FIŞA DISCIPLINEI

2024-2025

1. Date despre program

1.1 Instituţia de învăţământ superior	**“Alexandru Ioan Cuza” University of Iaşi**
1.2 Facultatea	**Faculty of Physics**
1.3 Departamentul	**Physics**
1.4 Domeniul de studii	**Exact Sciences**
1.5 Ciclul de studii	**Master**
1.6 Programul de studii / Calificarea	**Biophysics and Medical Physics**

2. Date despre disciplină

2.1 Denumirea disciplinei			**Physics of radiotherapy. Irradiation techniques**				
2.2 Titularul activităţilor de curs			**Expert in Medical Physics, Dr. Mihaela Oprea**				
2.3 Titularul activităţilor de seminar			**Expert in Medical Physics, Dr. Mihaela Oprea**				
2.4 An de studiu	**II**	**2.5** Semestru	**I**	**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	**64**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren	**35**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri	**45**
Tutoriat	
Examinări	
Alte activităţi	

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	Basic knowledge of Radiation Sources, Nuclear Physics, Dosimetry, Radiobiology.
4.2 De competenţe	

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	
5.2 De desfăşurare a seminarului/ laboratorului	Specific radiotherapy equipment is required.

6. Competenţe specifice acumulate

Competenţe profesionale	**C1**. Mastery of research methods and techniques, specific to the specialization Medical Physics; **C2**. Language skills at academic level, in foreign languages, needed for scientific documentation; **C3**. Use of communication and information technologies; **C4**. Use the software for analyzing and processing experimental data and to perform virtual experiments.
Competenţe transversale	**CT1.** **CT2.** **CT3.**

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	This course provides the necessary practical and theoretical background for the support of a radiotherapy physics service within radiotherapy..
7.2 Obiectivele specifice	On completion, the students will be able to: ▪ mastery of research methods and techniques, specific to the Medical Physics specialty; ▪ language skills at academic level, in foreign languages, needed for scientific documentation; ▪ use of communication and information technologies;- ▪ use the software for analyzing and processing experimental data and to perform virtual experiments; ▪ understanding and ability to apply the principles and the values of the professional and research ethics;

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	**X-ray production** (low power X ray tubes, high power X ray tubes, characteristics of X rays)	Lecture, Debate, Problematization	2 hours
2.	**CT – Simulator** (Physical principles of operation of a Computed Tomography Simulator)	Lecture, Debate, Problematization	2 hours
3.	**Radiotherapy machines** (Cobalt machines, linear accelerators, betatron, cyclotron, therapywith proton beams)	Lecture, Debate, Problematization	4 hours
4.	**Radiotherapy** (informatics used in external exposure, treatment planning, photon beam therapy, electron beam therapy)	Lecture, Debate, Problematization	4 hours
5.	**Conformal radiotherapy** (generalities, patient identification, anatomic data acquisition,	Lecture, Debate, Problematization	2 hours

	beams definition, dose calculation and optimization, verification and treatment realization, volumes and dose determination in conformal radiotherapy)		
6.	**External radiotherapy techniques** (principles and methods, importance of radiation intensity modulation in radiotherapy, treatment planning, mathematic modelling of IMRT, optimization algorithms)	Lecture, Debate, Problematization	2 hours
7.	**Portal imaging in radiotherapy** (different types of portal imaging systems, comparison ofportal imagery, status, limits and future in portal imagery, real time systems in portal imagery,computer programs, quality control, dosimetry through portal imagery)	Lecture, Debate, Problematization	2 hours
8	**The treatment planning in three dimensions** (necessary elements, informatics, visualization methods, dose calculations methods, evaluation methods of 3D treatment plan, advantages and disadvantages of using 3D system in treatment planning)	Lecture, Debate, Problematization	2 hours
9	**The treatment planning with modern radiotherapy technique** (IMRT, RapidArc)	Lecture, Debate, Problematization	2 hours
10	**Brachytherapy** (Systems of Implant Dosimetry, Implantation Techniques, Afterloading)	Lecture, Debate, Problematization	2 hours
11	**Radioprotection**(Principles of radioprotection, Radiation protection surveys, Administrative requirements, Technical requirements)	Lecture, Debate, Problematization	2 hours
12	**Quality assurance in radiotherapy**	Lecture, Debate, Problematization	2 hours

