SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babes-Bolyai University
1.2 Faculty	of Physics
1.3 Department	Biomolecular Physics
1.4 Field of study	Physics
1.5 Study cycle	Master
1.6 Study programme / Qualification	Biophysics and medical physics, Computational Physics

2. Information regarding the discipline

2.1 Name of the discipline	Molecular Spectroscopy Complements						
2.2 Course coordinator	Assoc Prof. dr. Maniu Dana, Asist Prof. dr. Mihai Vasilescu						
2.3 Seminar coordinator							
2.4 Seminar coordinator	Assoc Prof. dr. Maniu Dana, Asist Prof. dr. Mihai Vasilescu						
2.5. Year of study	I	2.6 Semester	1	2.7. Type of evaluation	E	2.8 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					28
Additional documentation (in libraries, on electronic platforms, field documentation)					30
Preparation for seminars/labs, homework, papers, portfolios and essays					35
Tutorship					14
Evaluations					7
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	
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 skills acquired

Professional skills	• Operating with physical laws and physical principles in biophysics and medical physics at all levels; • Performing experiments of medical physics and biophysics and evaluating their results based on existing theoretical models; • Use of fundamental research laboratory equipment for conducting research experiments; • Planning and performing of the experiments or investigations, independently, and evaluating the degree of uncertainty of the results; • Communication of complex scientific ideas, experimental findings or the results of a scientific project; • Use of specific experimental equipment and techniques from biophysics and medical physics in restricted or interdisciplinary fields; • Advanced planning and organization capacity

Transversal skills	• Applying the values and ethics of the profession of researcher and responsible execution of professional tasks in terms of autonomy and decision-making based on evaluation and self-evaluation; • Application of efficient multidisciplinary team work techniques on various hierarchical levels; • Effective use of information sources and communication and training resources, both in Romanian and in an international language; • Objective self-evaluation of the need for continuing vocational training for the purpose of insertion into the labor market and adaptation to the dynamics of its requirements and for personal and professional development and effective use of multilingual skills and knowledge of information and communication technology;

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

7.1 General objective of the discipline	Acquiring notions on the theoretical methods and experimental techniques concerning the interaction of electromagnetic radiation with matter
7.2 Specific objective of the discipline	Acquiring theoretical and practical skills in the acquisition, interpretation and use of spectroscopic information in the study of physico-chemical and structural properties of various materials.

8. Content

8.1 Course	Teaching methods	Remarks
Optical Spectroscopy - Light interaction with atomic and molecular systems. Rotational, roto-vibrational, vibrational and electronic transitions.	Lecture, demonstration, debate, the experiment demonstration and presentations on the computer	2 hours
The theory of molecular vibrations. Diatomic molecules, polyatomic molecules. Different approximations. Normal coordinates		2 hours
IR Spectroscopy. Dipole moment. Selection rules. Characteristic IR Spectra. Examples and applications.		2 hours
Raman spectroscopy. Molecular polarizability. Raman Effect Theory. Characteristic Raman Spectra. Examples and applications.		2 hours
Methods and equipment in IR and Raman spectroscopy		2 hours
UV-Vis Spectroscopy. Classification of electronic states and Franck-Condon principle. Electronic transitions and selection rules.		2 hours
Fluorescence emission spectroscopy. Jablonski diagram. Type of electronic transitions. Single-triplet transitions. phosphorescent emission spectroscopy.		2 hours
Nuclear Magnetic Resonance Spectroscopy: History, Introduction, Physical Basics of NMR, Formalism, Types of Interactions		2 hours
Nuclear Magnetic Resonance Spectroscopy: Experimental Description, Fourier Transform, Spectra		2 hours
Methods and equipment in magnetic resonance spectroscopy		2 hours
Electron Paramagnetic Resonance Spectroscopy: Electron in Magnetic Field, Resonance Absorption, Gyromagnetic Factor		2 hours
Methods and Equipment in Electron Paramagnetic Resonance Spectroscopy		2 hours
Photoelectronic, Absorption and Fluorescence X-ray Spectroscopy		2 hours
Methods and Equipment in XPS		2 hours

Bibliography

1. S. Astilean, *Metode şi tehnici moderne de spectroscopie optica*, Ed. Casa Cărţii de Stiinţă, Cluj-Napoca, 2002.
2. T. Iliescu, S. Cîntă Pînzaru, D. Maniu, S. Astilean, R. Grecu, *Aplicaţii ale spectroscopiei vibraţionale*, Ed. Casa Cărţii de Stiinţă, Cluj-Napoca, 2002.
3. W. S. Struve, *Fundamentals of molecular spectroscopy*, Ed. John Wiley & Sons, 1997.
4. M. Diem, *Introduction to modern vibrational spectroscopy*, Ed. John Wiley & Sons, 1993
5. S. Ramusch, *Fundamentals of UV-visible spectroscoopy*, Hewlett-Packard Group, 2003.
6. J. R. Lakowicz, *Principles of fluorescence spectroscopy*, Springer Science, 1999.
7. D. M. Grant, R.K. Harris, *Encyclopedia of Nuclear Magnetic Resonance*, John Wiley&Sons, 1996.

8. C. P. Slichter, *Principles of Magnetic Resonance*, Springer, 1996.
9. O. Cozar, V.V. Grecu, V. Znamirovschi, *Aplicatii ale rezonantei electronice de spin in fizica molecule*, Cluj-Napoca, 1995.
10. G.E. Pake, T.L. Estle, *The Physical Principles of Electron Paramagnetic Resonance*, Benjamin Cummings, Menlo Park, CA, 1070.
11. N.M. Atherton, *Principles of Electron Spin Resonance*, Ellis Horwood Ltd., Chichester, 1993.
12. D. Briggs and M.P. Seah, *Practical Surface analysis and X-ray photoelectron Spectroscopy*, Wiley, New-York, 1983.
13. A.W. Czanderna, *Methods of Surface Analysis, Elsevier*, New York, 1975.

8.2 Seminar / laboratory	Teaching methods	Remarks
IR spectroscopic analysis of CO2 rotational spectrum	Presenting the equipment, performing measurements, making calculations, interpreting the results, discussions.	2 hours
Determination of ethanol concentration using Raman spectrometer		2 hours
Study of the shape and position of the UV-Visible spectra of some chromophores (eosin, tetrazine) depending on the polarity or pH of the solvent		2 hours
NMR spectroscopic analyzes of some liquid samples		2 hours
Structural investigations using RES spectroscopy		2 hours
Investigation using XPS spectroscopy		2 hours
Laboratory colloquium		2 hours
Bibliography: laboratory reports and technical books of used instruments		

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 students acquire theoretical and practical skills in the acquisition, interpretation and use of spectroscopic information in the study of physico-chemical and structural properties of various materials. These competencies are required after abstraction in scientific research, service or commercial activities in the field of spectral equipment, technological consultancy and didactic activities, both in the country and abroad.

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 interaction between electromagnetic radiation and matter and capacity to make connexion between the results obtained by different spectroscopic methods and physico-chemical and structural properties of various materials.	Final exam Mid-term exam	45 % 30%
10.5 Laboratory /seminar activities	The quality of the presentation.	Direct evaluation	10%
	Written report on a specific subject. Answer to questions.	Discussion and correction if it will be neccesary of the report.	15%
10.6 Minimum performance standards			
➢ The main differences between spectroscopic methods ➢ Understanding the principles of main techniques used in molecular spectroscopy ➢ Planning and carrying out an spectroscopic experiment.			

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

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