FIŞA DISCIPLINEI

2023/2024

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			**Prof. Dan-Gheorghe DIMITRIU, Assoc. prof. Sebastian POPESCU**				
2.3 Titularul activităţilor de seminar			**Prof. Dan-Gheorghe DIMITRIU, Assoc. prof. Sebastian POPESCU**				
2.4 An de studiu	**2**	**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					**15**
Tutoriat					**30**
Examinări					**4**
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	Mechanics, Thermodynamics, Differential Equations, Electrodynamics, Electricity and Magnetism/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	Online within the maximum limit of the procentage approved by the Faculty’s Council (if necessary)

5.2 De desfăşurare a seminarului/ laboratorului	Online within the maximum limit of the procentage approved by the Faculty's Council (if necessary)

6. Competenţe specifice acumulate

Competenţe profesionale	**C1.** Identification of the main subjects related to the physics of chaotic phenomena **C2.** Critical analysis of the results obtained by using the known models/theories **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 **CT2.** Analysis and communication of Physics information with didactical, scientific and popularization character; **CT3.** Opening to lifelong learning; **CT4.** Language skills at academic level, in English, needed for scientific documentation; **CT5.** Use of communication and information technologies; **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: ▪ Analyze different physical phenomena leading to similar behaviors of different nonlinear systems; ▪ Understand the self-assembling mechanisms of self-organized structures which appear in different complex systems; ▪ Use the current methods of study of self-organized systems; ▪ Formulate hypotheses and models on the obtained experimental research results ▪ Critically analyse the obtained results by using the known models/theories ▪ 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]
2.	Qualitative changes in the dynamics of nonlinear systems. Bifurcations.	Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education	4 hours [1,3,4]
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]

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]
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]
6.	Nonlinear oscillations	Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education	3 hours, [1,3,4]
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]
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]
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]
10.	Self-organization in fluids and magnetofluids	Presentation, demonstration, conversation, university lecture, synthesizing analysis, computer assisted education	3 hours [5]

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	4 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	4 hours, [1-3] onsite
5.	Chua chaotic circuit. Control of chaos. Synchronization of chaotic circuits.	Experiment, synthesizing analysis, computer assisted education	2 hours, [1-3] onsite
6.	Nonlinear oscillations	Exercise solving, discussions	2 hours, [1] online
7.	Modeling nonlinear systems	Exercise solving, discussions	2 hours, [1,4] online
8.	Reaction – diffusion systems	Exercise solving, discussions	4 hours online
9.	Negative differential resistance	Exercise solving, discussions	2 hours online
10.	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.
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 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
22.09.2023	Prof. Dan-Gheorghe DIMITRIU	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

2023-2024

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. habil. Claudiu COSTIN**				
2.3 Titularul activităţilor de seminar			**Prof. dr. Diana Mihaela MARDARE, Conf. dr. habil. 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					**25**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**20**
Tutoriat					**12**
Examinări					**2**
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	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	Room with videoprojector and projection screen, blackboard or whiteboard.

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). **C2.** Understanding and ability to apply the principles and the values of the professional and research ethics (1 credit). **C3.** Use the software for analyzing and processing experimental data and to perform virtual experiments (1 credit). **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). **CT2.** Application of Physics knowledge to practical situations (1 credit). **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: ▪ Understand and explain the main transport and transfer phenomena in solid bodies, fluids and plasmas. ▪ Calculate the relaxation time for different scatttering mechanisms of the charge carriers in solid bodies. ▪ Correlate the deposition conditions with the photocatalytic properties of a thin film. ▪ Apply the concepts of transfer phenomena to real life situations (estimation of mass and energy losses in experimental, industrial and current usage devices). ▪ 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 notions.	Lecture, explanation, demonstration, debate	2h / [1-3]
2.	Boltzmann transport equation. Relaxation time. Part I.	Lecture, explanation, demonstration, debate	2h / [1-3]
3.	Boltzmann transport equation. Relaxation time. Part II.	Lecture, explanation, demonstration, debate	2h / [1-3]
4.	Scatttering mechanisms of the charge carriers in solid bodies.	Lecture, explanation, demonstration, debate	2h / [1-3]
5.	Processes at different interfaces.	Lecture, explanation, demonstration, debate	2h / [1-3]

