# FIŞA DISCIPLINEI

**2021-2022**

## 1. Date despre program

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

## 2. Date despre disciplină

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **2.1** Denumirea disciplinei | | | **Physics of nonlinear phenomena** | | | | | |
| **2.2** Titularul activităţilor de curs | | | **Assoc. prof. Dan-Gheorghe DIMITRIU, Assoc. prof. Sebastian POPESCU** | | | | | |
| **2.3** Titularul activităţilor de seminar | | | **Assoc. prof. Dan-Gheorghe DIMITRIU, Assoc. prof. Sebastian POPESCU** | | | | | |
| **2.4** An de studiu | **M2** | **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 | | | | | | **35** |
| Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren | | | | | | **35** |
| Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri | | | | | | **40** |
| Tutoriat | | | | | | **30** |
| Examinări | | | | | | **4** |
| Alte activităţi ..... | | | | | | **0** |

| | |
|---|---|
| **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 | Mechanics, Thermodynamics, Differential Equations, Electrodynamics, Plasma Physics |
| **4.2** De competenţe | All the competences formed and consolidated by the above classes |

## 5. Condiţii (dacă este cazul)

| | |
|---|---|
| **5.1** De desfăşurare a cursului | |

| | |
|---|---|
| **5.2** De desfăşurare a seminarului/ laboratorului | |

**6. Competenţe specifice acumulate**

| | |
|---|---|
| **Competenţe profesionale** | **C1.** Identification of the main subjects related to the physics of chaotic phenomena<br>**C2.** Critical analysis of the results obtained by using the known models/theories<br>**C3.** Explaining and interpretation of the physical phenomena and the operationality of the key concepts based on the proper use of the laboratory devices |
| **Competenţe transversale** | **CT1.** Identification of the role and responsibilities as a member of a team and the application of communication techniques and efficient teamworking<br>**CT2.** Analysis and communication of Physics information with didactical, scientific and popularization character;<br>**CT3.** Opening to lifelong learning;<br>**CT4.** Language skills at academic level, in English, needed for scientific documentation;<br>**CT5.** Use of communication and information technologies;<br>**CT6.** Understanding and applying the principles and the values of professional and research ethics. |

**7. Obiectivele disciplinei** (din grila competenţelor specifice acumulate)

| | |
|---|---|
| **7.1 Obiectivul general** | Identification of the main characteristics of the nonlinear physics phenomena |
| **7.2 Obiectivele specifice** | At the successful finalization of this course, the students will be able to:<br>▪ Analyze different physical phenomena leading to similar behaviors of different nonlinear systems;<br>▪ Understand the self-assembling mechanisms of self-organized structures which appear in different complex systems;<br>▪ Use the current methods of study of self-organized systems;<br>▪ Formulate hypotheses and models on the obtained experimental research results<br>▪ Critically analyse the obtained results by using the known models/theories<br>▪ Explain and interpret physical phenomena and operate with the key concepts based on the proper using of the experimental results |

**8. Conţinut**

| **8.1** | **Curs** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | Main characteristics of nonlinear systems | Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education | 2 hours [1-4] online |
| 2. | Qualitative changes in the dynamics of nonlinear systems. Bifurcations. | Presentation, demonstration, conversation, university | 4 hours [1,3,4] online |

| | | | |
|---|---|---|---|
| | | lecture, synthesizing analysis, computer assisted education | |
| 3. | Routes to chaos: by intermittency, by quasi-periodicity, by cascade of period-doubling bifurcations (Feigenbaum scenario). Crises | Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education | 2 hours, [1-3] online |
| 4. | Quantities for chaotic states characterization: Lyapunov exponents, Kolmogorov-Sinai entropy, box-counting dimension, informational dimension, correlation dimension, generalized correlation dimension, Hausdorff dimension, Lyapunov dimension | Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education | 4 hours, [1-3] online |
| 5. | Chaos control (by feedback methods: Ott-Grebogi-Yorke method, Pyragas methods; through synchronization; inteligent control: by neuronal networks, by adaptive fuzzy logic method; experimental chaos control) | Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education | 2 hours, [1-3] online |
| 6. | Nonlinear oscillations. | Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education | 3 hours, [1,3,4] online |
| 7. | Complex systems; Order, organization and self-organization in complex systems; Intermittent and cascade self-organization | Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education | 2 hours [4,5] online |
| 8. | Reaction – Diffusion systems. Turing structures. Application: The Brusselator; Turing structures in plasma systems. The ball of fire (quasi-spherical electric double layer). | Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education | 3 hours [4,5] online |
| 9. | Negative differential resistance. S-type negative differential resistance; N-type negative differential resistance; Equivalent electrical circuit of the ball of fire in plasma; Electrical double layer and physical basis of negative differential resistances in plasma | Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education | 3 hours [5] online |
| 10. | Self-organization in fluids and magnetofluids | Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education | 3 hours [5] online |

**Bibliografie**

**Referinţe principale:**

[1] A. H. Nayfeh, B. Balachandran – Applied Nonlinear Dynamics – Analytical, Computational, and Experimental Methods, Wiley-VCH, Weinheim, 2004;
[2] H. G. Schuster, W. Just – Deterministic chaos. An Introduction, 4th ed., Wiley-VCH, Weinheim, 2005

[3] S. H. Strogatz – Nonlinear Dynamics and Chaos, 2nd ed., Westview Press, Boulder, 2015.
[4] G. Nicolis – Introduction to Nonlinear Science, Cambridge Univ. Press, Cambridge, 1995.
[5] S. Popescu – Probleme actuale ale fizicii sistemelor autoorganizate, Tehnopress, Iași, 2003.

**Referinţe suplimentare:**

[1] R. C. Hilborn – Chaos and Nonlinear Dynamics – An Introduction for Scientists and Engineers, 2nd ed., Oxford University Press, Oxford, 2001;
[2] E. Lorenz – The Essence of Chaos, University of Washington Press, Seattle, 1993;
[3] J. C. Sprott – Elegant Chaos – Algebraically Simple Chaotic Flows, World Scientific, Singapore, 2010;
[4] E. Schöll, H. G. Schuster (Eds.) – Handbook of Chaos Control, 2nd ed., Wiley-VCH, Weinheim, 2008.

| **8.2** | **Seminar / Laborator** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | Bifurcations, Symmetry-breaking | Exercise solving, discussions | 2 hours [1,4] online |
| 2. | Experimental analysis of some scenarios of transition to chaos in plasma (by cascade of sub-harmonic bifurcations, by type I intermittency, Feigenbaum scenario) | Experiment, synthesizing analysis, computer assisted education | 2 hours, [1-3] onsite |
| 3. | Turbulence analysis in plasma and liquids. Rayleigh-Bénard convection | Experiment, synthesizing analysis, computer assisted education, numerical simulation | 2 hours, [1-3] onsite |
| 4. | Analysis of chaotic time series with specialized software | Synthesizing analysis, computer assisted education, numerical simulation | 2 hours, [1-3] online |
| 5. | Chua chaotic circuit. Control of chaos. Synchronization of chaotic circuits. | Experiment, synthesizing analysis, computer assisted education | 2 hours, [1-3] onsite |
| 6. | Control of chaos in plasma by using external circuit elements | Experiment, synthesizing analysis, computer assisted education | 2 hours, [1-3] onsite |
| 7. | Analysis of uncorrelated dynamics of some complex space charge structures in plasma. Flicker noise | Experiment, synthesizing analysis, computer assisted education | 2 hours, [1-3] onsite |
| 8. | Nonlinear oscillations | Exercise solving, discussions | 2 hours, [1] online |
| 9. | Modeling nonlinear systems | Exercise solving, discussions | 2 hours, [1,4] online |
| 10. | Reaction – diffusion systems | Exercise solving, discussions | 4 hours online |
| 11. | Negative differential resistance | Exercise solving, discussions | 2 hours online |
| 12. | Self-organization in fluids and magnetofluids | Exercise solving, discussions | 4 hours online |

