FIŞA DISCIPLINEI

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	**DEPARTAMENTUL DE FIZICA**
1.4 Domeniul de studii	**Fizică**
1.5 Ciclul de studii	**Masterat**
1.6 Programul de studii / Calificarea	**Fizică pentru tehnologii avansate/ Physics for advanced technologies**

2. Date despre disciplină

2.1 Denumirea disciplinei			Fizica Materialelor I (dielectrici, materiale magnetice)				
2.2 Titularul activităţilor de curs			Prof. Dr. LILIANA MITOSERIU/ Conf. Dr. IOAN DUMITRU				
2.3 Titularul activităţilor de seminar			Conf. Dr. LAVINIA PETRONELA CURECHERIU/ Conf. Dr. IOAN DUMITRU				
2.4 An de studiu	I	**2.5** Semestrul	I	**2.6** Tip de evaluare*	E	**2.7** Regimul disciplinei**	Ob

**E – Examen / C – Colocviu / V – Verificare*

***OB – Obligatoriu / OP – Opţional / F – Facultativ*

3. Timpul total estimat (ore pe semestru si activitati didactice)

3.1 Număr de ore pe săptămână	6	**3.2** curs	3	**3.3** seminar/laborator	3
3.4 Total ore din planul de învăţământ	84	**3.5** curs	42	**3.6** seminar/laborator	42

Distribuţia fondului de timp	ore
Studiu după manual, suport de curs, bibliografie şi altele	50
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren	40
Pregătire seminare/laboratoare, teme, referate, portofolii şi eseuri	35
Tutoriat	15
Examinări	4
Alte activităţi	0

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

4. Precondiţii - De curriculum (dacă este cazul)

Electricity and Magnetism, Solid State Physics
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. Obiective

Understanding the electrical and magnetic properties of substances and their correlation with chemical and phase composition and with micro/nanostructural characteristics
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.

7. Competenţe/Rezultate ale învăţării

- identificarea şi utilizarea adecvată a legilor, principiilor, noţiunilor şi metodelor fizice în diverse contexte;
- stăpânirea metodelor şi tehnicilor de cercetare specifice specializării Fizică pentru Tehnologii Avansate;
- utilizarea de pachete software pentru analiza şi prelucrarea datelor experimentale şi pentru efectuarea de experimente virtuale;

8. Conţinut

8.1 Curs	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
Eqs. describing the electric field in materials. Dipole, multipole. General properties of dielectrics, classifications.	Lecture, Power Point presentation	2h
Polarization. Fundamental eq. of dielectrics. Applications: dielectric plan, sphere. Local fields (Lorentz, Onsager)	Lecture, Power Point presentation. Case study	2h
Electrostatic forces and energies in substances.	Lecture, Power Point presentation	2h
Induced polarisation. Field-dependence of polarisation and susceptibility in non-polar substances.	Lecture, Power Point presentation	2h
Orientation polarisation. Field-dependence of polarisation and susceptibility in polar substances.	Lecture, Power Point presentation	2h
Dielectric relaxation, emipiral laws. Debye relaxation. Microscopical mechanisms.	Lecture, Power Point presentation. Case study	2h
Impedance spectroscopy: principles, methods, applications to determine broadband dielectric properties.	Lecture, Power Point presentation. Case study	2h
Fundamental laws of magnetism in substances. Origin of magnetic properties.	Magistral lecture. Case study	2h
Diamagetism, paramagnetism, ferromagnetism: phenomenological aspects. Hysteresis loop; permeability and magnetic susceptibility.	Lecture. Debates. Case study	2h
Magnetization of substances in ac fields. Magnetic interactions. Temperature-induced modification of magnetisation curves. Curie temperature.	Lecture. Debates. Case study	2h
Nature of magnetic moments in ferromagnetic solids. Weiss model. Other theoreis for polarisable media. Theory of magnetisation curves.	Lecture. Computer-aided learning.	2h
Soft magnetic materials. Hard magnetic materials.	Lecture. Debates. Case study	2h
Nanostructured magnetic materials. Thin film magnetic materials.	Magistral lecture	2h

8.1 Curs	Metode de predare	Observaţii (ore şi referinţe bibliografice)
Applications of magnetic materials. Recording/storage media.	Lecture. Case study. Brainstorming	2h

Bibliografie
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

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

Bibliografie
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. Chicinaş, N. Jumate, (2001) Editura Presa Universitară Clujeană O. Calţun editor, Ferite de cobalt magnetostrictive (2009) Editura Universităţii Alexandru Ioan Cuza Iaşi

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

10.1 Evaluare continuă		Pondere (min. 30%)		50
Curs	Forma de evaluare			Verificare scrisă
	Pondere			50
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale			Nu
	Metode de evaluare	Detalii	Pondere	cu reexaminare
		Verificare scrisă periodică	100	Nu
Seminar / Laborator	Forma de evaluare			Verificare scrisă
	Pondere			50
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale			Nu
	Metode de evaluare	Detalii	Pondere	cu reexaminare
		Verificare scrisă periodică	100	Nu

10.2 Evaluare finală	Pondere (max. 70%)	50
	Forma de evaluare	Verificare scrisă finală

10.3 Menţiuni (situaţii speciale în evaluare)	

10.4 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,

Titular de curs,
Prof. Dr. LILIANA MITOSERIU/ Conf. Dr. IOAN DUMITRU

Titular de seminar,
Conf. Dr. LAVINIA PETRONELA CURECHERIU/ Conf. Dr. IOAN DUMITRU

Data avizării în departament,

Director de departament,
Conf. Dr. IORDANA ASTEFANOAEI

FIŞA DISCIPLINEI

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	**DEPARTAMENTUL DE FIZICA**
1.4 Domeniul de studii	**Fizică**
1.5 Ciclul de studii	**Masterat**
1.6 Programul de studii / Calificarea	**Fizică pentru tehnologii avansate/ Physics for advanced technologies**

2. Date despre disciplină

2.1 Denumirea disciplinei			Modelarea proceselor fizice				
2.2 Titularul activităţilor de curs			Prof. Dr. LAURENTIU STOLERIU				
2.3 Titularul activităţilor de seminar			Prof. Dr. LAURENTIU STOLERIU				
2.4 An de studiu	I	**2.5** Semestrul	I	**2.6** Tip de evaluare*	E	**2.7** Regimul disciplinei**	Ob

E – Examen / C – Colocviu / V – Verificare

***OB – Obligatoriu / OP – Opţional / F – Facultativ*

3. Timpul total estimat (ore pe semestru si activitati didactice)

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

Distribuţia fondului de timp	ore
Studiu după manual, suport de curs, bibliografie şi altele	36
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren	36
Pregătire seminare/laboratoare, teme, referate, portofolii şi eseuri	36
Tutoriat	8
Examinări	3
Alte activităţi	0

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

4. Precondiţii - De curriculum (dacă este cazul)

Undergraduate course in programming languages (C or Python)

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	Room with access to internet, videoprojector and projection screen. Individual access to computers for students.
5.2 De desfăşurare a seminarului/ laboratorului	Room with access to internet, videoprojector and projection screen. Individual access to computers for students.