Bibliografie

[1] Leksell L. Stereotaxic and surgery. Springfield, IL: Charles C. Thomas; 1967.
[2] Abbatucci J, Quint R, Bloquel J, Roussel A, Delozier T. Technique de radiotherapie (photons –electrons) ed. l'ex-pansion scientifique francaise, Paris, 1981.
[3] Podgorsak E.B. Handbook for Teachers and Students. Review of Radiation Oncology Physics.AIEA, 1998.
[4] Khan F.M., The Physics of Radiation Therapy - Third Edition, Williams & Wilkins, Baltimore, USA, 2003.
[5] Hendee W.R., Ibbot G.S., Hendee E.G., Radiation Therapy Physics - Third Edition, John Wiley& Sons, New Jersey, 2005.
[6] BORCIA CATALIN, Surse de radiaţii si protecţia radiologica, Editura Universităţii "AlexandruIoan Cuza" Iasi - 2003.
[7] V. I. CERNEA, -Elemente de Radiobiologie, Ed. Medicală Universitară Iuliu Haţieganu, Cluj-Napoca 2003
[8] Mihailescu D., Borcia C., Interactiunea Radiatiilor Ionizante cu Substanta, partea I: Radiatii Incarcate Electric, Sedcom Libris, Iasi, 2007

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	**The treatment planning in three dimensions**	Problematization/ Guided experiment	10 hours

2.	**The treatment planning with modern radiotherapy technique** (IMRT, RapidArc)	Problematization/ Guided experiment	8 hours
3.	**Treatment plan dosimetry in brachytherapy.**	Problematization/ Guided experiment	4 hours
4.	**Quality Assurance in external radiotherapy**	Problematization/ Guided experiment	4 hours
5.	**Quality Assurance in brachitherapy.**	Problematization/ Guided experiment	2 hours

Bibliografie:

[1] International commission on radiation units and measurements. ICRU Report 62, Prescribing,Recording. And Reporting Photon Beam Therapy, Bethesda, MD: ICRU Publications; 2000.
[2] Podgorsak E.B. Handbook for Teachers and Students. Review of Radiation Oncology Physics. AIEA, 1998.
[3] Khan F.M., The Physics of Radiation Therapy - Third Edition, Williams & Wilkins, Baltimore, USA, 2003.
[4] Absorbed dose determination in external beam radiotherapy: An international Code ofPractice for Dosimetry based on standards of absorbed dose to water, IAEA TRS-398, 2001

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

Course content is consistent with the CNCAN (National Commission for Nuclear Activities Control) standards on Medical Physics Expert.

10. Evaluare

Tip activitate	**10.1 Criterii de evaluare**	**10.2 Metode de evaluare**	**10.3 Pondere în nota finală (%)**
10.4 Curs	Accuracy of information; Scientific language; Clear and coherent presentation.	Exam	50%
10.5 Seminar/ Laborator	Proper use of laboratory equipment; Proper interpretation of experimental data; Correct processing of results.	Colloquium exam	50%
10.6 Standard minim de performanţă			
1 Elaboration of a report/speciality project identifying and using the basic principles and lows of physics involved in a real problem or context. 2. Solving o some specific problems in the field of radiotherapy.			

Data completării	Titular de curs	Titular de seminar
2.10.2024	Expert in Medical Physics., Dr. Mihaela Oprea	Expert in Medical Physics., Dr. Mihaela Oprea

Data avizării în departament

Director de departament

FIŞA DISCIPLINEI

2024-2025

1. Date despre program

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

2. Date despre disciplină

2.1 Denumirea disciplinei	**Quality ensurance and Quality Control**							
2.2 Titularul activităţilor de curs	**Conf. dr. habil. Ionuţ Cristian TOPALĂ**							
2.3 Titularul activităţilor de lab.	**Conf. dr. habil. Ionuţ Cristian TOPALĂ**							
2.4 An de studiu	**II**	**2.5** Semestru	**1**	**2.6** Tip de evaluare	**E**	**2.7** Regimul disciplinei*	**OB**	

* *OB – Obligatoriu / OP – Opţional*

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

3.1 Număr de ore pe săptămână	**4**	din care: **3.2** curs	**2**	**3.3** laborator	**2**
3.4 Total ore din planul de învăţământ	**56**	din care: **3.5** curs	**28**	**3.6** laborator	**28**
Distribuţia fondului de timp					ore
Studiu după manual, suport de curs, bibliografie şi altele					**55**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**42**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**35**
Tutoriat					**8**
Examinări					**4**
Alte activităţi					