**Bibliografie**

[1] A. H. Nayfeh, B. Balachandran – Applied Nonlinear Dynamics – Analytical, Computational, and Experimental Methods, Wiley-VCH, Weinheim, 2004;
[2] W.-H. Steeb – The Nonlinear Workbook, 4th ed., World Scientific, Singapore, 2008;
[3] H. J. Korsch, H.-J. Jodl, T. Hartmann – Chaos – A Program Collection for the PC, 3rd ed., Springer-Verlag, Berlin, 2008.
[4] H. Haken – Advanced Synergetics – instability hierarchies of self-organizing systems and devices, Springer Verlag (Berlin, Germany) 1983.

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

| |
|---|
| The content of the course perfectly corroborate with the expectations of the community, profesional associations, and main employers representatives from the program's domain.<br>The content of the syllabus ensures, besides the formation of the above professional competences, the consolidation of divergent thinking, the transfer of knowledge from one area to another, and some transversal competences requested by any company hiring physicists. |

**10. Evaluare**

| **Tip activitate** | **10.1 Criterii de evaluare** | **10.2 Metode de evaluare** | **10.3 Pondere în nota finală (%)** |
|---|---|---|---|
| **10.4** Curs | Project and exam | Continuous, formative, summative | 50% |
| **10.5** Seminar/ Laborator | Active participation in the class activities | Continuous, formative, summative | 20 % presence<br>30 % seminar |
| **10.6** Standard minim de performanţă | | | |
| Independent analysis of a typical problem from Non-linear Science, using the characteristic methods and instruments specific to Complexity Science. | | | |

| Data completării | Titular de curs | Titular de seminar/laborator |
|---|---|---|
| 21.09.2021 | Assoc. Prof. Dan-Gheorghe DIMITRIU | Assoc. Prof. Dan-Gheorghe DIMITRIU |
| | Assoc. Prof. Sebastian POPESCU | Assoc. Prof. Sebastian POPESCU |

Data avizării în departament

Director de departament

Assoc.Prof. Iordana AȘTEFĂNOAEI

# FIŞA DISCIPLINEI

**2021/2022**

## 1. Date despre program

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

## 2. Date despre disciplină

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2.1** Denumirea disciplinei | | | **Transfer Phenomena** | | | | |
| **2.2** Titularul activităţilor de curs | | | **Prof. dr. Diana Mihaela MARDARE, Conf. dr. Claudiu COSTIN** | | | | |
| **2.3** Titularul activităţilor de seminar | | | **Prof. dr. Diana Mihaela MARDARE, Conf. dr. Claudiu COSTIN** | | | | |
| **2.4** An de studiu | **II** | **2.5** Semestru | **3** | **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 | | | | | **35** |
| Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren | | | | | **35** |
| Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri | | | | | **35** |
| Tutoriat | | | | | **12** |
| Examinări | | | | | **2** |
| Alte activităţi ..... | | | | | |

| | |
|---|---|
| **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 | Mechanics, Thermodynamics, Electricity and Magnetism, Plasma Physics, Condensed Matter Physics |
| **4.2** De competenţe | Numerical programming, Origin software operation, proficiency in written and oral English |

## 5. Condiţii (dacă este cazul)

| | |
|---|---|
| **5.1** De desfăşurare a cursului | |
| **5.2** De desfăşurare a seminarului/ laboratorului | Performing all practical works is mandatory. |

**6. Competenţe specifice acumulate**

| | |
|---|---|
| **Competenţe profesionale** | **C1.** Mastery of research methods and techniques, specific to the specialization *Physics for Advanced Technologies* (1 credit).<br>**C2.** Understanding and ability to apply the principles and the values of the professional and research ethics (1 credit).<br>**C3.** Use the software for analyzing and processing experimental data and to perform virtual experiments (1 credit).<br>**C4.** Use of communication and information technologies (1 credit). |
| **Competenţe transversale** | **CT1.** Identification and proper use of laws, principles, notions and physical methods in various circumstances (1 credit).<br>**CT2.** Application of Physics knowledge to practical situations (1 credit).<br>**CT3.** Opening to lifelong learning (1 credit). |

**7. Obiectivele disciplinei** (din grila competenţelor specifice acumulate)

| | |
|---|---|
| **7.1 Obiectivul general** | Developing theoretical and experimental competences on transport and transfer phenomena in solid bodies, fluids and plasmas. |
| **7.2 Obiectivele specifice** | On successful completion of this course, the students will be able to:<br>▪ Understand and explain the main transport and transfer phenomena in solid bodies, fluids and plasmas.<br>▪ Calculate the relaxation time for different scatttering mechanisms of the charge carriers in solid bodies.<br>▪ Correlate the deposition conditions with the photocatalytic properties of a thin film.<br>▪ Apply the concepts of transfer phenomena to real life situations (estimation of mass and energy losses in experimental, industrial and current usage devices).<br>▪ Solve medium complexity problems on transport and transfer phenomena. |

**8. Conţinut**

| **8.1** | **Course** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | Recapitulative essential notion | Lecture, explanation, demonstration, debate (on-line) | 2h / [1-3] |
| 2. | Boltzmann transport equation. Relaxation time. | Lecture, explanation, demonstration, debate (on-line) | 4h / [1-3] |
| 3. | Scatttering mechanisms of the charge carriers in solid bodies. | Lecture, explanation, demonstration, debate (on-line) | 2h / [1-3] |
| 4. | Processes at different interfaces. | Lecture, explanation, demonstration, debate (on-line) | 3h / [1-3] |
| 5. | Electronic processes in photocatalysis. | Lecture, explanation, demonstration (on-line) | 3h / [4,5] |

| | | | |
|---|---|---|---|
| 6. | The three moments of the Boltzmann equation: mass, momentum and energy transfer equations. | Lecture, explanation, demonstration (on-line) | 2h / [6,7] |
| 7. | Momentum transfer. Viscosity and the mechanism of momentum transfer. Newton's law of viscosity. Molecular theory of the viscosity of gases. | Lecture, explanation, demonstration (on-line) | 2h / [8,9] |
| 8. | Momentum transfer. Generalization of Newton's law of viscosity. Navier Stokes Equation. Reynolds number. Streamlines. | Lecture, explanation, demonstration, debate (on-line) | 2h / [8,9] |
| 9. | Mass transport. Fick's law of diffusion. Equation of diffusion. | Lecture, explanation, demonstration (on-line) | 2h / [8-10] |
| 10. | Plasma diffusion in a magnetic field. Transport coefficients in plasmas. | Lecture, demonstration, debate (on-line) | 2h / [8-10] |
| 11. | Heat transfer. Coduction. Fourier's law. Thermal conductivity. | Lecture, explanation, demonstration (on-line) | 2h / [8-10] |
| 12. | Heat transfer. Convection. Radiation. | Lecture, explanation, demonstration (on-line) | 2h / [8-10] |

