SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babes-Bolyai University
1.2 Faculty	Physics
1.3 Department	Solid State 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				Physics of Magnetic Phenomena			
2.2 Course coordinator				Prof. Dr. Viorel Pop			
2.3 Seminar coordinator				Lector. Dr. Roxana Dudric			
2.4. Year of study	**2**	2.5 Semester	**4**	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	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					77
Additional documentation (in libraries, on electronic platforms, field documentation)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					17
Tutorship					3
Evaluations					3
Other activities:					–

3.7 Total individual study hours	120
3.8 Total hours per semester	162
3.9 Number of ECTS credits	5

4. Prerequisites (if necessary)

4.1. curriculum	Solid state Physics, Magnetism, Quantum Physics
4.2. competencies	Valorisation of physical fundamentals in magnetism, of methods and tools in magnetism and material science for specific applications. Use and development of research results from laboratory equipment and industrial laboratory for conducting research experiments.

5. Conditions (if necessary)

5.1. for the course	Classroom equipped with blackboard and projector
5.2. for the seminar /lab activities	Access to the research laboratory of Babes-Bolyai University

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 the physical processes that occur in magnetism and magnetic materials **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. **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	Thorough knowledge of the theoretical and practical aspects in magnetism and, within it, the proper use of specific language in communicating with different professional backgrounds.
7.2 Specific objective of the discipline	Valorisation of physical fundamentals, of theoretical and practical knowledge related to the study of magnetism and magnetic materials with different structuration/microstructuration: bulk, nanomaterials, thin layers or amorphous.

8. Content

8.1 Course	Teaching methods	Remarks
1. Fundamental aspects in magnetism: magnetic moments, magnetic interactions, magnetic structure etc.	Lecture combined with debates. Will be used the video	2 h
2. Isolated magnetic moments.		2 h

3. Order and magnetic structures	projector and the blackboard.	4 h
4. Crystal field, magnetocrystalline anisotropy.		2 h
5. Magnetism in metals.		4 h
6. Magnetic resonance.		4 h
7.Competing interactions and low dimensionality (frustration, spin glasses, superparamagnetism, one-dimensional and two-dimensional magnets).		4 h
8. Nanoscale magnetism.		2 h
9. Magnetoresistance and spin electronics.		2 h
10. Coercivity an hysteresis in magnetism		2 h

8.2 Seminar	Teaching methods	Remarks
1. Theoretical fundaments and experimental methods in magnetism.	Critical presentation of given subjects. Will be used the video projector and the blackboard.	3 h
2. Magnetic behaviour of matter: diamagnetism, paramagnetism, ordered magnetic materials.		4 h
3. X-ray photoelectron spectroscopy and magnetic behaviour.		2 h
4. FORC diagrams and coercivity		2
5. Magnetic materials fundamental aspects/applications: bulk, nanomaterials, thin layers or amorphous.		3
6.		
7.		
8.		

Bibliography

1. Blundel S., Magnetism in condens matter, Oxford University Press, New York 2001.
2. Burzo E., Fizica fenomenelor magnetice, Ed. Academiei Române, Bucureşti, vol. I (1979), vol. II (1981), vol. III (1983).
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4. Du Trémolet de Lacheisserie E. (editor), Magnetisme, Presses Universitaires de Grenoble, 1999.
5. Fert A., Vouille C., Magnetoresistance Overview: AMR, GMR, TMR, CMR in 30. Ferienkurs des Instituts fur Festkorperforschung 1999, Magnetische Schichtsysteme, Forschungszentrum, Julich
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9. Pop V., Chicinaş I., Proprietăţi fizice ale metalelor şi aliajelor, Universitatea Babeş-Bolyai Cluj-Napoca, 1997.
10. Rado G. T., Suhl H., Magnetism, Academic Press, 1963.
11. Sellmyer D., Skomski R., Advanced Magnetic Nanostructures, Springer 2006
12. Sîcev V.V., Sisteme termodinamice complexe, Ed. Ştiinţifică şi enciclopedică, Bucureşti 1982.
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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

Course content is consistent with what we study in other universities from Romania or abroad being adapted to the peculiarities of research activity at Babes-Bolyai University. To adapt to the requirements of the labour market, the content of these lectures was adjusted to the specific requirements of university education, research institutes and industry.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Depth knowledge and understanding of concepts, basic theories and methods in Magnetism. Using advance knowledge of material sciences for explanation and interpretation of new concepts, situations, processes, projects etc. associated to theoretical and practical knowledge in magnetism and magnetic materials.	Solving and explaining complex problems in material science more precisely in physics of solid state electronics.	75
10.5 Seminar	Integrated use of conceptual and methodological apparatus to solve theoretical and practical problems in magnetism. Nuanced and meaningful use criteria and assessment methods to make valuable judgments and promote constructive decisions.	Essay on an imposed theme, with public presentation. Lecture to strengthen experimental skills.	25
10.6 Minimum performance standards			
➢ Design of materials in accordance with quality management principles and elements considering environmental impact and health security. ➢ Use and development of research and/or industrial equipments to perform research experiments ➢ Planning and carrying out an experiment to validate a theoretical model in magnetism and magnetic materials.			

Date Signature of course coordinator Signature of seminar coordinator

20.12.2018. .....#..... .....

Date of approval Signature of the head of department

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