FIŞA DISCIPLINEI

2021-2022

1. Date despre program

1.1 Instituţia de învăţământ superior	**University “Alexandru Ioan Cuza” from Iaşi**
1.2 Facultatea	**Facultaty of Physics**
1.3 Departamentul	**Physics**
1.4 Domeniul de studii	**Physics**
1.5 Ciclul de studii	**Master**
1.6 Programul de studii / Calificarea	***Master*** *in the specialization* **„PHYSICS FOR ADVANCED TECHNOLOGIES”**

2. Date despre disciplină

2.1 Denumirea disciplinei			***Physics of materials I (dielectrics, magnetic materials)***				
2.2 Titularul activităţilor de curs			**Prof. dr. Liliana Mitoșeriu, Conf. dr. Ioan Dumitru**				
2.3 Titularul activităţilor de seminar			**Lect. dr.habil. Lavinia Curecheriu, Conf. dr. Ioan Dumitru**				
2.4 An de studiu	**MI**	**2.5** Semestru	**1**	**2.6** Tip de evaluare	**E**	**2.7** Regimul disciplinei*	**OB**

** OB – Obligatoriu / OP – Opţional*

3. Timpul total estimat (ore pe semestru şi activităţi didactice)

3.1 Număr de ore pe săptămână	**5**	din care: **3.2** curs	**3**	**3.3** seminar/laborator	**3**
3.4 Total ore din planul de învăţământ	**84**	din care: **3.5** curs	**42**	**3.6** seminar/laborator	**42**
Distribuţia fondului de timp					ore
Studiu după manual, suport de curs, bibliografie şi altele					**40**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**35**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**27**
Tutoriat					**10**
Examinări					**4**
Alte activităţi					**0**

3.7 Total ore studiu individual	**116**
3.8 Total ore pe semestru	**200**
3.9 Număr de credite	**8**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	**Electricitaty and Magnetism, Solid State Physics**
4.2 De competenţe	**Interdisciplinary scientific and technological general background, Positive team working attitude and competences in science communication**

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	Lecture room with multimedia tools (projector, screen) and blackboard, Acces internet, CISCO Webex platform, Skype, etc.

5.2 De desfăşurare a seminarului/ laboratorului	Labs with specific equipments/tools for the characterisation of electrical and magnetic properties of materials with technological applications, Acces internet, CISCO Webex platform, Skype, etc.

6. Competenţe specifice acumulate

Competenţe profesionale	**C1.** Capacitaty to identify properly in practical situations the priciples, laws, models and theories to describe the electrical and magnetic properties of materials in correlation with composition and microstructures; **C2.** Capacitaty to identify, classify and describe materials from the point of view of their behaviour under electric/magnetic fields and understanding their potrential for possible applications; **C3.** Capacity to analyse and valorify the experimental results obtained in the lab and identification of error sources and influence of various parameters; **C4.** Capacitaty to study recommended bibliography, to sinthesise scientific information and critically discuss models for interpretation of materials properties with possible technological and industrial applications.
Competenţe transversale	**CT1.** Capacity of communication concerning scientific results, ability to realise a scientific presentation concerning materials with techological applications; **CT2.** Capacity of collaboration and working in a team; **CT3.** Capacity to realise a personal project of bibliographycal or scientific research; **CT4.** Open and positive attitude for solving problems and assuming the professional deontological principles and values.

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	**Understanding the electrical and magnetic properties of substances and their correlation with chemical and phase composition and with micro/nanostructural characteristics**
7.2 Obiectivele specifice	After successfully finalising this discipline, the students will be able to: ▪ Explain the diferences between the functional properties of various materials with technological applications with linear/nonlinear response under the application of electric/magnetic fields; ▪ Describe the material response in electric/magnetic field as a function of temperature field frequency, field intensity, mechanical stress; ▪ Use various experimental methods to characterise materials with technological applications from electric/magnetic point of view; ▪ Comparatively analyse the materials properties, searching for potential applications; ▪ Use adequate models for interpretation of polarisation/magnetisation processes in substances.

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Eqs. describing the electric field in materials. Dipole, multipole. General properties of dielectrics, classifications.	Lecture, Power Point presentation	4h
2.	Polarization. Fundamental eq. of dielectrics. Applications: dielectric plan, sphere. Local fields (Lorentz, Onsager)	Lecture, Power Point presentation. Case study	4h
3.	Electrostatic forces and energies in substances.	Lecture, Power Point presentation	2h

4.	Induced polarisation. Field-dependence of polarisation and susceptibility in non-polar substances.	Lecture, Power Point presentation	2h
5.	Orientation polarisation. Field-dependence of polarisation and susceptibility in polar substances.	Lecture, Power Point presentation	2h
6.	Dielectric relaxation, emipiral laws. Debye relaxation. Microscopical mechanisms.	Lecture, Power Point presentation. Case study	4h
7.	Impedance spectroscopy: principles, methods, applications to determine broadband dielectric properties.	Lecture, Power Point presentation. Case study	3h
8.	Fundamental laws of magnetism in substances. Origin of magnetic properties.	Magistral lecture. Case study	3h
9.	Diamagetism, paramagnetism, ferromagnetism: phenomenological aspects. Hysteresis loop; permeability and magnetic susceptibility.	Lecture. Debates. Case study	3h
10.	Magnetization of substances in ac fields. Magnetic interactions. Temperature-induced modification of magnetisation curves. Curie temperature.	Lecture. Debates. Case study	3h
11.	Nature of magnetic moments in ferromagnetic solids. Weiss model. Other theoreis for polarisable media. Theory of magnetisation curves.	Lecture. Computer-aided learning.	3h
12.	Soft magnetic materials. Hard magnetic materials.	Lecture. Debates. Case study	3h
13.	Nanostructured magnetic materials. Thin film magnetic materials.	Magistral lecture	3h
14.	Applications of magnetic materials. Recording/storage media.	Lecture. Case study. Brainstorming	3h

Bibliography

Principal references:

- L. Mitoseriu, V. Tura, Fizica dielectricilor, Ed. Univ.”Al.I. Cuza” Iasi, 1999
- A. Jonsker, Dielectric relaxation in solids, Chelsea Dielectric Press., London, 1983
- A. Ianculescu, L. Mitoseriu, Ceramici avansate cu aplicatii in microelectronica, Ed. Politehnica Bucuresti 2007
- L. Mitoseriu (ed.), New development in advanced functional ceramics, Transworld Res. Network, 2007
- G. Bertotti, Hysteresis in Magnetism (For Physicists, Material Scientists and Engineers) Academic Press Boston, 1998
- R. M. Bozorth, Ferromagnetism, IEEE Press, 1993
- E. Burzo, Fizica fenomenelor magnetice, vol I, II, III, Editura Academiei Bucureşti, 1979
- S. Chikazumi, Magnetismul Editura Ştiinţifică şi Enciclopedică, Bucureşti ,1981

Supplementary references:

- H. Gavrila, V. Ioniţă, Metode experimentale în magnetism Editura UMF, 2003
- H. Gavrilă, H. Chiriac, P. Ciureanu, V. Ioniţă, A. Yelon, Magnetism tehnic şi aplicat, Editura Academiei Române, 2004
- D. Jiles, Magnetism and Magnetic Materials Chapman & Hall, New York, 1991
- M. E. Lines, A. M. Glass, Principles and Applications of Ferroelectrics and Related Materials, Oxford,

	Classic Texts in the Physical Sciences), 2001		
8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Field and potential of various dipole distributions. Problems with boundary conditions in dielectrics.	Solving problems. Demonstrations	Sem. 3h
2.	Calculation of permittivity of polar and non-polar dielectrics. Problems	Solving problems. Demonstrations. Case studies	Sem. 3h
3.	Problems of dielectric relaxations	Solving problems. Demonstrations. Case studies	Sem. 3h
4.	Study of dielectric relaxation by impedance spectroscopy	Lab activity (experimental)	Lab. 3h
5.	Study of ferro-para phase transition and of Curie-Weiss law in ferroelectric ceramics	Lab activity (experimental)	Lab. 3h
6.	Study of ferroelectric P(E) loops	Lab activity (experimental)	Lab. 3h
7.	Study of non-linear dielectric properties $\varepsilon(E)$	Lab activity (experimental)	Lab. 3h
8.	Field and potential of currents distributions. Problems solving.	Solving problems. Debates and discussions	Sem. 3h
9.	Calculations of induction, fields, susceptibility in nonlinear polarisable media. Problems.	Solving problems. Debates and discussions	Sem. 3h
10.	Inductometric methods for determination of M(H) loops and magnetisation curves.Generalities and problems.	Lab activity (experimental)	Lab. 3h
11.	Histeresisgraph method	Lab activity (experimental)	Lab. 3h
12.	Vibrating magnetometer. High order magnetisation curves. Determination of Curie temperatures.	Lab activity (experimental)	Lab. 3h
13.	Determination of initial permeability and its variation with frequency and temperature.	Lab activity (experimental)	Lab. 3h
14.	Determination of magnetostriction and magnetoelectric constants	Lab activity (experimental)	Lab. 3h

Bibliografie

- Electromagnetism. Carte de lucrări practice, A. Mândreci, O. F. Călţun, Editura Universităţii “Al. I. Cuza”, Iaşi, 2002
- A. Mandreci, O. F. Călţun, L. Spinu, Cr. Papusoi, Electricitate, magnetism şi electronică. Probleme rezolvate pentru studenţii Facultăţii de Chimie”, partea a doua Editura Universităţii “Al. I. Cuza”, Iaşi, 1999
- H. Gavrila, V. Ioniţă (2003) Metode experimentale în magnetism Editura UMF
- V. Pop, I. Chicinaș, N. Jumate, (2001) Editura Presa Universitară Clujeană
- O. Calțun editor, Ferite de cobalt magnetostrictive (2009) Editura Universității Alexandru Ioan Cuza Iași

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor profesionale şi angajatorilor reprezentativi din domeniul aferent programului

The objectives and containts have been selected according to the expectances of the main employers (research institutes, universities, SMEs, schools) in order to favour the professional insertion. The discipline is adapted to the recommendation of ANCS (National Research Agency) and Physics Romanian Society.

10. Evaluare

Tip activitate	**10.1 Criterii de evaluare**	**10.2 Metode de evaluare**	**10.3 Pondere în nota finală (%)**
10.4 Lecture	Presence, implication, constructive feedback	Written test. Individual project. Written report.	25%
10.5 Seminar/ Laboratory	Implication, preparation of activities, quality of contribuitions, assuming charges and activities in workteam, collaboration in the workgroup	Individual project, lab portfolio, participation to seminars, solved problems, individual and group tasks	75%
10.6 Standard minim de performanţă			
The students should demonstrate their ability to discuss using specific scientific language about the electric/magnetic properties of various materials with technological applications. The students will be able to realise at least an individual mini-project of bibliographic or scientific research and to present it to the community in a coherent way.			

