SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babes-Bolyai University
1.2 Faculty	Of Physics
1.3 Department	Condensed Matter Physics and Advanced Technologies
1.4 Field of study	Physics
1.5 Study cycle	Master
1.6 Study programme / Qualification	Solid State Physics

2. Information regarding the discipline

2.1 Name of the discipline	Nanostructured Materials						
2.2 Course coordinator	Prof.dr. Romulus Tetean						
2.3 Seminar coordinator	Prof.dr. Romulus Tetean						
2.4. Year of study	II	2.5 Semester	2	2.6. Type of evaluation	E	2.7 Type of discipline	O

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14

Time allotment:	hours
Learning using manual, course support, bibliography, course notes	30
Additional documentation (in libraries, on electronic platforms, field documentation)	35
Preparation for seminars/labs, homework, papers, portfolios and essays	35
Tutorship	8
Evaluations	2
Other activities:	-

3.7 Total individual study hours	112
3.8 Total hours per semester	154
3.9 Number of ECTS credits	6

4. Prerequisites (if necessary)

4.1. curriculum	• Solid State Physics, Quantum Physics
4.2. competencies	• To know basic notions on physics from the basic courses

5. Conditions (if necessary)

5.1. for the course	• Course hall with blackboard, projector and software
5.2. for the seminar /lab activities	• Laboratory with specific equipment

6. Specific competencies acquired

Professional competencies	**C1.** Using of advanced knowledge of physics, mathematics and chemistry of solids for study in Sold State Physics and Materials Science. Capacity for analysis and synthesis of physical data, the ability to model complex phenomena. **C2.** Capitalization of physical fundamentals, of methods and tools of solid state physics and materials science for specific production activities, expertise and monitoring. Mindset multi-and interdisciplinary. **C3.** Planning and conducting experiments to assess the uncertainty and interpretation of the results. Use basic research laboratory equipment and industrial laboratory for conducting research experiments. Planning and implementation independently experiments or experimental investigations and evaluating the uncertainty of the results **C4.** Communicating complex scientific ideas, conclusions or results of a scientific project experiments. Ability to obtain and argue scientific results, the ability to produce scientific papers and to relate to the editorial board of scientific journals of the field.	
Transversal competencies	**CT1.** Fulfil the professional tasks effectively and responsibly with respect for law and ethics under qualified assistance. Responsible execution of professional duties in terms of autonomy and decision-making based on self-assessment. **CT2.** Effective work in multidisciplinary team on different hierarchical levels. Implementation of activities and fulfilling specific teamwork roles on different hierarchical levels, showing initiative and entrepreneurial leadership based on promoting dialogue, cooperation positive attitudes, mutual respect, diversity and multiculturalism and continuous improvement of their activities. **CT3.** Effective use of information sources and communication resources and training assistance, both in Romanian and in a foreign language. Objective self-evaluation of the need for continues training to labour market insertion and the adaptation to dynamic requirements of labour market.	

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Acquiring notions on the experimental and theoretical techniques and methods concerning preparation, structures and properties of the nanostructured materials.
7.2 Specific objective of the discipline	• Introduction on general characteristics of nanomaterials • Acquiring competences on preparation methods of nanomaterials • Acquiring competences on characterization techniques • Introduction on applications of nanostructured materials

8. Content

8.1 Course	Teaching methods	Remarks
Introduction. Why nanomaterials? Nanomaterials for nanoscience and nanotechnology. Characterization of nanophase materials.	Lecture, demonstration, debate, the experiment demonstration and presentations on the computer	
Nanostructured materials preparation. Nanoclusters and nanocrystals. Nanoclusters synthesis.		
Equilibrium grows. Non-equilibrium grows. Lattices mismache. Semiconductor nanoparticles.		
Noble metal coloids. Nanomagnetism. Magnetism in		

reduced dimensional systems. Superparamagnetism. Spin transport. Giant magnetoresistane.		
Nanowires		
Super-lattices. Nanoparticle clusters. Passivation. Carbon based materials.		
Fullerene. Carbon nanotubes. SWCN's. MWCN's. Preparation and characterization. Physical properties.		
X-ray characterization of nanoparticles. Diffraction in small particles case. Crystalline and noncrystalline particles.		
Direct analysis of nanoparticles diffraction patterns. X-ray absorption spectroscopy. XANES. EXAFS.		
Characteristic features of nanoparticles in EXAFS. EXAFS signal extraction.		
Transmission electron spectroscopy and microscopy on nanoparticles. HR-TEM.		
Poliedral shape nanoparticles. Surface reconstruction. Twin structures. Decahedral and icosahedral particles.		
Self-assembled supperlattices. STM. Auger electrons spectroscopy.		
Applications.		

Bibliography

Compulsory:

1. Z. L. Wang (editor), Characteriyation of Nanophase Materials, Ed. Wiley-VCH, Weinheim, New York, Chichester, Brisbane, Singapore, Toronto, 2000
2. Gunter Schmid (editor) Nanoparticles. From Theory to Applications, Ed. Wiley-VCH, Weinheim, 2004
3. M.Kohler, W. Fritzsche, Nanotecnology, Ed. Wiley-VCH, Weinheim, 2004
4. A.S.Edelstein, R.C. Cammarata (editors), Nanomaterials: Synthesis, Properties and Applications, Institute of Phys., London, 1996
5. F.J.Himpsel, J.E.Ortega, G.J.Mankey, R.F.Willis, Magnetic nanostructures, Advances in Phys, Vol.47, Nr. 4, 511-597, 1998
6. Z.I.Wang, Elastic and Inelastic Scattering in Electron Diffraction and Imaging, Plenum Pub.Co, New York, 1995
7. Liz-Marzán**,** Luis M**.,** Kamat**,** Prashant V., Nanoscale materials, Kluver Academic Press, 2003
8. J. Zhang, Z. Wang, J.Liu, S.Chen, G.Liu, Self Assembled Nanostructures, Ed.Springer, 2002

Optional:

1. Journal of Nanoscience and Nanotechnology
2. http://xxx.lanl.gov/archive/cond-mat
3. Journal of Nanomaterials

8.2 Seminar / laboratory	Teaching methods	Remarks
Nanomaterials preparation through high energy ball milling method.	Work in a team in laboratory using different equipment. Correlations between experimental results and theoretical	
X-ray diffraction on prepared samples.		
Transport properties.		

Magnetic properties.	models	
Bibliography User manuals of different equipments.		

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The content of the discipline is in accordance with the subjects who are studied in the same field in romanian and foreign universities and with the specific demands of research institutes, economy and labour market.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Understanding of the physical phenomena in nanostructured materials and capacity to make connexion between the results obtained by different techniques.	Exam	75 %
10.5 Seminar/lab activities	The quality of the prepared samples and of the experimental measurements in large temperature ranges (5-300K) and high magnetic fieelds up to 12 T.	Supervising all activities	10%
	The correlations between the different techniquls results used for characterization. A written report on scientific results.	Discussion and correction if it will be neccesary of the report.	15%
10.6 Minimum performance standards			
➢ Specific characteristics of nanomaterials ➢ The main differences between bulk and nanostructured materials ➢ Main techniques used for characterization ➢ Planning and carrying out an experiment to validate a theoretical model in physics of metals and alloys.			

Date ..... Signature of course coordinator ..... Signature of seminar coordinator .....

Date of approval ..... Signature of the head of department .....