6.	Processes at different interfaces.	Lecture, explanation, demonstration, debate	2h / [1-3]
7.	Electronic processes in photocatalysis.	Lecture, explanation, demonstration	2h / [4,5]
8.	The three moments of the Boltzmann equation: mass, momentum and energy transfer equations.	Lecture, explanation, demonstration	2h / [6,7]
9.	Momentum transfer. Viscosity and the mechanism of momentum transfer. Newton's law of viscosity. Molecular theory of the viscosity of gases.	Lecture, explanation, demonstration	2h / [8,9]
10.	Momentum transfer. Generalization of Newton's law of viscosity. Navier Stokes Equation. Reynolds number. Streamlines.	Lecture, explanation, demonstration, debate	2h / [8,9]
11.	Mass transport. Fick's law of diffusion. Equation of diffusion.	Lecture, explanation, demonstration	2h / [8-10]
12.	Plasma diffusion in a magnetic field. Transport coefficients in plasmas.	Lecture, explanation, demonstration, debate	2h / [8-10]
13.	Heat transfer. Coduction. Fourier's law. Thermal conductivity.	Lecture, explanation, demonstration	2h / [8-10]
14.	Heat transfer. Convection. Radiation.	Lecture, explanation, demonstration	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	Laboratory experiment	2h / [1,3]
2.	Effective mass of charge carriers	Solving problems and exercises	2h / [3,4]
3.	Demonstration of different relations presented during the course. Part I.	Solving problems and exercises	2h / [3]
4.	Demonstration of different relations presented during the course. Part II.	Solving problems and exercises	2h / [3]
5.	Different expressions of the relaxation time.	Solving problems and	2h / [1]

		exercises	
6.	Study of the photocatalytic /hydrophilic properties of a material. Part I.	Driven experiment	2h / [1,2,5]
7.	Study of the photocatalytic /hydrophilic properties of a material. Part II.	Driven experiment	2h / [1,2,5]
8.	Study of the ambipolar diffusion in a non-magnetized plasma.	Laboratory experiment, observation	2h / [6]
9.	Study of the diffusion in a magnetized plasma.	Laboratory experiment	2h / [6]
10.	Gas flow measurements. Calibration of a needle valve.	Laboratory experiment	2h / [7,8]
11.	Solving 1D mass transfer equation using numerical methods.	Solving problems by numerical methods	2h / [7,8]
12.	Solving 2D mass transfer equation using numerical methods.	Solving problems by numerical methods	2h / [7,8]
13.	Computing electron drift velocity in magnetized plasmas.	Solving problems by numerical methods	2h / [9]
14.	Computing electron difusion coefficient in magnetized plasmas.	Solving problems by numerical methods	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; - capacity of operating with the acquired knowledge; - capacity of analysis, personal interpretation, originality, creativity.	Summative assessment (final) - written exam.	50 %
10.5 Seminar/ Laboratory	- active participation to practical works; - the capacity of using in practice the acquired knowledge.	Formative assessment (during the semester) - work projects.	50 %
10.6 Standard of minimum performance			
Minimum mark to both course and laboratory: 5. Independent solving of a typical problem of medium complexity using the formalism of transfer phenomena. Attendance to laboratories and seminars (100%). Written report for every practical work.			

Data completării
25.09.2023

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

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

Data avizării în departament

Director de departament,
Conf. dr. habil. Iordana AŞTEFĂNOAEI

FIŞA DISCIPLINEI

2023/2024

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	**Etică şi integritate academică**							
2.2 Titularul activităţilor de curs	**Prof. univ. dr. Cristian ENĂCHESCU**							
2.3 Titularul activităţilor de seminar	**Prof. univ. dr. Cristian ENĂCHESCU**							
2.4 An de studiu	**2**	**2.5** Semestru	**1**	**2.6** Tip de evaluare	**EVP**	**2.7** Regimul discipinei*	**OB**	