Data completării
25.09.2021

Titular de curs
Prof. dr. Liliana Mitoşeriu,
Conf. dr. Ioan Dumitru,

Titular de seminar
Lect. dr. habil. Lavinia Curecheriu
Conf. dr. Ioan Dumitru

Data avizării în departament

Director de departament
Conf. dr. Iordana Aştefănoaei

Course Syllabus

2021-2022

1. Program infos

1.1 High education Institution	**Alexandru Ioan Cuza University of Iasi**
1.2 Faculty	**Faculty of Physics**
1.3 Department	**Physics**
1.4 Study domain	**Physics**
1.5 Study cycle	**Master**
1.6 Study program / Specialization	**PHYSICS FOR ADVANCED TECHNOLOGIES**

2. Course infos

2.1 Course title			***TECHNIQUES FOR MATERIALS PREPARATION***				
2.2 Course instructor			**Prof. univ. dr. habil. Liviu Leontie**				
2.3 Seminary/laboratory instructor			**Lect. univ. dr. Radu Apetrei**				
2.4 Study year	**1**	**2.5** Semester	**1**	**2.6** Evaluation type	**EVP**	**2.7** Course type	**OB**

3. Total estimated time (no. hours per semester and didactical activities)

3.1 No. hours/week	**4**	from which: **3.2** course	**2**	**3.3** seminary/laboratory	**2**
3.4 Total no. hours in Curriculum	**56**	from which: **3.5** course	**28**	**3.6** seminary/laboratory	**28**

Time share	hours
Study: textbook, supporting materials, references, etc.	**40**
Additional documentation: library, specialized electronic platforms and on site	**40**
Preparation of seminars / labs, homework, essays, portfolios	**30**
Tutoring	**28**
Examinations	**4**
Other activities	**2**

3.7 No. hours for indidual study	**144**
3.8 Total no. hours/Semester	**200**
3.9 Number of credits	**8**

4. Preconditions (if the case)

4.1 Curriculum	Calculus and Solid State Physics
4.2 Competences	Language skills at academic level, in foreign languages, for scientific documentation.

5. Conditions (if the case)*

5.1 for course*	
5.2 for seminary/laboratory*	

* Web platforms for conducting online activities (Cisco Webex), if necessary, in case of pandemic restrictions.

6. Specific competences to be acquired

Professional competences	**C1.** mastery of research methods and techniques, specific to the specialization *Physics for Advanced Technologies* (2 C); **C2.** language skills at academic level, in foreign languages, needed for scientific documentation (1 C); **C3.** use of communication and information technologies (1 C); **C4.** use of the software for analyzing and processing of experimental data (1 C).
Transversal competences	**CT1.** ssuccessful and responsible realization of professional tasks in compliance with ethics laws specific to the domain/elaboration of specialty papers or dissertation thesis respecting the objectives, proposed terms and rules of professional ethics; **CT2.** efficient use of information sources and communication resources (assisted training), both in Romanian and in a foreign language/drafting, typing and defending in Romanian or in a foreign language of a specialty paper with a hot topics in current research in the field.

7. Course Objectives

7.1 General objective	To provide students with a comprehensive overview on the fundamentals of thin film preparation and characterization.
7.2 Specific objectives	♦ To enable the students to develop a thorough understanding of how core physics can be used to understand thin film deposition processes. ♦ To establish the correlation between processing variables and materials characteristics and performance within the framework of key modern technologies. ♦ To allow students to develop a sense of teamwork, communication skills and research methodologies through team project.

8. Content

8.1	Course	Teaching methods*	Observations
1.	Thin film definition. Crystalline and amorphous films.	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3]; G. M. G. Rusu, Gh. I. Rusu, *The Basics of Semiconductor Physics*, Alexandru Ioan Cuza University Publishing House, Iasi, 2015. Addit. Ref.: [2].
2.	Choosing a deposition method. Classification of Deposition Technologies.	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer,	2 h Main Ref.: [1–3]. Addit. Ref.: [2].

		TV). Online resources.	
3.	Thin-film nucleation and growth	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3]. Addit. Ref.: [2].
4.	Thermal vacuum evaporation. Basics	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1, 3]. Addit. Ref.: [1, 2].
5.	Thermal vacuum evaporation. Apparatus. Applications.	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1, 3]. Addit. Ref.: [1, 2].
6.	Magnetron sputtering. Basics	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3]. Addit. Ref.: [1, 2].
7.	Magnetron sputtering. Apparatus. Applications.	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3]. Addit. Ref.: [1, 2].
8.	Chemical methods. Chemical Vapor Deposition (CVD). Basics	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3]. Addit. Ref.: [1, 2].
9.	Chemical Vapor Deposition (CVD). Apparatus. Applications.	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3]. Addit. Ref.: [1, 2].
10.	Electrochemical and electroless methods.	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3]. Addit. Ref.: [1–3].
11.	Pulsed laser deposition (PLD). Basics	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3].

12.	Pulsed laser deposition (PLD). Apparatus. Applications.	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3].
13.	Thin film applications in nano- and microelectronics (optoelectronic devices, photodetectors).	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3]. Addit. Ref.: [1, 2].
14.	Thin film applications in nano- and microelectronics (solar cells, sensors and actuators), nanotechnologies.	Mixed (inductive-deductive and deductive-inductive), heuristic. Audio-visual teaching aids (video techniques, computer, TV). Online resources.	2 h Main Ref.: [1–3]. Addit. Ref.: [1, 2].

References

Main References:

1. Peter M. Martin, *Handbook of Deposition Technologies for Films and Coatings, Third Edition: Science, Applications and Technology*, Elsevier, Amsterdam-Boston, 2010.
2. Xiaosheng Fang and Limin Wu (Eds.), Handbook of Innovative Nanomaterials, CRC Press, Taylor & Francis Group, Boca Raton, FL, 2013.
3. I. Spînulescu, *Thin Film Physics and Applications*, Scientific Publishing House, Bucharest, 1975 (in Romanian).

Additional References:

1. N. Suliţanu, *Physics of Solid Surface*, AL. I. Cuza Publishing House, Iaşi, 1997.
2. I. Dima, I. Munteanu, *Semiconductor Materials and Devices*, Didactical and Pedagogical Publishing House, Bucharest, 1980 (in Romanian).
3. L. Oniciu, E. Grunwald, *Galvanotechnics*, Scientific and Encyclopedical Publishing House, Bucharest, 1980.

8.2	**Seminary / Laboratory**	**Teaching methods****	**Observations**
1.	Thin metal (Bi, Sn, Zn) film deposition by thermal vacuum evaporation.	Laboratory practice.	2 ore
2.	Preparation of thin oxide films by thermal dry oxidation of as-prepared metallic films.	Laboratory practice.	2 ore
3.	Optical and electric characterization of as-prepared oxide films.	Laboratory practice.	2 ore
4.	Preparation of oxide films by sputtering.	Laboratory practice.	2 ore
5.	Optical and electric characterization of as-prepared oxide films.	Laboratory practice.	2 ore
6.	Preparation of oxide films by PLD.	Laboratory practice.	2 ore, RAMTECH
7.	Preparation of ferroelectric nanoparticles.	Laboratory practice.	2 ore
8.	Preparation of thin organic films by spin coating and solution deposition (immersion method).	Laboratory practice.	2 ore

9.	Optical and electric characterization of as-prepared organic films.	Laboratory practice.	2 ore
10.	Advanced preparation techniques for polymeric materials (thin films).	Demonstrative experiments	2 ore, Petru Poni Institute of Macromolecular Chemistry
11.	Advanced preparation techniques for polymeric materials (fibers, membranes, etc).	Demonstrative experiments	2 ore, Petru Poni Institute of Macromolecular Chemistry
12.	Physicochemical Characterization of as-prepared materials	Laboratory showcase	2 ore, Petru Poni Institute of Macromolecular Chemistry
13.	Advanced preparation techniques for inorganic nanomaterials (powders, fibers, thin films, etc-)	Demonstrative experiments	2 ore, NIRD for Technical Physics Iasi
14.	Physical properties of as-prepared materials	Laboratory showcase	2 ore, NIRD for Technical Physics Iasi

References

1. David Levy and Marcos Zayat (Eds.), The Sol-Gel Handbook. Vol. 1: Synthesis and Processing; Vol. 2: Characterization and Properties of Sol-Gel Materials; Vol. 3: Application of Sol-Gel Materials, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, 2015.
2. Hartmut Frey and Hamid R. Khan (Eds.), Handbook of Thin-Film Technology, Springer-Verlag, Berlin-Heidelberg, 2015.
3. Zexian Cao (Ed.), Thin-Film Growth. Physics, materials science and applications, Woodhead Publishing Limited, Oxford, 2011.

* Web platforms for conducting online activities (Cisco Webex), if necessary, in case of pandemic restrictions.
** Mixted way, online and face-to-face, if necessary, in case of pandemic restrictions.

9. Corroboration of Course content with expectations of community, professional associations and employers' representatives in the program field

The planned activities are also intended to meet smart, sustainable and inclusive growth requirements, and societal values and expectations.

10. Evaluation

Activity	**10.1 Evaluation Criteria**	**10.2 Evaluation Methods**	**10.3 Scoring weights of evaluation forms in final assessment formula (%)**
10.4 Course	Accuracy of knowledge	Written papers	50 %
10.5 Seminary/ Laboratory	Reasoning based upon practical considerations	Practical work, project	50 %
10.6 Minimum performance standards			
- understanding core physics of main thin-film deposition techniques; - choosing a proper deposition method for a given material; - elaboration of a study / project on a specific preparation method.			