**Principal References**

[1] Diana Mardare, Transport Phenomena in Solid Bodies, Ed. "Gh. Asachi", Iaşi, 2002
[2] P. S. Kireev, Semiconductor Physics, Ed. Şt. Enc., Bucureşti, 1977
[3] M. Balkanski (Ed.), Handbook on Semiconductors, North-Holland, Amsterdam, 1994.
[4] Diana Mardare, Polycrystalline and Amorphous Thin Films. Titanium oxide, Ed. "Politehnium", Iaşi, 2005
[5] $TiO_2$ PHOTOCATALYSIS. FUNDAMENTALS AND APPLICATIONS. A. Fujishima,K. Hashimoto, T. Watanabe, BKC Inc. 4-5-11 Kudanminami, Chiyoda-ku, Tokyo 102-0074 Japan
[6] M. M. Becker, D. Loffhagen, 'Derivation of Moment Equations for the Theoretical Description of Electrons in Nonthermal Plasmas', Advances in Pure Mathematics 3 (2013) 343-352
[7] S. Höfner, The equations of fluid dynamics and their connection with the Boltzmann equation, Lecture notes, Department of Physics and Astronomy, Uppsala University, http://www.astro.uu.se/~hoefner/astro/teach/adp08_L3_notes.pdf
[8] R. B. Bird, W. E. Stewart, E. N. Lightfoot, Transport Phenomena, 2nd Edition, John Wiley & Sons, NY, 2002
[9] J. R. Welty, C. E. Wicks, R. E. Wilson, G. L. Rorrer, Fundamentals of Momentum, Heat, and Mass Transfer, 5th Edition, John Wiley & Sons, USA, 2008
[10] F. P. Incropera, D. P. DeWitt, T. L. Bergman, A. S. Lavine, Fundamentals of Heat and Mass Transfer, 6th Edition, John Wiley & Sons, USA, 2007

**Supplementary References**

[11] Scientific papers

| **8.2** | **Seminar / Laboratory** | **Teaching Methods** | **Comments** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | The growth of a polycrystalline solid from the solution | Experiment (on-line) | 2h / [1,3] |
| 2. | Effective mass of charge carriers | Problems and exercises (on-line) | 2h / [3,4] |
| 3. | Demonstration of different relations presented during the course. | Problems and exercises (on-line) | 4h / [3] |
| 4. | Different expressions of the relaxation time. | Problems and exercises (on-line) | 2h / [1] |
| 5. | Study of the photocatalytic /hydrophilic properties of a material | Driven experiment | 4h / [1,2,5] |
| 6. | Study of the ambipolar diffusion in a non-magnetized plasma. | Laboratory experiment, observation | 2h / [6] |

| | | | |
|---|---|---|---|
| 7. | Study of the diffusion in a magnetized plasma. | Laboratory experiment | 2h / [6] |
| 8. | Solving 1D mass transfer equation using numerical methods. | Solving problems by numerical methods (on-line) | 2h / [7,8] |
| 9. | Solving 1D momentum transfer equation using numerical methods. | Solving problems by numerical methods (on-line) | 2h / [7,8] |
| 10. | Solving 1D energy transfer equation using numerical methods. | Solving problems by numerical methods (on-line) | 2h / [7,8] |
| 8. | Computing electron drift velocity in magnetized plasmas. | Solving problems by numerical methods (on-line) | 2h / [9] |
| 9. | Computing electron difusion coefficient in magnetized plasmas. | Solving problems by numerical methods (on-line) | 2h / [9] |

**References**

[1] Laboratory papers
[2] Scientific papers, ISI quoted
[3] Diana Mardare, Transport Phenomena in Solid Bodies, Ed. "Gh. Asachi", Iaşi, 2002
[4] L.L.Kazmerski (Ed.) *Polycrystalline and Amorphous Thin Films and Devices,* Academic Press, New York, 1980.
[5] $TiO_2$ PHOTOCATALYSIS. FUNDAMENTALS AND APPLICATIONS. A. Fujishima,K. Hashimoto, T. Watanabe, BKC Inc. 4-5-11 Kudanminami, Chiyoda-ku, Tokyo 102-0074 Japan
[6] G. Popa, D. Alexandroaei, Îndrumar de lucrări practice pentru fizica plasmei, Ed. Universităţii Alexandru Ioan Cuza, Iaşi, 1991
[7] T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, Introduction to Algorithms, 3rd ed., MIT Press, Cambridge, US, 2009
[8] G. H. Golub, C. F. Van Loan, Matrix Computations, 4th ed., The Johns Hopkins University Press, Baltimore, US, 2013
[9] C. Costin, T. M. Minea, G. Popa, 'Electron transport in magnetrons by a posteriori Monte Carlo simulations', Plasma Sources Science and Technology 23(1) (2014) 015012

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

Studying this discipline the students acquire knowledge about transfer phenomena. This allows students to apply the concepts of transfer phenomena to real life problems: design and optimization of different devices that use thin films such as optoelectronic devices, gas sensing, solar cells, etc; estimation and prediction of mass and energy losses in experimental, industrial and current usage devices. The students will be thus prepared to be integrated in research or industrial activities.

**10. Evaluare**

| **Activity** | **10.1 Assesment criteria** | **10.2 Assesment methods** | **10.3 Weight in the final mark (%)** |
|---|---|---|---|
| **10.4** Course | - completeness and correctness of the acquired knowledge;<br>- capacity of operating with the acquired knowledge;<br>- capacity of analysis, personal interpretation, originality, creativity. | Summative assessment (final) - written exam. | 60 % |

| | | | |
|---|---|---|---|
| **10.5** Seminar/ Laboratory | - active participation to practical works;<br>- the capacity of using in practice the acquired knowledge. | Formative assessment (during the semester) - work projects. | 40 % |
| **10.6** Standard of minimum performance | | | |
| Minimum mark to both course and laboratory: 5.<br>Independent solving of a typical problem of medium complexity using the formalism of transfer phenomena.<br>Attendance to laboratories and seminars (100%). Written report for every practical work. | | | |