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	Nuclear physics, Dosimetry and radiation protection, Radiology and medical imaging, Physics of radiotherapy. Irradiation techniques
4.2 De competenţe	—

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

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	1. Correct identification and use of the physical notions, laws and principles related to the interaction of ionizing radiation with substance, within a given context and capacity to apply this knowledge to practice 2. Ability to work in a team to solve experimental and technological problems, demonstrating determination and perseverance to achieve the tasks and fulfil the responsibilities 3. Interpretation of the information on ionizing radiation interaction and its communication in coherent and accessible form 4. Identification and utilization of bibliographical resources for continuous learning, formation and development
7.2 Obiectivele specifice	On successful completion of this course, the students will be able to: ▪ Identify and use adequately the principal laws and physical principles related to the interaction of ionizing radiations with substance in a given context ▪ Explain what are the suitable methods to model the interaction of ionizing radiations, in relation to a targeted application ▪ Use laboratory equipment to determine the effects of interactions of ionizing radiations ▪ Analyse and discuss the measured or numerical modelling data and present a report on the effects of the interaction of ionizing radiation with various materials

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Quality assurance: principles, tools and techniques		2 hours, ref. 1 - 6
2.	Technology, quality control (QC) and quality assurance (QA) in classical radiography and Computed Radiography (CR)		2 hours, ref. 5, S1

3.	Technology, quality control (QC) and quality assurance (QA) in digital radiography	Online lecture, thematic debates, applications	2 hours, ref. 5, S1
4.	Technology, quality control (QC) and quality assurance (QA) in classical and digital pediatric radiography		2 hours, ref. 5, S1
5.	Quality assurance of image receptor and of the photographic process		2 hours, ref. 5, S1
6.	Technology, quality control (QC) and quality assurance (QA) in classical and digital mammography		2 hours, ref. 6
7.	Technology, quality control (QC) and quality assurance (QA) in fluoroscopy		2 hours, ref. 1
8.	Performance evaluation and quality control of scintillation cameras in planar mode		2 hours, ref. 1
9.	Performance evaluation and quality control of scintillation cameras in whole body mode		2 hours, ref. 2
10.	Technology, quality control (QC) and quality assurance (QA) in digital angiography		2 hours, ref. 3
11.	Technology, quality control (QC) and quality assurance (QA) in computed tomography (CT).		2 hours, ref. 3
12.	Technology, quality control (QC) and quality assurance (QA) in single photon emission tomography		2 hours, ref. 3
13.	Technology, quality control (QC) and quality assurance (QA) in positron emission tomography		2 hours, ref. 4
14.	Technology, quality control (QC) and quality assurance (QA) in Magnetic Resonance Imaging (MRI).		2 hours, ref. 7

References

Main references:

1. *Quality Control Recommendations for Diagnostic Radiography*, Conference of Radiation Control Program Directors, Inc., 205 Capital Avenue, Frankfort, Kentucky 40601, www.crcpd.org
2. *Quality Assurance Programme for Computed Tomography*: Diagnostic and Therapy Applications, IAEA Human Health Series No. 19, Vienna 2012.
3. *Quality Assurance for SPECT Systems*, IAEA Human Health Series No. 6, Vienna 2009.
4. *Quality Assurance for PET and PET/CT Systems*, IAEA Human Health Series No. 1, Vienna 2009.
5. *Quality Assurance Programme for Digital Mammography*, IAEA Human Health Series No. 17, Vienna 2011
6. AAPM REPORT NO. 74, *Quality Control In Diagnostic Radiology*, Medical Physics Publishing 2002
7. AAPM REPORT NO. 100, *Acceptance Testing and Quality Assurance Procedures for Magnetic Resonance Imaging Facilities*, American Association of Physicists in Medicine, 2010.

