SYLLABUS

1. Course title:

Differential Geometry

2. Code:

DifGeo

3. Cycle of study:

1

4. ECTS credits:

6

5. Type of course:

(•) Mandatory ( ) Elective

6. Prerequisites:

Analysis !, II, III and IV, Geometry I and II, Linear Algebra I and II, Ordinary Differential Equations

7. Class restrictions:

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8. Duration / semester:

1 VI

9. Weekly contact hours:

9.1. Lectures:	3
9.2. Seminars:	2
9.3. Laboratory/Practice classes:	0

10. Faculty:

Natural Sciences and Mathematics

11. Department/study program:

Mathematics / Mathematics Education and Applied Mathematics

12. Lecturer:

Vedad Pašić

13. Lecturer's e-mail:

vedad.pasic@untz.ba

14. Web site:

http://www.vedad.frontslobode.org/DifGeo/

15. Course aims:

The main aim of this course is for the students to learn the basic concepts in the field of differential geometry, i.e. to study geometry of curves and surfaces using the methods of differential calculus - namely differentiation and integration (hence "differential" geometry). In studying the geometry of curves and surfaces, we are only interested in characteristics independent from the position of the curve (or surface) in space, i.e. in characteristics which are invariant under transformations of Euclidean 3-space (translations and rotations).

16. Learning outcomes:

At the end of the semester, successful students which have continuously fulfilled their obligations, will be equipped for:

1. Analysis of geometric shapes in space using the most current methods of differential calculus;

2. Application of knowledge from this area in various fields, especially physics;

3. Proving all fundamental theorems of differential geometry, as well as solving a series of practical problems from this field.

17. Course content:

Curves: parametric and implicit form. Parametrization. Arc length, strips, normal and tangent vector fields, principal normal. Osculating plane. Torsion. Orthonormal reference frame. Curvature and torsion in the sense of arbitrary parameterization. Frenet formulae. Fundamental theorem for spatial curves. General helices. Adapted frames, general structural equations, parallel normal fields, parallel frames.
Surfaces: Parametric form and implicit form, regularity, reparameterization of surfaces, curves on surfaces, first fundamental form, matrix representation of the first fundamental form, isometric parameterization, conformal parameterization. Isometry of parametrized surfaces, tangent plane, normal line and Gauss map. Line curves, developable surfaces.Normal and geodesic curvature on surface curves, second fundamental form. Asymptotic direction and asymptotic lines. Meusnier's theorem. Shape operator. Median curvature, Gaussian curvature, principal curvatures and their mutual relationship. Rodrigues equation. Umbilical and flat points, elliptic, parabolic and hyperbolic surface points. Euler's theorem, principal curvatures as extremal values of normal curves in a point, conformality of Gauss' map. Tensor notation. Covariant derivative and Levi-Civita connection, Christoffel symbols. Koszul's formula. Codazzi's equations. Gauss' Theorema Egregium. Fundamental theorem of surfaces. Geodesic curvature. Geodesics.

18. Learning methods:

Lectures and exercise classes.

Students are obliged to attend all lectures and exercise classes.

The condition for obtaining the signature confirming student obligations are fulfilled is minimum 70% attendance.

19. Assessment methods:

Pre-exam obligations consist of two tests taken during the semester which carry 20% each of the total mark awarded, as well as weekly problem sheets which are marked and discussed in exercise classes and which carry a total of 15% of the total mark.

Tests are in written form and consist of problems from the areas of study covered in lectures and exercise classes up to that point.

The first test is done in the middle of the semester, while the second is done at the end of the semester.

Final exam: the final exam aims to check knowledge from the entirety of the course and carries 45% of the final mark awarded. The exam is done in written form.

The condition for successfully passing the exam is to obtain a minimum of 23 out of 45 points in the final exam obligations, while the student must obtain a minimum of 54 points for a passing grade (6).

20. Assessment components:

Pre-exam obligations: First test 20%; Second test 20%. Problem sheets 15%.
Final exam: 45%.
The student must obtain a minimum of 23 points at the final exam, and a minimum of 54 points to obtain a passing grade (6).
The following is the grading scale, showing the points, numerical grade, descriptive grade and letter grade:
0-53 5 (five) fail F
54-63 6 (six) satisfactory E
64-73 7 (seven) good D
74-83 8 (eight) very good C
84-93 9 (nine) excellent B
94-100 10 (ten) outstanding A

21. Required reading list:

1. W. Kuhnel Differential Geometry: Curves - Surfaces - Manifolds, 3rd ed, American Mathematical Society, New York (2015)
2. M. Spivak: A Comprehensive Introduction to Differential Geometry; Publish or Perish, Berkeley (1979)
3. D. J. Struik: Lectures on Classical Dierential Geometry, 2nd Ed; Dover, New York (1988)
4. M. do Carmo: Differential Geometry of Curves and Surfaces; Prentice-Hall, Englewood Clis (1976)
5. B. Žarinac-Frančula: Diferencijalna geometrija - Zbirka zadataka i repetitorij; Školska knjiga, Zagreb 1990.
6. D. Mihajlović: Elementi vektorske analize, diferencijalne geometrije i teorije polja, Zavod za izdavanje udžbenika , Beograd 1968.
7. R. Stojanović: Osnovi diferencijalne geometrije, Beograd 1963.
8. G. Valiron: The Classical Differential Geometry of Curves and Surfaces, Math Sci Press, Brookline 1950.
9. R. A. Sharipov: Course of Differential Geometry, Bakshir State University, 1996.

22. Web sources:

http://www.vedad.frontslobode.org/DifGeo/
https://en.wikipedia.org/wiki/Differential_geometry

23. Applicable starting from the academic year:

2016/17

24. Adopted in the Faculty/Academy session:

16.03.2016.