Data completării
27.09.2021

Titular de curs,
Prof. dr. Diana Mihaela MARDARE
Conf. dr. Claudiu COSTIN

Titular de seminar,
Prof. dr. Diana Mihaela MARDARE
Conf. dr. Claudiu COSTIN

Data avizării în departament

Director de departament,
Conf. dr. Iordana AŞTEFĂNOAEI

# FIŞA DISCIPLINEI

**2021-2022**

## 1. Date despre program

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

## 2. Date despre disciplină

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **2.1** Denumirea disciplinei | **Optical Spectroscopy: methods and instrumentation** | | | | | | | |
| **2.2** Titularul activităţilor de curs | **Lect. dr. Valentin POHOAŢĂ** | | | | | | | |
| **2.3** Titularul activităţilor de seminar | **Lect. dr. Valentin POHOAŢĂ** | | | | | | | |
| **2.4** An de studiu | **2** | **2.5** Semestru | **1** | **2.6** Tip de evaluare | **EVP** | **2.7** Regimul discipinei* | **OP** | |

** OB – Obligatoriu / OP – Opţional*

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

| | | | | | | |
|---|---|---|---|---|---|---|
| **3.1** Număr de ore pe săptămână | **4** | din care: **3.2** | curs | **2** | **3.3** seminar/laborator | **2** |
| **3.4** Total ore din planul de învăţământ | **56** | din care: **3.5** | curs | **28** | **3.6** seminar/laborator | **28** |
| Distribuţia fondului de timp | | | | | | ore |
| Studiu după manual, suport de curs, bibliografie şi altele | | | | | | **28** |
| Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren | | | | | | **21** |
| Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri | | | | | | **10** |
| Tutoriat | | | | | | **6** |
| Examinări | | | | | | **4** |
| Alte activităţi ..... | | | | | | |

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

## 4. Precondiţii (dacă este cazul)

| | |
|---|---|
| **4.1** De curriculum | Optics. Physics of atoms and molecules. Plasma Physics. Spectroscopy and Lasers. |
| **4.2** De competenţe | |

## 5. Condiţii (dacă este cazul)

| | |
|---|---|
| **5.1** De desfăşurare a cursului | |
| **5.2** De desfăşurare a seminarului/ laboratorului | Presence is mandatory at practical laboratories. Students will conduct individual or group laboratory experiments. |

**6. Competenţe specifice acumulate**

| | |
|---|---|
| **Competenţe profesionale** | Identification and proper use of laws, principles, notions and physical methods in various circumstances<br>Analysis and communication of Physics information with didactical, scientific and popularization character<br>Capacity to teach Physics at secondary and post-secondary education levels<br>Capacity of interrelationing and teamworking<br>Application of Physics knowledge to practical situations<br>Opening to lifelong learning |
| **Competenţe transversale** | Mastery of research methods and techniques, specific to the specialization Plasma Physics, Spectroscopy and Self-Organization<br>Language skills at academic level, in foreign languages, needed for scientific documentation<br>Use of communication and information technologies<br>Use the software for analyzing and processing experimental data and to perform virtual experiments<br>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** | Familiarization with the major spectroscopic tools and research techniques used in the analysis and control of composition, structure and quality of the materials. The course will review the main techniques and spectral methods of investigation, spectral types of appliances, basic components, sources and spectrum detectors. |
| **7.2 Obiectivele specifice** | ▪ On successful completion of this subject, students will be able to understand what spectral techniques are indicated for both qualitative and quantitative diagnosis of samples in different states of aggregation. |

**8. Conţinut**

| **8.1** | **Curs On-line și On-site** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | Vibrational Spectroscopy. Infrared spectroscopy. Classical acquisitions techniques (pallets, gas and liquid cell, nujol emulsion) | Lecture, thematic debates, applications. | 4 h [1-9] |
| 2. | Vibrational Spectroscopy. Infrared spectroscopy. New acquisitions techniques (ATR, diffuse reflectance) | Lecture, thematic debates, applications. | 2 h [1-9] |
| 3. | Elastic light scattering – Rayleigh scattering, Mie scattering, non-selective scattering or geometrical scattering. | Lecture, thematic debates, applications. | 2 h [1-9] |
| 4. | Inelastic scattering- Raman scattering. | Lecture, thematic debates, applications. | 2 h [1-9] |
| 5. | Molecular Spectroscopy - Visible and Ultraviolet Spectroscopy | Lecture, thematic debates, applications. | 2 h [1-9] |

| | | | |
|---|---|---|---|
| 6. | Components of various types of instrument for optical spectroscopy. instrumentation – spectrophotometer, monochromator, double beam scanning specttrophottometter, artefacts. | Lecture, thematic debates, applications. | 4 h [1-9] |
| 7. | Fluorescence spectroscopy | Lecture, thematic debates, applications. | 2 h [1-9] |
| 8. | X-Ray Fluorescence | Lecture, thematic debates, applications. | 2 h [1-9] |
| 9. | Nuclear Magnetic Resonance Spectroscopy. | Lecture, thematic debates, applications. | 2 h [1-9] |
| 10. | Laser-induced spectroscopy. Atomic emission spectroscopy, molecular, UV-VIS-IR. Atomic fluorescence spectroscopy. FTIR and Raman vibrational spectroscopy. | Lecture, thematic debates, applications. | 2 h [1-9] |
| 11 | Laser induced fluorescence. Broadenings mechanisms, shifts and splits. (Doppler, Stark, Zeeman, wan der Walls, resonance broadenings of spectral lines) | Lecture, thematic debates, applications. | 2 h [1-9] |
| 12. | Mass Spectrometry.Types of Mass Spectrometers. Inductively coupled plasma mass spectrometry (ICP-MS). Gas Chromatography—Mass Spectrometry (GC-MS). Matrix Assisted Laser Desorption/Ionization MALDI | Lecture, thematic debates, applications. | 2 h [10,11] |

**Bibliografie**

**Referinţe principale:**

1.A. Vlahovici, Metode optice si spectrale de analiza, Ed. Univ. “Al. I. Cuza“Iasi, 2002;
2.M. Delibaş, Optică şi spectroscopie, Iaşi, 1999;
3.M. Strat, Spectroscopie si laseri, Ed.Univ. “Al. I. Cuza” Iasi, 1988;
4.M. Strat, Introducere in spectroscopia mediilor condensate, Ed. Tehnica, Bucuresti, 1985;
5.M. Strat, Analiza structurala prin metode fizice, Ed. Academiei Romane, 1985;
6.A. N. Zaidel, s.a., Tehnica şi practica spectroscopiei, Bucureşti, 1984;
7.I. Iova, “Spectroscopie si laseri”, Ed.Univ. Bucuresti, 1984;
8.M. A. Eliasevici, Spectroscopie atomica si moleculara, Ed. Academiei Române, Bucuresti, 1966;
9.D. Birca-Galateanu, M. Giurgea, I. Iova, V. Sahini, A. Trutia si R. Titeica, Introducere in spectroscopia experimentala, Ed. Tehnica, Bucuresti, 1966.
10 Christopher G. Herbert, Robert A.W. Johnstone, Mass Spectrometry Basics June 26, 2002, CRC Press
11. Dr. Christoph A. Schalley Modern Mass Spectrometry, 2003 Springerlink

| **8.2** | **Laborator On-line şi On-site** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | Spectrophotometer and monochromator for UV-VIS: technical details. | Essays, laboratory work | 2 h [1] |
| 2. | Colour theory - CIE 1931 colour space | Essays, laboratory work | 2 h [1,4] |
| 3 | Night vision and thermal vision – human body temperature measurement | Essays, laboratory work | 2 h [1] |
| 4. | Absorption spectra of blood: pulse oximeter | Essays, laboratory work | 2 h [1] |