Suplementary references:

S1. EUROPEAN COMMISSION RADIATION PROTECTION N° 162, Criteria for Acceptability of Medical Radiological Equipment used in Diagnostic Radiology, Nuclear Medicine and Radiotherapy (2012)

8.2	Laborator	Metode de predare	Observaţii (ore şi referinţe bibliografice)
1.	Practical aspects and implementation of quality control procedures in classical radiology	Discussion and debates, including professionals. Practical work, set up a QC/QA system.	2 hours, ref. 1
2.	Practical aspects and implementation of quality control procedures in digital radiology		2 hours, ref. 1
3.	Practical aspects and implementation of quality control procedures in classical and digital pediatric radiography		2 hours, ref. 1
4.	Practical aspects and implementation of quality control procedures for the image receptor and the photographic process		2 hours, ref. 1
5.	Practical aspects and implementation of quality control procedures in classical and digital mammography		2 hours, ref. 1, 5
6,	Practical aspects and implementation of quality control procedures in fluoroscopy		2 hours, ref. 1
7.	Practical aspects and implementation of quality control procedures in evaluating scintillation cameras in planar mode		2 hours, ref. 1
8.	Practical aspects and implementation of quality control procedures in evaluating scintillation cameras in whole body mode		2 hours, ref. 2
9.	Practical aspects and implementation of quality control procedures in digital angiography		2 hours, ref. 3
10.	Practical aspects and implementation of quality control procedures in computed tomography (CT).		2 hours, ref. 3
11.	Practical aspects and implementation of quality control procedures in single photon emission computed tomography (SPECT)		2 hours, ref. 3
12.	Practical aspects and implementation of quality control procedures in positron emission tomography (PET)		2 hours, ref. 4
13.	Practical aspects and implementation of quality control procedures in Magnetic Resonance Imaging (MRI).		2 hours, ref. 6
14.	Revision of all presented QC/QA systems.	Discussion.	2 hours, ref. 1-6

References

Main references:
1. *Quality Control Recommendations for Diagnostic Radiography*, Conference of Radiation Control Program Directors, Inc., 205 Capital Avenue, Frankfort, Kentucky 40601, www.crcpd.org
2. *Quality Assurance Programme for Computed Tomography*: Diagnostic and Therapy Applications, IAEA Human Health Series No. 19, Vienna 2012.
3. *Quality Assurance for SPECT Systems*, IAEA Human Health Series No. 6, Vienna 2009.
4. *Quality Assurance for PET and PET/CT Systems*, IAEA Human Health Series No. 1, Vienna 2009.

Suplementary references:
5. *Quality Assurance Programme for Digital Mammography*, IAEA Human Health Series No. 17, Vienna 2011

6. AAPM REPORT NO. 100, *Acceptance Testing and Quality Assurance Procedures for Magnetic Resonance Imaging Facilities*, American Association of Physicists in Medicine, 2010.

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

This course aims to introduce the main paradigms in QC/QA system. This will be an important component of daily activity of our graduates that select Medical Physicists as future profession. It offers comprehensive information on technology and quality assurance in medical physics to sustain the professional exams in order to obtain medical physics staffing levels, as defined by the Romanian National Commission for Nuclear Activities Control. The graduates will be able to use their acquired knowledge as medical physicists, for implementing quality assurance programmes for various devices used in medical imaging and diagnostics.

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; - logical coherence.	Exam (CNCAN type questions)	50%
10.5 Laborator	- active participation to practical works and debates; - the capacity of using in practice the acquired knowledge. - individual Quality Assurance Plan	Laboratory	50%
10.6 Standard minim de performanţă			
- Independent set up of QC/QA systems in medical physics and implementation of related actions. - Reports for practical works, after analysis of results presented in the literature and debates with professionals.			

Data completării
30.09.2024

Titular de curs
Conf. dr. habil. Ionut Cristian TOPALA

Titular de laborator
Conf. dr. habil. Ionut Cristian TOPALA

Data avizării în departament

Director de departament
Conf. dr. habil. Iordana ASTEFANOAEI

FIŞA DISCIPLINEI

2024-2025

1. Date despre program

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

2. Date despre disciplină

2.1 Denumirea disciplinei	**Physical Basis of Clinical Dosimetry**						
2.2 Titularul activităţilor de curs	**Lect. univ.dr. Dan Mihăilescu**						
2.3 Titularul activităţilor de seminar	**Medical Physics Expert Mihaela Oprea PhD**						
2.4 An de studiu	**II**	**2.5** Semestru	**I**	**2.6** Tip de evaluare	**EVP**	**2.7** Regimul disciplinei*	**OB**

** OB – Obligatoriu / OP – Opţional*

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

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

Distribuţia fondului de timp	ore
Studiu după manual, suport de curs, bibliografie şi altele	**35**
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren	**20**
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri	**26**
Tutoriat	**5**
Examinări	**8**
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	**Interaction of Ionizing Radiation with Matter, Detectors, Dosimetry, Radioprotection, Radiobiology**
4.2 De competenţe	

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	
5.2 De desfăşurare a seminarului/ laboratorului	Specific clinical dosimetry equipment is required.