6. Obiective

- Identification and proper use of laws, principles, notions and physical methods in various circumstances;
- Analysis and communication of Physics information
- Application of Physics knowledge to practical situations;
- Opening to lifelong learning.

7. Competenţe/Rezultate ale învăţării

- identificarea şi utilizarea adecvată a legilor, principiilor, noţiunilor şi metodelor fizice în diverse contexte;
- analiza şi comunicarea informaţiilor cu caracter didactic, ştiinţific şi de popularizare din domeniul Fizicii;
- stăpânirea metodelor şi tehnicilor de cercetare specifice specializării Fizică pentru Tehnologii Avansate;
- utilizarea de pachete software pentru analiza şi prelucrarea datelor experimentale şi pentru efectuarea de experimente virtuale;

8. Conţinut

8.1 Curs	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
Generalities. Systems, models and simulations. Errors in numerical calculus: the machine constant and the floating point round-off error.	Lecture, exemplification	4 ore
Maple/Maxima programming platform and Python languages: how are they comparing to other programming environments, advantages and disadvantages.	Lecture, exemplification	4 ore
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
Finding the trajectory of a body in gravitational field – wind effect (numerically solving the equation of motion). Movement in central force field.	Lecture, exemplification	2 ore
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
Advanced computing of field lines - plotting electric field lines for an arbitrary number of electric charges. Paraview	Lecture, exemplification	4 ore
Harmonic oscillator. Different ways of approaching animations in Maple/Maxima.	Lecture, exemplification	2 ore
Solution of a practical work problem. Lissajous curves. More advanced programming in Maple/Maxima – plotting the resonance curve	Lecture, exemplification	2 ore
Nonlinear systems: the double pendulum. Random vs. chaotic vs. deterministic.	Lecture, exemplification	2 ore
Analyzing chaos: Lyapunov exponents, phase portraits, Poincare sections.	Lecture, exemplification	4 ore

Bibliografie
https://stoner.phys.uaic.ro/moodle/ L. Stoleriu, A. Stancu, Introducere in modelarea si simularea proceselor fizice, Ed. Tehnopress, 2007. F. Wang, Physics with MAPLE, Wiley-VCH, 2005. W. Press et al, “Numerical Recipes”, Cambridge University Press, 1992 Burden R. et al, “Numerical analysis”, PWS-KENT Publishing Company, Boston, 1985. G.L. Baker, J.P.Gollub, “Chaotic dynamics. An introduction”, Cambridge University Press, 1990.

8.2 Seminar / Laborator	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
Errors in numerical calculus.	Problem solving	2 ore
Basic elements of Maple. Differences when comparing Maple with a classical programming languages like Python. Advantages. Disadvantages.	Problem solving	4 ore
Physical fields. Visualization.	Problem solving	4 ore
Practical work - evaluation	Problem solving	2 ore
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
Numerical study of chaotic systems. Chaotic vs. random.	Problem solving	6 ore

Bibliografie
https://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

10.1 Evaluare continuă		Pondere (min. 30%)	50	
Curs	Forma de evaluare			
	Pondere		0	
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale			
	Metode de evaluare	Detalii	Pondere	cu reexaminare
Seminar / Laborator	Forma de evaluare		Verificare practică	
	Pondere		100	
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale		Da	
	Metode de evaluare	Detalii	Pondere	cu reexaminare
		Verificare practică periodică	50	Nu
		Portofoliu	50	Da

10.2 Evaluare finală	Pondere (max. 70%)	50
	Forma de evaluare	Verificare practică finală

10.3 Menţiuni (situaţii speciale în evaluare)	

10.4 Standard minim de performanţă
Identifying and using basic IT notion, comparing data from numerical models 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, **Titular de curs,** **Titular de seminar,**
Prof. Dr. LAURENTIU STOLERIU **Prof. Dr. LAURENTIU STOLERIU**

Data avizării în departament, **Director de departament,**
Conf. Dr. IORDANA ASTEFANOAEI

FIŞA DISCIPLINEI

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	**DEPARTAMENTUL DE FIZICA**
1.4 Domeniul de studii	**Fizică**
1.5 Ciclul de studii	**Masterat**
1.6 Programul de studii / Calificarea	**Fizică pentru tehnologii avansate/ Physics for advanced technologies**

2. Date despre disciplină

2.1 Denumirea disciplinei			Tehnici de preparare si caracterizare a materialelor				
2.2 Titularul activităţilor de curs			Conf. Dr. CRISTIAN IOAN BABAN/ Lect. Dr. IOANA LAURA VELICU				
2.3 Titularul activităţilor de seminar			Conf. Dr. CRISTIAN IOAN BABAN/ Lect. Dr. IOANA LAURA VELICU/ Specialist Dr. MIHAI-ALEXANDRU CIOLAN/ Specialist Dr. MARIUS DOBROMIR				
2.4 An de studiu	I	**2.5** Semestrul	II	**2.6** Tip de evaluare*	V	**2.7** Regimul disciplinei**	Ob

**E – Examen / C – Colocviu / V – Verificare*

***OB – Obligatoriu / OP – Opţional / F – Facultativ*

3. Timpul total estimat (ore pe semestru si activitati didactice)

3.1 Număr de ore pe săptămână	4	**3.2** curs	2	**3.3** seminar/laborator	2
3.4 Total ore din planul de învăţământ	56	**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 seminare/laboratoare, teme, referate, portofolii şi eseuri	30
Tutoriat	4
Examinări	5
Alte activităţi	25

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

4. Precondiţii - De curriculum (dacă este cazul)

Solid state physics, Quantum mechanics, Physics of atoms and molecules

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. Obiective

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;

On successful completion of this subject, students will be able to:
• show a basic knowledge of materials characterization methods based on microscopy, chemical, physical and structure analysis;
• show a good understanding of the capabilities and limitations of different types of analysis introduced in the course;
• have an ability to recommend appropriate methods for particular material problems;
• apply the principles and knowledge obtained to put forward individually a work plan in solving a particular problem;
• explain the data obtained and the phenomena exhibited in the materials analysis;
• show an ability to present and discuss project work in an oral performance and a written report;
• identify a need for further knowledge and be capable of further self-learning in the relevant fields.