** OB – Obligatoriu / OP – Opţional*

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

3.1 Număr de ore pe săptămână	**2**	din care: **3.2** curs	**1**	**3.3** seminar/laborator	**1**	
3.4 Total ore din planul de învăţământ	**28**	din care: **3.5** curs	**14**	**3.6** seminar/laborator	**14**	
Distribuţia fondului de timp						ore
Studiu după manual, suport de curs, bibliografie şi altele						**9**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren						**5**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri						**6**
Tutoriat						
Examinări						**2**
Alte activităţi						

3.7 Total ore studiu individual	**22**
3.8 Total ore pe semestru	**50**
3.9 Număr de credite	**2**

4. Precondiţii (dacă este cazul)

4.1 De curriculum	**Nu**
4.2 De competenţe	**Nu**

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. Experiză avansată în domeniu C2. Competențe de a identifica, implementa și oferi soluții problemelor de cercetare
Competenţe transversale	CT1. Competențe de comunicare orală și scrisă CT2. Folosirea mijloacelor IT și a tehnologiilor informaționale CT3. Lucrul în echipă și abilitățsi sociale

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	Însușirea de cunoștințe privind metodologia și etica cercetării științifice
7.2 Obiectivele specifice	La finalizarea cu succes a acestei discipline, studenţii vor fi capabili să: ▪ Prelucreze și analizeze informații în mod corect dintr-o varietate de surse bibliografice ▪ Cunoască metodologia cercetării științifice ▪ Cunoască principiile fundamentale ale cercetării științifice ▪ Cunoască ce este un plagiat ▪ Cunoască obligațiile pe care le au cercetătorii ▪ Cunoască responsabilitățile ce revin autorilor unui articol științific ▪ Identifice elementele unei conduite necorespunzătoare în cercetare

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1	Considerații istorice și fiolosofice asupra eticii	Prelegere, exemplificare	1 ora
2	Principiile fundamentale ale cercetării ştiinţifice	Prelegere, exemplificare	1 ora
3	Etica cercetării	Prelegere, exemplificare	1 ora
4	Conduita necorespunzătoare în cercetare	Prelegere, exemplificare	1 ora
5	Etică și comunicare științifică. Autorii și rolul lor	Prelegere, exemplificare	1 ora
6-7	Plagiat și auto-plagiat	Prelegere, exemplificare	2 ore
8-9	Citarea și referințele bibliografice	Prelegere, exemplificare	2 ore
10-11	Mentoratul și colaborările științifice	Prelegere, exemplificare	2 ore
12	Managementul datelor	Prelegere, exemplificare	1 ora

13	Reglementarea eticii în România	Prelegere, exemplificare	1 ora
14	Știință și responsabilitate socială	Prelegere, exemplificare	1 ora

Bibliografie

1. Roy Jensen, Communicating Science-an introductory guide for conveying scientific information to academic and public audiences, Second edition, ISBN 978-0-9937397-3-6 (electronic edition), 2016.
2. Jaime A. Teixeira da Silva and Judit Dobra´nszki, Multiple Authorship in Scientific Manuscripts: Ethical Challenges, Ghost and Guest/Gift Authorship, and the Cultural/Disciplinary Perspective, Sci. Eng. Ethics 22 (2016) 1457–1472.
3. Karen Englander, Writing and Publishing Science Research Papers in English-A Global Perspective, Springer Dordrecht Heidelberg NewYork London, 2014.
4. B. L. N. Kennet, Planning and Managing Scientifc Research- A guide for the beginning researcher, ANU Press, The Australian National University Canberra, 2014.
5. John D'Angelo, Ethics in Science- Ethical Misconduct in Scientific Research, CRC Press, Taylor & Francis, Boca Raton London New York, 2012.
6. A. Yavuz Oruç, Handbook of Scientifc Proposal Writing, CRC Press, Taylor & Francis, Boca Raton London New York, 2012.
7. L. Scott Montgomery, The Chicago guide to communicating science, The University of Chicago Press, Chicago and London, 2003.
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9. European Comission, Ethics for researchers – Facilitating Research Excellence, Bruxelles, 2013
10. "On Being a Scientist: Responsible Conduct in Research"; National Academy Press, Washington D.C, 2009
11. S. Florea, Plagiatul și încălcarea dreputilor de autor, Dezbateri juridice, https://www.juridice.ro/467536/plagiatul-si-incalcarea-drepturilor-de-autor.html
13. Legea nr. 206 din 27 mai 2004
14. Codul de etică al UAIC
15.Ghidul de integritate CNECSTDI
16. Ghidul anti-plagiat SNSPA

