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				Magnetic and Superconducting materials			
2.2 Course coordinator				Prof. Dr. Viorel Pop, Prof. dr. Romulus Tetean			
2.3 Seminar coordinator				Prof. Dr. Viorel Pop, Prof. dr. Romulus Tetean			
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	4	Of which: 3.2 course	2	3.3 seminar/laboratory	2
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory	28
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					37
Tutorship					3
Evaluations					3
Other activities:					–

3.7 Total individual study hours	140
3.8 Total hours per semester	196
3.9 Number of ECTS credits	8

4. Prerequisites (if necessary)

4.1. curriculum	Magnetism, Superconductivity, Solid state Physics, Quantum Physics
4.2. competencies	Valorisation of physical fundamentals, of methods and tools of solid state physics and material science for specific applications. Use and development of research 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 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	Thorough knowledge of the fundamental and practical aspects in the field of magnetic and superconducting materials 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 methods and tools for study, production and applications of magnetic and superconducting materials. Use and development of research and/or industrial equipments to perform research experiments.

8. Content

8.1 Course	Teaching methods	Remarks
1. Fundamental aspects in magnetism		2 h

2. Fundamental interactions in magnetic materials. Magnetic free energy.	with debates. Will be used the video projector and the blackboard.	2 h
3. Soft magnetic materials		2 h
4. Hard magnetic materials		2 h
5. Nanocomposite and nanostructured magnetic materials		2 h
6. Thin films magnetic materials		2 h
7. Applications of magnetic materials		2 h
8. Introduction to superconductors; Meissner effect; Characteristic lengths in SC; Categories of SC; Magnetic properties; Critical current density		2 h
9. London equations; Models on superconductivity; BCS theory.		2 h
10. Intermetallic and oxide superconductors known before 1986		2 h
11. High temperature superconductors		2 h
12. Diborides; Organic superconductors; Pnictides; Flux pinning		2 h
13. Wires; Superconducting cables, Superconducting thin films,		2 h
14. Applications of superconductivity		2 h

Bibliography

1. Andersen J. C., Leaver K. D., Rawlings R. D., Alexander J. M., Materials Sciences, Van Nostrand Reinhold (UK) Co. Ltd, 1986.
2. Ashcroft N. W., Mermin N. D., Solid State Physics, Holt-Saunders International Editions Tokyo, 1981.
3. Burzo E., Magneți permanenți, Ed. Academiei Române Bucureşti, vol. I, vol. II (1986).
4. Chicinaş I, Mărimi magnetice de material, Ed. Casa Cărții de Știință, 2002.
5. G.Ilonca, A.V.Pop-Supraconductibilitatea si supraconductori cu temperature critica inalta, Ed.Bit, Iasi (1998).
6. Du Trémolet de Lacheisserie E. (editor), Magnetisme, Presses Universitaires de Grenoble, 1999. Du Trémolet de Lacheisserie E. (editor), Magnetism, Kluwer Academic Publisher, 2003
7. Morrish A. H., The Physical Principles of Magnetism, John Wiley &Sons, Inc.
8. Pop A.V., Introducere in fizica sistemelor vortex, Ed.Efes, Cluj_Napoca, 2004
9. Sellmyer D., Skomski R., Advanced Magnetic Nanostructures, Springer 2006
10. Pascal Tixador, Les supraconducteurs , Ed. Harmes, Paris, 1995
11. Karl-Heinz Bennemann , John B. Ketterson, The physics of superconductors, Ed. Springer, 2003
12. Michael Tinkham, Introduction to superconductivity-second edition, Dover books on physics, 2004
13. Charles P., Jr. Poole, et al, Superconductivity, Academic Press, 1995
14. P. G. de Gennes, Superconductivity of metals and alloys, W. A. Benjamin Inc. , New York, Amsterdam, 1966
15. R. Griessen, Superconductivity, Vrije U., Amsterdam, 1994
16. S. Simon, M. Crişan, Supraconductibilitatea la temperaturi ridicate, Presa Univ. Clujeană, 1998