Completion date	Course instructor’s signature	Laboratory instructor’s signature
24.09.2021	prof. univ.dr. habil. Liviu Leontie	lect. univ.dr. Radu Apetrei

Date of endorsement	Director of department

FIŞA DISCIPLINEI

2021-2022

1. Date despre program

1.1 Instituţia de învăţământ superior	**”Alexandru Ioan Cuza” University of Iasi**
1.2 Facultatea	**Faculty of Physics**
1.3 Departamentul	**Department of Physics**
1.4 Domeniul de studii	**Physics**
1.5 Ciclul de studii	**Master**
1.6 Programul de studii / Calificarea	Physics for Advanced Technologies

2. Date despre disciplină

2.1 Denumirea disciplinei			**Modeling of physical processes**				
2.2 Titularul activităţilor de curs			**Prof. dr. Laurenţiu STOLERIU**				
2.3 Titularul activităţilor de laborator			**Prof. dr. Laurenţiu STOLERIU**				
2.4 An de studiu	**1**	**2.5** Semestru	**1**	**2.6** Tip de evaluare	**E**	**2.7** Regimul disciplinei*	**OB**

** OB – Obligatoriu / OP – Opţional*

3. Timpul total estimat (ore pe semestru şi activităţi didactice)

3.1 Număr de ore pe săptămână	**4**	din care: **3.2** curs	**2**	**3.3** laborator	**2**
3.4 Total ore din planul de învăţământ	**56**	din care: **3.5** curs	**28**	**3.6** laborator	**28**
Distribuţia fondului de timp					ore
Studiu după manual, suport de curs, bibliografie şi altele					**28**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**16**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**15**
Tutoriat					**8**
Examinări					**2**
Alte activităţi					**0**

3.7 Total ore studiu individual	**69**
3.8 Total ore pe semestru	**125**
3.9 Număr de credite	**5**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	**Undergraduate course in programming languages**
4.2 De competenţe	**Basic computer skills**

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	**Room with access to internet, videoprojector and projection screen**
5.2 De desfăşurare a seminarului/ laboratorului	**Students must have individual access to computers**

6. Competenţe specifice acumulate

Competenţe profesionale	C1.1 Mastery of research methods and techniques, specific to the specialization Advanced Materials. Nanotechnologies; C2.1 Language skills at academic level, in foreign languages, needed for scientific documentation; C3.1 Use of communication and information technologies; C4.1 Use the software for analyzing and processing experimental data and to perform virtual experiments;
Competenţe transversale	CT1. Use of communication and information technologies; CT2. Use the software for analyzing and processing experimental data and to perform virtual experiments; CT3. Understanding and ability to apply the principles and the values of the professional and research ethics.

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	C1. Identification and proper use of laws, principles, notions and physical methods in various circumstances; C2. Analysis and communication of Physics information C3. Capacity to teach Physics at secondary and post-secondary education levels; C4. Application of Physics knowledge to practical situations; C5. Opening to lifelong learning.
7.2 Obiectivele specifice	After successfuly finalizing this course, the students will be able to: ▪ Use computing modeling tools to describe physics problems ▪ Identify and control sources of numerical errors ▪ Analyze numerical results and establish conclusions starting from numerical simulations

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1	Generalities. Systems, models and simulations. Errors in numerical calculus: the machine constant and the round-off error.	Lecture, exemplification	2 ore
2	Maple programming platform: how it compares to other programming environments, advantages and disadvantages.	Lecture, exemplification	2 ore
3	The trajectory of a body in a 2D gravitational field: - plotting the parametric trajectory starting from known solutions, - finding solutions by solving the equation of motion, - the consequences of adding viscous friction	Lecture, exemplification	2 ore
4	Finding the trajectory of a body in gravitational field – wind effect (numerically solving the equation of motion).	Lecture, exemplification	2 ore

	Movement in central force field.		
5	Computing and graphical representation of fields. Electrical field of a system of electric charges. The field lines spectrum of a system of two electric charges.	Lecture, exemplification	2 ore
6	Advanced computing of field lines - plotting electric field lines for an arbitrary number of electric charges.	Lecture, exemplification	2 ore
7	Harmonic oscillator. Different ways of approaching animations in Maple/Maxima.	Lecture, exemplification	2 ore
8	Discussing the solution of the practical work problem. Lissajous curves	Lecture, exemplification	2 ore
9	More advanced programming in Maple/Maxima – plotting the resonance curve	Lecture, exemplification	2 ore
10	More advanced programming in Maple/Maxima – animating a falling satellite	Lecture, exemplification	2 ore
11	Working with external data in Maple/Maxima: read, write, statistics.	Lecture, exemplification	2 ore
12	Nonlinear systems: the double pendulum. Random vs. chaotic vs. deterministic.	Lecture, exemplification	2 ore
13 - 14	Analyzing chaos: Lyapunov exponents, phase portraits, Poincare sections.	Lecture, exemplification	4 ore

Bibliografie

Referinţe:

[1] L. Stoleriu, A. Stancu, Introducere in modelarea si simularea proceselor fizice, Ed. Tehnopress, 2007.
[2] F. Wang, Physics with MAPLE, Wiley-VCH, 2005.
[3] W. Press et al, “Numerical Recipes”, Cambridge University Press, 1992
[4] Burden R. et al, “Numerical analysis”, PWS-KENT Publishing Company, Boston, 1985.
[5] B. Char et al, “Maple V”, Springer Verlag, 1992.
[6] Blachman N.R. et al, “Maple V - quick reference”, Brooks/Cole Publishing Company, Pacific Grove, California, 1994.
[6] G.L. Baker, J.P.Gollub, “Chaotic dynamics. An introduction”, Cambridge University Press, 1990.

Referinţe suplimentare:

http://stoner.phys.uaic.ro/moodle/

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Errors in numerical calculus.	Problem solving	2 ore
2 - 4	Basic elements of Maple. Differences when comparing Maple with a classical programming language. Advantages. Disadvantages.	Problem solving	6 ore
5 - 6	Physical fields. Visualization.	Problem solving	4 ore
7	Practical work - evaluation	Problem solving	2 ore
8 - 11	Solving ordinary differential equations (ODEs) and systems of ODEs. From a high order ODE to a system of first order ODEs.	Problem solving	8 ore

12 - 14	Numerical study of chaotic systems. Chaotic vs. random.	Problem solving	6 ore

Bibliografie

http://stoner.phys.uaic.ro/moodle/
L. Stoleriu, A. Stancu, Introducere in modelarea si simularea proceselor fizice, Ed. Tehnopress, 2007.

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor profesionale şi angajatorilor reprezentativi din domeniul aferent programului

In Romania there is a strong need for scientists and engineers with strong numerical skills as more and more companies are engaging in CAD activities.

10. Evaluare

Tip activitate	10.1 Criterii de evaluare	10.2 Metode de evaluare	10.3 Pondere în nota finală (%)
10.4 Curs		Personal project	70%
10.5 Seminar/ Laborator		Two practical tests	30%
10.6 Standard minim de performanţă			
Identifying and using basic IT notion, comparing numerical models data with experimental data, designing of an algorithm for a medium complex software application Making graphs and reports to explain the obtained results, evaluating the degree of confidence in the results.			

Data completării
24.09.2021

Titular de curs
Prof. dr. Laurenţiu STOLERIU

Titular de laborator
Prof. dr. Laurenţiu STOLERIU

Data avizării în departament

Director de departament
Conf. dr. Iordana AŞTEFĂNOAEI

FIŞA DISCIPLINEI

1. Date despre program

1.1 Instituţia de învăţământ superior	**”Alexandru Ioan Cuza” University of Iasi**
1.2 Facultatea	**Faculty of Physics**
1.3 Departamentul	**Department of Physics**
1.4 Domeniul de studii	**Physics**
1.5 Ciclul de studii	**Master**
1.6 Programul de studii / Calificarea	**Physics for Advanced Technologies** .

2. Date despre disciplină

2.1 Denumirea disciplinei			**Etică și integritate academică (Ethics and academic integrity)**					
2.2 Titularul activităţilor de curs			**Prof. univ. dr. Cristian ENĂCHESCU**					
2.3 Titularul activităţilor de seminar			**Prof. univ. dr. Cristian ENĂCHESCU**					
2.4 An de studiu	**3**	**2.5** Semestru	**1**	**2.6** Tip de evaluare	**EVP**	**2.7** Regimul discipinei*	**OB**	

** OB – Obligatoriu / OP – Opţional*

3. Timpul total estimat (ore pe semestru şi activităţi didactice)

3.1 Număr de ore pe săptămână	**2**	din care: **3.2** curs	**1**	**3.3** seminar/laborator	**1**	
3.4 Total ore din planul de învăţământ	**28**	din care: **3.5** curs	**14**	**3.6** seminar/laborator	**14**	
Distribuţia fondului de timp					ore	
Studiu după manual, suport de curs, bibliografie şi altele					**5**	
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**5**	
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**10**	
Tutoriat					**1**	
Examinări					**1**	
Alte activităţi						

3.7 Total ore studiu individual	**72**
3.8 Total ore pe semestru	**50**
3.9 Număr de credite	**2**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	**Nu**
4.2 De competenţe	**English knowledge**

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	**-**
5.2 De desfăşurare a seminarului/ laboratorului	**-**

6. Competenţe specifice acumulate

Competenţe profesionale	C1. Advanced expertise in the field C2. Competence to identify, implement and give solution to research problems.
Competenţe transversale	CT1. Compentence of written and oral communication CT2. Using IT and information technology CT3. Team working and social abilities

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	Acquiring knowledge on the methoology and ethics of research and standards of academic integrity
7.2 Obiectivele specifice	Upon successful completion of this discipline, students will be able to: □ Process and analyze information correctly from a variety of bibliographic sources □ Know the methodology of scientific research □ Know the fundamental principles of scientific research □ Know what plagiarism is □ Know the obligations that researchers have □ Know the responsibilities of the authors of a scientific article ▪ □ Identify the elements of inappropriate conduct in research

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1	The philosophical foundations of ethics	Interactive lecture, debate	-
2	Fundamental principles of scientific research	Interactive lecture, debate	-
3	Research ethics in the context of current Romanian and European legislation and regulations	Interactive lecture, debate	-
4	Misconduct in research	Interactive lecture, debate	
5	Authors and their role	Interactive lecture, debate	
6-7	Plagiarism and self-plagiarism. Plagiarism screening programs	Interactive lecture, debate	-
8-9	Scientometry	Interactive lecture, debate	
10-11	Mentoring and scientific collaborations	Interactive lecture, debate	
12-13	Data management	Interactive lecture, debate	

14	Science and social responsibility	Interactive lecture, debate	

Bibliografie

1. European Comission, Ethics for researchers – Facilitating Research Excellence, Bruxelles, 2013
2. “On Being a Scientist: Responsible Conduct in Research”; National Academy Press, Washington D.C, 2009
3. D.B. Resnick – The ethics of science, Routhles, NY, 2005
4. Studii de caz: https://oir.nih.gov/sourcebook/ethical-conduct/responsible-conduct-research-training/annual-review-ethics-case-studies
5. S. Florea, Plagiatul și încălcarea dreptului de autor, Dezbateri juridice, https://www.juridice.ro/467536/plagiatul-si-incalcarea-drepturilor-de-autor.html

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1	The philosophical foundations of ethics	Heuristic conversation	-
2	Fundamental principles of scientific research	Heuristic conversation	
3	Research ethics in the context of current Romanian and European legislation and regulations	Heuristic conversation	
4	Misconduct in research	Heuristic conversation	
5	Authors and their role	Heuristic conversation	
6-7	Plagiarism and self-plagiarism. Plagiarism screening programs	Heuristic conversation	
8-9	Scientometry	Heuristic conversation	
10-11	Mentoring and scientific collaborations	Heuristic conversation	
12-13	Data management	Heuristic conversation	
14	Science and social responsibility	Heuristic conversation	

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor profesionale şi angajatorilor reprezentativi din domeniul aferent programului

In the current context, knowledge of the notions of ethics and integrity is essential to ensure the correctness of the activities carried out by students and for the work of future researchers.

