SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babeş-Bolyai University, Cluj-Napoca
1.2 Faculty	of Physics
1.3 Department	Department of the Condensed Matter Phyiscs and Advanced Technologies
1.4 Field of study	Applied Engineering Science
1.5 Study cycle	Master
1.6 Study programme / Qualification	Biomaterials

2. Information regarding the discipline

2.1 Name of the discipline	Modern spectroscopic technics applied in the study of the advanced materials						
2.2 Course coordinator	Prof. Simion Simon (PhD)/ Assoc. Prof. Lucian Baia (PhD)						
2.3 Seminar coordinator	Prof. Simion Simon (PhD)/ Assoc. Prof. Lucian Baia (PhD)						
2.4. Year of study	1	2.5 Semester	2	2.6. Type of evaluation	E	2.7 Type of discipline	S

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

3.1 Hours per week	5	Of which: 3.2 course	3	3.3 seminar/laboratory	2
3.4 Total hours in the curriculum	70	Of which: 3.5 course	42	3.6 seminar/laboratory	28

Time allotment:	hours
Learning using manual, course support, bibliography, course notes	36
Additional documentation (in libraries, on electronic platforms, field documentation)	40
Preparation for seminars/labs, homework, papers, portfolios and essays	44
Tutorship	3
Evaluations	3
Other activities:	-

3.7 Total individual study hours	126
3.8 Total hours per semester	196
3.9 Number of ECTS credits	8

4. Prerequisites (if necessary)

4.1. curriculum	• Fundamental knowledge about the atomic and molecular physics, and solid state physics
4.2. competencies	• Adequate use of the fundamental knowledge of atomic and molecular physics, and solid state physics • Adequate use of the equipments involved in the advanced materials research

5. Conditions (if necessary)

5.1. for the course	• Course hall with table, vide projector and adequate software • At least two students should be present
5.2. for the seminar /lab activities	• Laboratories possess adequate equipments for performing the proposed lab works

6. Specific competencies acquired

Professional competencies	**C1.** Use of the main physics and biomaterials laws and principles that operate at different dimensional scales. **C4.** Individual planning and implementation of the experimental investigations and assessing of the obtained results from the perspective of their uncertainty. **C5.** Ability to communicate complex scientific ideas, conclusions derived from experimental investigations or results obtained during a scientific project. **C6.** Ability to use equipments and experimental techniques in limited or interdisciplinary domains from biomaterials field.
Transversal competencies	**CT1.** Achievement of the proposed professional tasks in an efficient and responsible way keeping in mind the effective laws and deontological rules **CT2.** Applying the work methods that conduct to efficient results in a multidisciplinary team on diverse levels.

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

7.1 General objective of the discipline	• Getting the theoretical and experimental knowledge related to the phenomena that govern the principles of the used spectroscopic techniques and about the efficient involvement of these investigation techniques for elucidating the structural particularities of a large variety of materials
7.2 Specific objective of the discipline	• Getting the experimental and theoretical notions useful when spectroscopic techniques are involved • Understanding the structure and properties of a large variety of materials from the data analysis recorded by using various complementary spectroscopic techniques

8. Content

8.1 Course	Teaching methods	Remarks
1. The role played by the spectroscopic techniques in elucidating the materials structure. The importance of choosing the right spectroscopic method.		2 hours
2. The use of IR spectroscopy (ATR-IR, IR-RAS, IR-DRIFT) to the study of advanced materials.		4 hours
3. The investigation of the materials structure by means of Raman spectroscopy (micro-Raman, resonance Raman, confocal micro-Raman, SERS spectroscopy).		6 hours