7. Competenţe/Rezultate ale învăţării

- identificarea şi utilizarea adecvată a legilor, principiilor, noţiunilor şi metodelor fizice în diverse contexte;
- analiza şi comunicarea informaţiilor cu caracter didactic, ştiinţific şi de popularizare din domeniul Fizicii
- stăpânirea metodelor şi tehnicilor de cercetare specifice specializării Fizică pentru Tehnologii Avansate
- utilizarea de pachete software pentru analiza şi prelucrarea datelor experimentale şi pentru efectuarea de experimente virtuale

8. Conţinut

8.1 Curs	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
An overview of techniques for materials preparation in different shapes	Lecture	1 hour, Refs 1-5
Magnetron sputtering – fundamentals, parameters, magnetic balance degree, direct-current (dc), radio-frequency (rf)	Lecture	3 hours, Refs 1-2
High power impulse magnetron sputtering – ultra short pulses, additional magnetic field, reactive, bipolar	Lecture	3 hours, Ref 3
Pulsed laser deposition	Lecture	1 hour, Ref 4
Thermionic vacuum arc (TVA)	Lecture	2 hours, Refs 1-2
Spin coating	Lecture	2 hours, Ref 5
Chemical methods	Lecture	2 hours, Ref 6
Characterization methods.Introduction	Lecture	1 hours, Refs. 7,8
X-ray diffraction technique (XRD)	Lecture	3 hours, Refs. 7-9
Fundamentals of electron microscopy (SEM, TEM, Electron diffraction, STEM Electron Probe Micro Analisys (EPMA) , EDS, WDS, Electron Energy-Loss Spectroscopy (EELS)).	Lecture	3 hours, Refs 7-9
Scanning tunneling microscopy and atomic force microscopy.	Lecture	3 hours, Refs 7-9

8.1 Curs	Metode de predare	Observaţii (ore şi referinţe bibliografice)
Electron emission spectroscopies (XPS, AES, UPS).	Lecture	2 hours, Refs 7-9
X-Ray Fluorescence (XRF)	Lecture	1 hours, Refs 7-9
Ion scattering techniques and mass spectroscopy	Lecture	1 hours, Refs 7-9

Bibliografie

1. Peter M. Martin, Handbook of Deposition Technologies for Films and Coatings, William Andrew, 3rd edition, 2009;
2. Donald M. Mattox, Physical Vapor Deposition of Thin Films, William Andrew, 1998;
3. D. Lundin, K. Sarakinos, An Introduction to Thin Film Processing Using High-Power Impulse Magnetron Sputtering, Journal of Materials Science 27 (2012) 780-792;
4. Robert Eason, Pulsed Laser Deposition of Thin Films: Applications-Led Growth of Functional Materials, John Wiley & Sons, 2006;
5. Stephan F. Kistler, Peter M. Schweizer, Liquid Film Coating: Scientific principles and their technological implications, Springer, 2012;
6. Theodor Schneller, Rainer Waser, Marija Kosec, David Payne, Chemical Solution Deposition of Functional Oxide Thin Films, Springer Science & Business Media, 2014;
7. V. Pop, I. Chicinaş, N. Jumate, Fizica Materialelor: Metode experimentale, Presa Universitară Clujeană, 2001;
8. P.E.J. Flewitt, R.K. Wild, Physical Methods for Materials Characterisation, Institute of Physics, Bristol and Philadelphia, 1994;
9. 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)
Introduction	Recap	1 hour, Refs 1-6
Presentation of on-site equipment used for materials preparation (Magnetron sputtering, TVA, PLD, Spin coater)	Experiment, discussion	2 hours, Refs 1-4
Deposition of thin films using DC magentron sputtering (variation of deposition parameters)	Experiment, discussion	2 hours, Refs 1-2
Deposition of thin films using HiPIMS (variation of deposition parameters)	Experiment, discussion	3 hour, Ref 3
Deposition of thin films using TVA (variation of deposition parameters)	Experiment, discussion	2 hours, Refs 1-2
Deposition of thin films using PLD & Spin coater (variation of deposition parameters)	Experiment, discussion	2 hours, Refs 4-5
Test	Problems solving	2 hours
Characterization methods. Introduction	Recap	2 hours, Refs 7-9
Presentation on site of experimental equipments for materials characterization (XRD,SEM, XPS)	Experiment, discussion	6 hours, Refs 7-9
XRD patterns from crystal structure analysis	Experiment, discussion	2 hours, Refs 7-9
Qualitative and quantitative analysis in XRD	Experiment, discussion	2 hours, Refs 7-9
Interpretation of XPS spectra	Experiment, discussion	2 hours, Refs 7-9
Individual work for project elaboration and presentation	Experiment, discussion	2 hours, Refs 7-9
Test	Problems solving	2 hours

Bibliografie

1. Peter M. Martin, Handbook of Deposition Technologies for Films and Coatings, William Andrew, 3rd edition, 2009;
2. Donald M. Mattox, Physical Vapor Deposition of Thin Films, William Andrew, 1998;
3. D. Lundin, K. Sarakinos, An Introduction to Thin Film Processing Using High-Power Impulse Magnetron Sputtering, Journal of Materials Science 27 (2012) 780-792;
4. Robert Eason, Pulsed Laser Deposition of Thin Films: Applications-Led Growth of Functional Materials, John Wiley & Sons, 2006;
5. Stephan F. Kistler, Peter M. Schweizer, Liquid Film Coating: Scientific principles and their technological implications, Springer, 2012;
6. Theodor Schneller, Rainer Waser, Marija Kosec, David Payne, Chemical Solution Deposition of Functional Oxide Thin Films, Springer Science & Business Media, 2014;
7. V. Pop, I. Chicinaş, N. Jumate, Fizica Materialelor: Metode experimentale, Presa Universitară Clujeană, 2001;
8. P.E.J. Flewitt, R.K. Wild, Physical Methods for Materials Characterisation, Institute of Physics, Bristol and Philadelphia, 1994;
9. 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

