SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babes-Bolyai University Cluj-Napoca**
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Department of Mathematics**
1.4 Field of study	**Mathematics**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**Mathematics**

2. Information regarding the discipline

2.1 Name of the discipline	**Algebraic and Differential Topology**						
2.2 Course coordinator	**Lect. Dr. Liana Topan**						
2.3 Seminar coordinator	**Lect. Dr. Liana Topan**						
2.4. Year of study	**II**	2.5 Semester	**4**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Elective Course**

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	39
Additional documentation (in libraries, on electronic platforms, field documentation)	15
Preparation for seminars/labs, homework, papers, portfolios and essays	30
Tutorship	15
Evaluations	20
Other activities:	-

3.7 Total individual study hours	**119**
3.8 Total hours per semester	**175**
3.9 Number of ECTS credits	**7**

4. Prerequisites (if necessary)

4.1. curriculum	•
4.2. competencies	• Some backgrounds in differential geometry and mathematical analysis, as well as theory of manifolds

5. Conditions (if necessary)

5.1. for the course	•

5.2. for the seminar /lab activities	

6. Specific competencies acquired

Professional competencies	Ability to understand and manipulate advanced concepts of fundamental mathematical structures. Ability to permanently learn, understand and apply the most recent scientific results. Ability to work independently and/or in a team in order to solve problems in various professional contexts. Ability in verbal and written communication of ideas and knowledge.
Transversal competencies	Ability to transmit and value the studied knowledge and methods. Ability to analyze, understand, approach and modelling problems of mathematical nature from other areas.

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

7.1 General objective of the discipline	Ability to understand and approach problems from this field and to apply particular tools of algebraic and differential topology
7.2 Specific objective of the discipline	The purpose of the course is to present an introduction in algebraic and differential topology and applications.

8. Content

8.1 Course	Teaching methods	Remarks
1. Smooth manifolds: local Euclidean spaces, topological manifolds, differential manifolds	Exposure: description, explanation, examples, proofs	
2. Tangent spaces. Tangent maps	Exposure: description, explanation, examples, proofs	
3. The tangent bundle of a smooth manifold	Exposure: description, explanation, examples, proofs	
4. Partitions of unity	Exposure: description, explanation, examples, proofs	
5. Submanifolds	Exposure: description, explanation, examples, proofs	
6. Manifolds with boundary	Exposure: description, explanation, examples, proofs	
7. Submanifolds of manifolds with boundary	Exposure: description, explanation, examples, proofs	
8. The degree modulo two of a map	Exposure: description, explanation, examples, proofs	
9. Elements of Riemannian geometry	Exposure: description, explanation, examples, proofs	

10. Quotient topologies. Cells attaching	Exposure: description, explanation, examples, proofs	
11. The groups π_n(X, x_0). The fundamental group	Exposure: description, explanation, examples, proofs	
12. The homotopic invariance of homotopy groups	Exposure: description, explanation, examples, proofs	
13. Relative homotopy groups	Exposure: description, explanation, examples, proofs	
14. Fibrations and covering spaces	Exposure: description, explanation, examples, proofs	

Bibliography

1. Do Carmo, M.P., Riemannian Geometry, Birkhäuser,
2. Dundas, B.I., Differential Topology, course material, 2007 (http://www.uib.no/People/nmabd/pp/070814dt.pdf)
3. Hatcher, A., Algebraic Topology, Cambridge University Press, 2002 (http://www.math.cornell.edu/~hatcher/AT/AT.pdf)
4. Nicolaescu, L.I., Lectures on the Geometry of Manifolds, World Scientific, 1996

Additional references

1. Conlon, L., Differentiable Manifolds, Birkhäuser, 2001
2. Craioveanu, M., Introducere în geometria diferențială, Editura Mirton, 2004
3. May, J.P., A Concise Course in Algebraic Topology, Chicago Lectures in Mathematics, 1999
4. Postnikov, M., Leçons de géometrie. Varietés différentiables., MIR, 1990
5. Sandovici, P., Țarină, M., Geometrie Diferențială, Litografia UBB, Cluj-Napoca, 1974
   Sharpe, R.W., Differential Geometry, Springer, 1996

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Examples of smooth manifolds	explanation, examples, proofs	
2. Equivalent definitions for the tangent space of a smooth manifold	explanation, examples, proofs	
3. Vector bundles. Examples	explanation, examples, proofs	
4. Operations with vector bundles	explanation, examples, proofs	
5. The rank theorem. The local inversion theorem	explanation, examples, proofs	
6. Sard's theorem	explanation, examples, proofs	
7. Whitney's theorem (I)	explanation, examples, proofs	
8. Whitney's theorem (II)	explanation, examples, proofs	
9. Existence of Riemann metrics on a manifold	explanation, examples, proofs	
10. Example of quotient spaces	explanation, examples, proofs	
11. Change of base point	explanation, examples, proofs	
12. Computation of the fundamental group of n-dimensional sphere and n-dimensional torus. Brower's Fixed point theorem. Fundamental theorem of algebra.	explanation, examples, proofs	
13. Exact sequence of homotopy groups of a	explanation,	

topological pair	examples, proofs	
14. Fibrations and covering spaces	explanation, examples, proofs	
Bibliography The same as for courses section		

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 course respects the IEEE and ACM Curriculla Recommendations for Computer Science studies;
- The course exists in the studying program of all major universities in Romania and abroad;

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- know the basic results of the domain; - apply the course concepts and presented tools	Final written exam	60%
10.5 Seminar/lab activities	-be able to elaborate and defend a small proceeding	-oral expositions -continuous observations	40%
10.6 Minimum performance standards			
➢ At least grade 5 (from a scale of 1 to 10) after the final exam			

Date ....

Signature of course coordinator
Lect. Dr. Liana Topan

Signature of seminar coordinator
Lect. Dr. Liana Topan

Date of approval ....

Signature of the head of department
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