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1	Principiile fundamentale ale cercetării ştiinţifice	Conversație euristică	1 ora
2-3	Etica cercetării în contextul legislației și reglementărilor actuale românești și europene	Conversație euristică	2 ore
4	Conduita necorespunzătoare în cercetare	Conversație euristică	1 ora
5	Autorii și rolul lor	Conversație euristică	1 ora
6-7	Plagiat și auto-plagiat	Conversație euristică	2 ore
8-9	Citarea și referințele bibliografice	Conversație euristică	2 ore
10-11	Mentoratul și colaborările științifice	Conversație euristică	2 ore
12-13	Managementul datelor	Conversație euristică	2 ore
14	Știință și responsabilitatea socială	Conversație euristică	1 ora

9. Coroborarea conţinutului disciplinei cu aşteptările reprezentanţilor comunităţii, asociaţiilor

profesionale şi angajatorilor reprezentativi din domeniul aferent programului

În contextul actual, cunoașterea noțiunilor de etică și integritate este esențiala pentru asigurarea corectitudinii activităților desfășurate de studenți și pentru activitatea viitorilor cercetători.

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		Probe practice, discutarea unor studii de caz	100%
10.6 Standard minim de performanţă			
• Studenții trebuie să fie capabili să înțeleagă și să aplice regulile de etică în cercetarea științifică			

Data completării
28.09.2023

Titular de curs
Prof.dr. Cristian Enăchescu

Titular de seminar
Prof.dr. Cristian Enăchescu

Data avizării în departament

Director de departament
Conf.dr. Iordana Aștefănoaei

FIŞA DISCIPLINEI

2023/2024

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	**Nanocomposite materials: design, physico-chemical properties and applications**						
2.2 Titularul activităţilor de curs	**Prof. dr. Liliana Mitoşeriu**						
2.3 Titularul activităţilor de seminar	**Conf. dr. Lavinia Curecheriu**						
2.4 An de studiu	**2**	**2.5** Semestru	**1**	**2.6** Tip de evaluare	**EVP**	**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					**25**	
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**21**	
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**19**	
Tutoriat					**0**	
Examinări					**4**	
Alte activităţi					**0**	

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

4. Precondiţii (dacă este cazul)

4.1 De curriculum	**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 preparation, microstructural characterisation and electrical properties of composites; Acces internet, CISCO Webex platform, Skype, etc. Laborator cu echipamente specifice pentru preparare, caracterizare micro-nanostructurala si de faza a compozitelor.

6. Competenţe specifice acumulate

Competenţe profesionale	**C1.** Capability to identify and use laws and principles in order to design and realise composites with defined structural and functional properties. **C2.** Capability to classify and describe composite materials. **C3.** Capacity of analysis and understanding the results of dielectric and magnetic measurements of specific composite structures **C4.** Capability of elaboreation of a bibliographic study concerning the functional composites materials.
Competenţe transversale	**CT1.** Capacity of communication concerning scientific results, ability to realise a scientific presentation concerning composite materials with techological applications; **CT2.** Capacity of collaboration and working in a team; **CT3.** Capacity to realise a personal project of bibliographycal/scientific research concerning composite complex materials; **CT4.** Open and positive attitude for solving problems and assuming the professional deontological principles and values. **CT5.** Development of critical capacity to read and use scientific literature and produce a scientific report in a topic concerning nanocomposites. **CT6.** Formation of competences in the use of softwares for virtual experiments, data analysis amd evaluation of errors.