10.1 Evaluare continuă		Pondere (min. 30%)		100
Curs	Forma de evaluare			Verificare orală
	Pondere			20
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale			Da
	Metode de evaluare	Detalii	Pondere	cu reexaminare
		Verificare orală periodică	50	Da
		Studiu de caz	50	Da
Seminar / Laborator	Forma de evaluare			Verificare mixtă
	Pondere			80
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale			Da
	Metode de evaluare	Detalii	Pondere	cu reexaminare
		Proiect	60	Nu
		Test	20	Da
		Referat	20	Nu

10.2 Menţiuni (situaţii speciale în evaluare)	

10.3 Standard minim de performanţă
Developing a science project by identifying and using Physics knowledge to solve a practical situation;

Data completării,

Titular de curs,
Conf. Dr. CRISTIAN IOAN BABAN/ Lect. Dr. IOANA LAURA VELICU

Titular de seminar,
Conf. Dr. CRISTIAN IOAN BABAN/ Lect. Dr. IOANA LAURA VELICU/ Specialist Dr. MIHAI-ALEXANDRU CIOLAN/ Specialist Dr. MARIUS DOBROMIR

Data avizării în departament,

Director de departament,
Conf. Dr. IORDANA ASTEFANOAEI

FIŞA DISCIPLINEI

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	**DEPARTAMENTUL DE FIZICA**
1.4 Domeniul de studii	**Fizică**
1.5 Ciclul de studii	**Masterat**
1.6 Programul de studii / Calificarea	**Fizică pentru tehnologii avansate/ Physics for advanced technologies**

2. Date despre disciplină

2.1 Denumirea disciplinei			Capitole speciale de fizică cuantică				
2.2 Titularul activităţilor de curs			Prof. Dr. MARINA AURA DARIESCU				
2.3 Titularul activităţilor de seminar			Prof. Dr. MARINA AURA DARIESCU				
2.4 An de studiu	I	**2.5** Semestrul	II	**2.6** Tip de evaluare*	E	**2.7** Regimul disciplinei**	Ob

**E – Examen / C – Colocviu / V – Verificare*

***OB – Obligatoriu / OP – Opţional / F – Facultativ*

3. Timpul total estimat (ore pe semestru si activitati didactice)

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

Distribuţia fondului de timp	ore
Studiu după manual, suport de curs, bibliografie şi altele	48
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren	38
Pregătire seminare/laboratoare, teme, referate, portofolii şi eseuri	38
Tutoriat	0
Examinări	18
Alte activităţi	2

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

4. Precondiţii - De curriculum (dacă este cazul)

Quantum Physics, Statistical Physics, Solid State Physics, Mathematical Physics Equations, Algebra

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	Blackboard, Overhead projector, computers
5.2 De desfăşurare a seminarului/ laboratorului	Blackboard, Overhead projector, computers

6. Obiective

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. Competenţe/Rezultate ale învăţării

8. Conţinut

8.1 Curs	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
Schrodinger's Equation for various potentials.	Lecture, debate, guiding discovering process	2
Potential wells.	Lecture, debate, guiding discovering process	2
Potential barriers, quantum tunneling	Lecture, debate, guiding discovering process	2
The Quantum Hall Effect	Lecture, debate, guiding discovering process	2
Perturbation theory: First order perturbation theory Second order perturbation theory. The degenerate case	Lecture, debate, guiding discovering process	2
Time-dependent perturbation theory. Transition probabilities	Lecture, debate, guiding discovering process	2
Scattering Theory: Cross sections.	Lecture, debate, guiding discovering process	2
Many-Particle Systems	Lecture, debate, guiding discovering process	2
Born-Oppenheimer approximation,	Lecture, debate, guiding discovering process	2
Quantum Statistics: Fermi-Dirac and Bose-Einstein	Lecture, debate, guiding discovering process	2
Heat capacities	Lecture, debate, guiding discovering process	2
Relativistic quantum mechanics. The Klein-Gordon Equation	Lecture, debate, guiding discovering process	2
Relativistic quantum mechanics. The Dirac Equation	Lecture, debate, guiding discovering process	4

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)
Applications to Schrodinger equation: Cold fusion, tunnel diode, tunneling microscop	Applications, guiding discovering process	4
Significant models of potential wells and barriers	Applications, guiding discovering process	2
Periodic potentials, energy bands.	Applications, guiding discovering process	2
Scattering of quantum particles from different potentials	Applications, guiding discovering process	2
Perturbation Theory. Applications	Applications, guiding discovering process	4
Charged particles in electric and magnetic fields	Applications, guiding discovering process	2
Applications of Quantum Statistics	Applications, guiding discovering process	2
Bose-Einstein condensate	Applications, guiding discovering process	2
Low temperature behavior of fermions	Applications, guiding discovering process	2
Relativistic particles. A brief review of theory of relativity. The Klein-Gordon equation. Applications	Applications, guiding discovering process	2
The Dirac equation. Electron in the electromagnetic field	Applications, guiding discovering process	4

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

10.1 Evaluare continuă	Pondere (min. 30%)	50

Curs	Forma de evaluare			
	Pondere		0	
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale		Nu	
	Metode de evaluare	Detalii	Pondere	cu reexaminare
			0	
			0	
Seminar / Laborator	Forma de evaluare		Verificare orală	
	Pondere		100	
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale		Nu	
	Metode de evaluare	Detalii	Pondere	cu reexaminare
		Referat	50	Nu
		Verificare orală periodică	50	Nu

10.2 Evaluare finală	Pondere (max. 70%)	50
	Forma de evaluare	Verificare scrisă finală

10.3 Menţiuni (situaţii speciale în evaluare)	

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

Data completării, **Titular de curs,** **Titular de seminar,**
Prof. Dr. MARINA AURA DARIESCU **Prof. Dr. MARINA AURA DARIESCU**

Data avizării în departament, **Director de departament,**
Conf. Dr. IORDANA ASTEFANOAEI

FIŞA DISCIPLINEI

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	**DEPARTAMENTUL DE FIZICA**
1.4 Domeniul de studii	**Fizică**
1.5 Ciclul de studii	**Masterat**
1.6 Programul de studii / Calificarea	**Fizică pentru tehnologii avansate/ Physics for advanced technologies**

