Universitatea de Vest din Timişoara

SYLLABUS

1. Information about the study programme

1.1 Institution of higher education	West University of Timisoara
1.2 Faculty	Faculty of Physics and Mathematics
1.3 Department of	Department of Physics
1.4 Field of study	Physics
1.5 Study cycle	Master
1.6 Study programme	ADVANCED RESEARCH METHODS IN PHYSICS

2. Information about the subject/discipline

2.1 Name	Advanced methosd in optical spectroscopy						
2.2 Course coordinator	Assoc. Prof. Marius Ștef, PhD						
2.3 Seminar coordinator	Carla Schörnig, PhD						
2.4 Year of study	II	**2.5 Semester**	1	**2.6 Type of assessment**	E[1]	**2.7 Type of discipline**	DS, DOB

3. Total estimated time (hours of teaching per semester)[2]

3.1 Number of hours per week	**4**	**3.2 course**	**2**	**3.3 seminar/laboratory**	**2**
3.4 Total hours in the curriculum	**56**	**3.5 course**	**28**	**3.6 seminar/laboratory**	**28**
Distribution of time:					**hours**
Study based on Instructions, course materials, bibliography and notes					**42**
Additional documentation library, specialized electronic platforms / field					**34**
Training seminars / laboratories, homework, essays, portfolios and essays					**34**
Tutoring					**34**
Examinations[3]					**2**
Other activities					**-**

3.7 Total hours of individual study	**144**
3.8 Total hours per semester[4]	**200**
3.9 Number of credits	**8**

[1] According to article 37, paragraph (1) of the Higher Education Law no. 199/2023, with subsequent amendments and additions, "the academic success of a student during a study program is determined by verifying the acquisition of the expected learning outcomes through exam-type evaluations and evaluation throughout the semester".

[2] The total number of contact hours and individual study hours will be aligned with the number of credits allocated to the course. One credit corresponds to a total between 25 and 30 hours of teaching activities and individual study. At the level of academic departments may establish, by discipline categories, the exact equivalence between one credit and the number of hours.

[3] The hours corresponding to examinations are added only to the point 3.8 – The total hours per semester, not to be added to the point 3.7 – Total hours of individual study.

[4] Total hours per semester = total hours in the curriculum + total hours of individual study + hours allocated to examinations.

4. Prerequisites (where applicable)

4.1 of curriculum	• Complements of Theoretical Physics; • Complements of Solid State Physics; • Complements of Atom and Molecule Physics.
4.2 of skills	• General skills: the ability to accumulate basic knowledges; correct use of terminology in Physics; basic PC operation skills; the ability to work in a team; • Professional competences: identification and appropriate use of the main physical laws and principles; solving simple physics problems.

5. Conditions (where applicable)

5.1 for the course	blackboard, videoprojector, laptop.
5.2 for the seminar / laboratory	• blackboard, videoprojector, computers (2 students/computer); • Experimental setup for the study of the phenomena addressed.

6. Discipline objectives - expected learning outcomes which contribute to the completion and passing the discipline

Knowledge	- To know the advanced notions in the field of Physics, which involves a critical understanding of theories and principles; - To know the language specific to the field; - To know physical phenomena and interpret them by formulating hypotheses and operationalizing key concepts and the appropriate use of laboratory equipment; - To know the constructive and operating principles of the equipment for obtaining and characterizing materials and to explain how to use it.
Skills	- To compare the theoretical results provided by the specialized literature with those of an experiment carried out within a professional project; - To describe physical systems using specific theories and tools (experimental and theoretical models, algorithms, schemes, etc.); - To apply the principles and laws of physics in solving theoretical or practical problems, under conditions of qualified assistance. - To characterize the specific properties of some materials taking into account the field in which they are used; - To use experimental techniques for obtaining and characterizing materials; - To identify the most appropriate methods to develop new materials with well-defined properties.
Responsibility and autonomy	- Participate in some concrete physics experiments; - To critically analyze a specialized report, scientific communication with a medium degree of difficulty in the field of physics; - To be autonomous in the context of handling laboratory equipment, including in situations requiring an interdisciplinary approach; - To autonomously use information sources and resources for communication and assisted professional training (Internet portals, specialized software applications, databases, online courses, etc.) both in Romanian and in a language of international circulation.

7. Contents

The platform through which the course materials in electronic format and other learning/bibliographic resources can be accessed: https://classroom.google.com/c/ODE4NzEwNTM5MDA5?cjc=ibs5jnad

7.1 Course	**Teaching methods**	**Comments**
Introduction in optical spectroscopy (2h)	Lecture, presentation, examples, etc. Course materials (including those on e-learning/Google Classroom)	[1]
Physical quantities used in optical spectroscopy (2h)		[1]
Radiation sources in optical spectroscopy, monochromators and detectors (2h)		[1,2]
Measuring and analyzing optical absorption spectra (2h)		[1-3]
The study of emission spectra (2h)		[2]
Quantum yield. Case study. (2h)		[1-3]
The lifetime of excited states (2h)		[1-4]
Raman spectroscopy (2h)		[1]
Fourier transform spectroscopy (2h)		[2]
Optical spectroscopy of rare earth ions (2h)		[1,2]
Optical spectroscopy of transition metal ions (2h)		[1-3]
Optical spectroscopy of color centers (2h)		[8]
Judd-Ofelt analysis (2h)		[8-11]
Laser spectroscopy (2h)		[1,2]