| | | | |
|---|---|---|---|
| 5. | The antioxidant properties of Vitamin E determined by UV-VIS spectroscopy using the DPPH method. | Essays, laboratory work | 2 h [1,5] |
| 6. | Surface plasmon resonance in silver nanoparticles monitored by UV-VIS spectroscopy | Essays, laboratory work | 2 h [1,6,7] |
| 7. | FTIR spectrometer: technical specifications | Essays, laboratory work | 2 h [1] |
| 8. | Use of FTIR spectra in identification of pharmaceutical products. | Essays, laboratory work | 2 h [1,8] |
| 9. | IR Spectra analysis, deconvolution of fine structure peaks. | Essays, laboratory work | 2 h [1] |
| 10. | Fluorescence spectrometers and microscopy: technical details; spectra of chlorophyll | Essays, laboratory work | 2 h [1,3] |
| 11. | Structural vibration spectroscopy using Raman technique | Essays, laboratory work | 2 h [1,10] |
| 12 | Compositional analysis by mass spectrometry. | Essays, laboratory work | 2 h [1,11] |
| 13. | The Use of the FTIR-ATR technique to Examine Polymer coated surfaces | Essays, laboratory work | 2 h [1,12] |
| 14. | LIDAR – air pollutant measurements by Raman analysis | Essays, laboratory work | 2 h [1] |

**Bibliografie**

1. Laboratory reports (.pdf)
2. Biochim Biophys Acta. 1966 Jun 8;120(2):247-58. Absorption and fluorescence spectra of spinach chloroplast fractions obtained by solvent extraction. Cederstrand CN, Rabinowitch E, Govindjee.
3. Plant, Cell and Environment (2002) 25, 1663–1676 The use of chlorophyll fluorescence excitation spectra for the non-destructive in situ assessment of UV-absorbing compounds in leaves; Z. G. Cerovic, A. Ounis, A. Cartelat, G. Latouche, Y. Goulas, S. Meyer, I. Moya
4. https://en.wikipedia.org/wiki/CIE_1931_color_space
5. Estimation of antiradical properties of antioxidants using DPPH assay: A critical review and results; Krishnanand Mishra, Himanshu Ojha, Nabo Kumar Chaudhury; Food Chemistry 130 (2012) 1036–1043
6. International Journal of Pharmacy and Biological Sciences (e-ISSN: 2230-7605); IJPBS Volume 2 Issue 3 Jul-Sep 2012 pages 10-14; Synthesis and characterisation of silver nanoparticles; Basavaraj Udapudi, Praveenkumar Naik, Sabiha Tabassum Savadatti, Rupali Sharma, Samprita Balgi
7. Spectroscopy 17 (2003) 255–273 255; IOS Press; Surface plasmon resonance: principles, methods and applications in biomedical sciences; Patrick Englebienne, Anne Van Hoonacker, Michel Verhas
8. Yves Roggo, Pascal Chalus, Lene Maurer, Carmen Lema-Martinez, Aur´elie Edmond, Nadine Jent, A review of near infrared spectroscopy and chemometrics in pharmaceutical technologies, Journal of Pharmaceutical and Biomedical Analysis 44 (2007) 683–700
9. Amarendra Narayan Misra, Meena Misra and Ranjeet Singh, (2012) Chlorophyll Fluorescence in Plant Biology, Biophysics, Dr. Prof. Dr. A.N. Misra (Ed.), ISBN: 978-953-51-0376-9, InTech
10. Ewen Smith, Modern Raman Spectroscopy– A Practical Approach, John Wiley & Sons Ltd
11.Dr. Christoph A. Schalley Modern Mass Spectrometry, 2003 Springerlink
12. Advanced Aspects of Spectroscopy; Edited by Muhammad Akhyar Farrukh, ISBN 978-953-51-0715-6, 548 pages, Publisher: InTech, Chapters published August 29, 2012 under CC BY 3.0 license DOI: 10.5772/2757; Chapter 3 The Use of the FTIR-ATR technique to Examine the Polymers Surface by Wieslawa Urbaniak-Domagala
13. Advanced Aspects of Spectroscopy; Edited by Muhammad Akhyar Farrukh, ISBN 978-953-51-0715-6, 548 pages, Publisher: InTech, Chapters published August 29, 2012 under CC BY 3.0 license DOI: 10.5772/2757; Chapter 1 Electronic (Absorption) Spectra of 3d Transition Metal Complexes by S. Lakshmi Reddy, Tamio Endo and G. Siva Reddy

**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 | Critical analysis on the methods and criteria used to select the correct solutions to attain specified performance in a given application | summative evaluation | Written exam 50% |
| **10.5** Seminar/ Laborator | Physical interpretation on the results of experimental measurements or theoretical calculations, using appropriate numerical or statistical methods | formative evaluation | Practical work reports (30%) Individual project (essay) (20%) |
| **10.6** Standard minim de performanţă | | | |
| Application of an algorithm for a medium complexity software application (data acquisition and analysis, physical phenomena models)<br>Elaboration of an individual project by analysis of results presented in the literature | | | |

Data completării
27.09.2021

Titular de curs
Lect. Dr. Valentin Pohoaţă

Titular de seminar
Lect. dr. Valentin POHOAŢĂ

Data avizării în departament

Director de departament
Conf. Dr. Iordana Ștefanoaei

# 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 | **Fizică** |
| **1.4** Domeniul de studii | **Fizică** |
| **1.5** Ciclul de studii | **Master** |
| **1.6** Programul de studii / Calificarea | **Fizica pentru tehnologii avansate / Physics for Advanced Technologies** |

**2. Date despre disciplină**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2.1** Denumirea disciplinei | | | **Surse de plasma. Diagnoza plasmei/ Plasma Sources and Diagnosis** | | | | |
| **2.2** Titularul activităţilor de curs | | | **Prof. univ. dr. habil. Lucel SÎRGHI** | | | | |
| **2.3** Titularul activităţilor de laborator | | | **Prof. univ. dr. habil. Lucel SÎRGHI** | | | | |
| **2.4** An de studiu | **2** | **2.5** Semestru | **2** | **2.6** Tip de evaluare | **E** | **2.7** Regimul disciplinei* | **O** |

** 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 | | | | | **42** |
| Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren | | | | | |
| Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri | | | | | **42** |
| Tutoriat | | | | | **5** |
| Examinări | | | | | **5** |
| Alte activităţi ..... | | | | | |

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

**4. Precondiţii** (dacă este cazul)

| | |
|---|---|
| **4.1** De curriculum | General physics (mechanics, electricity and magnetism, physics of atom and molecule). Basics of plasma physics. |
| **4.2** De competenţe | Proficiency in written and oral English |

**5. Condiţii** (dacă este cazul)

| | |
|---|---|
| **5.1** De desfăşurare a cursului | |

| | |
|---|---|
| **5.2** De desfăşurare a seminarului/ laboratorului | performing all laboratory works is mandatory |