2. Date despre disciplină

2.1 Denumirea disciplinei			Fizica Materialelor II (semiconductori, polimeri)				
2.2 Titularul activităţilor de curs			Prof. Dr. GABRIELA BORCIA/ Conf. Dr. CRISTIAN IOAN BABAN				
2.3 Titularul activităţilor de seminar			Prof. Dr. GABRIELA BORCIA/ Conf. Dr. CRISTIAN IOAN BABAN/ Specialist Dr. LAURA HROSTEA				
2.4 An de studiu	I	**2.5** Semestrul	II	**2.6** Tip de evaluare*	E	**2.7** Regimul disciplinei**	Ob

E – Examen / C – Colocviu / V – Verificare

***OB – Obligatoriu / OP – Opţional / F – Facultativ*

3. Timpul total estimat (ore pe semestru si activitati didactice)

3.1 Număr de ore pe săptămână	6	**3.2** curs	3	**3.3** seminar/laborator	3
3.4 Total ore din planul de învăţământ	84	**3.5** curs	42	**3.6** seminar/laborator	42
Distribuţia fondului de timp					ore
Studiu după manual, suport de curs, bibliografie şi altele					35
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					30
Pregătire seminare/laboratoare, teme, referate, portofolii şi eseuri					35
Tutoriat					10
Examinări					6
Alte activităţi					0

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

4. Precondiţii - De curriculum (dacă este cazul)

General Physics knowledge - undergraduate level Experimental skills

5. Condiţii (dacă este cazul)

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

6. Obiective

1. Accurate identification and application of physical concepts, laws, and principles related to polymer materials, semiconductors, and semiconductor structures, within a given context, and the ability to apply this knowledge in practice.
2. Ability to work effectively in a team to solve experimental and technological problems, demonstrating determination and perseverance in completing tasks and fulfilling responsibilities.
3. Interpretation of information related to polymer materials, semiconductors, and semiconductor structures, and its communication in a coherent and accessible manner.
4. IIdentification and use of bibliographical resources for continuous learning, education, and professional development.

Upon successful completion of this course, students will be able to:
- Identify and appropriately apply the fundamental laws and physical principles related to polymer materials, semiconductors, and semiconductor structures within a given context.
- Explain the characteristics of polymer materials and semiconductors required for specific applications and their relationship to material structure.
- Explain the appropriate methods for analyzing a material in relation to its intended application.
- Use laboratory equipment effectively to examine and characterize materials.
- Analyze and discuss experimental or numerical modeling data and prepare a report on the material characteristics.

7. Competenţe/Rezultate ale învăţării

- identificarea şi utilizarea adecvată a legilor, principiilor, noţiunilor şi metodelor fizice în diverse contexte;
- analiza şi comunicarea informaţiilor cu caracter didactic, ştiinţific şi de popularizare din domeniul Fizicii;
- stăpânirea metodelor şi tehnicilor de cercetare specifice specializării Fizică pentru Tehnologii Avansate;
- utilizarea de pachete software pentru analiza şi prelucrarea datelor experimentale şi pentru efectuarea de experimente virtuale;
- identificarea şi utilizarea adecvată a legilor, principiilor, noţiunilor şi metodelor fizice în diverse contexte

8. Conţinut

8.1 Curs	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
Characterization techniques for polymer materials - Surface energy analysis, Infrared spectroscopy (IR), X-ray photoelectron spectroscopy (XPS), X-ray difraction (XRD)	Lectures, media presentations, interactive discussions, real-world applications	4 hours [1, 2, 13]
Overview of polymers - Definitions, molecular mass, nomenclature, classification criteria	Lectures, media presentations, interactive discussions, real-world applications	3 hours [1, 14, 15]
Molecular interactions - Primary and secondary bonds, van der Waals bonds, hydrogen bond, cohesive energy	Lectures, media presentations, interactive discussions, real-world applications	2 hours [1, 15]
Physical states in polymers - Physical states and state transitions, transition temperatures, study of polymer physical states, amorphous and amorphous-crystalline polymers	Lectures, media presentations, interactive discussions, real-world applications	4 hours [1, 15]
Physical properties of polymers - Mechanical properties, Thermal properties, Electrical properties, Optical properties	Lectures, media presentations, interactive discussions, real-world applications	6 hours [1, 3, 4, 15]
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	Lectures, media presentations, interactive discussions, real-world applications	2 hours [1, 3, 4]

8.1 Curs	Metode de predare	Observaţii (ore şi referinţe bibliografice)
Basic properties of semiconductors. Energy bands in semiconductors.	Lecture, media presentation	3 hours [5-7]
Nearly free electrons approximation, tight-binding model, kp method.	Lecture, media presentation	3 hours [5-7]
Impurity states in semiconductors	Lecture, media presentation, practical applications	3 hours [6-8]
Charge carrier statistics. Intrinsic and extrinsic cases.	Lecture, media presentation	3 hours [6, 7, 9, 10]
Non-equilibrium charge carriers. Generation and recombination processes. Continuity equations. Particular cases.	Lecture, media presentation	3 hours [6, 7, 9, 10]
Transport phenomena. Electrical conduction in semiconductors.	Lecture, media presentation, applications	3 hours [5-7, 11]
Optical and photoelectrical phenomena in semiconductors.	Lecture, media presentation, applications	3 hours [5-7, 9, 11]
Surface phenomena.Semiconductor interfaces. Surface and interface phenomena	Lecture, media presentation, applications	3 hours [8, 12]

Bibliografie

Principal references:
1. G. Borcia, Physics of polymers - Course notes (electronic format), 2025
2. G. Borcia, Physics of polymers - Practical applications (electronic format), 2025
3. Materials Today, , Elsevier B.V. journal, 2019 - to date, http://www.sciencedirect.com/science/journal/13697021 - Open Access
4. Progress in Polymer Science, Elsevier B.V. journal, 2019 - to date, http://www.sciencedirect.com/science/journal/00796700 - Contains Open Access
5. A. Anselm, Introduction to Semiconductor Theory, Mir Publisher, Moscow, 1981
6. G.I. Rusu, G.G. Rusu, Bazele fizicii semiconductorilor, Editura Ştiinţifică şi didactică CERMI, Iaşi, 2005,
7. G.I. Rusu, G.G. Rusu, Bazele fizicii semiconductorilor (vol I-IV) Editura Universităţii „Alexandru Ioan Cuza" Iaşi, 2016
8. C. Constantinescu, A. Glodeanu, Stări locale în semiconductori, Editura Acad. RSR, Bucureşti, 1967
9. P.S. Kireev, Fizica semiconductorilor, Editura Ştiinţifică şi Enciclopedică, Bucureşti, 1977
10. K. Seeger, Semiconductor Physics, Springer-Verlag, Berlin-Heidelberg-New York, 1982, 1999
11. I. Pop, M. Crişan, Fizica corpului solid şi a semiconductorilor, Editura Ştiinţifică şi Pedagogică, Bucureşti, 1983
12. M.C. Desjonqueres, D. Spanjaard, Concepte de fizica suprafeţei, Editura Tehnică, Bucureşti, 1998

