinted 1999)
[3] Electronic Structure – Basic Properties and Practical Methods (Cambridge Univ. Press, 2020)
[4] Quantum Transport in Nanostructures and Molecules, Colin John Lambert, (IOP Publishing, 2021)
[5] TensorFlow: https://www.tensorflow.org

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit aims at developing specific theoretical and practical competences and abilities in the field of advanced solid state physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates (industry, research – e.g. the National R and D Institute for Materials Physics, secondary school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of equations/mathematical methods/physical models and theories - ability to indicate/analyze specific examples	Written exam	50%
Tutorial	- ability to solve problems	Homeworks	25%
Practical	- ability to design and perform specific experiments - ability to present and discuss the results	Colloquium	25%
Minimal requirements for passing the exam	To obtain grade 5: - Performing all experiments, presentation of Lab reports and grade 5 at Colloquium - Correct solution for indicated subjects in homeworks and the final exam Knowledge of basic elements: transmission functions and ballistic transport in nanostructures, spin filter effects, setup of an atomistic model, working principles of artificial neural networks. Minimum participation: 50% lectures and 100% labs. For online evaluations, the exam subjects shall be sent via email / Google Meet / Google Classroom / Microsoft Teams. During the exam the students shall have the camera on. The exam shall be recorded.		

Date, 25.09.2026	Teacher's name and signature, Prof. George Alexandru Nemnes	Practicals/Tutorials/Project instructor(s), name and signature Prof. George Alexandru Nemnes
Date of approval 28.09.2026		Head of department name and signature Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOP.316.1.P Electronic devices and circuits / Dispozitive şi circuite electronice

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title			Electronic devices and circuits / Dispozitive şi circuite electronice				
2.2. Teacher			Conf. dr. Adrian Radu				
2.3. Tutorials/Practicals instructor(s)			Lect. dr. Bogdan Biţă				
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	30	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					48
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					23
Tutorat					0
Other activities					0
3.7. Total hours of individual study					95
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Parcurgerea cursurilor de Electricitate şi magnetism, Electronică
4.2. competences	Abilitati de Fizică experimentală

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Sală cu dotări multimedia (videoproiector)
5.2. for tutorials/practicals	Sală de laborator cu infrastructură specifică

6. Learning outcomes

Knowledge	R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods).
Skills	R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics.
Responsibility and autonomy	R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations

Impedanţa de intrare. Abaterea de la idealitate.	Expunere sistematică - prelegere. Exemple	2 Hours
Impedanţa de ieşire. Efectele impedanţei asupra semnalului.	Expunere sistematică - prelegere. Exemple	2 Hours
Metode de ajustare automata a impedantelor. Reacţia selectivă.	Expunere sistematică - prelegere. Exemple	2 Hours
Dispozitive şi circuite cu funcţionare în comutatie.	Expunere sistematică - prelegere. Exemple	2 Hours
Comparatorul de tensiune. Circuite cu histerezis.	Expunere sistematică - prelegere. Exemple	4 Hours
Analiza comparativa intre circuite liniare şi în comutatie. Randamentul.	Expunere sistematică - prelegere. Exemple	4 Hours
Circuite de alimentare de putere.	Expunere sistematică - prelegere. Exemple	4 Hours

References:

- Mihai P Dinca, "Electronica - Manualul studentului", vol1, Editura Universitatii din Bucuresti, 2003.
- C. Alexander and M. Sadiku, "Fundamentals of electric circuits", McGraw-Hill, 2009 - R. Dorf and J. Svoboda, "Introducton to electric
circuits", John Wiley and Sons, 2010
- R. Boylestad and L. Nashelsky, "Electronic devices and circuit theory", Prentice Hall - T. Floyd, "Electronic devices", Pearson Education, 2005
- P. Horowitz and W. Hill, "The art of electronics", 2nd edition, Cambridge Unversity Press,1994

7.3 Practicals	Teaching techniques	Observations
Determinarea impedanţelor		2 Hours
Circuite de reacţie selectivă		2 Hours
Dispozitive de comutaţie		2 Hours
Comparatoare de tensiune		2 Hours
Surse de putere		2 Hours

References:

