SYLLABUS

1. Information on the study programme

1.1 Higher education institution	West University of Timisoara
1.2 Faculty	Physics
1.3 Department	Physics
1.4 Study program field	Physics
1.5 Study cycle	Master
1.6 Study programme / Qualification	PHYSICS AND TECHNOLOGY OF ADVANCED MATERIALS/conform COR: asistent de cercetare in fizica (248102), in fizica tehnologică (211107), în fizică – chimie (248104), în metrologie (251309) ; fizician (211101); profesor in invatamantul liceal (232201 - în condiţiile legii)

2. Information on the course

2.1 Course title			Scientific Research Internship				PTAM 2402
2.2 Lecture instructor			-				
2.3 Laboratory instructor			Conf. Dr. Barvinschi Paul				
2.4 Study year	2	2.5 Semester	4	2.6 Examination type	V	2.7 Course type	DS

3. Estimated study time (number of hours per semester)

3.1 Attendance hours per week	4	out of which: 3.2 lecture	-	3.3 seminar/lab	4
3.2. Attendance hours per semester	56	out of which: 3.5 lecture	-	3.6 seminar/lab	56

Distribution of the allocated amount of time*		hours
Study of literature, course handbook and personal notes		32
Supplementary documentation at library or using electronic repositories		32
Preparing for laboratories, homework, reports etc.		32
Tutoring		40
Exams		8
Other activities……		

3.7 Total number of hours of individual study	144
3.8 Total number of hours per semester	200
3.9 Number of credits (ECTS)	8

4. Prerequisites (if it is the case)

4.1 curriculum	All lectures of master program in the first 3 semesters.
4.2 competences	General skills: Creative application of research methods and problem solving; Elaborating studies and reports; Capacity to manage working groups and to communicate in different situations. Competente profesionale: Skills in problems solving; Skill in using laboratory equipment; Skills in using computers and software for numerical simulation of physical phenomena.

5. Requirements (if it is the case)

5.1 for the lecture	-
5.2 for the seminar / laboratory	Lab notes, PC/laptop with data base for X-ray phases identification (PDF or Match), PowderCell, Diffrac-EVA, MATLAB/Octave, FlexPDE or ANSYS software, X-ray diffractometer, IR and UV-VIS spectrometers

6. Course objectives

6.1 Knowledge	- To present theoretical knowledge necessary for the understanding of the processes involved in the interaction of X-rays, IR and UV-VIS electromagnetic waves with matter - To present the characterization techniques that use X-rays, IR and UV-VIS electromagnetic waves to study different physical systems - To offer the possibility to work with an X-ray diffractometer and a spectroscopic equipment
6.2 Skills	- Computational skills (PC uses for research, data acquisition) - Bibliography investigation - To develop the skills necessary for the acquisition and analysis of experimental data, and to present the results - The capacity to transfer the acquired knowledge in practical applications - Capacity to plan and organize experimental or theoretical applications - Capacity of solving characteristic problems for real physical systems.
6.3 Responsibility and autonomy	- Adaptability to new situations by taking decisions and assuming responsabilities; - The ability to manage complex projects and to develop partnerships in economic environments; - Creativeness and initiative in solving complex problems - Capacity of critical evaluations and auto evaluation. - Capacity of communication inside a group

7. Contents

8.1 Laboratory	Teaching methods	Remarks, details
Properties and nature of X-rays. Sources of X-rays.	Introductory conversation, heuristic conversation, problematization, learning-retention conversation, case studies, numerical modeling and numerical simulations. We will use the GoogleMeet software..	References (in the X-ray and spectroscopy labs libraries): [1] – [8] -The students will be asked to answer questions meant to help them update, deepen and systematize their
Interaction of X-rays with matter.		
Elements of crystallography. Kinematical theory of X-ray diffraction. Laue and Bragg equations.		
The intensity of diffracted X-ray beams.		
Scattering of X rays on disordered and amorphous materials.		
Snell's law and the Fresnel equations in the X-ray region. Specular reflection from multilayers		
X-ray spectroscopies (XAFS, XRF, XPS).		
The X-ray lab. Equipment and radiologic security		

Phase analysis and the use of PDF database Crystal structure determination, crystallite size, lattice strain, texture, stress. Rietveld refinement. Grazing-incidence diffraction on thin films. Molecular spectroscopy: infrared spectroscopy, Raman spectroscopy, UV-VIS spectroscopy, photoluminescence spectroscopy, nuclear magnetic resonance spectroscopy, epectron spin resonance spectroscopy, Mossbauer spectroscopy Atomic spectroscopy: atomic absorption spectroscopy, atomic emission spectroscopy, laser induced breakdown spectroscopy, Spectroscopy lab, instrumentation, data collection and analysis.		knowledge, then we will apply this knowledge for solving specific problems. -The students will describe physical phenomena and systems using specific theories and instruments – experimental and theoretical models, algorithms, diagrams, etc. -The students will form / practice / develop their: ---data processing abilities and the ability to interpret experimental results ---team work abilities ---organization and investigation abilities -The students will use appropriate numerical and mathematical statistical methods when analyzing and processing subject-specific data. -In order to obtain performance we aim to develop the student's ability to write a scientific report which will include the processing of experimental data and solutions regarding the application of X-ray and spectroscopic characterization techniques.

Recommended literature:

1. L.Als-Nielsen, D. Mc Morrow: *Elements of Modern X-ray Physics* (Wiley, New York, 2001)
2. B.D. Cullity, *Elements of X-Ray Diffraction*, 2-nd edition.(Addison-Wesley, Reading, Mass., 1978)
3. V. Pecharsky, P. Zavalij: *Fundamentals of Powder Diffraction and Structural Characterization of Materials*

(Springer, Berlin, 2005)
4. W. Demtroder, *Laser Spectroscopy. Basic Concept and Instrumentation* (Springer, Berlin, 1988)
5. Peter F. Bernath, *Spectra of Atoms and Molecules* (Oxford University Press, 1995)
6. J.G. Sole, L.E. Bausa, D. Jaque, *An Introduction to the Optical Spectroscopy of Inorganic Solids* (John Wiley & Sons Ltd., 2005)
7. N.V. Tkachenko, *Optical Spectroscopy. Methods and Instrumentation* (Elsevier, Amsterdam, 2006)
8. C.Suryanarayana, M.Grant Norton: *X-Ray Diffraction. A Practical Approach* (Plenum Press, New York & London , 1998)

8. Corroboration of study subjects with the expectations of the representatives of the epistemic community, the professional organizations and representative employers from fields related to the study program

The needs and expectations of the employers from related fields (academic institutions, research centers, corporate employers) were identified. The study subjects are coordinated with those of similar academic programs offered by other higher education institutions.

9. Evaluation

Activity	9.1 Assessment criteria	9.2 Assessment methods	9.3 Weight in the final mark
9.4 Seminar / Lab	-The students will identify the notions and will describe / explain the subject-specific phenomena in a given context. -The students, grouped into teams, will process data using specific software packages and will correctly interpret the results. -The students, grouped into teams, will write a scientific paper / report on a given subject. The teams will present these papers and will discuss them.	- Lab reports (by e-mail). - PowerPoint presentation of a subject related to the topic of the course. We will use the GoogleMeet software.	60% 40%
9.5 Minimum needed performance for passing			
- To obtain correct results at the labs. - To write the scientific paper / report on a given subject.			

Date of completion
20.01.2022

Lecture instructor
Conf. Dr. Paul BARVINSCHI

[redacted]

Date of approval by department head

[redacted]ctor of the department