4. UV-vis spectroscopy applied to the study of the materials. The study of optical properties.		4 hours
5. Characterization of the surface and interface of materials by various spectroscopic techniques (ATR-IR, IR-RAS, confocal micro-Raman spectroscopy, XPS, etc.).		5 hours
6. Magnetic resonance. General aspects.		3 hours
7. Electronic paramagnetic resonance. The spin Hamiltonian.		3 hours
8. Paramagnetic centers in advanced materials.		3 hours
9. Nuclear magnetic resonance. Rotation to the magical angle.		3 hours
10. Nuclei with spn ½ in advanced materials.		3 hours
11. Quadrupolar nuclei in advanced materials.		3 hours
12. Mösbauer spectroscopy.		3 hours

Bibliography

1. J. M. Chalmers, Peter R. Griffiths, (eds.): *Handbook of vibrational spectroscopy*, vol. 1-5, J. Wiley & Sons, Chichester, 2002.
2. L. V. Interrante, M. J. Hampden-Smith, (eds.), Chemistry of advanced materials, John-Wiley & Sons New York, 1998.
3. Elemente de spectroscopie optică moleculară, T Iliescu, Casa Cărții de Știință, Cluj-Napoca, 2003.
4. P. Chakraborty, Metal nanoclusters in glasses as non-linear photonic materials (Review), J. Mater. Science, **33**, 1998, 2235-2249.
5. I. Ursu, Rezonanța electronică de spin, Ed. Academiei, 1965.
6. Al. Nicula, Ed. Didactică şi Pedagogică, 1980.
7. H. Friebolin, Basic one and Two Dimensional NMR Spectroscopy, VCH Publ., 1991.
8. R. Ernst, Principles of Nucleus Magnetic Resonance in One and Two Dimensions, Oxford Sci. Publ., 1990.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Study of advanced materials with crystalline, partial crystalline or amorphous structure by means of IR, ATR-IR and Raman spectroscopy.	Lecture, debate, presentation	7 hours
2. Analysis of optical properties and morphological particularities of some advanced materials by UV-vis spectroscopy.		7 hours
3. Investigations of advanced materials with crystalline, partial crystalline or amorphous structure by means of ERS.		7 hours
4. NMR spectroscopic analyses of advanced materials with crystalline and partial crystalline structure.		7 hours

Bibliography

1. L. Baia, Theory and applications of confocal micro-Raman spectroscopy on hybrid polymer coatings and PDMS membranes and spectroscopic studies of doped B_2O_3-Bi_2O_3 glass systems, PhD thesis, Würzburg, 2003.
2. L. Baia, M. Baia, W. Kiefer, J. Popp, S. Simon, Structural and morphological properties of silver nanoparticles-phosphate glass composites, *Chemical Physics*, **327**, (2006), 63-69.
3. Aplicatii ale spectroscopiei vibrationale, T. Iliescu, S. Cinta Pinzaru, D. Maniu, R. Grecu, S. Astilean, Casa Cărții de Știință, Cluj-Napoca, 2002.
4. H. Friebolin, Basic one and Two Dimensional NMR Spectroscopy, VCH Publ., 1991.
5. R. Ernst, Principles of Nucleus Magnetic Resonance in One and Two Dimensions, Oxford Sci. Publ., 1990.

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 teaching line is in agreement with other activities taught in other national and international university canters. In order to fit the teaching line with the market requirements its content was synchronized.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- correctness of the knowledge - completeness of the knowledge - logical coherence of the presentation	- final evaluation	45
		- intermediate evaluation	30
10.5 Seminar/lab activities	- capacity to apply the learned knowledge - ability to work with the acquired knowledge	- oral evaluation	25
10.6 Minimum performance standards			
➢ To be present at minimum 75% of laboratories ➢ The passing of the master student is closely related with the knowledge of the following notions: the principle of measuring for the main spectroscopic techniques used in materials investigation			

Date	Signature of course coordinator	Signature of seminar coordinator
22.09.2012	Assoc. Prof. Lucian Baia (PhD)	Assoc. Prof. Lucian Baia (PhD)

Date of approval

Signature of the head of department

Prof. Romulus Tetean (PhD)