- Mihai P Dinca, "Electronica - Manualul studentului", vol1, Editura Universitatii din Bucuresti, 2003.
- C. Alexander and M. Sadiku, "Fundamentals of electric circuits", McGraw-Hill, 2009 - R. Dorf and J. Svoboda, "Introducton to electric
circuits", John Wiley and Sons, 2010
- R. Boylestad and L. Nashelsky, "Electronic devices and circuit theory", Prentice Hall - T. Floyd, "Electronic devices", Pearson Education, 2005
- P. Horowitz and W. Hill, "The art of electronics", 2nd edition, Cambridge Unversity Press,1994

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

Conţinutul disciplinei este în concordanţă cu conţinutul unor cursuri similare predate la universităţi din ţară

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Claritatea, coerenţa şi concizia expunerii; - Utilizarea corectă a modelelor studiate,	Examen oral	80%
Practical	- Utilizarea corectă a modelelor fizice, formulelor şi relaţiilor de calcul;	Verivicare	20%
Minimal requirements for passing the exam	Obţinerea notei 5 - Verificarea lucrarilor de laborator - Obtinerea notei 5 prin însumarea punctelor obţinute la activităţile de pe parcurs şi examen, în acord cu ponderile specificate Obţinerea notei 10 - Capacitate demonstrată de analiză a fenomenelor şi proceselor - Rezolvarea corectă si argumentata a tuturor subiectelor		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
25.09.2026	Conf. dr. Adrian Radu	Lect. dr. Bogdan Biţă

Date of approval	Head of department name and signature
28.09.2026	Assoc. prof. Adrian RADU

Syllabus

Academic year 2026/2027
DOP.316.2.P Introduction to nanotechnologies / Introducere în nanotehnologii

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Electricity, Solid State and Biophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Licenţă
1.6. Study program	Physics

2. Course unit

2.1. Course unit title				Introduction to nanotechnologies / Introducere în nanotehnologii			
2.2. Teacher				Prof. PhD Eng. Habil. Vlad-Andrei ANTOHE			
2.3. Tutorials/Practicals instructor(s)				Prof. PhD Eng. Habil. Vlad-Andrei ANTOHE / Assoc. Prof. PhD Sorina IFTIMIE			
2.4 Year of study	3	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DOP

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	30	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					48
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					13
Tutorat					4
Other activities					6
3.7. Total hours of individual study					95
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	DFC.111.EN (Physical chemistry); DI.116EN (Electricity and Magnetism); DI.201EN (Optics); DI.212EN (Electronics); DI.303EN (Solid State Physics); DI.105EN and DI.205EN (Foreign language - English).
4.2. competences	DFC.110EN (Object oriented programming); DO.216.1EN (Virtual instrumentation and data acquisition); Basic skills of handling small laboratory equipment and tools; Basic skills of data analysis and processing using dedicated software packages.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Multimedia room (Video-beamer, PC, Internet connectivity).
5.2. for tutorials/practicals	Laboratory (place): MDEO research infrastructure, Nanotechnologies Lab. Requirements: experimental settings for carrying out basic experiments on the preparation and characterization of nanomaterials.

6. Learning outcomes

Knowledge	R1. The student/graduate describes concepts, theories, principles, phenomena, and fundamental laws of physics (e.g., Archimedes' principle, Coulomb's law, the first law of thermodynamics). R2. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena in professional communication. R3. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R4. The student/graduate explains and interprets concepts, theories, models, and principles of physics (e.g., the atomic model, the uncertainty principle), highlighting practical applications (e.g., experimental techniques, technological applications). R5. The student/graduate applies the principles and laws of physics in solving theoretical or practical problems, including in partially unpredictable situations. R7. The student/graduate determines appropriate methods of analysis for specific situations in the field of physics (e.g., dimensional analysis, approximation methods). R8. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R10. The student/graduate deduces working formulas for calculations involving physical quantities, correctly applying fundamental principles and laws. R11. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R12. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R13. The student/graduate describes physical systems (e.g., thermodynamic systems, electrical circuits), using specific theories and tools to characterize them. R14. The student/graduate knows the basic vocabulary and specialized terminology in a foreign language in the field of physics, the structure of scientific texts and international academic communication formats.