Suplementary references:
13. C. Vasile, M.C. Pascu, Eds., Surface properties of polymers, Research Signpost, Kerala, India, 2007
14. C. Simionescu et al., Macromolecular chemistry, Ed. Didactică şi Pedagogică, Bucureşti, 1985
15. M. Dărângă, C. Mihăilescu, M. Popa, M. Nicu, N. Bejan, Polymer physics: introduction to science of polymer materials, Editura Ex Libris, Brăila, 2000

8.2 Seminar / Laborator	Metode de predare	Observaţii (ore şi referinţe bibliografice)
Work safety and protection guidelines: equipment use and activity procedures Symmetry in atomic systems - Study of symmetry elements in molecular structures	Practical laboratory work, discussions, problem-solving, teamwork	3 hours [1]
Infrared spectroscopy (IR) - Applications in polymer characterization. Analysis of FTIR spectra of polymers across various classes	Practical laboratory work, discussions, problem-solving, teamwork	3 hours [1, 7]
X-ray photoelectron spectroscopy (XPS) - Applications in polymer characterization. Analysis of XPS spectra of polymers from various classes	Practical laboratory work, discussions, problem-solving, teamwork	6 hours [1, 7]
X-ray photoelectron spectroscopy (XPS) - Study of surface chemical modifications of polymers using XPS	Practical laboratory work, discussions, problem-solving, teamwork	3 hours [1, 7, 8]
X-ray diffraction (XRD) - Applications in polymer characterization. Study of surface treatment effects on polymer crystallinity using XRD	Practical laboratory work, discussions, problem-solving, teamwork	3 hours [1]
Contact angle measurement - Evaluation of surface energy and its components in polymer films	Practical laboratory work, discussions, problem-solving, teamwork	3 hours [1, 7]
Obtaining of the semiconducting thin films samples (thin film deposition, electrodes deposition, thermal treatment) Thickness	Laboratory practice, discussions	3 hours [2-5]

8.2 Seminar / Laborator	Metode de predare	Observaţii (ore şi referinţe bibliografice)
measurement, XRD and XPS studies of the obtained semiconducting thin films.		
Measurement of the temperature dependence of the electrical conductivity. Determination of the activation energies.	Laboratory practice, discussions	3 hours [5]
Measurement of the transmission and reflection spectra. Determination of the absorption spectra and of the optical band-gap. Swanepoel method.	Laboratory practice, discussions	3 hours [3]
Measurement of the spectral dependence of the photoconductivity. Determination of the carrier's life time.	Laboratory practice, discussions	3 hours [6]
Determination of some interfaces (homo- and hetero-junctions) properties (I-V, C-V and photovoltaic characteristics)	Laboratory practice, discussions	3 hours [6]
Density of states in semiconductors	Problematization, discussions	3 hours [6]
SRH recombination mechanism	Problematization, discussions	3 hours [6]

Bibliografie

Principal references:
1. G. Borcia, Physics of polymers - Practical applications (electronic format), 2025
2. A.S. grove, Fizica şi tehnologia dispozitivelor semiconductoare, Editura Tehnică, Bucureşti, 1973
3. G.G. Rusu, C. Baban, M. Rusu, Materiale şi dispozitive semiconductoare, Editura Universităţii „Al. I. Cuza" Iaşi, 2002
4. G. Mateescu, Tehnologii avansate. Straturi subţiri depuse în vid, Editura Dorotea, Bucureşti, 1998
5. P.E.J. Flewitt, R.K. Wild, Physical Methods for Materials Characterization, Institute of Physics Publishing, Bristol and Philadephia, IOP Publishing Ltd. London, 1994
6. T.S. Moss,Optical Properties of Semiconductors, Butterworths Scientific Publications, London, 1959

Supplementary references:
7. C. Vasile, M.C. Pascu, Eds., Surface properties of polymers, Research Signpost, Kerala, India, 2007
8. C. Vasile, A.P. Chiriac, L.E. Niță, Eds., Degradable and biocompatible polymers, Tehnopress, Iaşi, 2006

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

In a context where polymers and semiconductors have become ubiquitous in everyday life, industry, and technology, this course provides both theoretical and practical knowledge, enabling students to obtain, identify, and characterize these materials for specific applications. Particular emphasis will be placed on plasma-processed polymers, examining their physical and chemical structures and corresponding properties. The synthesis and characterization of semiconducting thin films and structures also constitute key objectives of the course. More broadly, the course provides foundational knowledge in materials science and technology.

10. Evaluare

10.1 Evaluare continuă		Pondere (min. 30%)		50
Curs	Forma de evaluare			
	Pondere			0
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale			
	Metode de evaluare	Detalii	Pondere	cu reexaminare
Seminar / Laborator	Forma de evaluare			Verificare mixtă
	Pondere			100
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale			Da
	Metode de evaluare	Detalii	Pondere	cu reexaminare
		Portofoliu	50	Nu
		Proiect	50	Nu

10.2 Evaluare finală	Pondere (max. 70%)	50
	Forma de evaluare	Verificare mixtă finală

10.3 Menţiuni (situaţii speciale în evaluare)	

10.4 Standard minim de performanţă
Critical analysis of the methods and criteria used to select appropriate solutions for achieving the desired performance in a given application. Physical interpretation of the results obtained from experimental measurements or theoretical calculations using appropriate numerical or statistical methods. Application of algorithms to develop medium-complexity software solutions for data acquisition and analysis, or for modeling physical phenomena. Development of an individual project based on the analysis of results presented in scientific literature.