10. Evaluare

Tip activitate	**10.1 Criterii de evaluare**	**10.2 Metode de evaluare**	**10.3 Pondere în nota finală (%)**
10.4 Curs			
10.5 Seminar/ Laborator	active participation to class activities	Case studies interpretation	100%
10.6 Standard minim de performanţă			
• Students must be able to understand and apply the rules of ethics in scientific research			

Data completării
24.09.2021

Titular de curs
Prof.dr. Cristian Enăchescu

Titular de seminar
Prof.dr. Cristian Enăchescu

Data avizării în departament

Director de departament
Conf.dr. Iordana Aștefănoaei

FIŞA DISCIPLINEI

2021-2022

1. Date despre program

1.1 Instituţia de învăţământ superior	“Alexandru Ioan Cuza” University of Iaşi
1.2 Facultatea	Faculty of Physics
1.3 Departamentul	Physics
1.4 Domeniul de studii	Physics, Master
1.5 Ciclul de studii	Master
1.6 Programul de studii / Calificarea	Physics for Advanced Technologies

2. Date despre disciplină

2.1 Denumirea disciplinei	FUNDAMENTALS OF MATHEMATICAL PHYSICS						
2.2 Titularul activităţilor de curs	CONF. DR. Iordana AȘTEFĂNOAEI /prof. dr. Ciprian DARIESCU						
2.3 Titularul activităţilor de seminar	prof. dr. Ciprian DARIESCU						
2.4 An de studiu	**1**	**2.5** Semestru	**1**	**2.6** Tip de evaluare	**E**	**2.7** Regimul disciplinei*	**OB**

* *OB – Obligatoriu / OP – Opţional*

3. Timpul total estimat (ore pe semestru şi activităţi didactice)

3.1 Număr de ore pe săptămână	**4**	din care: **3.2** curs	**2**	**3.3** seminar/laborator	**2**
3.4 Total ore din planul de învăţământ	**56**	din care: **3.5** curs	**28**	**3.6** seminar/laborator	**28**

Distribuţia fondului de timp	ore
Studiu după manual, suport de curs, bibliografie şi altele	**43**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren	**35**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri	**31**
Tutoriat	**0**
Examinări	**8**
Alte activităţi	**2**

3.7 Total ore studiu individual	**119**
3.8 Total ore pe semestru	**175**
3.9 Număr de credite	**7**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	Mathematical Physics Equations, Differential Equations, Functional Analysis, Algebra.
4.2 De competenţe	Computer skills, programming knowledge, English knowledge

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	Online on Webex platform, computer, tablet
5.2 De desfăşurare a seminarului	Online on Webex platform, computer, tablet

6. Competenţe specifice acumulate

Competenţe profesionale	**C1.** identification and proper use of laws, principles, notions and physical methods in various circumstances; **C2.** analysis and communication of physics information with didactical, scientific and popularization character; **C3.** capacity of interrelationing and teamworking; **C4.** application of Physics knowledge to practical situations; **C5.** opening to lifelong learning.
Competenţe transversale	**CT1.** mastery of research methods and techniques, specific to the Master specialization **CT2.** language skills at academic level, in foreign languages, needed for scientific documentation; **CT3.** use of communication and information technologies; CT4. use the software for analyzing and processing experimental data and to perform virtual experiments; **CT5**. understanding and ability to apply the principles and the values of the professional and research ethics.

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	The present course intends to supply good knowledge on basics and main results of mathematical physics. By its role, this course should prepare the student for a Ph.D. in Physics. Therefore, the modern views and the checked formalisms are constantly emphasized as far as possible.
7.2 Obiectivele specifice	▪ Ability to use theoretical physics methods in various fields; ▪ application of knowledge to practical situations; ▪ Ability in extracting information from a large variety of sources. ▪ Use of specific software for analyzing and processing experimental data;

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Generalities on differential equations;	Lecture, Applications	2 ore
2.	Physically significant differential equations;	Lecture, applications, guided discovering process	2 ore
3.	Ordinary differential equations; First and Second order differential equations	Lecture, applications, guided discovering process	2 ore
4.	Ordinary differential equations; Higher Order Differential equations	Lecture, debate, guided discovering process	2 ore
5.	Euler equations. Cauchy-Euler equations	Lecture, applications	2 ore
6	Systems of first order differential equations;	Lecture, guided discovering process, applications	2 ore

7	First order differential equations with partial derivatives;	Lecture, guided discovering process, applications	2 ore
8.	Second order differential equations with partial derivatives;	Lecture, guided discovering process, applications	2 ore
9	Legendre Polynomials;	Lecture, guided discovering process, applications	2 ore
10	Basic symmetries and special functions: spherical and Bessel functions;	Lecture, guided discovering process, applications	2 ore
11.	Laplace and Poisson Equations,	Lecture, debate	2 ore
12.	Laplace – Fourier method of variables separation;	Lecture, applications	2 ore
13.	Parabolic equations: General physical processes, Heat propagation equation, solutions and Laplace-Fourier method, heat propagation equation in entire space, fundamental solution of heat propagation operator.	Lecture, applications	2 ore
14.	Hyperbolic equations: physical general processes, Wave equation and standard conditions, Laplace-Fourier method and types of solutions, Propagation in R^3 : radiation conditions.	Lecture, applications,debate, guided discovering process	2 ore

Bibliografie

Referinţe principale:

1. V. Barbu. *Procese la limita pentru ecuatii cu derivate partiale*. Ed. Academiei Romane, Bucuresti, 1993.
2.A. N. Tihonov si A. A. Samarski. *Ecuatiile fizicii matematice*. Ed. Tehnica, Bucuresti, 1956,
3. V. S. Vladimirov, *Ecuatiile fizicii matematice*. Ed. St. si Ped, Bucuresti, 1980.
4. I. S.Gradshteyn, I. M Ryzhik, *Table of Integrals, Series, and Products*, 7th edn, Academic, New York, 1990.
5. D. Zwillinger, *Handbook of Differenţial Equations* , Boston, Academic Press, 1997.

Referinţe suplimentare:

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Geometrical interpretation of first order differential equations' solutions	Applications, guided discovering process	2 ore
2.	Homogeneous equations. Applications. Linear equations. Bernoulli equation. Riccati equation.	Applications, guided discovering process	2 ore
3.	Second order differential equations. I. n-th order differential equations with constant coefficients. Variation of constants method	Applications, guided discovering process	2 ore
4.	Higher Order Differential equations II. n-th order differential equations with constant coefficients. Variation of	Applications, guided discovering process	2 ore

	constants method		
5.	Euler equations. Cauchy-Euler equations. Applications.	Applications, guided discovering process	2 ore
6.	Systems of first order differential equations; Applications	Applications, guided discovering process	2 ore
7.	First order differential equations with partial derivatives; Applications	Applications, guided discovering process	2 ore
8.	I. Second order differential equations with partial derivatives; Applications	Applications, guided discovering process	2 ore
9	II. Second order differential equations with partial derivatives; Applications	Applications, guided discovering process	2 ore
10.	Basic symmetries and special functions: spherical and Bessel functions; Applications (I)	Applications, guided discovering process	2 ore
11.	Basic symmetries and special functions: spherical and Bessel functions; Applications (II)	Applications, guided discovering process	2 ore
12.	Complex numbers. Operations with complex numbers.	Applications, guided discovering process, debate	2 ore
13.	Complex functions of real and complex variables	Applications, guided discovering process	2 ore
14.	Complex series. Singularities and poles. Residua Theorem.	Applications, guided discovering process	2 ore

Bibliografie

1. V. Barbu. *Procese la limita pentru ecuatii cu derivate partiale*. Ed. Academiei Romane, Bucuresti, 1993.
2. A. N. Tihonov si A. A. Samarski. *Ecuatiile fizicii matematice*. Ed. Tehnica, Bucuresti, 1956,
3. V. S. Vladimirov, *Ecuatiile fizicii matematice*. Ed. St. si Ped, Bucuresti, 1980.
4. I. S.Gradshteyn, I. M Ryzhik, *Table of Integrals, Series, and Products*, 7th edn, Academic, New York, 1990.
5. D. Zwillinger, *Handbook of Differenţial Equations* , Boston, Academic Press, 1997.

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor profesionale şi angajatorilor reprezentativi din domeniul aferent programului

10. Evaluare

Tip activitate	10.1 Criterii de evaluare	10.2 Metode de evaluare	10.3 Pondere în nota finală (%)
10.4 Curs	Course attendance	Written paper	50%

	active participation to class activities		
10.5 Seminar/ Laborator	Seminar activity and rate of participation	presentation of a research topic	50%
10.6 Standard minim de performanţă			
Obtaining the minimal grade 5 for each ongoing assessment.			

Data completării	Titular de curs	Titular de seminar
1 October 2021	CONF. DR. Iordana AȘTEFĂNOAEI prof. dr. Ciprian DARIESCU	prof. dr. Ciprian DARIESCU

Data avizării în departament

Director de departament
Conf. univ. dr. Iordana Astefanoaei

FIŞA DISCIPLINEI

2021-2022

1. Date despre program

1.1 Instituţia de învăţământ superior	**Universitatea “Alexandru Ioan Cuza” din Iaşi**
1.2 Facultatea	**Faculty of Physics**
1.3 Departamentul	**Physics**
1.4 Domeniul de studii	**Physics**
1.5 Ciclul de studii	**MASTER**
1.6 Programul de studii / Calificarea	**PHYSICS FOR ADVANCED TECHNOLOGIES**

2. Date despre disciplină

2.1 Denumirea disciplinei			**VIRTUAL INSTRUMENTATION**					
2.2 Titularul activităţilor de curs			**Lect. Dr. Valentin POHOATA**					
2.3 Titularul activităţilor de seminar			**Conf. Habil. Dr. Silviu GURLUI**					
2.4 An de studiu	**1**	**2.5** Semestru	**2**	**2.6** Tip de evaluare	**EVP**	**2.7** Regimul disciplinei*	**OB**	

** OB – Obligatoriu / OP – Opţional*

3. Timpul total estimat (ore pe semestru şi activităţi didactice)

3.1 Număr de ore pe săptămână	**4**	din care: **3.2** curs	**2**	**3.3** seminar/laborator	**2**
3.4 Total ore din planul de învăţământ	**56**	din care: **3.5** curs	**28**	**3.6** seminar/laborator	**28**
Distribuţia fondului de timp					ore
Studiu după manual, suport de curs, bibliografie şi altele					**39**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**36**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**20**
Tutoriat					**6**
Examinări					**4**
Alte activităţi Proiect individual					**14**

3.7 Total ore studiu individual	**119**
3.8 Total ore pe semestru	**175**
3.9 Număr de credite	**7**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	Electricity and magnetism, Electronics, Computer programming
4.2 De competenţe	- basics of proper use of laboratory and research instruments - basics of electric and electronic circuits