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

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

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)

1.	Introduction in composites. Mixing scale, matrices, filling factor. Classification, examples and applications.	Lecture, Power Point presentation	2h
2.	Composites in archeological artefacts. Examples.	Lecture, Power Point presentation	4h
3.	Biomposites. Case studies. Structuring and hierarchisation. Bio-inspired composites	Lecture, Power Point presentation	4h
4.	Caracterisation of phase interconnectivity by (n, m) numbers. Examples	Lecture, Power Point presentation. Case study	2h
5.	Sum, product and combinatorial properties in composites	Lecture, Power Point presentation. Case studies	2h
6.	Ceramic-based composites. Classification and applications	Lecture, Power Point presentation	2h
7.	Caracterisation of oxide particulated composites	Lecture, Power Point presentation	2h
8.	Pressing and sintering of composite ceramics. Sintering mechanisms.	Lecture, Power Point presentation. Case studies	2h
9.	Phase and microstructural characterisation of composites. Single-phase materials, doped materials, composites. Examples	Lecture, Power Point presentation. Case studies	2h
10.	Polymer-based composites. Classification of polymer matrices. Electroactive polymers. Applications in transparent and flexible electronics. Bio-medical applications	Magistral lecture. Case studies	4h
11.	Carbon structures, carbon-based composites. Characterisation and applications.	Lecture. Case studies	2h

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Principal references:

- M. Taya, Electronic composites, Cambridge Univ. Press., 2005
- P. Knauth, J. Schoonman (eds.), Electronic Materials: Science&Technol., Nanocomposites, Ed. Springer 2008
- G.W. Milton, The theory of composites, Cambridge Univ. Press. 2004
- M.A. Stroscio, M. Dutta (ed): Biological nanostructures and applications of nanostructures in biology. Electrical, mechanical and optical properties, Kluwer Academic, 2004, ISBN 0-306-48627-X.
- G.W. Milton, The theory of composites, Cambridge Univ. Press. 2004
- Z.M. Dang et al., Fundamentals, processes and applications of high-permittivity polymer–matrix composites, Progress in Materials Science 57, 660–723, 2012 (review)
- P.M. Ajayan (ed): Nanocomposite Science and Technology, Wiley Verlag GmbH, Weinheim, 2003, ISBN 3-527-30359-6.

Supplementary references:

- 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.	Preparation of ceramic or polymer-based composites (metallic, carbon, oxide fillers).	Lab activities: preparation of precursors, mixing, pressing, sintering, casting from solutions.	Lab. 4h
2.	Structural and microstructural characterisation of the produced composites	Lab activity (experimental: XRD, SEM) and Seminary (data analyses)	Lab./Sem. 4h
3.	Study of the electrical properties of composites by impedance spectroscopy	Lab activity (experimental and data analyses)	Lab. 4h
4.	Study of the nonlinear dielectric and piezoelectric properties of composites	Lab activity (experimental and data analyses)	Lab. 4h
5.	Phase interconnectivity. Sum, combinatorial and product properties. Percolation theory.	Seminary and lab. activity (experimental, data analyses)	Sem./Lab. 4h
6.	Effective field approximations. Analitic calculations. Case studies.	Solving analytical problems, discussions.	Sem. 2h
7.	Numerical methods for the calculation of electric field and of the composites electric, piezoelectric and mechanical properties of complex composites.	Solving numerical problems. Monte Carlo and Finite Element methods. Case studies	Sem./Lab. 6h

Bibliografie

- D.S. McLachlan, G. Sauti, The AC and DC Conductivity of Nanocomposites, Journal of Nanomaterials, Article ID 30389, 9 pages, 2007 (review)
- C.-W. Nan, Y. Shen, J. Ma, Physical Properties of Composites Near Percolation, Annual Review of Materials Research 40, 131-151, 2010 (review)
- H. Quian et al., Carbon nanotube-based hierarchical composites: a review, Journal of Material Chemistry 20, 4751-4762 (2010)
- L. Nicolais, G. Carotenuto, Metal-Polymer Nanocomposites, John Wiley and Sons, 2005, ISBN 0-471-47131-3.

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 Seminary/ 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 different types of natural and artificial composites for technological applications. The students will be able to realise at least an individual mini-project of bibliographic or scientific research and to present it to the community in a coherent way.