**6. Competenţe specifice acumulate**

| | |
|---|---|
| **Competenţe profesionale** | **C1** identification and proper use of laws, principles, notions and physical methods in various plasmas specific to specialization in physics of plasmas and plasma technological processing;<br>**C2** language skills at academic level, in foreign languages, needed for scientific documentation;<br>**C3** use the software for analyzing and processing experimental data and to perform virtual experiments; |
| **Competenţe transversale** | **CT1** understanding and ability to apply the principles and the values of the professional and research ethics.<br>**CT2** capacity of interrelationing and teamworking;<br>**CT3** opening to lifelong learning. |

**7. Obiectivele disciplinei** (din grila competenţelor specifice acumulate)

| | |
|---|---|
| **7.1 Obiectivul general** | • Familiarizing students with the methods and techniques of plasma diagnostics<br>• Acquiring knowledge on: 1) plasma parameters in technological facilities, laboratory and in nature; 2) techniques and methods employed in measuring and monitoring plasma parameters; 3) control plasmas in the laboratory and technological facilities.<br>• Familiarizing students with standard laboratory equipment, understanding the principles of operation, and the interpretation of results. Deepening the theoretical knowledge and acquiring good laboratory practice. |
| **7.2 Obiectivele specifice** | On successful completion of this discipline, students will be able to:<br>♣ Explain the principles of the main methods of measurement of plasmas parameters<br>♣ Describe the methods and models used in plasma diagnostics.<br>♣ Use appropriately of the scientific terminology specific to the field of plasma physics<br>♣ Analyze the processes occurring in plasma, processes on which are based the principles of plasma measurements |

**8. Conţinut**

| **8.1** | **Curs** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | Introduction. Plasma parameters. Classification of plasmas and plasma diagnostics methods. Low pressure plasmas. Experimental and industrial plasma devices. Monitoring of gas pressure and gas flow | Lecture presentation, explanation, demonstration, discussion | 2 |
| 2. | Direct current glow discharge in gases at low pressure. Negative glow and positive column plasmas | Lecture presentation, explanation, demonstration, discussion | 2 |

| | | | |
|---|---|---|---|
| 3. | Radio frequency plasma. Measuring of voltage, current intensity, power and impedance of dc and rf. electrical discharges in gases. | Lecture presentation, explanation, demonstration, discussion | 2 |
| 4. | Plasma as source of radiation. Determination of molecular and atomic composition by mass and optical spectroscopy. Spectral measurements of optical adsorption and emission in plasmas. Measurements of Stark width of optical emission lines. Measurements of Faraday rotation of light polarization in plasma | Lecture presentation, explanation, demonstration, discussion | 2 |
| 5. | Plasmas of microwave discharges. Microwave power measurements | Lecture presentation, explanation, demonstration, discussion | 2 |
| 6. | Magnetron discharge | Lecture presentation, explanation, demonstration, discussion | 2 |
| 7. | Electrical discharge plasmas in magnetic field. Measurements of electric and magnetic fields in plasma. Capacitive and B dot probes. | Lecture presentation, explanation, demonstration, discussion | 2 |
| 8. | Plasma potential. Floating potential. Bohm current. Measurement of plasma potential by emissive probe. | Lecture presentation, explanation, demonstration, discussion | 2 |
| 9. | Diffusion plasma in a discharge with multi-polar magnetic field confinement. Density and temperature of electrons. Electron and ion currents of Langmuir probe. | Lecture presentation, explanation, demonstration, discussion | 2 |
| 10. | Fusion plasma. Microwave methods of measuring plasma density. Plasma density by measurements of Thomson light scattering | Lecture presentation, explanation, demonstration, discussion | 2 |
| 11. | Fusion plasma. Plasma density measurements by Bremstasslung radiation and cyclotron radiation | Lecture presentation, explanation, demonstration, discussion | 2 |
| 12. | Energy distribution function of electrons. Method of II$^{nd}$ derivative of I-V characteristic of Langmuir probe in non stationary plasmas, radiofrequency and microwave plasmas. | Lecture presentation, explanation, demonstration, discussion | 2 |
| 13. | Measurements of velocity distribution function. Electrostatic analyzer, directive probes and multi channel probes. Faraday probe. | Lecture presentation, explanation, demonstration, discussion | 2 |

| | | | |
|---|---|---|---|
| 14. | Atmospheric pressure plasmas. Plasma sources and applications. | Lecture presentation, explanation, demonstration, discussion | 2 |

**Bibliografie**

**Referinţe principale:**

1. H. Hudchinson, *Principles of Plasma Diagnostics*, 2nd edition, Cambridge University Press 2002
2. D. L. Flamm, *Plasma Diagnostics*, Ed. Orlando Auciello, Academic Press Inc. San Diego 1989.
3. W. Lochte-Holtgreeven, *Plasma Diagnostics*, North-Holland Pub. Comp., Amsterdam 1968.
4. R. H. Huddlestone, *Plasma Diagnostics* Techniques, Acad. Press, NY 1965.
5. G. Popa si L. Sirghi, *Bazele fizicii plasmei*, Ed. Univ. “Al. I. Cuza” 2004
6. Michael A. Lieberman, Allan J. Lichtenberg, *Principles of Plasma Discharges and Materials Processing, Second Edition*.Willey and Sons, New Jersey 2005.

**Referinţe suplimentare:**

1. D. Ciubotariu, I.I. Popescu, Bazele fizicii plasmei, Ed. tehnică, 1987
2. E. Badarau, I.I. Popescu - Fizica descărcărilor în gaze, Ed. tehnică, 1965
3. I.I. Popescu, I. Iova, E. Toader - Fizica plasmei şi aplicaţii, Ed. ştiinţifică şi enciclopedică, 1981
4. F.F. Chen – Introduction to plasma physics, Plenum Press., 1985

| **8.2** | **Seminar / Laborator** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | Introduction in laboratory procedures, protocols ans safety regulations | Presentation, explanation, demonstration, discussion | 2 |
| 2. | Current –voltage characteristics of cold and hot cathode discharge plasmas. Hysteresis effects. | conducted experiment, explanation, discussion. | 2 |
| 3. | Digital data acquisition and processing. Time series and I-V characteristic data acquisitions. | conducted experiment, explanation, discussion.. | 2 |
| 4. | Radial profile of light emission density of positive plasma column by inverse Abel transformation | conducted experiment, explanation, discussion. | 2 |
| 5. | Study of saturation electronic and ionic currents of a cylindrical Langmuir probe in an homogeneous plasma; | conducted experiment, explanation, discussion. | 2 |
| 6. | Langmuir probe I-V characteristics in plasmas with two groups of electrons | conducted experiment, explanation, discussion. | 2 |
| 7. | Study of double electrical probe characteristics in homogenous plasma in absence of electric field. Measurement of electron density and temperature; | conducted experiment, explanation, discussion. | 2 |
| 8. | Study of double probe characteristics in the inhomogeneous plasma of a positive column in presence of the electric field. | conducted experiment, explanation, discussion. | 2 |

| | | | |
|---|---|---|---|
| | Measurements of the electric field intensity. | | |
| 9. | Study of double probe characteristics in the inhomogeneous plasma of a positive column in presence of the electric field. Measurements of the electric field intensity. | conducted experiment, explanation, discussion. | 2 |
| 10. | Use of triple electrical probe for measurements of electron temperature in a homogeneous stationary and transient plasmas; | conducted experiment, explanation, discussion. | 2 |
| 11. | Measuring of plasma potential with an emissive probe; | conducted experiment, explanation, discussion. | 2 |
| 12. | Determination of ion energy distribution function by an electrostatic analyzer. | conducted experiment, explanation, discussion. | 2 |
| 13. | Determination of density and velocity distribution function of atoms in magnetron plasma by laser induced fluorescence laser resonant absorption; | conducted experiment, explanation, discussion. | 2 |
| 14. | Colloqvium. | written evaluation test. | 2 |

