FIŞA DISCIPLINEI

2024-2025

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. HABIL. Iordana AȘTEFĂNOAEI				
2.3 Titularul activităţilor de seminar			conf. Dr. habil. Iordana AȘTEFĂNOAEI				
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	**144**
3.8 Total ore pe semestru	**200**
3.9 Număr de credite	**8**

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 Onsite/Online**	**Observaţii** (ore şi referinţe bibliografice)
1.	Generalities on differential equations;	Lecture, Applications **Onsite**	2 ore
2.	Physically significant differential equations;	Lecture, applications, guided discovering process **Onsite**	2 ore
3.	Ordinary differential equations; First and Second order differential equations	Lecture, applications, guided discovering process **Onsite**	2 ore
4.	Ordinary differential equations; Higher Order Differential equations	Lecture, debate, guided discovering process **Onsite**	2 ore
5.	Euler equations. Cauchy-Euler equations	Lecture, applications **Onsite**	2 ore

6	Systems of first order differential equations;	Lecture, guided discovering process, applications **Onsite**	2 ore
7	First order differential equations with partial derivatives;	Lecture, guided discovering process, applications **Onsite**	2 ore
8.	Second order differential equations with partial derivatives;	Lecture, guided discovering process, applications **Onsite**	2 ore
9	Legendre Polynomials;	Lecture, guided discovering process, applications **Onsite**	2 ore
10	Basic symmetries and special functions: spherical and Bessel functions;	Lecture, guided discovering process, applications **Onsite**	2 ore
11.	Laplace and Poisson Equations,	Lecture, guided discovering process, applications **Onsite**	2 ore
12.	Laplace – Fourier method of variables separation;	Lecture, guided discovering process, applications **Onsite**	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, guided discovering process, applications **Online**	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, guided discovering process, applications **Onsite**	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 Onsite/Online**	**Observaţii** (ore şi referinţe bibliografice)
1.	Geometrical interpretation of first order differential equations' solutions	Applications, guided discovering process **Onsite**	2 ore
2.	Homogeneous equations. Applications. Linear equations. Bernoulli equation. Riccati equation.	Applications, guided discovering process **Onsite**	2 ore

3.	Second order differential equations. I. n-th order differential equations with constant coefficients. Variation of constants method	Applications, guided discovering process **Onsite**	2 ore
4.	Higher Order Differential equations II. n-th order differential equations with constant coefficients. Variation of constants method	Applications, guided discovering process **Onsite**	2 ore
5.	Euler equations. Cauchy-Euler equations. Applications.	Applications, guided discovering process **Onsite**	2 ore
6.	Systems of first order differential equations; Applications	Applications, guided discovering process **Onsite**	2 ore
7.	First order differential equations with partial derivatives; Applications	Applications, guided discovering process **Onsite**	2 ore
8.	I. Second order differential equations with partial derivatives; Applications	Applications, guided discovering process **Onsite**	2 ore
9	II. Second order differential equations with partial derivatives; Applications	Applications, guided discovering process **Onsite**	2 ore
10.	Basic symmetries and special functions: spherical and Bessel functions; Applications (I)	Applications, guided discovering process **Onsite**	2 ore
11.	Basic symmetries and special functions: spherical and Bessel functions; Applications (II)	Applications, guided discovering process **Onsite**	2 ore
12.	Complex numbers. Operations with complex numbers.	Applications, guided discovering process, debate **Onsite**	2 ore
13.	Complex functions of real and complex variables	Applications, guided discovering process **online**	2 ore
14.	Complex series. Singularities and poles. Residua Theorem.	Applications, guided discovering process **Onsite**	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 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
26 September 2024	CONF. DR. Iordana AȘTEFĂNOAEI	Conf. univ. dr. Iordana Astefanoaei

Data avizării în departament

Director de departament
Conf. univ. dr. Iordana Astefanoaei

FIŞA DISCIPLINEI

2024-2025

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 Mitoşeriu, Lect. dr. Ioan Dumitru**				
2.3 Titularul activităţilor de seminar			**Asist. dr. Lavinia Curecheriu, Lect. dr. Ioan Dumitru**				
2.4 An de studiu	**I**	**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	**70**	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						**35**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren						**35**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri						**30**
Tutoriat						**10**
Examinări						**6**
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
1.10.2024

Titular de curs
Prof. dr. Liliana Mitoșeriu,

Lect. dr. Ioan Dumitru,

Titular de seminar
Asist. dr. Lavinia Curecheriu

Lect. dr. Ioan Dumitru

Data avizării în departament

Director de departament
Conf. dr. Iordana Aştefănoaei

FIŞA DISCIPLINEI

2024-2025

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	**VP**	**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						**36**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren						**36**
Pregătire seminarii/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 Număr de credite	**7**

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. 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. 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 floating point round-off error.	Lecture, exemplification	
2	Maple/Maxima programming platform and Python languages: how are they comparing to other programming environments, advantages and disadvantages.	Lecture, exemplification	
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	
4	Finding the trajectory of a body in gravitational field – wind effect (numerically solving the equation of motion).	Lecture, exemplification	

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

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 - 4	Basic elements of Maple. Differences when comparing Maple with a classical programming language. Advantages. Disadvantages.	Problem solving	
5 - 6	Physical fields. Visualization.	Problem solving	
7	Practical work - evaluation	Problem solving	
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	

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

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	50%
10.5 Seminar/Laborator		Two practical tests	50%
10.6 Standard minim de performață			
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
27.09.2024

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

2024/2025

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	**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			**VIRTUAL INSTRUMENTATION**					
2.2 Titularul activităţilor de curs			**Lect. Dr. Cătălin AGHEORGHIESEI**					
2.3 Titularul activităţilor de seminar			**Lect. Dr. Cătălin AGHEORGHIESEI**					
2.4 An de studiu	**1**	**2.5** Semestru	**1**	**2.6** Tip de evaluare	**VP**	**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	**45**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren	**34**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri	**20**
Tutoriat	**6**
Examinări	**4**
Alte activităţi Proiect individual	**10**

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, practical problems	2 hours, Refs 1-3
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
30.09.2024

Titular de curs
Lect. Dr. Cătălin AGHEORGHIESEI

Titular de laborator
Lect. Dr. Cătălin AGHEORGHIESEI

Data avizării în departament

Director de departament
Conf. Dr. Iordana AȘTEFĂNOAIE