6. Competenţe specifice acumulate

Competenţe profesionale	**C1**. Mastery of research methods and techniques, specific to the specialization Medical Physics; **C2**. Language skills at academic level, in foreign languages, needed for scientific documentation; **C3**. Use of communication and information technologies; **C4**. Use the software for analyzing and processing experimental data and to perform virtual experiments.
Competenţe transversale	**CT1.** **CT2.** **CT3.**

7. Obiectivele disciplinei (din grila competenţelor specifice acumulate)

7.1 Obiectivul general	Acquiring theoretical and practical skills in the field of clinical dosimetry, according to national and international Codes of Practice.
7.2 Obiectivele specifice	On completion, the students will be able to: ▪ Use the methods and techniques of measuring/research in clinical dosimetry; ▪ Use the information and communication technologies; ▪ Use software packages for analyzing and processing of experimental data and to perform virtual experiments (treatment plans in radiotherapy); ▪ Understand and posses the ability to apply the principles and values of professional and research ethics.

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	**Dosimetric principles, quantities and units** (1. Absorbed dose, Kerma and Cema, Exposure; 2. Stopping powers; Relationships between dosimetric quantities; 3. Cavity theory).	Lecture, Debate, Problematization	4 hours
2.	**Radiation dosimeters** (1. Properties of dosimeters; 2. Ionizing chambers; 3. Film dosimetry; 4. Luminescence dosimetry; 5. Semiconductor dosimetry; 6. Other dosimetry systems; 7. Primary standards).	Lecture, Debate, Problematization	5 hours
3.	**Radiotherapy with external photon beams: physical aspects** (1. Quantities used in describing a photon beam; 2. Dose distributions into a phantom/patient).	Lecture, Debate, Problematization	4 hours

4.	**Radiotherapy with external electron beams: physical aspects** (1. Dose distributions; 2. Dosimetric parameters of electron beams).	Lecture, Debate, Problematization	4 hours
5.	**Dosimetry of electron and photon beams. Calibration of electron and photon beams** (1. Dosimetric methods; 2. Dosimetric protocols; 3. Determination of absorbed dose in water using different dosimetric systems. 4. Correction factors; 5. Errors and uncertainties).	Lecture, Debate, Problematization	4 hours
6.	**Acceptance tests and commissioning** (1. Measurement equipment. 2. Acceptance tests. 3. Commissioning).	Lecture, Debate, Problematization	2 hours
7.	**Brachytherapy: physical aspects and dosimetry** (1. Sources used in Brachytherapy; (2) Dose specification; (3) Dose distributions; (4) Dose calculation procedures; (5) Commissioning).	Lecture, Debate, Problematization	2 hours
8	**Hadrontherapy** (Rationale for hadrontherapy: Heavy charged particles versus photons, Beam delivery - passive versus active methods, Radiobiology: - Carbon ions versus protons; Accelerators for hadrontherapy, Present status and future perspectives, Hadrontherapy in Romania; Dosimetry equipment; Beam quality specification; Determination of absorbed dose to water)	Lecture, Debate, Problematization	3 hours

Bibliografie

Referinţe principale:

[1] Ervin B. Podgorsak, *Review of Radiation Oncology Physics: A Handbook for Teachers and Students*, IAEA Vienna, 2003.
[2] F.M. Khan, *The physics of radiation therapy*, Williams and Wilkins, Baltimore, Maryland, U.S.A., 1994.
[3] H.E. Johns, J.R. Cunningham, J.R., *The physics of radiology*, Thomas, Springfield, Illinois, U.S.A., 1984.

Referinţe suplimentare:

[1] D. Mihăilescu, Dozimetria Radiatiilor Ionizante, Ed. Univ. “Al.I.Cuza”, Iaşi, 2001.
[2] D. Mihăilescu, C. Borcia, Interactiunea radiatiilor ionizante cu substanta (I: Particule incarcate), Ed. Sedcom Libris, Iaşi, 2007.