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	Classroom equipped with: screen, projector, computer
5.2 De desfăşurare a seminarului/ laboratorului	Laboratory room equipped with scientific equipment and related consumables: acquisition boards, software LabVIEW, oscilloscope, power programmable sources

6. Competenţe specifice acumulate

Competenţe profesionale	**C1.** identification and proper use of laws, principles, notions and physical methods in various circumstances; **C2.** analysis and communication of Physics information with didactical, scientific and popularization character; **C3.** capacity to teach Physics at secondary and post-secondary education levels; **C4.** capacity of interrelating and team working; **C5.** application of Physics knowledge to practical situations; **C6.** opening to lifelong learning.
Competenţe transversale	**CT1.** mastery of research methods and techniques, specific to the specialization Biophysics and Medical Physics; **CT2.** language skills at academic level, in foreign languages, needed for scientific documentation; **CT3.** use of communication and information technologies; **CT4.** use the software for analyzing and processing experimental data and to perform virtual experiments; **CT5.** understanding and ability to apply the principles and the values of the professional and research ethics

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	Knowledge of the analog and digital experimental measuring methods;
7.2 Obiectivele specifice	On successful completion of this subject, students will be able to: 1. Understanding of the data acquisition system; 2. Ability to analyze and design an virtual acquisition systems of different experimental devices; 3. Awareness of the typical problems in virtual instrumentation, according to the mainstream scientific literature of the last decade

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Introduction	Lectures, problems solving	2hours, Refs. 1-6
2.	I. Measuring and control experimental systems – analog systems	Lectures, problems solving	2hours, Refs. 1,2,5
3.	I. Measuring and control experimental systems – digital systems	Lectures, problems solving	2hours, Refs 1,2,5
4.	II. Data acquisition – Data acquisition board	Lectures, problems solving	2hours, Refs 1,2,5
5.	II. Data acquisition – Serial port RS-232, USB	Lectures, problems solving	2hours, Refs 1,2,5

6.	II. Data acquisition – Parallel port IEEE-1284	Lectures, problems solving	2hours, Refs 1,2,5
7.	II. Data acquisition – GPIB port IEEE 488.2	Lectures, problems solving	2hours, Refs 1,2,5
8.	III. Virtual instrumentation programming in LabVIEW – Introduction (front panel, block diagram)	Lectures, problems solving	2hours, Refs 3,4,6
9.	III. Virtual instrumentation programming in LabVIEW – Data types and operators	Lectures, problems solving	2hours, Refs 3,4,6
10.	III. Virtual instrumentation programming in LabVIEW – LabVIEW commands	Lectures, problems solving	2hours, Refs 3,4,6
11.	III. Virtual instrumentation programming in LabVIEW – Graphics in LabVIEW	Lectures, problems solving	2hours, Refs 3,4,6
12.	III. Virtual instrumentation programming in LabVIEW – Design Virtual Instruments in LabVIEW	Lectures, problems solving	2hours, Refs 3,4,6
13.	III. Virtual instrumentation programming in LabVIEW – Advanced Topics	Lectures, problems solving	2hours, Refs 3,4,6
14.	Reviews in Virtual Instrumentation	Lectures, problems solving	2hours, Refs 3,4,6

Bibliografie

Main References:
1. Robert A.Witte, Analog and Digital Measurements, Prentice Hall PTR, 2002
2. John Turner and Martyn Hill, Instrumentation for Engineers and Scientists, Oxford University Press Inc. NY, 1999
3. LabView Tutorial Manual, National InstrumentsCorp., 1996 (www.ni.com).
4. LabVIEW. Basics Course Manual, National Instruments Corp., USA, 1998.

Further References:
5. Tran Tien Lang, Electronics of Measuring Systems: Practical Implementation of Analogue and Digital Techniques, John Wiley & Sons Inc., 1987
6. LabVIEW. Advanced Couse Manual, National Instruments Corp., USA, 1998

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	LabVIEW startup	Problems solving, discussions, practical problems	2 hours, Refs 1-3
2.	Programming structures in LabVIEW	Problems solving, discussions, practical problems	2 hours, Refs 1-3
3.	Data structures used in virtual instrumentation	Problems solving, discussions, practical problems	2 hours, Refs 1-3
4.	Clusters, Files and Nodes	Problems solving, discussions, practical problems	2 hours, Refs 1-3
5.	Virtual instrumentation design	Problems solving, discussions, practical problems	2 hours, Refs 1-3
6.	Analogic signals acquisition (part I)	Problems solving, discussions,	2 hours, Refs 1-3

		practical problems	
7.	Analogic signals acquisition (part II)	Problems solving, discussions, practical problems	2 hours, Refs 1-3
8.	Graphics and special functions in LabVIEW I	Problems solving, discussions, practical problems	2 hours, Refs 1-3
9.	Graphics and special functions in LabVIEW II	Problems solving, discussions, practical problems	2 hours, Refs 1-3
10.	Digital port control using virtual instrumentation I	Problems solving, discussions, practical problems	2 hours, Refs 1-3
11.	Digital port control using virtual instrumentation II	Problems solving, discussions, practical problems	2 hours, Refs 1-3
12.	Individual student practical using LabVIEW	Problems solving, discussions, practical problems	2 hours, Refs 1-3
13.	Individual student practical using LabVIEW	Problems solving, discussions, practical problems	2 hours, Refs 1-3
14.	Individual student practical using LabVIEW	Problems solving, discussions, practical problems	2 hours, Refs 1-3

References

1. LabView Tutorial Manual, National InstrumentsCorp., 1996 (www.ni.com).
2. LabVIEW. Basics Course Manual, National Instruments Corp., USA, 1998.
3. LabVIEW. Advanced Couse Manual, National Instruments Corp., USA, 1998

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor profesionale şi angajatorilor reprezentativi din domeniul aferent programului

Course content is consistent with the virtual instrumentation techniques used in scientific and research laboratories in the country and abroad**.**

10. Evaluare

Tip activitate	**10.1 Criterii de evaluare**	**10.2 Metode de evaluare**	**10.3 Pondere în nota finală (%)**
10.4 Curs	active participation in the class activities	Final exam	50
10.5 Seminar/ Laborator	active participation to labs activities	Weekly monitoring of the projects progress, final presentation of the project on the chosen topic	50
10.6 Standard minim de performanţă			
Independent analysis of a typical design for virtual instrumentation, using LabVIEW programming			

Data completării
27.09.2021

Titular de curs
Lect. Dr. Valentin POHOATA

Titular de laborator
Conf. Habil. Dr. Dr. Silviu GURLUI

Data avizării în departament

Director de departament
Conf. Dr. Iordana AȘTEFĂNOAIE

FIŞA DISCIPLINEI

2021-2022

1. Date despre program

1.1 Instituţia de învăţământ superior	“Alexandru Ioan Cuza” University of Iaşi
1.2 Facultatea	Faculty of Physics
1.3 Departamentul	Physics
1.4 Domeniul de studii	Physics, Master
1.5 Ciclul de studii	Master
1.6 Programul de studii / Calificarea	Physics for Advanced Technologies

2. Date despre disciplină

2.1 Denumirea disciplinei			SPECIAL TOPICS ON QUANTUM PHYSICS				
2.2 Titularul activităţilor de curs			PROF. PH. D. Dariescu Marina-Aura				
2.3 Titularul activităţilor de seminar			PROF. PH. D. Dariescu Marina-Aura				
2.4 An de studiu	**1**	**2.5** Semestru	**2**	**2.6** Tip de evaluare	**E**	**2.7** Regimul disciplinei*	**OB**

** OB – Obligatoriu / OP – Opţional*

3. Timpul total estimat (ore pe semestru şi activităţi didactice)

3.1 Număr de ore pe săptămână	**4**	din care: **3.2** curs	**2**	**3.3** seminar/laborator	**2**
3.4 Total ore din planul de învăţământ	**56**	din care: **3.5** curs	**28**	**3.6** seminar/laborator	**28**

Distribuţia fondului de timp	ore
Studiu după manual, suport de curs, bibliografie şi altele	**51**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren	**46**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri	**37**
Tutoriat	**0**
Examinări	**8**
Alte activităţi	**2**

3.7 Total ore studiu individual	**144**
3.8 Total ore pe semestru	**200**
3.9 Număr de credite	**8**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	Quantum Physics, Statistical Physics, Solid State Physics, Mathematical Physics Equations, Algebra
4.2 De competenţe	Computer skills, English knowledge

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	Blackboard, Overhead projector, computers If demanded, Online on Webex platform
5.2 De desfăşurare a seminarului/ laboratorului	Blackboard, Overhead projector, computers If demanded, Online on Webex platform

6. Competenţe specifice acumulate

Competenţe profesionale	**C1.** identification and proper use of laws, principles, notions and physical methods in various circumstances; **C2.** capacity of interrelationing and teamworking; **C3.** application of Physics knowledge to practical situations; **C4.** opening to lifelong learning.
Competenţe transversale	**CT1.** mastery of research methods and techniques, specific to the Master specialization **CT2.** language skills at academic level, in foreign languages, needed for scientific documentation; **CT3.** use of communication and information technologies; CT4. use the software for analyzing and processing experimental data and to perform virtual experiments; CT5. understanding and ability to apply the principles and the values of the professional and research ethics.

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	To supply good knowledge on special elements of Quantum Mechanics, Quantum Statistics and Quantum Field Theories, with major applications in most important chapters of physics.
7.2 Obiectivele specifice	▪ Ability to use theoretical physics methods in various fields; ▪ application of knowledge to practical situations; ▪ Ability in extracting information from a large variety of sources. ▪ Use of specific software for analyzing and processing experimental data.