Data completării	Titular de curs	Titular de seminar
2.10.2023	**Prof. dr. Liliana Mitoșeriu**,	**Asist. dr. Lavinia Curecheriu**

Data avizării în departament	Director de departament
	Conf. dr. Iordana Aştefănoaei

FIŞA DISCIPLINEI

2023-2024

1. Date despre program

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

2. Date despre disciplină

2.1 Denumirea disciplinei			**Design of computer algorithms**					
2.2 Titularul activităţilor de curs			**Conf. dr. habil. Claudiu COSTIN**					
2.3 Titularul activităţilor de seminar			**Conf. dr. habil. Claudiu COSTIN**					
2.4 An de studiu	**2**	**2.5** Semestru	**3**	**2.6** Tip de evaluare	**EVP**	**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					**21**	
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**14**	
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**28**	
Tutoriat					**6**	
Examinări						
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	Undergraduate course in programming languages, Modelling of physical processes.
4.2 De competenţe	Numerical programming skills; scientific graphing and data analysis software operation; proficiency in written and oral English.

5. Condiţii (dacă este cazul)

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

6. Competenţe specifice acumulate

Competenţe profesionale	**C1.** Mastery of research methods and techniques, specific to the specialization Physics for Advanced Technologies. (1 credit) **C2.** Use the software for analyzing and processing experimental data and to perform virtual experiments. (1 credit) **C3.** Use of communication and information technologies. (1 credit)
Competenţe transversale	**CT1.** Language skills at academic level, in foreign languages, needed for scientific documentation. (1 credit) **CT2.** Capacity of interrelationing and teamworking. (1 credit)

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 course, students will be able to: ▪ Explain the algorithm design paradigms, randomization and dynamic programming. ▪ Describe a basic set of numerical algorithms used in Physcis. ▪ Use computing modeling tools to describe Physics problems. ▪ Develop medium-complexity algorithms for real-world problem solving.

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Introduction to numerical algorithms. Random numbers generation.	Lecture, explanation, demonstration	2h [1,2]
2.	Transformation of uniform deviates. Inverse of the Cumulative Distribution Function (ICDF) method. Acceptance-rejection method.	Lecture, explanation, demonstration	2h [1,2]
3.	Generation of random numbers with specific distributions: uniform, isotropic, normal (Gauss), cosine, Maxwell-Boltzmann.	Lecture, explanation, demonstration, debate	2h [1,2]
4.	Monte Carlo Methods. Evaluation of an integral. Monte Carlo Collision.	Lecture, explanation, demonstration, debate	2h [1-3]
5.	Radioactive decay. Diffusion process. Random walks algorithm.	Lecture, explanation, demonstration, debate	2h [2]
6.	Particle-In-Cell technique. The computational cycle. Space and time discretisation. Particle loading, injection, boundary conditions.	Lecture, explanation, demonstration, debate	2h [4]
7.	Particle-In-Cell technique. Particle and force to grid weighting.	Lecture, explanation, demonstration, debate	2h [4]

8.	Particle-In-Cell technique. Leap-frog algorithm. Poisson's equation solver.	Lecture, explanation, demonstration, debate	2h [4]
9.	Scharfetter-Gummel discretization scheme for drift-diffusion equations.	Lecture, explanation, demonstration	2h [5]
10.	Basics of the collisional-radiative model.	Lecture, explanation, demonstration	2h [6]
11.	Signal processing. Cross-correlation method.	Lecture, explanation, demonstration	2h [7]
12.	Signal processing. Fast Fourier Transform method (FFT).	Lecture, explanation, demonstration	2h [7]
13.	Signal processing. Filtering methods: low-pass, high-pass, band-pass.	Lecture, explanation, demonstration	2h [7]
14.	Algorithm optimization.	Lecture, explanation, demonstration, debate	2h [2]

Bibliografie

Referinţe principale:

1. J. E. Gentle, *Random Number Generation and Monte Carlo Methods*, 2nd Edition (Springer, 2003).
2. Morten Hjorth-Jensen, *Computational Physics* (University of Oslo, Fall 2009).
3. D. Depla, S. Mahieu (eds.), *Reactive Sputter Deposition*, Springer Series in Materials Science, vol. 109 (Springer, Berlin, 2008), chapter 3.
4. C. K. Birdsall and A. B. Langdon, *Plasma Physics via Computer Simulations* (IOP Publishing, New York, 1991).
5. D. L. Scharfetter and H. K. Gummel, “*Large-Signal Analysis of a Silicon Read Diode Oscillator*”, IEEE Trans. Electron Devices, ED-16 (1969) 64.
6. Y. Ralchenko (ed.), *Modern Methods in Collisional-Radiative Modeling of Plasmas*, Springer Series on Atomic, Optical, and Plasma Physics, vol. 90 (Springer, 2016).
7. C. Sidney Burrus, *Fast Fourier Transforms* (Open Textbook Library, 2012).