Data completării,

Titular de curs,
Prof. Dr. GABRIELA BORCIA/ Conf. Dr. CRISTIAN IOAN BABAN

Titular de seminar,
Prof. Dr. GABRIELA BORCIA/ Conf. Dr. CRISTIAN IOAN BABAN/ Specialist Dr. LAURA HROSTEA

Data avizării în departament,

Director de departament,
Conf. Dr. IORDANA ASTEFANOAEI

FIŞA DISCIPLINEI

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	**DEPARTAMENTUL DE FIZICA**
1.4 Domeniul de studii	**Fizică**
1.5 Ciclul de studii	**Masterat**
1.6 Programul de studii / Calificarea	**Fizică pentru tehnologii avansate/ Physics for advanced technologies**

2. Date despre disciplină

2.1 Denumirea disciplinei			Fizica aplicată în Industria Auto				
2.2 Titularul activităţilor de curs			Conf. Dr. VALENTIN POHOATA/ Lect. Dr. IOANA LAURA VELICU/ Specialist Dr. CRISTINA-STEFANIA OLARIU/ Specialist CONSTANTIN-CATALIN ZAVU/ Specialist Dr. OANA ARCU				
2.3 Titularul activităţilor de seminar			Conf. Dr. VALENTIN POHOATA/ Lect. Dr. IOANA LAURA VELICU/ Specialist MIHAIL HUMA/ Specialist Dr. CRISTINA-STEFANIA OLARIU/ Specialist Dr. OANA ARCU				
2.4 An de studiu	I	**2.5** Semestrul	II	**2.6** Tip de evaluare*	V	**2.7** Regimul disciplinei**	Ob

**E – Examen / C – Colocviu / V – Verificare*

***OB – Obligatoriu / OP – Opţional / F – Facultativ*

3. Timpul total estimat (ore pe semestru si activitati didactice)

3.1 Număr de ore pe săptămână	4	**3.2** curs	2	**3.3** seminar/laborator	2
3.4 Total ore din planul de învăţământ	56	**3.5** curs	28	**3.6** seminar/laborator	28
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					33
Pregătire seminare/laboratoare, teme, referate, portofolii şi eseuri					40
Tutoriat					0
Examinări					6
Alte activităţi					0

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

4. Precondiţii - De curriculum (dacă este cazul)

Basic knowledge of general physics and materials science. Familiarity with concepts related to the structure of materials. Ability to use the technical language specific to the field and to interpret the physical parameters of the materials employed.

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	The activity takes place in classrooms equipped with projection systems, individual computers for each student, and internet access. Multimedia presentations, numerical simulations, demonstrative setups, mock-ups, and functional models are used to facilitate the understanding of physical phenomena applied in the automotive industry.
5.2 De desfăşurare a seminarului/ laboratorului	The activity takes place in classrooms equipped with projection systems, individual computers for each student, and internet access. Multimedia presentations, numerical simulations, demonstrative setups, mock-ups, and functional models are used to facilitate the understanding of physical phenomena applied in the automotive industry.

6. Obiective

The course aims to develop competencies in applying physics concepts to the analysis and design of systems within the automotive industry. Students will learn to use numerical simulation methods and finite element analysis to study the thermal and electrical behavior of components, to design and test automotive electronic circuits, and to integrate sensors into complex systems. In addition, the course develops skills in using modeling, control, and validation software through an interdisciplinary approach to applied physics in automotive engineering.

7. Competenţe/Rezultate ale învăţării

- analiza şi comunicarea informaţiilor cu caracter didactic, ştiinţific şi de popularizare din domeniul Fizicii
- stăpânirea metodelor şi tehnicilor de cercetare specifice specializării Fizică pentru Tehnologii Avansate
- utilizarea de pachete software pentru analiza şi prelucrarea datelor experimentale şi pentru efectuarea de experimente virtuale

8. Conţinut

8.1 Curs	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
Introduction to the automotive industry. Evolution and general architecture of the modern automobile. Presentation of mechanical, electrical, and electronic subsystems.	Interactive lecture; guided discussions; practical demonstration.	2h Ref 1-3
Fundamental performance parameters of automobiles. Energy, power, torque, efficiency, emissions. Correlation of these parameters with electronic control systems.	Interactive lecture; case study; problem-based learning.	2h Ref 1-3
Introduction to automotive electronics. Structure of modern electronic systems. Principles of operation of the ECU. Interconnection of sensors, actuators, and control modules.	Interactive lecture; software demonstration; technical debate.	2h Ref 1-3
Sensor and transducer systems (I). Classification, general principles, thermal, piezoelectric, optoelectronic, and electromagnetic sensors.	Interactive lecture; practical demonstration; comparative analysis.	2h Ref 1-3
Sensor and transducer systems (II). Sensors for environmental monitoring, emissions control, and dynamic vehicle parameters.	Case study; simulation; group-based applied activity.	2h Ref 1-3
Finite Element Analysis (FEA) in the automotive industry. Use of numerical methods for studying the structural and thermal behavior of sensors. Introduction to Ansys Workbench (geometry, materials, contacts, boundary conditions, mesh).	Software demonstration; project-based learning; applied exercise.	4h Ref 1-4
3D modeling and functionality of a high-voltage inverter. The role of the inverter in the electric vehicle.	Interactive lecture; software demonstration; debate.	4h Ref 1-4
Introduction to Model-Based Systems Engineering. Use of graphical models for understanding and designing sensor-based systems.	Interactive lecture; simulation; project-based learning.	2h Ref 1-6

8.1 Curs	Metode de predare	Observaţii (ore şi referinţe bibliografice)
Product development and validation model (V-cycle). Stages: requirements, functional architecture, design, interfaces, simulation, testing, and validation.	Interactive lecture; case study; applied exercise.	2h Ref 1-6
Automotive industry standards and processes. ASPICE, ISO 26262, Functional Safety, Cybersecurity. Implementation of customer requirements during product development.	Lecture; technical-scientific debate; standards analysis.	2h Ref 1-6
Model-Based Engineering (MBE). Modeling of the product and its interactions with the environment. Model-Driven Development (MDD). Model-based software development, automatic code generation, and automated testing.	Interactive lecture; simulation; collaborative learning.	2h Ref 1-6
Automotive standards and processes. ASPICE, ISO 26262, Functional Safety, Cybersecurity. Relationship with customer requirements and their implementation throughout the development of sensor-based products in the automotive industry.	Software demonstration (Simulink/Stateflow); project-based learning.	2h Ref 1-6

Bibliografie

1. Course support materials.
2. Robert Bosch GmbH, editor. Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive Wiesbaden: Springer Fachmedien Wiesbaden; 2014.
3. Ribbens, W.B., Understanding Automotive Electronics, Elsevier, 2017.
4. Ansys Inc., Getting Started with Ansys Workbench, User Manual.
5. ISO 26262:2018 – Road vehicles – Functional safety.
6. Automotive SPICE – Process Assessment Model, V3.1, 2022.