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Schrodinger’s Equation for various potentials:	Lecture, applications	2
2.	potential wells;	Lecture, debate	2
3.	Potential barriers, quantum tunneling;	Lecture, debate, guiding discovering process	2

4.	The Quantum Hall Effect	Lecture, debate, guiding discovering process	2
5.	Time-dependent Perturbation Theory	Lecture, applications	2
6.	Scattering Theory: Cross sections.	Lecture, debate, guiding discovering process	2
7.	Many-Particle Systems	Lecture, applications	2
8.	Born-Oppenheimer approximation,	Lecture, debate	2
9.	Quantum Statistics: Fermi-Dirac and Bose-Einstein	Applications, guiding discovering process	2
10.	Heat capacities	Applications, guiding discovering process	2
11.	Relativistic quantum mechanics	Lecture, guiding discovering process	2
12.	Basics of Quantum Field Theories: annihilation-creation algebra	Lecture, applications	2
13.	The S-matrix formalism	Lecture, debate	2
14.	Elements of Quantum Dynamics in mesoscopic systems.	Lecture debate, guiding discovering process	2

Bibliografie

Referinţe principale:
1. C. Kittel, *Introduction to Solid State Physics*, 8-th Ed., Wiley Press, 2005.
2. P.J.E.Peebles, *Quantum Mechanics* , Princeton University Press, New Jersey, 1992
3. B. H. Bransden, C. J. Joachain, *Introducere in mecanica cuantica*,Ed. Tehnica, Bucuresti, 1995.
4. C.Dariescu, Marina-Aura Dariescu, I. Gottlieb, *Capitole de baza in Mecanica Cuantica. Microparticule si Campuri* Ed. Venus, Iasi, 2007

Referinţe suplimentare:
1. C. Dariescu, I.Gottlieb, Marina-Aura Dariescu, *Campuri Cuantice Libere*, Ed. BIT, Iasi, 1998
2.. S. Datta, *Electronic transport in mesoscopic sistems* Cambridge Univ. Press, 2003
3. M. Ignat. *Termodinamica si fizica statistica*. Ed. Univ. Al. I. Cuza Iasi, 1983-1984

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Applications to Schrodinger equation: Cold fusion, tunnel diode, tunneling microscop	Applications, guiding discovering process	4
2.	Significant models of potential wells and barriers	Applications, guiding discovering process	2
3.	periodic potentials, energy bands.	Applications, guiding discovering process	2

4.	Scattering of quantum particles from different potentials	Applications, guiding discovering process	2
5.	Time-dependent Perturbation Theory. Applications	Applications, guiding discovering process	2
6.	Charged particles in electromagnetic fields	Applications, guiding discovering process	2
7.	Applications of Quantum Statistics	Applications, guiding discovering process	2
8.	Bose-Einstein condensate	Applications, guiding discovering process	2
9.	Low temperature behavior of fermions	Applications, guiding discovering process	2
10.	The Klein-Gordon equation	Applications, guiding discovering process	2
11.	The Dirac equation. Solutions. Negative energy interpretation.	Applications, guiding discovering process	2
12.	Feynman diagrams.	Applications, guiding discovering process	2
13.	Applications	Applications, guiding discovering process	2

Bibliografie

1. F. Constantinescu, E. Magyari, Mecanica cuantica. Probleme, Ed. Tehnica, Bucuresti, 1968.
2. B. H. Bransden, C. J. Joachain, *Introducere in mecanica cuantica*,Ed. Tehnica, Bucuresti, 1995.
3. M. Ignat. *Termodinamica si fizica statistica*. Ed. Univ. Al. I. Cuza Iasi, 1983-1984

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor profesionale şi angajatorilor reprezentativi din domeniul aferent programului

10. Evaluare

Tip activitate	10.1 Criterii de evaluare	10.2 Metode de evaluare	10.3 Pondere în nota finală (%)
10.4 Curs	Course attendance active participation to class activities	Written paper	50%
10.5 Seminar/ Laborator	Seminar activity and rate of participation	presentation of a research topic	50%

10.6 Standard minim de performanţă
Obtaining the minimal grade 5 for each ongoing assessment.

Data completării	Titular de curs	Titular de seminar
1 octombrie 2021	PROF. PH. D. Dariescu Marina-Aura	PROF. PH. D. Dariescu Marina-Aura

Data avizării în departament Director de departament

FIŞA DISCIPLINEI

2021- 2022

1. Date despre program

1.1 Instituţia de învăţământ superior	**"Alexandru Ioan Cuza" University of Iaşi**
1.2 Facultatea	**Faculty of Physics**
1.3 Departamentul	**Physics**
1.4 Domeniul de studii	**Physics**
1.5 Ciclul de studii	**Master**
1.6 Programul de studii / Calificarea	**Physics for Advanced Technologies**

2. Date despre disciplină

2.1 Denumirea disciplinei	**Physics of Materials II (polymers, semiconductors)**						
2.2 Titularul activităţilor de curs	**Prof. dr. habil. Gabriela BORCIA, Conf. dr. George RUSU**						
2.3 Titularul activităţilor de lab.	**Prof. dr. habil. Gabriela BORCIA, Conf. dr. George RUSU**						
2.4 An de studiu	**I**	**2.5** Semestru	**2**	**2.6** Tip de evaluare	**E**	**2.7** Regimul disciplinei*	**OB**

* *OB – Obligatoriu / OP – Opţional*

3. Timpul total estimat (ore pe semestru şi activităţi didactice)

3.1 Număr de ore pe săptămână	**6**	din care: **3.2** curs	**3**	**3.3** laborator		**3**
3.4 Total ore din planul de învăţământ	**84**	din care: **3.5** curs	**42**	**3.6** laborator		**42**
Distribuţia fondului de timp						ore
Studiu după manual, suport de curs, bibliografie şi altele						**43**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren						**37**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri						**29**
Tutoriat						**3**
Examinări						**4**
Alte activităţi						**--**

3.7 Total ore studiu individual	**116**
3.8 Total ore pe semestru	**200**
3.9 Număr de credite	**8**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	—
4.2 De competenţe	—

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	—
5.2 De desfăşurare a seminarului/ laboratorului	**Physics laboratory**

6. Competenţe specifice acumulate

Competenţe profesionale	**C1.** Identification and proper use of laws, principles, notions and physical methods related to polymer and semiconducting materials and structures in various circumstances **C2.** Correct application of the analysis methods and of the selection criteria for the solutions targeting a given goal in practical situations **C3.** Planning of analysis strategies using the available methods **C4.** Mastery of research methods and techniques, specific to the specialization Physics for Advanced Technologies **C5.** Analysis and communication of Physics information with didactical, scientific and popularization character **C6.** Capacity to teach Physics at secondary and post-secondary education levels **C7.** Capacity of interrelationing and teamworking **C8.** Opening to lifelong learning
Competenţe transversale	**CT1.** Carrying out the professional tasks in efficient and responsible manner, respecting the rules specific to the domain, under qualified assistance **CT2.** Applying the techniques for efficient team work on various hierarchical levels **CT3**. Efficient use of information sources and of communication and assisted training resources **CT4.** Use of software for analyzing and processing experimental data and to perform virtual experiments **CT5.** Language skills at academic level, in foreign languages, needed for scientific documentation **CT6.** Understanding and ability to apply the principles and the values of the professional and research ethics

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	1. Correct identification and use of the physical notions, laws and principles related to polymer materials, semiconductors and semiconducting structures, within a given context and capacity to apply this knowledge to practice 2. Ability to work in a team to solve experimental and technological problems, demonstrating determination and perseverance to achieve the tasks and fulfill the responsibilities 3. Interpretation of the information on polymer materials, semiconductors and semiconducting structures, and its communication in coherent and accessible form 4. Identification and utilization of bibliographical resources for continuous learning, formation and development
7.2 Obiectivele specifice	On successful completion of this course, the students will be able to: ▪ Identify and use adequately the principal laws and physical principles related to polymer materials, semiconductors and semiconducting structures, in a given context ▪ Explain what are the characteristics of a polymer material and of a semiconductor required in precise applications and their relation to the material structure ▪ Explain what are the suitable methods to analyse a material, in relation to its application ▪ Use laboratory equipment to examine materials ▪ Analyse and discuss the measured or numerical modelling data and present a report on the material characteristics

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Characterization techniques for polymer materials – Surface energetic characteristics, Infrared (IR) spectroscopy, X-ray photoelectron spectroscopy (XPS), X-ray difractometry (XRD)	Lecture, media presentation, thematic debates, applications / on site / online	4 hours, ref. 3, 4, 5, 6, 19, 20
2.	General description of polymer materials – Definitions, molecular mass, nomenclature, classification criteria		3 hours, ref. 1, 2
3.	Intermolecular interactions – Primary and secondary valences, van der Waals forces, hydrogen bond, cohesion energy		2 hours, ref. 1

4.	Physical states of polymers – Physical states and state transitions of polymers, transition temperatures, study of the polymer physical states, polymer structure, amorphous-crystalline character of polymers		4 hours, ref. 1
5.	Polymer properties – Mechanical properties, Thermal properties, Electrical properties, Optical properties		5 hours, ref. 1, 5, 6
6.	Polymer materials with special properties – "smart" materials, sensors, interpenetrating networks, liquid crystals, biomedical applications, membranes, carbon fibers and composites, conductor and semiconductor polymers, biodegradable polymers		3 hours, ref. 3, 5, 6, 19, 20
7.	Basic properties of semiconductors. Generation and recombination processes.	Lecture, media presentation / on site / online	2 hours, ref. 7, 13, 16, 17
8.	Charge carrier statistics. Intrinsic and extrinsic cases. Strong degeneration case.	Didactical demonstration, exposure, debates / on site / online	2 hours, ref. 8, 11, 13
9.	General theory of the transport phenomena (Effective mass, Drift mobility, Boltzmann equation)		1 hours, ref. 8, 11, 18, 21
10.	Electrical conduction. Hall effect. Magnetoresistive effect.	Lecture, media presentation / on site / online	3 hours, ref. 9, 10, 14, 26
11.	Non-equilibrium charge carriers. Continuity equations. Particular cases.	Didactical demonstration, exposure, debates / on site / online	3 hours, ref. 8, 9, 22
12.	Thermal conductivity. Diffusion. Thermo-electric and thermo-magnetic effects	Didactical demonstration, media presentation / on site / online	3 hours, ref. 15
13.	Optical and photoelectrical phenomena in semiconductors. Surface and interface phenomena		3 hours, ref. 23, 24, 25
14.	Surface phenomena. Semiconductor interfaces.	Didactical demonstration, media presentation / on site / online	4 hours, ref. 12, 17, 9

References

Principal references:

1. M. DĂRÂNGĂ, C. MIHĂILESCU, M. POPA, M. NICU, N. BEJAN, Polymer physics: introduction to science of polymer materials, Editura Ex Libris, Brăila, 2000
2. C. SIMIONESCU et al., Macromolecular chemistry, Ed. Didactică şi Pedagogică, Bucureşti, 1985
3. C. VASILE, M.C. PASCU, Eds., Surface properties of polymers, Research Signpost, Kerala, India, 2007
4. H. BUBBERT, H. JENETT, Surface and Thin Film Analysis: Principles, Instrumentation, Applications, Wiley-VCH, 2002
5. MATERIALS TODAY, Elsevier B.V. journal, 2006 - to date http://www.sciencedirect.com/science/journal/13697021 - Open Access
6. PROGRESS IN POLYMER SCIENCE, Elsevier B.V. journal, 2006 - to date http://www.sciencedirect.com/science/journal/00796700 - Contains Open Access
7. A. ANSELM, Introduction to Semiconductor Theory, Mir Publisher, Moscow, 1981
8. K.L. CHOPRA, Thin Films Phenomena, Mc Graw Hill, New York, 1969
9. V. DOLOCAN, Fizica dispozitivelor cu corp solid, Editura Academiei R.S.R., Bucureşti, 1978
10. A.S. GROVE, Fizica şi tehnologia dispozitivelor semiconductoare, Editura Tehnică, Bucureşti, 1973
11. L.P. HUNTER, Semiconductor Phenomena and Devices, Addison-Wesley Reading, Massachusets, 1966
12. M. JAROS, Physics and Applications of Semiconductor Microstuctures, Oxford Science, Publications, Oxford, 1990
13. P.S. KIREEV, Fizica semiconductorilor, Editura Ştiinţifică şi Enciclopedică, Bucureşti, 1977