Referinţe suplimentare:

8. W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, *Numerical Recipes in C, The Art of Scientific Computing*, 2nd Edition (Cambridge University Press, New York, 2002).

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Comparison of different random numbers generators.	Numerical applications, guided discovery process	2h [1,2]
2.	Generation of random numbers with specific distributions using the Acceptance-rejection method.	Numerical applications, guided discovery process	2h [1,2]
3.	Generation of random numbers with specific distributions using the ICDF method.	Numerical applications, guided discovery process	2h [1,2]
4.	Collision treatment using the Monte Carlo Collision method.	Numerical applications, guided discovery process	2h [3]
5.	Collision treatment using the null-collision method.	Numerical applications, guided discovery process	2h [3]
6.	Random walks algorithms.	Numerical applications, guided discovery process	2h [2]
7.	Radioactive decay algorithm.	Numerical applications, guided discovery process	2h [2]

8.	Space discretisation (uniform grids: 1D, 2D and 3D), particle loading and boundary conditions for Particle-In-Cell.	Numerical applications, guided discovery process	2h [4]
9.	Particle and force to grid weighting for Particle-In-Cell.	Numerical applications, guided discovery process	2h [4]
10.	Scharfetter-Gummel discretization scheme: numerical implementation.	Numerical applications, guided discovery process	2h [5]
11.	Collisional-radiative model: numerical implementation.	Numerical applications, guided discovery process	2h [6]
12.	Cross-correlation algorithm.	Numerical applications, guided discovery process	2h [7]
13.	Fast Fourier Transform algorithm.	Numerical applications, guided discovery process	2h [7]
14.	Signal filtering algorithms.	Numerical applications, guided discovery process	2h [7]

Bibliografie

Referinţe principale:
1. J. E. Gentle, *Random Number Generation and Monte Carlo Methods*, 2nd Edition (Springer, 2003).
2. Morten Hjorth-Jensen, *Computational Physics* (University of Oslo, Fall 2009).
3. D. Depla, S. Mahieu (eds.), *Reactive Sputter Deposition*, Springer Series in Materials Science, vol. 109 (Springer, Berlin, 2008), chapter 3.
4. C. K. Birdsall and A. B. Langdon, *Plasma Physics via Computer Simulations* (IOP Publishing, New York, 1991).
5. D. L. Scharfetter and H. K. Gummel, “Large-Signal Analysis of a Silicon Read Diode Oscillator”, IEEE Trans. Electron Devices, ED-16 (1969) 64.
6. Y. Ralchenko (ed.), *Modern Methods in Collisional-Radiative Modeling of Plasmas*, Springer Series on Atomic, Optical, and Plasma Physics, vol. 90 (Springer, 2016).
7. C. Sidney Burrus, *Fast Fourier Transforms* (Open Textbook Library, 2012).

Referinţe suplimentare:
8. W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, *Numerical Recipes in C, The Art of Scientific Computing*, 2nd Edition (Cambridge University Press, New York, 2002).

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

Algorithm analysis and design are compulsory components of computer programming education, required by both scientific and industrial research.

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 correctness of the acquired knowledge; - capacity of operating with the acquired knowledge; - capacity of analysis, personal interpretation, originality, creativity.	Formative assessment (during the semester) - written tests.	50%
10.5 Seminar/	- active participation to practical works;	Formative assessment	50%

Laborator	- the capacity of using in practice the acquired knowledge.	(during the semester) - problem solving and homeworks.	
10.6 Standard minim de performanţă			
Minimum grade (course and laboratory): 5. Explain the specific steps required to develop algorithms for solving problems of medium difficulty. Independent solving of a medium complexity problem using numerical algorithms.			

Data completării 25.09.2023	Titular de curs Conf. dr. habil. Claudiu COSTIN	Titular de seminar Conf. dr. habil. Claudiu COSTIN

Data avizării în departament

Director de departament

Conf. dr. habil. Iordana AȘTEFĂNOAEI