**Bibliografie**

1. G. Popa, D. Alexandroaei, Îndrumar de lucrări practice pentru fizica plasmei, Ed. Universităţii Alexandru Ioan Cuza, Iaşi, 1991
2. G. Popa, L. Sîrghi – Bazele fizicii plasmei, Ed. Universităţii Alexandru Ioan Cuza, Iaşi, 2000
3. H. Hudchinson, *Principles of Plasma Diagnostics*, 2nd edition, Cambridge University Press 2002
4. D. L. Flamm, *Plasma Diagnostics*, Ed. Orlando Auciello, Academic Press Inc. San Diego 1989.
5. W. Lochte-Holtgreeven, *Plasma Diagnostics*, North-Holland Pub. Comp., Amsterdam 1968.

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

Students acquire basic knowledge in the field of plasma diagnostics and are then able to use this knowledge in practical applications (determining and monitoring various parameters of plasmas in laboratory and technological facilities , skills that are required in scientific research and industry activities.

**10. Evaluare**

| Tip activitate | 10.1 Criterii de evaluare | 10.2 Metode de evaluare | 10.3 Pondere în nota finală (%) |
|---|---|---|---|
| **10.4** Curs | - Completeness and accuracy of knowledge; | Summative (final) - oral exam. | 75 |

| | | | |
|---|---|---|---|
| | - Ability to work with their learned knowledge;<br>- Ability to analyze, interpret personally and originality the physics phenomena in plasmas;<br>- creativity and logical consistency.<br>- Active participation in laboratory works;<br>- Ability to apply learned knowledge into practice. | | |
| **10.5** Seminar / Laborator | | Formative assessment (ongoing) and summative (final) - Laboratory colloquium. | 25 |
| **10.6** Standard minim de performanţă | | | |
| -Learning correctly of the key techniques and methods used in plasma diagnostics.<br>-Understanding of basic principles of investigation of different plasma systems<br>-Completion of laboratory works. | | | |

Data completării
28.09.2021

Titular de curs

Prof.univ.dr.habil. Lucel SIRGHI

Titular de laborator

Prof.univ.dr.habil. Lucel SIRGHI

Data avizării în departament

Director de departament

Conf.univ.dr. Iordana ASTEFANOAIEI

# FIŞA DISCIPLINEI

**2021-2022**

## 1. Date despre program

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

## 2. Date despre disciplină

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

* *OB – Obligatoriu / OP – Opţional*

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

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

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

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

## 4. Precondiţii (dacă este cazul)

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

## 5. Condiţii (dacă este cazul)

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

**6. Competenţe specifice acumulate**

| | |
|---|---|
| **Competenţe profesionale** | **C1.** identification and proper use of laws, principles, notions and physical methods in various circumstances;<br>**C2.** analysis and communication of physics information with didactical, scientific and popularization character;<br>**C3.** capacity of interrelationing and teamworking;<br>**C4.** application of Physics knowledge to practical situations;<br>**C5.** opening to lifelong learning. |
| **Competenţe transversale** | **CT1.** mastery of research methods and techniques, specific to the Master specialization<br>**CT2.** language skills at academic level, in foreign languages, needed for scientific documentation;<br>**CT3.** use of communication and information technologies;<br>CT4. use the software for analyzing and processing experimental data and to perform virtual experiments;<br>**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.<br>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;<br>▪ application of knowledge to practical situations;<br>▪ Ability in extracting information from a large variety of sources.<br>▪ Use of specific software for analyzing and processing experimental data; |

**8. Conţinut**

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

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

**Bibliografie**

**Referinţe principale:**

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

**Referinţe suplimentare:**

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

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

**Bibliografie**

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

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

**10. Evaluare**

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

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

| Data completării | Titular de curs | Titular de seminar |
|---|---|---|
| 1 October 2021 | CONF. DR. Iordana AȘTEFĂNOAEI<br>prof. dr. Ciprian DARIESCU | prof. dr. Ciprian DARIESCU |

Data avizării în departament

Director de departament
Conf. univ. dr. Iordana Astefanoaei

# FIŞA DISCIPLINEI

## 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 | **Physics for Advanced Technologies** |

## 2. Date despre disciplină

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2.1** Denumirea disciplinei | | | **Practical work** | | | | |
| **2.2** Titularul activităţilor de curs | | | | | | | |
| **2.3** Titularul activităţilor de seminar | | | **Lect.dr. habil.Lavinia-Petronela Curecheriu** | | | | |
| **2.4** An de studiu | **II** | **2.5** Semestru | **2** | **2.6** Tip de evaluare | **CO** | **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 | **0** | **3.3** seminar/laborator | **4** |
| **3.4** Total ore din planul de învăţământ | **48** | din care: **3.5** curs | **0** | **3.6** seminar/laborator | **48** |

| | |
|---|---|
| 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 seminarii/laboratoare, teme, referate, portofolii şi eseuri | **16** |
| Tutoriat | **0** |
| Examinări | **13** |
| 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 | Solid state Physics, Theoretical Physics, Electricity and Magnetism |
| **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 | |

| | |
|---|---|
| **5.2** De desfăşurare a seminarului/ laboratorului | Lecture room with multimedia tools (projector, screen) and acces to Zoom and CISCO Webex |

**6. Competenţe specifice acumulate**

| | |
|---|---|
| **Competenţe profesionale** | **C1.** Language skills at academic level, in foreign languages, needed for scientific documentation;<br>**C2.** Capacitaty to study recommended bibliography, to sinthesise scientific information and critically discuss models for interpretation of materials properties.<br>**C3.**<br>**C4.**<br>**C5.** |
| **Competenţe transversale** | **CT1.** Understanding and ability to apply the principles and the values of the professional and research ethics<br>**CT2.** Capacity of communication concerning scientific results, ability to realise a scientific presentation concerning materials with techological applications;<br>**CT3.** Capacity to realise a personal project of bibliographycal or scientific research; |

**7. Obiectivele disciplinei** (din grila competenţelor specifice acumulate)

| | |
|---|---|
| **7.1 Obiectivul general** | **Development the capacity to study the recommended bibliography and to sinthesise scientific information and critically discuss** |
| **7.2 Obiectivele specifice** | After successfully finalising this discipline, the students will be able to:<br>• to read and understand a scientific article in their research field |