Skills	R1. The student/graduate appropriately uses concepts and methods specific to the modeling of physical phenomena (e.g., Maxwell's equations, the Schrödinger equation) in professional communication. R2. The student/graduate applies the principles and laws of physics (e.g., the laws of motion, the ideal gas law) in solving theoretical or practical problems, including in partially unpredictable situations. R3. The student/graduate correlates statistical analysis methods (e.g., correlation coefficients, linear regression) with experimental data, integrating the results and critically interpreting the obtained information. R4. The student/graduate critically evaluates a scientific communication or a specialized report of low difficulty (e.g., a laboratory report, an introductory study), analyzing the arguments and conclusions presented. R5. The student/graduate collects and interprets data obtained from applying scientific methods (e.g., experimental design, sensor measurements), integrating the results into an analytical framework. R7. The student/graduate prepares scientific reports and presentations (e.g., symposium presentation, popular science article), constructing logical and coherent arguments on general physics topics. R8. The student/graduate compares theoretical results from specialized literature (e.g., textbooks, indexed articles) with experimental ones, integrating the data into a professional report or project. R10. Students/graduates prepare and present, in English, scientific or outreach reports and communications, using appropriate technical language and logical argumentation. R11. The student/graduate provides examples of the application of basic theoretical concepts and results to solve exercises and problems related to the topics covered in the curriculum subjects. R12. The student/graduate develops personal, interpersonal, and intercultural competencies through involvement in activities that promote self-awareness, empathy, effective communication, respect for diversity, and collaboration with individuals from different cultural backgrounds to achieve objectives. R13. The student/graduate is able to read, understand, and translate specialized texts, extract relevant information from international scientific sources, and communicate orally and in writing in an autonomous and professional manner. R14. The student/graduate is able to read, understand and translate specialized texts, extract relevant information from international scientific sources and communicate orally and in writing in an autonomous and professional manner.

Responsibility and autonomy	R1. The student/graduate presents scientific or outreach papers and seminars (e.g., posters, workshops), adapting the content to the target audience. R2. The student/graduate manages technical or professional activities or projects (e.g., experiment planning, resource allocation), making decisions and coordinating teams in unforeseen situations. R3. The student/graduate takes responsibility for professional development (e.g., attending conferences, participating in science outreach events), planning and evaluating their own progress. R4. The student/graduate responsibly carries out independent work tasks and contributes to interdisciplinary approaches (e.g., integrating physics knowledge into multidisciplinary projects). R5. The student/graduate efficiently organizes their schedule and resources (e.g., time management, equipment handling), respecting deadlines and safety regulations. R7. The student/graduate undertakes research internships in specialized units (e.g., research institutes, university laboratories), writing reports on the activities and results obtained. R8. The student/graduate critically analyzes a specialized paper or scientific communication of medium difficulty (e.g., peer-reviewed article, scientific report), assuming the conclusions and recommendations. R10. Students/graduates take responsibility for interacting, contributing, and integrating into multilingual work teams and professional communities, demonstrating autonomy in using information sources in English. R11. The student/graduate uses logical thinking, analyzes problem statements, and selects the specific method for solving problems from the topics covered in the curriculum subjects. R12. The student/graduate becomes aware of responsibly assuming risks by taking initiatives, making decisions in uncertain situations, and managing consequences in an ethical and constructive manner. R13. The student/graduate responsibly uses international information sources, respecting academic ethics standards and demonstrating initiative in learning specialized scientific language. R14. The student/graduate uses information sources responsibly, respecting the norms of academic ethics and demonstrating initiative in learning the scientific language of the specialty.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
C1 and C2. Introduction into the nanoscale science and technology: - Emergent applications and nanotechnologies; - Examples. Evolution of the computing systems; - Breakthrough applications of nanotechnology.	Systematic exposition. Lecture. Critical discussions. Examples.	4 Hours
C3 and C4. Nanomaterials and low-dimensional systems: - Nanotechnology. Basic concepts and definitions; - Length's scale. Classification of nanostructures; - Physical effects at nanometer scale.	Systematic exposition. Lecture. Critical discussions. Examples.	4 Hours
C5 and C6. Preparation of nanomaterials and nanostructures: - Contamination in nanotechnology; - Cleanrooms. Classification and standards; - Cleanroom basic processes. Overview.	Systematic exposition. Lecture. Critical discussions. Examples.	4 Hours
C7 and C8. Synthesis of thin films and nanomaterials: - Basics on thin film deposition techniques; - Electrochemical processes in nanotechnology; - Surfaces manipulation and patterning.	Systematic exposition. Lecture. Critical discussions. Examples.	4 Hours
C9 and C10. Processing and manufacturing of silicon wafers: - Semiconducting silicon. Structural properties; - Fabrication of mono-crystalline silicon wafers; - Filed-effect transistors. Microchips design.	Systematic exposition. Lecture. Critical discussions. Examples.	4 Hours