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	Study of dose distributions in different materials irradiated with high energy particle beams using Monte Carlo techniques	Problematization/ Guided experiment	6 hours
2.	Determination of dose distribution in water for electron and photon beams using different types of radiation detectors.	Problematization/ Guided experiment	4 hours
3.	Evaluation of dosimetric parameters from dose distributions (Monte Carlo and experiment). Comparisons.	Problematization/ Guided experiment	4 hours

4.	Calculation of stopping power ratios for electron, photon, and heavy charged particle beams.	Problematization/ Guided experiment	2 hours
5.	Investigation of tissue-equivalent materials used in clinical dosimetry; Phantoms.	Problematization/ Guided experiment	2 hours
6.	Elaboration and simulation of a clinical treatment plan in external radiotherapy with electron/photon beams (patient data simulation, evaluation, treatment time and monitor unit calculation).	Problematization/ Guided experiment	6 hours
7.	Quality Assurance and Commissioning tests.	Problematization/ Guided experiment	4 hours

Bibliografie:

[1] Ervin B. Podgorsak, *Review of Radiation Oncology Physics: A Handbook for Teachers and Students*, IAEA Vienna, 2003.
[2] INTERNATIONAL ATOMIC ENEREGY AGENCY “*Absorbed Dose Determination in External Beam Radiotherapy: An International Code of Practice for Dosimetry Based on Standards of Absorbed Dose to Water*” – IAEA TRS-398, IAEA Vienna (2000).

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

Course content is consistent with the CNCAN (National Commission for Nuclear Activities Control) standards on Medical Physics Expert.

10. Evaluare

Tip activitate	10.1 Criterii de evaluare	10.2 Metode de evaluare	10.3 Pondere în nota finală (%)
10.4 Curs	Accuracy of information; Scientific language; Clear and coherent presentation.	Exam	50%
10.5 Seminar/ Laborator	Proper use of laboratory equipment; Proper interpretation of experimental data; Correct processing of results.	Colloquium exam	50%
10.6 Standard minim de performanţă			
1. Solving specific problems of clinical dosimetry. 2. Knowledge and use of specific laboratory equipment, the successful completion of all practical works.			

Data completării — Titular de curs — Titular de seminar

01.10.2024 — Lect. univ.dr. Dan Mihăilescu — Medical Phys., Dr. Mihaela Oprea

Data avizării în departament

Director de departament,
Conf. univ. dr. habil. Iordana Astefanoaei

FIŞA DISCIPLINEI

2024/2025

1. Date despre program

1.1 Instituţia de învăţământ superior	**Universitatea “Alexandru Ioan Cuza” din Iaşi**
1.2 Facultatea	**Facultatea de FIZICA**
1.3 Departamentul	**FIZICA**
1.4 Domeniul de studii	**FIZICĂ/*PHYSICS***
1.5 Ciclul de studii	**MASTER**
1.6 Programul de studii / Calificarea	„**BIOFIZICĂ ŞI FIZICĂ MEDICALĂ” (în limba engleză) / „*BIOPHYSICS AND MEDICAL PHYSICS*” /Diplomă de master** în specializarea **„BIOFIZICĂ ŞI FIZICĂ MEDICALĂ”/** ***Master diploma*** *in the specialization* **„*BIOPHYSICS AND MEDICAL PHYSICS*”**

2. Date despre disciplină

2.1 Denumirea disciplinei			**Acţiunea câmpului electromagnetic asupra sistemelor complexe / *Electromagnetic field action on complex systems***					
2.2 Titularul activităţilor de curs			**Conf. univ. dr. habil Loredana MEREUTA**					
2.3 Titularul activităţilor de seminar			**Conf. univ. dr. habil Loredana MEREUTA**					
2.4 An de studiu	**II**	**2.5** Semestru	**I**	**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, support de curs, bibliografie şi altele					**50**	
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**50**	
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**30**	
Tutoriat					**10**	
Examinări					**4**	
Alte activităţi						

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	
4.2 De competenţe	Basic knowledge of biophysics, physics of atom and molecule, physics equations

5. Condiţii (dacă este cazul)

5.1 De desfăşurare a cursului	Videoprojector on line
5.2 De desfăşurare a seminarului/ laboratorului	PC, specific software, laboratory equipment

6. Competenţe specifice acumulate

Competenţe profesionale	- mastery of research methods and techniques, specific to the specialization Biophysics and Medical Physics; - language skills at academic level, in foreign languages, needed for scientific documentation; - use the software for analyzing and processing experimental data and to perform virtual experiments;
Competenţe transversale	- 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	Understanding the main electromagnetic phenomena from living tissues with focus on the medical applications (methods of clinical diagnosis and treatment) of the electromagnetic fields.
7.2 Obiectivele specifice	Ability to use the software for analyzing and processing specific experimental data.