14. T.S. MOSS, Handbook on Semiconductors; P.T. LANDSBERG (Volume Editor) Basic Propeties of Semiconductors, North Holland, Amsterdam, New York, London, Tokyo, 1992
15. Al. NICULA, Fizica semiconductorilor şi aplicaţii, Editura Didactică şi Pedagocică, Bucureşti, 1976
16. I. POP, M. CRIŞAN, Fizica corpului solid şi a semiconductorilor, Editura Ştiinţifică şi Pedagogică, Bucureşti, 1983
17. G.I. RUSU, G.G. RUSU, Bazele fizicii semiconductorilor, Editura Ştiinţifică şi didactică CERMI, Iaşi, 2005
18. K. SEEGER, Semiconductor Physics, Springer-Verlag, Berlin-Heidelberg-New York, 1982, 1999

Suplementary references:

19. C. VASILE, A.P. CHIRIAC, L.E. NIŢĂ, Eds., Degradable and biocompatible polymers, Tehnopress, Iaşi, 2006
20. N. DUMITRAŞCU, Biomaterials and biocompatibility, Editura Universităţii „Alexandru Ioan Cuza" Iaşi, 2007
21. C. CONSTANTINESCU, A. GLODEANU, Stări locale în semiconductori, Editura Acad. RSR, Bucureşti, 1967
22. S.G. DAVISON, M. STESLICKA, Basic Theory of Surface States, Clarendon Press, Oxford, 1996
23. M.C. DESJONQUERES, D. SPANJAARD, Concepte de fizica suprafeţei, Editura Tehnică, Bucureşti, 1998
24. V.A. JONSON, Photo and Thermoelectric Effects in Semiconductors, Pergamon Press, New York, 1962
25. T.S. MOSS, Optical Properties of Semiconductors, Butterworths Scientific Publications, London, 1959
26. E.H. PUTLEY, The Hall Effect in Semiconductor Physics, Dover Publications, New York, 1960

8.2	**Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Rules for work safety and protection. Equipment and conduct of the activities Symmetry of atomic systems–- Study on the symmetry elements of molecular structures	Discussion, practical work / on site / online	3 hours, ref. 1
2.	Infrared (IR) spectroscopy – Applications of IR spectroscopy in polymer characterization for various class of polymers		3 hours, ref. 2
3.	X-ray photoelectron spectroscopy (XPS) – Applications of XPS in polymer characterization. Analysis of XPS spectra of complex polymer materials		6 hours, ref. 3
4.	X-ray photoelectron spectroscopy (XPS) – Study on the surface chemical modification of polymer materials using XPS		3 hours, ref. 4
5.	X-ray diffractometry (XRD) – Applications of XRD in polymer characterization. Study on the modification, by surface treatment, of the degree of crystallinity of a polymer, using XRD		3 hours, ref. 5
6.	Contact angle measurement – Evaluation of the surface energy and surface energy components of polymer films		6 hours, ref. 6
7.	Obtaining of the semiconducting thin films samples (thin film deposition, electrodes deposition, thermal treatment)	Laboratory practice, discussions / on site / online	3 hours, ref. 7, 8, 9, 10
8.	Thickness measurement, XRD and XPS studies of the obtained semiconducting thin films.		3 hours, ref. 10
9.	Measurement of the temperature dependence of the electrical conductivity. Determination of the activation energies.		3 hours, ref. 8
10.	Measurement of the transmission and reflection spectra. Determination of the absorption spectra and of the optical band-gap. Swanepoel method.		3 hours, ref. 11

11.	Measurement of the spectral dependence of the photoconductivity. Determination of the carrier's life time.		3 hours, ref. 11
12.	Determination of the some interfaces (homo- and hetero-junctions) properties (I-V, C-V and photovoltaic characteristics)		3 hours, ref. 8

References

1. G. BORCIA, Symmetry of atomic systems – Study on the symmetry elements of molecular structures (Laboratory guideline for practical work ".pdf")
2. G. BORCIA, Infrared (IR) spectroscopy – Applications of IR spectroscopy in polymer characterization for various class of polymers (Laboratory guideline for practical work ".pdf")
3. G. BORCIA, X-ray photoelectron spectroscopy (XPS) – Applications of XPS in polymer characterization. Analysis of XPS spectra of complex polymer materials (Laboratory guideline for practical work ".pdf")
4. G. BORCIA, X-ray photoelectron spectroscopy (XPS) – Study on the surface chemical modification of polymer materials using XPS (Laboratory guideline for practical work ".pdf")
5. G. BORCIA, X-ray diffractometry (XRD) – Applications of XRD in polymer characterization. Study on the modification, by surface treatment, of the degree of crystallinity of a polymer, using XRD (Laboratory guideline for practical work ".pdf")
6. G. BORCIA, Contact angle measurement – Evaluation of the surface energy and surface energy components of polymer films (Laboratory guideline for practical work ".pdf")
7. A.S. GROVE, Fizica şi tehnologia dispozitivelor semiconductoare, Editura Tehnică, Bucureşti, 1973
8. G.G. RUSU, C. BABAN, M. RUSU, Materiale şi dispozitive semiconductoare, Editura Universităţii „Al.I.Cuza" Iaşi, 2002.
9. G. MATEESCU, Tehnologii avansate. Straturi subţiri depuse în vid, Editura Dorotea, Bucureşti, 1998.
10. P.E.J. FLEWITT, R.K.WILD, Physical Methods for Materials Characterization, Institute of Physics Publishing, Bristol and Philadephia, IOP Publishing Ltd. London, 1994.
11. T.S. MOSS, Optical Properties of Semiconductors, Butterworths Scientific Publications, London, 1959

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor profesionale şi angajatorilor reprezentativi din domeniul aferent programului

In a frame where polymers and semiconductors become ubiquitous materials in everyday life and also, in industry and technology, this course offers useful elements both from theoretical and applied point of view, allowing to obtain, identify and characterize these materials, required in precise applications. Particularly, plasma-processed polymers, in relation to their physical and chemical structure and their properties will be studied. Also, the obtaining and characterization of the semiconducting thin films and structures represent an important goal of the present course. In a broader context, this course also offers knowledge on topics related to materials science and technology.

10. Evaluare

Tip activitate	10.1 Criterii de evaluare	10.2 Metode de evaluare	10.3 Pondere în nota finală (%)
10.4 Curs	1. Presentation of a course subject 2. Solving an application related to data (graphs or tables) presented in the course 3. Presentation of an individual project (essay) on a topical issue in the field	Exam / on site / online	70%
10.5 Laborator	Laboratory portfolio (Reports on measured data, data analysis and extensive discussions, for the laboratory applications)	Laboratory portfolio / on site / online	30%

10.6 Standard minim de performanţă
Critical analysis on the methods and criteria used to select the correct solutions to attain specified performance in a given application Physical interpretation on the results of experimental measurements or theoretical calculations, using appropriate numerical or statistical methods Application of an algorithm for a medium complexity software application (data acquisition and analysis, physical phenomena models) Elaboration of an individual project by analysis of results presented in the literature

Data completării	Titular de curs	Titular de laborator
September 28, 2021	Prof. dr. habil. Gabriela BORCIA Conf. dr. George RUSU	Prof. dr. habil. Gabriela BORCIA Conf. dr. George RUSU

Data avizării în departament

Director de departament
Conf. dr. Iordana AȘTEFĂNOAEI

FIŞA DISCIPLINEI

2021-2022

1. Date despre program

1.1 Instituţia de învăţământ superior	**Universitatea “Alexandru Ioan Cuza” din Iaşi**
1.2 Facultatea	**Facultatea de Fizică**
1.3 Departamentul	**Fizică**
1.4 Domeniul de studii	**Fizică**
1.5 Ciclul de studii	**MASTER**
1.6 Programul de studii / Calificarea	**Physics for Advanced Technologies**

2. Date despre disciplină

2.1 Denumirea disciplinei			**Experimental methods for materials characterization**				
2.2 Titularul activităţilor de curs			**Conf. dr. Cristian-Ioan Baban**				
2.3 Titularul activităţilor de seminar			**Conf. dr. Cristian-Ioan Baban, CSII dr. Sorin Tașcu, CSIII dr. Marius Dobromir**				
2.4 An de studiu	**1**	**2.5** Semestru	**2**	**2.6** Tip de evaluare	**EVP**	**2.7** Regimul disciplinei*	**OB**

** OB – Obligatoriu / OP – Opţional*

3. Timpul total estimat (ore pe semestru şi activităţi didactice)

3.1 Număr de ore pe săptămână	**4**	din care: **3.2** curs	**2**	**3.3** seminar/laborator	**2**
3.4 Total ore din planul de învăţământ	**56**	din care: **3.5** curs	**28**	**3.6** seminar/laborator	**28**
Distribuţia fondului de timp					ore
Studiu după manual, suport de curs, bibliografie şi altele					**30**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**25**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**30**
Tutoriat					**4**
Examinări					**5**
Alte activităţi Proiect individual					**25**

3.7 Total ore studiu individual	**119**
3.8 Total ore pe semestru	**175**
3.9 Număr de credite	**7**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	Solid state physics, Quantum mechanics, Physics of atoms and molecules
4.2 De competenţe	- basics of proper use of laboratory and research instruments

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	Classroom equipped with: screen, projector, computer, internet
5.2 De desfăşurare a seminarului/ laboratorului	Laboratory room equipped with scientific equipment and related consumables, computer, internet

6. Competenţe specifice acumulate

Competenţe profesionale	- mastery of research methods and techniques, - language skills at academic level, in foreign languages, needed for scientific documentation; - use of communication and information technologies; - use the software for analyzing and processing experimental data and to perform virtual experiments; - understanding and ability to apply the principles and the values of the professional and research ethics.
Competenţe transversale	- capacity to teach Physics at secondary and post-secondary education levels; - opening to lifelong learning

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	- identification and proper use of laws, principles, notions and physical methods in various circumstances; - analysis and communication of Physics information with didactical, scientific and popularization character; - capacity of interrelationing and teamworking; - application of Physics knowledge to practical situations;
7.2 Obiectivele specifice	On successful completion of this subject, students will be able to: 1. Understanding of the data acquisition system; 2. Ability to analyze and design an virtual acquisition systems of different experimental devices; 3. Awareness of the typical problems in virtual instrumentation, according to the mainstream scientific literature of the last decade