References:

1. V. A. Antohe, "Capacitive Sensors Based on Localized Nanowire Arrays. Nanotechnology and Device Integration Routes", Lambert Academic Publishing (LAP), 244 Pages, ISBN: 978-3-659-38899-6 (May 2013);
2. M. Di Ventra, S. Evoy, J. R. Heflin Jr., Kluwer, "Introduction to Nanoscale Science and Technology", Academic Publishers 2004, ISBN: 1-402-07757-2;
3. B. Bhushan, "Springer Handbook of Nanotechnology", Springer 2007, ISBN: 3-540-29855-X.

7.3 Practicals	**Teaching techniques**	**Observations**
L1. Vacuum thermal evaporation of metallic thin films.	Guided practical activity.	2 Hours
L2. RF magnetron sputtering of inorganic thin films.	Guided practical activity.	2 Hours
L3. Spin-coating processes of organic thin films.	Guided practical activity.	2 Hours
L4. Nanomaterials synthesis by electrochemical processes.	Guided practical activity.	2 Hours
L5. Morphological characterization of thin films and nanomaterials.	Guided practical activity.	2 Hours

References:

Îndrumar de laborator:
1. S. Antohe, L. Ion, F. Stanculescu, S. Iftimie, A. Radu and V. A. Antohe, "Fizica şi tehnologia materialelor semiconductoare – Lucrări practice", Ars Docendi, Universitatea din Bucureşti, ISBN: 978-973-558-940-0 (2016).

Articole ştiinţifice în strânsă legătură cu domeniul disciplinei:
1. O. Toma, V. A. Antohe, A. M. Panaitescu, S. Iftimie, A. M. Răduţă, A. Radu, L. Ion and Ș. Antohe, "Effect of RF Power on the Physical Properties of Sputtered ZnSe Nanostructured Thin Films for Photovoltaic Applications", Nanomaterials 11(11), 2841 (2021), doi: 10.3390/nano11112841;
2. S. Matéfi-Tempfli, M. Matéfi-Tempfli, A. Vlad, V. A. Antohe and L. Piraux, "Nanowires and nanostructures fabrication using template methods: a step forward to real devices combining electrochemical synthesis with lithographic techniques", J. Mater. Sci – Mat. Electron. 20(1), 249 (2009), doi: 10.1007/s10854-008-9568-6.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit aims at developing specific theoretical competences and practical abilities in the field of nanoscale sciences and technologies. The content corresponds to all national and European/international standards. The content of lectures and the teaching methods were carefully selected and framed after the content of similar course units within internationally-recognized universities from Romania and European Union (Leibniz Universität Hannover – Germany and Université Catholique de Louvain – Belgium). All lectures and the proposed experiments comply with the high standards requirements and expectations of our main employers of the graduates (industry sector, research institutes – i.e., National Institute of Materials Physics, elementary and high school teaching).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	Coherence and clarity of exposition.	Written test and oral examination	60%
Practical	- Ability to use specific experimental settings and equipment; - Ability to perform specific experiments and to interpret scientific data; - Ability to present and discuss the scientific results.	Laboratory colloquium	40%
Minimal requirements for passing the exam	Requirements for mark 5 (10 points scale): - Mandatory attendance of all laboratory sessions; - Carrying out all experiments and passing the laboratory colloquium with a minimal mark of 5; - Obtaining a minimal mark of 5 at the final exam, addressing some basic questions. Requirements for mark 10 (10 points scale): - Attendance of minimum 50% of the lectures and mandatory attendance of all laboratory sessions; - Deeply argued skills and knowledge; - Correct answer to all the questions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
25.09.2026	Prof. PhD Eng. Habil. Vlad-Andrei ANTOHE	Prof. PhD Eng. Habil. Vlad-Andrei ANTOHE Assoc. Prof. PhD Sorina IFTIMIE

Date of approval	Head of department name and signature
28.09.2026	Assoc. prof. Adrian RADU