17. Christian Enss Siegfried Hunklinger, Low-Temperature Physics, Springer Berlin Heidelberg New York, 2005
18. Review articles in magnetism and superconductivity.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Fundamental aspects in magnetism	Critical presentation of given subjects. Will be used the video projector and the blackboard (seminar). Measurements shall be made on laboratory research equipment; subgroups of maximum 4 students, under the guidance of the professor, will interpret and discuss the results (laboratory).	2 h
2. Comparative study: bulk magnetic materials - nanostructured/nanocomposite materials; short student presentations and discussions.		2 h
3. Comparative study: bulk magnetic materials – thin films; short student presentations and discussions.		2 h
4. Fundamental aspects in superconductivity; Dissipative processes in superconducting materials		2 h
5. Anisotropy of oxide superconductors HTS		2 h
6. Research equipments in magnetism and superconductivity laboratory		2 h
7. Obtain a magnetic material		2 h
8. Study of magnetisation curves		2 h
9. Study of hysteresis curves		2 h
10. Complex magnetic susceptibility – result and discussions		2 h
11. Preparation of a high temperature material and characterization		6 h
12. Applications of superconductors		2 h

Bibliography

1. Andersen J. C., Leaver K. D., Rawlings R. D., Alexander J. M., Materials Sciences, Van Nostrand Reinhold (UK) Co. Ltd, 1986.
2. Ashcroft N. W., Mermin N. D., Solid State Physics, Holt-Saunders International Editions Tokyo, 1981.
3. Burzo E., Magneți permanenți, Ed. Academiei Române Bucureşti, vol. I, vol. II (1986).
4. Chicinaş I, Mărimi magnetice de material, Ed. Casa Cărții de Ştiință, 2002.
5. G.Ilonca, A.V.Pop-Supraconductibilitatea si supraconductori cu temperature critica inalta, Ed.Bit, Iasi (1998).
6. Du Trémolet de Lacheisserie E. (editor), Magnetisme, Presses Universitaires de Grenoble, 1999. Du Trémolet de Lacheisserie E. (editor), Magnetism, Kluwer Academic Publisher, 2003
7. Morrish A. H., The Physical Principles of Magnetism, John Wiley &Sons, Inc.
8. Pop A.V., Introducere in fizica sistemelor vortex, Ed.Efes, Cluj_Napoca, 2004
9. Pop V., Chicinas I., Nicolae J., Fizica Materialelor. Metode experimentale, Presa Universitară Clujeană, 2001
10. Sellmyer D., Skomski R., Advanced Magnetic Nanostructures, Springer 2006
11. Karl-Heinz Bennemann , John B. Ketterson, The physics of superconductors, Ed. Springer, 2003
12. Michael Tinkham, Introduction to superconductivity-second edition, Dover books on physics, 2004

13. Charles P., Jr. Poole, et al, Superconductivity, Academic Press, 1995
14. R. Griessen, Superconductivity, Vrije U., Amsterdam, 1994
15. S. Simon, M. Crişan, Supraconductibilitatea la temperaturi ridicate, Presa Univ. Clujeană, 1998
16. Christian Enss Siegfried Hunklinger, Low-Temperature Physics, Springer Berlin Heidelberg New York, 2005
17. Review articles in magnetism and superconductivity.

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 physics of magnetic and superconducting materials. Using advance knowledge of material sciences for explanation and interpretation of new concepts, situations, processes, projects etc. associated to physics of magnetic and superconducting materials.	Solving and explaining complex problems in material science more precisely in physics of magnetic and superconducting materials.	75
10.5 Seminar/lab activities	Integrated use of conceptual and methodological apparatus to solve theoretical and practical problems. 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 and laboratory work to strengthen experimental skills.	25
10.6 Minimum performance standards			
➢ Design of magnetic or superconducting materials in accordance with quality management principles and elements considering environmental impact and health security. ➢ Design the management to produce a new material. ➢ Planning and carrying out an experiment to validate a theoretical model in physics of magnetic and superconducting materials.			

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

Date of approval	Signature of the head of department
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