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Introduction	Lectures	2 hours, Refs. 1,2
2.	X-ray diffraction technique. Neutron diffraction	Lectures	4 hours, Refs. 1-3
3.	Fundamentals of electron microscopy (SEM, TEM, Electron diffraction, STEM).	Lectures	6 hours, Refs 1-3
4.	Electron Probe Micro Analisys (EPMA) (EDS, WDS)	Lectures	2 hours, Refs 1-3
5.	Electron Energy-Loss Spectroscopy (EELS)	Lectures	1 hours, Refs 1-3
6.	Scanning tunneling microscopy and atomic force microscopy.	Lectures	4 hours, Refs 1-3
7.	Electron emission spectroscopies (XPS, AES, UPS).	Lectures	3 hours, Refs 1-3

8.	X-Ray Fluorescence (XRF)	Lectures	2 hours, Refs 1-3
9.	Ion scattering techniques and mass spectroscopy	Lectures	4 hours, Refs 1-3

Bibliografie

1. V. Pop, I. Chicinaş, N. Jumate, Fizica Materialelor: Metode experimentale, Presa Universitară Clujeană, 2001
2. P.E.J. Flewitt, R.K. Wild, Physical Methods for Materials Characterisation, Institute of Physics, Bristol and Philadelphia, 1994.
3. R.C. Brundle et al., Encyclopedia of materials characterization: surfaces, interfaces, thin films, London: Butterworth-Heinemann, 1992

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Introduction	Recap	2 hours, Refs 1-3
2.	Presentation on site of experimental equipments for materials characterization (SEM, XRD, XPS, XRF, AFM, IR, Raman)	Experiment	10 hours, Refs 1-3
3.	XRD pattern analysis	Problems solving, discussions, practical problems	3 hours, Refs 1-3
4.	Qualitative and quantitative analysis in XRD	Problems solving, discussions, practical problems	3 hours, Refs 1-3
5.	Interpretation of XPS spectra	Problems solving, discussions, practical problems	2 hours, Refs 1-3
6.	Ion scattering techniques	Problems solving, discussions, practical problems	2 hours, Refs 1-3
7.	Individual work for project elaboration and presentation	Problems solving, discussions, practical problems	4 hours, Refs 1-3
8.	Test	Problems solving	2 hours

References

1. V. Pop, I. Chicinaş, N. Jumate, Fizica Materialelor: Metode experimentale, Presa Universitară Clujeană, 2001
2. P.E.J. Flewitt, R.K. Wild, Physical Methods for Materials Characterisation, Institute of Physics, Bristol and Philadelphia, 1994.
3. R.C. Brundle et al., Encyclopedia of materials characterization :surfaces, interfaces, thin films London: Butterworth-Heinemann, 1992

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor profesionale şi angajatorilor reprezentativi din domeniul aferent programului

Course content is consistent with the experimental techniques for advanced characterization of materials, used in scientific and research laboratories in the country and abroad**.**

10. Evaluare

Tip activitate	10.1 Criterii de evaluare	10.2 Metode de evaluare	10.3 Pondere în nota finală (%)
10.4 Curs	active participation in the class activities	- Students will be required to attend at least 50% of the course and laboratory activities - Attendance over 50 %	10 % maximum 10%
10.5 Seminar/ Laborator	active participation to labs activities	Assignments reports Project - paper 20 %, - presentation 20 % Test (last week of the semester)	20 % 40 % - 20 % - 20 % 20 %
10.6 Standard minim de performanţă			
Developing a science project by identifying and using Physics knowledge to solve a practical situation;			

Data completării
29.09.2021

Titular de curs
Conf. Dr. Cristian Ioan BABAN

Titular de laborator
Conf. Dr. Cristian Ioan BABAN
CSIII dr. Marius DOBROMIR
CSII dr. Sorin TAȘCU

Data avizării în departament

Director de departament
Conf. Dr. Iordana Aștefănoaei

FIŞA DISCIPLINEI

1. Date despre program

1.1 Instituţia de învăţământ superior	**“Alexandru Ioan Cuza” of Iaşi University**
1.2 Facultatea	**Faculty of Physics**
1.3 Departamentul	**Physics**
1.4 Domeniul de studii	**Physics**
1.5 Ciclul de studii	**Master**
1.6 Programul de studii / Calificarea	**Physics for Advanced Technologies**

2. Date despre disciplină

2.1 Denumirea disciplinei	**Design of computer algorithms**						
2.2 Titularul activităţilor de curs	**Assoc. Prof. Vasile Ţura**						
2.3 Titularul activităţilor de seminar	**Assoc. Prof. Vasile Ţura**						
2.4 An de studiu	**2**	**2.5** Semestru	**2**	**2.6** Tip de evaluare	**E**	**2.7** Regimul disciplinei*	**OP**

** OB – Obligatoriu / OP – Opţional*

3. Timpul total estimat (ore pe semestru şi activităţi didactice)

3.1 Număr de ore pe săptămână	**4**	din care: **3.2** curs	**2**	**3.3** seminar/laborator	**2**
3.4 Total ore din planul de învăţământ	**56**	din care: **3.5** curs	**28**	**3.6** seminar/laborator	**28**
Distribuţia fondului de timp					ore
Studiu după manual, suport de curs, bibliografie şi altele					
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**40**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**30**
Tutoriat					**14**
Examinări					**6**
Alte activităţi					**4**

3.7 Total ore studiu individual	**94**
3.8 Total ore pe semestru	**150**
3.9 Număr de credite	**6**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	Programming in C++, Algebra, Calculus
4.2 De competenţe	Set operations, equivalence relations, mathematical induction, the division algorithm, functions.

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	
5.2 De desfăşurare a seminarului/ laboratorului	

6. Competenţe specifice acumulate

Competenţe profesionale	**C1.** Identify the use of the basic IT notions (algorithms, programming languages, software specific, numerical modeling) to study physics. **C2.** Explain the specific steps required to develop algorithms for solving problems of medium difficulty. **C3.** Development of medium-complexity algorithms for automation of processes, acquisition, processing and interpretation of data. **C4.** Appropriate use in professional communication of universal programming languages, database or web type programming structures. **C5.** Appropriate use of standard assessment criteria and methods for assessing complex problem solving, well-defined in the area of computer applications, the management of databases and problems in theoretical and applied physics. **C6.** Development of a project including problem identification and analysis, designing, developing and demonstrating an understanding of high-level programming languages.
Competenţe transversale	**C1.** Exercise of professional duties in an efficient and responsible ethics specific to compliance under qualified assistance. **C2.** Applying the techniques of effective multidisciplinary team working on various hierarchical levels. **C3.** The effective use information sources and communication resources and training assistance, both in Romanian and in languages for international Communicationan.

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	The course aims to develop the formal thinking abilities needed for algorithm analysis and the practical skills for algorithm selection, design and implementation in real-world problem solving.
7.2 Obiectivele specifice	On successful completion of this subject, students will be able to: ▪ Explain the algorithm design paradigms divide and conquer, greedy algorithms, randomization and dynamic programming. ▪ Describe the basic set of core algorithms. ▪ Utilize asymptotic notation, recurrences, proof by induction, proof by contradiction, data structures like lists, trees, graphs, heaps, balanced trees and hash tables. ▪ Analyse the complexity of some typical problems (lower bounds and intractability). ▪ Apply some of the above techniques in real-world problems solving.

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Computing preliminaries: data structures and algorithms in C++.	Lecture	2
2.	Mathematical preliminaries: sets, logarithms, recurrences, mathematical induction, proofing techniques.	Lecture	2
3.	Fundamental data structures and algorithms.	Lecture	2

4.	Non-binary trees.	Lecture	2
5.	Internal sorting.	Lecture	2
6.	External sorting.	Lecture	2
7.	Searching.	Lecture	2
8.	Indexing.	Lecture	2
9.	Graphs.	Lecture	2
10.	Dynamic programming.	Lecture	2
11.	Analysis techniques of algorithms I. Summation, recurrence and amortized analysis.	Lecture	2
12.	Analysis techniques of algorithms II. Lower bounds.	Lecture	2
13.	Numerical algorithms.	Lecture	2
14.	NP-Completeness. Impossible problems.	Lecture	2

Bibliografie

Referinţe principale:
Thomas H. Cormen, Charles E. Leiserson, Ronald R. Rivest, *Introducere în Algoritmi*, Editura Computer Libris Agora, Cluj, 2000, ISBN 973-97534-7-7.

Referinţe suplimentare:
Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, Third Edition, The MIT Press, Cambridge, Massachusetts, USA, 2009, ISBN 978-0-262-53305-8.

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Mathematical proof techniques.	Seminar	2
2.	Calculation of the running time for a program.	Seminar	2
3.	Implementation of lists, stacks and queues.	Laboratory	2
4.	Binary tree node implementations.	Laboratory	2
5.	General tree implementations.	Laboratory	2
6.	Comparison of internal sorting algorithms.	Seminar & Laboratory	2
7.	File processing and external sorting.	Seminar & Laboratory	2

8.	Minimum-cost spanning trees. Prim's and Kruskal's algorithms.	Seminar & Laboratory	2
9.	Memory management. Dynamic storage allocation.	Seminar & Laboratory	2
10.	Balanced trees.	Seminar & Laboratory	2
11.	Divide and conquer recurrences. Amortized analysis.	Seminar & Laboratory	2
12.	Lower bounds proofs – optimal sorting.	Seminar & Laboratory	2
13.	Dynamic programming, the Knapsack problem.	Seminar & Laboratory	2
14.	Numerical algorithms – the Fast Fourier Transform.	Seminar & Laboratory	2

Bibliografie

1. Thomas H. Cormen, Clara Lee, Erica Lin, *Introduction to Algorithms Second Edition – Instructor's Manual*, The Massachusetts Institute of Technology and The McGraw-Hill Companies, NY 10020, USA, 2002, ISBN 9781495319280.
2. Philip Bille, Solutions for Introduction to Algorithms Second Edition (http://www2.compute.dtu.dk/~phbi/files/teaching/solution.pdf)

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor profesionale şi angajatorilor reprezentativi din domeniul aferent programului

Analysis and design of algorithms are compulsory components of computer programming education, required by all employers.

10. Evaluare

Tip activitate	**10.1 Criterii de evaluare**	**10.2 Metode de evaluare**	**10.3 Pondere în nota finală (%)**
10.4 Curs	Attendance		30
10.5 Seminar/ Laborator	Attendance and practical activity (lab. exercices).	Problem solving and homeworks.	70
10.6 Standard minim de performanţă			
All laboratory problems solved is a minimum. Every homework solved is a plus.			

Data completării
24.09.2020

Titular de curs
Assoc. Prof. Vasile Țura

Titular de seminar
Assoc. Prof. Vasile Țura

Data avizării în departament

Director de departament