FIŞA DISCIPLINEI / SYLLABUS

1. Program information

1.1 University	WEST UNIVERSITY OF TIMIȘOARA
1.2 Faculty	PHYSICS
1.3 Department	PHYSICS
1.4 Study direction	PHYSICS
1.5 Study cycle	MASTER
1.6 Study program / Qualification	ADVANCED RESEARCH METHODS IN PHYSICS/ according to COR: Analyst (251201); Research assistant in physics (211103); Physicist (211101); Teacher (233002); Education reviewer (235106)

2. Subject matter information

2.1 Subject matter			X Ray Characterization of Materials ARMP1203				
2.2 Course teacher			CS2 Dr. Maria Poienar				
2.3 Seminar teacher			CS2 Dr. Maria Poienar				
2.4 Lab teacher			-				
2.5 Study year	1	2.6 Semester	2	2.7 Assessment type	E	2.8 Subject type	Ob.

3. Study time distribution (hours per semester of didactical activities)

3.1. Number of hours per week	4	course	2	seminar	2	laboratory	-
3.2. Number of hours per semester	56	course	28	seminar	28	laboratory	-
3.3. Time distribution:							**hrs.**
Study using lecture notes, bibliography or notes							24
Additional documentation in the library, electronic specialty platforms/ field							34
Seminar / laboratory preparations, homework, portfolio and essays							26
Tutoring							6
Exams							4
Other activities							-

3.4 Total number of personal study hrs.	**94**	
3.5 Total number of hours in semester [1]	**150**	
3.6 Number of credits	**6**	

[1] Total number of hours shall not surpass the value (Number of credits) x 27 hrs.

4. Preconditions (where appropriate)

4.1 curriculum	• Complements of Theoretical Physics • Complements of Solid State Physics • Complements of Atom and Molecule Physics
4.2 skills	• Basic knowledge in solid state physics and chemistry • Basic knowledge in numerical data analysis

5. Conditions (where appropriate)

5.1 course	• laptop + projector, notebooks
5.2 seminar	• PCs with database for phases identification, Crystallography Open Database • software FullProf Suite, VESTA, • OrientExpress
5.3 laboratory	• laboratory equipment: • X-Ray difractometer

6. Specific skills gained

Professional skills	• Basic knowledge related to materials science. • Basic knowledge related to the characterization of material physical properties. • Identification of laboratory experimental techniques suitable for the study of physical properties (structural properties) characteristics to nano and micromaterials. • The ability to use certain software to model the crystal structure. • Bibliography investigation.
Transversal skills	• Effective use of information sources and communication resources. • Basic skills necessary to communicate (presentation, dialogue, report) • Capacity to analyze and synthesize. • Scientific communication in a foreign language (English)

7. Course Objectives

7.1 Main objective	• Students to identify the specific concepts and phenomena in a given context and to apply these knowledges in the analysis and interpretation of experimental data.
7.2 Specific objectives	• Students to define the specific notions of this discipline and to describe the phenomena • Students to use correct laboratory equipment to perform measurements. • Students to process experimental data using software packages and correctly interpret the experimental results. • Students to develop their organizational capacity • Students to develop their spirit of teamwork. • Students to appreciate and cultivate a scientific environment based on values and quality

8. Contents

8.1 Course	**Teaching methods**	**Observations**
1.Properties and nature of X-rays. Sources of X-rays	exposition	2 hours
2. Interaction of X-Ray with matter	exposition	2 hours
3.Instrumentation used for X-ray Diffraction	exposition	2 hours
4. Geometry of Crystals	exposition	2 hours
5. Scattering and Diffraction	exposition	2 hours
6. Diffraction from Polycrystalline Samples	exposition	2 hours
7. Width of diffraction maxima	exposition	2 hours
8. Lattice vibrations and the Debye Waller factor	exposition	2 hours
9.Laue Diffraction Method	exposition	3 hours
10. Microstructural Study based on X Ray data	exposition	2 hours
11. Reciprocal Lattice and Integrated Intensities of Crystals	exposition	2 hours
12. Interpreting the Results	exposition	2 hours
13. X Ray diffraction on thin films	exposition	2 hours
14. Invited lecture (Recognised international researcher/professor)	exposition	2 hours

Recommended Bibliography

1. J. Als-Nielsen, D. McMorrow, "Elements of modern x-ray physics", 2nd edition, A John Wiley & Sons, Ltd Publication, 2011.
2. B. D. Cullity, "Elements of x-ray difraction", Addison-Wesley Publishing Company Inc. 1978.
3.V. Pecharsky, P. Zavalij, "Fundamentals of powder diffraction and structural characterization of material", Springer, Berlin, 2005
4. E. Lifshin (Editor), „X-ray characterization of materials", Wiley-VCH, New York 1999

8.2 Seminar	**Teaching methods**	**Observations**
1. Production and properties of X-rays	exposition, experiment	2 hours
2. The X-Ray Diffraction: Equipment and radiologic security	exposition, dialog	2 hours
3. Phase analysis and the use of PDF database: single and multiple phases	exposition, data analysis	2 hours
4. Elements of crystallography	exposition, data analysis	2 hours
5. Crystal structure analysis	exposition, data analysis	2 hours
6. Interpretation of Powder Diffraction Patterns	exposition, data analysis	2 hours
7. Rietveld method- Theoretical background	exposition, data analysis	2 hours
8. Rietveld refinement- FullProf program	exposition, data analysis	2 hours
9. Exercises: determination of unit cell parameters for different materials.	Exposition, data analysis	2 hours
10. Study of micro-structural effects	exposition, data analysis	2 hours
11. The determination of crystal structure from powder diffraction data	exposition, data analysis	2 hours
12. Laue crystal orientation	exposition, data analysis	2 hours
13. X-Ray diffraction on thin films	exposition, data analysis	2 hours
14. Studies from research scientific articles: examples.	exposition, dialog	2 hours

Bibliography:
1.C.Whiston, X-Ray Methods,John Wiley and Sons, 1996
2. R. A. Young, The Rietveld Method, Oxford University Press, 1993
3. B. D. Cullity, Elements of X-Ray Diffraction, 2-nd edition.(Addison-Wesley, Reading, Mass., 1978)
4. V. Pecharsky, P. Zavalij: Fundamentals of Powder Diffraction and Structural Characterization of Materials (Springer, Berlin, 2005)
5. J. Rodriguez-Carvajal, Recent advances in magnetic structure determination by neutron powder diffraction + FullProf, Physica B: Condensed Matter 192 (1–2), Pages 55–6
6. P. W. Stephens, Phenomenological Model of Anisotropic Peak Broadening in Powder Diffraction J.

8.3 Laboratory	**Teaching methods**	**Observations**
-		

4 Corroboration of the contents with the expectation of the epistemic community, professional associations and representative employers from the program's corresponding domain

5 Evaluation

Activity type	Assessment criteria	Assessment methods	Percent in final mark
10.1 Course	knowledge of the theoretical notions	final evaluation (written)	50%
	homework, reports, essays	in the course of the semester	10%
10.2 Seminar	final answers at seminar activities	in the course of the semester (orally)	25%
	activity during seminars	in the course of the semester	15%
10.3 Laboratory	-		
10.4 Minimum performance standards			
Fulfillment of 50% of the abovementioned criteria.			

Completion date: 04.02.2025

Signature of the course instructor: CS2 Dr Maria Poienar

Signature of the seminar/laboratory instructor: CS2 Dr Maria Poienar

Signature of the department director:
Conf. Dr. Nicoleta Stefu