1. M. Ștef, "*Notițe de curs*", *https://physics.uvt.ro/~stef/spectroscopie/*
2. J.G. Sole, L.E. Bausa, D. Jaque, "*An introduction to the Optical Spectroscopy of Inorganic Solids*", John Wiley & Sons Ltd., England 2005;
3. N.V. Tkachenko, "*Optical spectroscopy. Methods and Instrumentation*", Elsevier, Amsterdam, Boston 2006;
4. N. M. Avram, "*Fizica Atomului şi Moleculei*", Univ. Timişoara, 1986
5. B. H. Brandsen, C. J. Joachain, "*Fizica atomului si a moleculei*", Ed. Tehnica, Buc.,1998
6. N.M.Avram, M.Prosteanu, "*Spectroscopie și laseri*", Univ.Timișoara,1989
7. Peter F. Bernath, "*Spectra of Atoms and Molecules*", Oxford University Press, 1995;
8.Demtroder W., "*Laser Spectroscopy. Basic Concept and Instrumentation*", Springer, Berlin, 1988
9. Josesph R. Lakowicz, "*Principles of Fluorescence Spectroscopy*", Springer, 2006.
10. B. Henderson, R. Bartram, "*Crystal-Field Engineering of Solid-State Laser Materials*", Cambridge University Press, 2000
11. W. Fowler, *Physics of color centers*, Acad. Press, 19688. B. Henderson, R. Bartram, "Crystal-Field Engineering of Solid-State Laser Materials", Cambridge University Press, 2000

7.2. Seminar / Laboratory	**Teaching methods**	**Comments**
Safety regulations (2h)	Experiment, presentation, examples, etc. Course materials (including those on e-learning/Google Classroom)	[1-3]
Presentation of laboratory equipment and devices (2h)		[1]
Measuring, processing and analyzing UV-VIS absorption spectra. Beer-Lambert law (4h)		[1-3]
The influence of impurity concentration on the spectroscopic properties of rare-earth doped fluorite crystals (4h)		[1-3]
Measuring, processing and analysis of FTIR absorption spectra for CaF_2:ErF_3 crystals (4h)		[1-3]
Measurement and analysis of emission and excitation spectra of rare-earth doped fluorite crystals (4h)		[1,2]

Spectral deconvolution (Gauss, Lorentz, Voigt) (4h)		[1-3]
Optical characterization of F centers in ionic crystals. Determination of the concentration of F centers in crystals (4h)		

1. M. Ștef, “*Bazele spectroscopiei și laserilor*”, Editura Eurobit, Timișoara, 2022
2. J.G. Sole, L.E. Bausa, D. Jaque, “*An introduction to the Optical Spectroscopy of Inorganic Solids*”, John Wiley & Sons Ltd., England 2005;
3. N.V. Tkachenko, “*Optical spectroscopy. Methods and Instrumentation*”, Elsevier, Amsterdam, Boston 2006;
4. N. M. Avram, "*Fizica Atomului şi Moleculei*", Univ. Timişoara, 1986
5. B. H. Brandsen, C. J. Joachain, "*Fizica atomului si a moleculei*", Ed. Tehnica, Buc.,1998
6. N.M.Avram, M.Prosteanu, “*Spectroscopie și laseri*”, Univ.Timișoara,1989
7. Peter F. Bernath, “*Spectra of Atoms and Molecules*”, Oxford University Press, 1995;
8. Demtroder W., "*Laser Spectroscopy. Basic Concept and Instrumentation*", Springer, Berlin, 1988
9. Josesph R. Lakowicz, “*Principles of Fluorescence Spectroscopy*”, Springer, 2006.
10. B. Henderson, R. Bartram, “*Crystal-Field Engineering of Solid-State Laser Materials*”, Cambridge University Press, 2000
11. W. Fowler, *Physics of color centers*, Acad. Press, 19688. B. Henderson, R. Bartram, “Crystal-Field Engineering of Solid-State Laser Materials”, Cambridge University Press, 2000

8. Corroboration of the course contents with the epistemic expectations of the community representative, professional associations and representative employers of the programme itself

Knowing and understanding the specific phenomena of the discipline, training and developing the practical skills of handling laboratory equipment, performing experiments, processing experimental data and interpreting the results correctly and completely, practicing the spirit of teamwork and the ability to organize and investigation, cultivating a scientific environment based on values, professional ethics and quality, are just a few arguments that motivate the usefulness of this discipline for training a future physicist.

9. Use of tools based on generative artificial intelligence

For completing the tasks defined in the assessment section, the use of generative AI (GenAI) is permitted for preparing the laboratory report, exclusively for generating ideas, grammatical correction, or structuring the content.

The best-known examples of generative AI tools include, but are not limited to: ChatGPT, Google Gemini, Copilot for text, or MidJourney for images.

Each student will specify, in a statement written separately for each assignment, according to the model in Annex 3 of the Regulation on the use of generative artificial intelligence in the educational process at UVT, the tool they used, how it was used, and the part of the assignment in which it was used. The statement shall be included by the student at the beginning of the laboratory report.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final mark
10.4 Course	Knowledge testing	Multiple-choice test	50 %
10.5 Seminar	Activity		50 %
10.6 Minimum performance standards: Course – minim grade 5, Laborator – minim grade 5			

Upon successful completion of the course, students will be able to:

- define and correctly use the basic terminology specific to the field;
- identify and apply the relevant physical laws and principles in the analysis of real-world problems and in the preparation of laboratory reports;
- analyse and interpret the results of experimental measurements and theoretical calculations using appropriate numerical and statistical methods.

Date of submission: 15.09.2026

Titular of the course:
Assoc. Prof. Marius Stef
[redacted]

Date of approval in department:

Seminary/Laboratory titular:
PhD. Carla Schornig
[redacted]

HEAD OF THE DEPARTMENT:
Assoc. Prof. Nicoleta Stefu