**8. Conţinut**

| **8.1** | **Curs** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |

| | | | |
|---|---|---|---|
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| 12. | | | |
| 13. | | | |
| 14. | | | |

**Bibliografie**

**Referinţe principale:**

**Referinţe suplimentare:**

| **8.2** | **Seminar / Laborator** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | Dissertation thesis: structure, content and references. Exemple of thesis | Power Point presentation | 4h |
| 2. | How to write a scientific paper: choose the journal, paper structure, paragraph content, paper revision, publication. | Power Point presentation | 2h |
| 3. | How to „survive” after graduating in materials science: Survival skills for scientist | Power Point presentation | 2h |
| 4. | How to „survive” after graduating in materials science: basic advice | Power Point presentation | 2h |
| 5. | How to „survive” after graduating in materials science: the peer review system | Power Point presentation | 2h |

| | | | |
|---|---|---|---|
| 6. | Scientific misconduct: fabrication, falsification and plagiarism | Power Point presentation | 2h |
| 7. | Plagiarism case | Power Point presentation | 2h |
| 8. | „State of the art” in field of own research | Lecture, powerpoint presentation, discussion | 32h |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| 12. | | | |
| 13. | | | |
| 14. | | | |

**Bibliografie**

Journal of Materials Education
Web of Knowledge
Robert Day (1995): How to write and publish a scientific paper. 4th Edition, Cambridge University Press
http://uefiscdi.gov.ro/
www.wikipedia.org
http://portal.isiknowledge.com/

**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 | | | |
| **10.5** Seminar/ Laborator | Implication, quality of contribuitions, assuming charges and activities in workteam, collaboration in the workgroup | Individual project, lab portfolio, | 100% |
| **10.6** Standard minim de performanţă | | | |

| |
|---|
| 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<br>25.09.2021 | Titular de curs | Titular de seminar<br>Lect.dr. habil.Lavinia-Petronela Curecheriu |
| Data avizării în departament | | Director de departament<br>Conf.univ.dr. Iordana Ștefănoaei |

# FIŞA DISCIPLINEI

## 1. Date despre program

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

## 2. Date despre disciplină

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

** OB – Obligatoriu / OP – Opţional*

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

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

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

## 4. Precondiţii (dacă este cazul)

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

## 5. Condiţii (dacă este cazul)

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

**6. Competenţe specifice acumulate**

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

**7. Obiectivele disciplinei** (din grila competenţelor specifice acumulate)

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

**8. Conţinut**

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

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

**Bibliografie**

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

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

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

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

**Bibliografie**

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

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

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

**10. Evaluare**

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

Data completării
24.09.2020

Titular de curs
Assoc. Prof. Vasile Țura

Titular de seminar
Assoc. Prof. Vasile Țura

Data avizării în departament

Director de departament

# FIŞA DISCIPLINEI

## 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 | **Physics for Advanced Technologies** |

## 2. Date despre disciplină

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2.1** Denumirea disciplinei | | | **Speciality practical work** | | | | |
| **2.2** Titularul activităţilor de curs | | | | | | | |
| **2.3** Titularul activităţilor de seminar | | | **Lect.dr.habil. Lavinia-Petronela Curecheriu** | | | | |
| **2.4** An de studiu | **II** | **2.5** Semestru | **2** | **2.6** Tip de evaluare | **CO** | **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 | **0** | **3.3** seminar/laborator | **4** |
| **3.4** Total ore din planul de învăţământ | **48** | din care: **3.5** curs | **0** | **3.6** seminar/laborator | **48** |

| | |
|---|---|
| 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 seminarii/laboratoare, teme, referate, portofolii şi eseuri | **16** |
| Tutoriat | **0** |
| Examinări | **13** |
| 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 | Solid state Physics, Theoretical Physics, Electricity and Magnetism |
| **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 | |

| | |
|---|---|
| **5.2** De desfăşurare a seminarului/ laboratorului | Lecture room with multimedia tools (projector, screen), acces to Zoom and CISCO Webex and acces to labs with specific equipments/tools for the characterisation of advanced materials |

**6. Competenţe specifice acumulate**

| | |
|---|---|
| **Competenţe profesionale** | **C1.** Language skills at academic level, in foreign languages, needed for scientific documentation;<br>**C2.** Capacitaty to study recommended bibliography, to sinthesise scientific information and critically discuss models for interpretation of materials properties.<br>**C3.**<br>**C4.**<br>**C5.** |
| **Competenţe transversale** | **CT1.** Understanding and ability to apply the principles and the values of the professional and research ethics<br>**CT2.** Capacity of communication concerning scientific results, ability to realise a scientific presentation concerning materials with techological applications;<br>**CT3.** Capacity to realise a personal project of bibliographycal or scientific research; |

**7. Obiectivele disciplinei** (din grila competenţelor specifice acumulate)

| | |
|---|---|
| **7.1 Obiectivul general** | **Development the capacity to propose and follow the research methodology necessary for the elaboration of the dissertation thesis** |
| **7.2 Obiectivele specifice** | After successfully finalising this discipline, the students will be able to:<br>• to use the investigation techniques specific to their reasearch |

**8. Conţinut**

| **8.1** | **Curs** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
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| 1. | | | |
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**Bibliografie**

**Referinţe principale:**

**Referinţe suplimentare:**

| **8.2** | **Seminar / Laborator** | **Metode de predare** | **Observaţii** (ore şi referinţe bibliografice) |
|---|---|---|---|
| 1. | Dissertation thesis: structure and experimental methods | Power Point presentation | 4h |
| 2. | Research methodology | Power Point presentation | 4h |
| 3. | Experimental tools used in their dissertation | Power Point presentation | 6h |
| 4. | Write a scientific paper: experimental methods, results, discussion | Power Point presentation | 4h |
| 5. | Experimental methods | Power Point presentation | 4h |
| 6. | Experimental/theoretic study for dissertation thesis | Power Point presentation | 26h |

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|---|---|---|---|
| 7. | | Power Point presentation | 2h |
| 8. | | Lecture, powerpoint presentation, discussion | 40h |
| 9. | | | |
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| 11. | | | |
| 12. | | | |
| 13. | | | |
| 14. | | | |

**Bibliografie**

Journal of Materials Education
Web of Knowledge
Robert Day (1995): How to write and publish a scientific paper. 4th Edition, Cambridge University Press
http://uefiscdi.gov.ro/
www.wikipedia.org
http://portal.isiknowledge.com/

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

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**10. Evaluare**

| **Tip activitate** | **10.1 Criterii de evaluare** | **10.2 Metode de evaluare** | **10.3 Pondere în nota finală (%)** |
|---|---|---|---|
| **10.4** Curs | | | |
| **10.5** Seminar/ Laborator | Implication, quality of contribuitions, assuming charges and activities in workteam, collaboration in the workgroup | Individual project, lab portfolio, | 100% |
| **10.6** Standard minim de performanţă | | | |
| 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. | | | |

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|---|---|---|
| Data completării<br>25.09.2021 | Titular de curs | Titular de seminar<br>Lect.dr. habil. Lavinia-Petronela Curecheriu |
| Data avizării în departament | | Director de departament<br>Conf.univ.dr. Iordana Ștefănoaei |