8. Conţinut

8.1	**Curs**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)
1.	The bioelectrogenesis in the human body excitable tissues and organs. The genesis of the electrocardiogram.	Subject presentation using video slides	2 ore
2.	The human body exploration by recording the electromagnetic activity of tissues and organs. Theoretical methods in bioelectromagnetism.	Subject presentation using video slides	2 ore
3.	Electric and magnetic measurement of the electric activity of the heart. Electro- and magneto - cardiography	Subject presentation using video slides	2 ore
4.	Electric and magnetic measurement of the electric activity of neural tissue. Electro- and magneto- encephalography, the electric signals originating in the eye.	Subject presentation using video slides	2 ore

5.	Measurement of the intrinsic electric properties of biological tissues. Impedance plethysmography. The electrodermal response.	Subject presentation using video slides	2 ore
6.	Living bodies and their sensitivity to the terrestrial magnetic field; Earth magnetic pole migration and life evolution; Geomagnetic Fields, their Fluctuations and Health Effects;	Subject presentation using video slides	2 ore
7.	Magnetoreception in animals; life in zero-magnetic field – experiments on plants, animal cell cultures, microorganisms; laboratory investigation of magnetic field bioeffects	Subject presentation using video slides	2 ore
8.	Bacterial magnetosomes: microbiology, biomineralization and biotechnological applications. Medical Applications of Siderophores.	Subject presentation using video slides	2 ore
9.	Interactions between Electromagnetic Fields and Biological Tissues. The cellular response to the action of electromagnetic fields; solar activity maxima and human mortality and morbidity.	Subject presentation using video slides	2 ore
10.	Bioeffects specific to microwaves (MW) and radiofrequency (RF) waves; SAR (specific absorption rate) and penetration depth and their dependence on various parameters.	Subject presentation using video slides	2 ore
11.	Nonthermal effects of microwaves upon the microorganisms, vegetal and animal organisms.	Subject presentation using video slides	2 ore
12.	Magnetic fields in therapy; physical principle, indications and contra-indications; application in the pain therapy; generators and applicators of magnetic field in medicine.	Subject presentation using video slides	2 ore
13.	Biophysical basics of electrotherapy. Current concepts in electrotherapy. Electrical stimulation of nerve and muscle.	Subject presentation using video slides	2 ore
14.	Definitions and descriptions of types of current used therapeutically. Physiological effects and therapeutic uses. Application and uses of specific currents.	Subject presentation using video slides	2 ore

Bibliografie

Referinţe principale:

1. Malmivuo, J., 2006, Video lectures on bioelectromagnetism, Ragnar Granit Institute
2. Bioelectromagnetism, Principles and Applications of Bioelectric and Biomagnetic Fields, J. Malmivuo & R.
3. Plonsey, Oxford University Press,1995

Referinţe suplimentare:

1. Bazele biomagnetismului , Creangă, D., Ed. Univ. Al. I. Cuza Iaşi, 2009
2. Creanga, D., Elemente de radiobiofizica, Ed. Cermi, 2005
3. Electromagnetic Biology and Medicine, 1999-2006

8.2	**Seminar / Laborator**	**Metode de predare**	**Observaţii** (ore şi referinţe bibliografice)