8.2 Seminar / Laborator	Metode de predare	Observaţii (ore şi referinţe bibliografice)
Engine sensors (I): piezoelectric, optoelectronic, and mechanical sensors. Examples: knock sensor, ambient light sensor, speed sensor. Conceptual analysis and modeling of the sensor response.	Software demonstration; project-based learning; applied exercise.	2h Ref 1-2
Engine sensors (II): principles and simulation of electrochemical and electronic sensors. Analysis of Lambda-type sensors (O_2, NOx), throttle position sensors. Functional modeling and interpretation of output signals.	Software demonstration; project-based learning; applied exercise.	2h Ref 1-2
Auxiliary sensors in automobiles. Operation and integration of sensors for airbag deployment, parking, rain detection, GPS, and interior lighting. Analysis of signal types and processing methods.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1-2
Introduction to the Finite Element Method (FEA) for 2D applications. General principles of the method; problem formulation; stages of an analysis project: geometry, material, boundary conditions, meshing, interpretation of results.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,3,4
FEA applications – physical phenomena relevant to automobiles. Heat conduction in solid, liquid, and gaseous media. Distribution of stresses and deformations in mechanical structures.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,3,4
Thermal behavior modeling of a high-voltage inverter – steady-state analysis. Set-up of a steady-state thermo-electric simulation in Ansys Workbench. Material selection, electrical parameters, definition of heat sources. When to apply the steady-state method.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,3,4
Thermal behavior modeling of the inverter – transient analysis. Configuration of a transient simulation. Introduction of time-varying boundary conditions, interpretation of thermal response curves.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,3,4
Comparison between steady-state and transient methods. Comparative analysis of results; interpretation of differences; justification of the simulation approach according to project objectives.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,5,6
Familiarization with requirements management environments. Presentation and basic use of platforms such as IBM DOORS, PTC Integrity, and Jira. Requirements traceability in an automotive project.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,5,6

8.2 Seminar / Laborator	Metode de predare	Observaţii (ore şi referinţe bibliografice)
Software tools for automotive product development. Overview of SPICE and other specialized tools. Choosing the appropriate software for different stages of the product development cycle.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,5,6
Modeling the physical architecture of a product – example: seat heating system. Building the physical architecture in Enterprise Architect (trial): identification of components and energy/information flows.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,5,6
Creation of UML diagrams for logical, functional, and hardware architectures. Use of Enterprise Architect to represent sensor-based systems (touch sensor, thermal control).	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,5,6
Modeling and testing the operation of a touch-sensor-based product. Construction of the graphical model, sensor parameter definition, configuration of simulation blocks.	Software demonstration; project-based learning; applied exercise.	2h Ref. 1,5,6

Bibliografie

1. Laboratory support materials.
2. Robert Bosch GmbH, editor. Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive Wiesbaden: Springer Fachmedien Wiesbaden; 2014.
3. Kurowski PM. Finite element analysis for design engineers. SAE International; 2004.
4. Ansys: Basics and Preprocessing, Ansys Mechanical Heat Transfer (Boundary Conditions, Engineering Data, Thermal Elements, Thermal Contact, Steady-state and Transient Thermal Analysis), Ansys Inc., 2016;
5.Charles S. Wasson, System Analysis, Design, and Development: Concepts, Principles and Practices, John Wiley & Sons, Inc. Hoboken, New Jersey, 2006
6. Bhattacharya S, Agarwal AK, Prakash O, Singh S, editors. Sensors for Automotive and Aerospace Applications Singapore: Springer Singapore; 2019.
7. Peter Wilson, H. Alan Mantooth, Model-Based Engineering for Complex Electronic Systems, Newnes, 2013

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

The course is developed and delivered in collaboration with specialists from the automotive industry with expertise in physics and electronics applied to modern vehicles. These experts work in prestigious companies based in Iași, such as Vitesco Technologies, recently integrated into the Schaeffler Group; Aumovio, the emerging Automotive division of Continental AG; and Preh Iași, part of the German supplier Preh, involved in the development of automotive electronic components.
This collaboration ensures the alignment of the course content with the current requirements of the automotive industry, providing students with a practical perspective on the processes of design, simulation, and validation of electrical and electronic equipment integrated into vehicles.

10. Evaluare

10.1 Evaluare continuă		Pondere (min. 30%)		100
Curs	Forma de evaluare			Verificare mixtă
	Pondere			50
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale			Da
	Metode de evaluare	Detalii	Pondere	cu reexaminare
		Verificare practică periodică	30	Da
		Proiect	30	Da
		Referat	30	Da
		Autoevaluare	10	Nu
Seminar / Laborator	Forma de evaluare			Verificare mixtă
	Pondere			50
	Nepromovarea Evaluării continue determină nepromovarea Evaluării finale			Da
	Metode de evaluare	Detalii	Pondere	cu reexaminare

		Verificare practică periodică	30	Da
		Proiect	30	Da
		Referat	30	Da
		Autoevaluare	10	Nu

10.2 Menţiuni (situaţii speciale în evaluare)	

10.3 Standard minim de performanţă
The student must demonstrate the ability to critically analyze design and simulation methods for automotive electronic systems and to provide a well-reasoned selection of appropriate solutions to achieve the minimum required functional performance.

Data completării,

Titular de curs,
Conf. Dr. VALENTIN POHOATA/ Lect. Dr. IOANA LAURA VELICU/ Specialist Dr. CRISTINA-STEFANIA OLARIU/ Specialist CONSTANTIN-CATALIN ZAVU/ Specialist Dr. OANA ARCU

Titular de seminar,
Conf. Dr. VALENTIN POHOATA/ Lect. Dr. IOANA LAURA VELICU/ Specialist MIHAIL HUMA/ Specialist Dr. CRISTINA-STEFANIA OLARIU/ Specialist Dr. OANA ARCU

Data avizării în departament,

Director de departament,
Conf. Dr. IORDANA ASTEFANOAEI