1.	The concept of bioelectromagnetism. Short history of bioelectromagnetism. Nobel prizes awarded in bioelectromagnetism and closely related subject areas.	Video presentation, interactive discussions	2 ore
2.	Measurement of electrodermal response.	Laboratory applications	2 ore
3.	Measurement of muscle electrical activity – electromyogram and electrocardiogram. Electrocardiogram recording analysis.	Laboratory applications computer assisted	2 ore
4.	The geo-magnetic field influence on the microorganisms; the assay of the resistance against antibiotics;	Experiments discussion by means of numerical data processing and graphical plotting;	2 ore
5.	The evidence of the radiofrequency field exposure on the blood red cells; hemolysis assay; MW/RF waves influence on DNA synthesis; nucleic acid spectrophotometric assay;	Experiments discussion by means of numerical data processing and graphical plotting;	2 ore
6.	Report of the Expert Group on the Health Effects of Electromagnetic Fields Report of the independent Advisory Group on non-ionising radiation Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300 GHz)	Video presentation, interactive discussions	2 ore
7.	Weak electromagnetic field effects on the catalase like enzymes activity in microorganisms.	Experiments discussion by means of numerical data processing and graphical plotting;	2 ore
8.	Bactericidal effects of electromagnetic field and ions from electric discharge.	Experiments discussion by means of numerical data processing and graphical plotting;	2 ore
9.	Magnetic fluid influence on the photosynthesis pigment; spectrophotometric assay.	Experiments discussion by means of numerical data processing and graphical plotting;	2 ore
10.	Electric discharge effects on the young plants during early ontogenetic stages – spectrophotometric assay.	Experiments discussion by means of numerical data processing and graphical plotting;	2 ore
11.	Atmospheric plasma biological impact on the bacterial cultures – measurements on the growth inhibition zones.	Experiments discussion by means of numerical data processing and graphical plotting;	2 ore
12.	MW influence on the bacterial cultures; biomass dynamics measured by turbidimetry.	Experiments discussion by means of numerical data processing and graphical plotting;	2 ore
13.	Electrotherapy Chronology. Cranial electrotherapy. Shockwave Therapies.	Video presentation, interactive discussions	2 ore
14.	Student project presentation	interactive discussions with students	2 ore

Bibliografie

Malmivuo, J., 2006, Video lectures on bioelectromagnetism, Ragnar Granit Institute
Bioelectromagnetism, Principles and Applications of Bioelectric and Biomagnetic Fields, J. Malmivuo & R. Plonsey, Oxford University Press,1995
http://www.electrotherapy.org/

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

The study of the main electromagnetic phenomena from living tissues with focus on the medical applications (methods of clinical diagnosis and treatment) of the electromagnetic fields: (i) the electromagnetic field generation within the human body tissues and organs (ii) biophysical mechanisms triggered by the electromagnetic waves absorption on the living bodies (iii) the electric impedances of living tissues: dielectric and conductive properties of biological media. The study of physical methods and devices for medical diagnosis and therapy based on electromagnetic fields

10. Evaluare

Tip activitate	**10.1 Criterii de evaluare**	**10.2 Metode de evaluare**	**10.3 Pondere în nota finală (%)**
10.4 Curs		Evaluare pe parcurs	50
10.5 Seminar/ Laborator		Prezentare proiect	50
10.6 Standard minim de performanţă Comunicarea informatiilor din domeniul fizicii si biofizicii; prezentarea de rapoarte profesionale cu grad de dificultate mediu			

Data completării

27.09.2024

Titular de curs
Conf. univ. dr. habil Loredana MEREUTA

Titular de seminar
Conf. univ. dr. habil Loredana MEREUTA

Data avizării în departament

Director de departament
Conf. univ. dr. habil Iordana ASTEFANOAEI

FIŞA DISCIPLINEI

2024-2025

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	**Biophysics and Medical Physics**

2. Date despre disciplină

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

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					**58**	
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					**40**	
Pregătire seminarii/laboratoare, teme, referate, portofolii şi eseuri					**36**	
Tutoriat					**6**	
Examinări					**4**	
Alte activităţi						

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	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 Analysis and communication of Physics information with didactical, scientific and popularization character Capacity to teach Physics at secondary and post-secondary education levels Capacity of interrelationing and teamworking Application of Physics knowledge to practical situations Opening to lifelong learning
Competenţe transversale	Mastery of research methods and techniques, specific to the specialization Plasma Physics, Spectroscopy and Self-Organization Language skills at academic level, in foreign languages, needed for scientific documentation Use of communication and information technologies Use the software for analyzing and processing experimental data and to perform virtual experiments Understanding and ability to apply the principles and the values of the professional and research ethics

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) Elaboration of an individual project by analysis of results presented in the literature			

Data completării
10.10.2024

Titular de curs
Conf. dr. Valentin Pohoaţă

Titular de seminar
Conf. dr. Valentin POHOAŢĂ

Data avizării în departament

Director de departament
Conf. Dr. Iordana Ștefanoaei