

**KARTA PRZEDMIOTU****I. Dane podstawowe**

|  |                                 |
|--|---------------------------------|
| Nazwa przedmiotu                               | Geometria różniczkowa           |
| Nazwa przedmiotu w języku angielskim           | Differential geometry           |
| Kierunek studiów                               | Matematyka (Mathematics)        |
| Poziom studiów (I, II, jednolite magisterskie) | I                               |
| Forma studiów (stacjonarne, niestacjonarne)    | Stacjonarne (Full-time studies) |
| Dyscyplina                                     | Matematyka (Mathematics)        |
| Język wykładowy                                | Angielski (English)             |

|   |                         |
|---|-------------------------|
| Koordinator przedmiotu/osoba odpowiedzialna | Dr hab. Dariusz Partyka |
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| Forma zajęć ( <i>katalog zamknięty ze słownika</i> ) | Liczba godzin | Semestr     | Punkty ECTS |
|--|---------------|-------------|-------------|
| wykład   | 30            | 2 or 4 or 6 | 5           |
| konwersatorium                                       |               |             |             |
| ćwiczenia  | 30            | 2 or 4 or 6 |             |
| laboratorium   |               |             |             |
| warsztaty  |               |             |             |
| seminarium   |               |             |             |
| proseminarium  |               |             |             |
| lektorat   |               |             |             |
| praktyki   |               |             |             |
| zajęcia terenowe                                     |               |             |             |
| pracownia dyplomowa                                  |               |             |             |
| translatorium  |               |             |             |
| wizyta studyjna                                      |               |             |             |

|                   |   |
|-------------------|---|
| Wymagania wstępne | Basis knowledge of mathematical logic, set theory, linear algebra, topology, analytic geometry and real analysis. |
|-------------------|---|

**II. Cele kształcenia dla przedmiotu**

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|---|
| C1. Presentation of basic concepts of the classical differential geometry including the local theory of curves and surfaces in the three-dimensional Euclidean space. |
| C2. Familiarize students with selected issues of the contemporary differential geometry involving differential manifolds.   |

### III. Efekty uczenia się dla przedmiotu wraz z odniesieniem do efektów kierunkowych

| Symbol                       | Opis efektu przedmiotowego  | Odniesienie do efektu kierunkowego       |
|------------------------------|---|--|
| <b>WIEDZA</b>                |   |  |
| W_01                         | The student has a basic knowledge of the differential geometry. Knows important theorems in the scope of curves and surfaces in Euclidean spaces. Knows their proofs.     | K_W01, K_W04, K_W05                      |
| W_02                         | The student has a basic knowledge on differential manifolds.  | K_W01, K_W04, K_W05                      |
| <b>UMIEJĘTNOŚCI</b>          |   |  |
| U_01                         | The student smoothly uses methods of differential geometry to prove facts in various fields of mathematics.   | K_U01, K_U06, K_U10, K_U12, K_U13, K_U16 |
| U_02                         | The student can calculate basic parameters describing curves and surfaces in Euclidean space.   | K_U11, K_U12, K_U13, K_U16               |
| U_03                         | The student is capable to use fundamental facts of differential geometry in order to solve some problems of various natural sciences.                                     | K_U11, K_U12, K_U13, K_U38               |
| <b>KOMPETENCJE SPOŁECZNE</b> |   |  |
| K_01                         | The student understands the need to further develop his knowledge and skills in differential geometry. Can formulate questions in order to better understand the subject. | K_K02                                    |
| K_02                         | The student can present issues dealing with differential geometry in an understandable way.   | K_K05                                    |

### IV. Opis przedmiotu/ treści programowe

1. The total variation of a function in a metric space.
2. Curves in a metric space. A natural parameterization of a curve.
3. Auxiliary facts of algebra and vector analysis in unitary spaces.
4. Regular curves in Euclidean space.
5. The vector and straight line tangent to a curve.
6. The normal and binormal vectors to a curve.
7. The curvature and torsion of a curve.
8. Frenet formulas.
9. The fundamental theorem of the local theory of curves.
10. Surfaces in Euclidean space.
11. The local parameterization of a surface, regular and singular points of a surface.
12. Regular surfaces.
13. The tangent plane and vector normal to a surface.
14. The orientation of a surface.
15. The first fundamental form of a surface.
16. The length of a curve in a surface, the angle between curves in a surface and the area measure.
17. The second fundamental form of a surface.
18. The gaussian curvature of a surface.

19. Christoffel symbols.
20. The fundamental theorem of the local theory of surfaces.
21. Differential manifolds.
22. Differentiability of functions between differential manifolds.
23. The tangent and dual spaces to differential manifolds at a point.
24. The differential operator of a mapping between differential manifolds.
25. A diffeomorphism of differential manifolds.
26. The orientability of differential manifolds.
27. Submanifolds of a differential manifolds.
28. The groups and Lie algebras.
29. Fibre bundles.

#### V. Metody realizacji i weryfikacji efektów uczenia się

| Symbol efektu                | Metody dydaktyczne<br><i>(lista wyboru)</i> | Metody weryfikacji<br><i>(lista wyboru)</i> | Sposoby dokumentacji<br><i>(lista wyboru)</i> |
|------------------------------|---|---|---|
| <b>WIEDZA</b>                |   |   |   |
| W_01                         | Conventional lecture, practical classes.    | Test, written exam.                         | Evaluated test, protocol.                     |
| W_02                         | Conventional lecture, practical classes.    | Test, written exam.                         | Evaluated test, protocol.                     |
| <b>UMIEJĘTNOŚCI</b>          |   |   |   |
| U_01                         | Conventional lecture, practical classes.    | Test, written exam.                         | Evaluated test, protocol.                     |
| U_02                         | Conventional lecture, practical classes.    | Test, written exam.                         | Evaluated test, protocol.                     |
| U_03                         | Conventional lecture, practical classes.    | Test of practical skills.                   | File.   |
| <b>KOMPETENCJE SPOŁECZNE</b> |   |   |   |
| K_01                         | Discussion.                                 | Observation.                                | Observation report.                           |
| K_02                         | Discussion.                                 | Observation.                                | Observation report.                           |

#### VI. Kryteria oceny, wagi...

##### LECTURE:

The completion of classes is required.

Written exam constitute the final grade:

91 – 100% (5,0)

81 – 90% (4,5)

71 – 80% (4,0)

61 – 70% (3,5)

51 – 60% (3,0)

Less than 51% (2,0)

##### CLASSES:

At least 80% of attendance is required.

Two tests together constitute the final grade:

91 – 100% (5,0)

81 – 90% (4,5)

71 – 80% (4,0)

61 – 70% (3,5)

51 – 60% (3,0)

Less than 51% (2,0)

Detailed rules of evaluation are given on lectures and classes.

**VII. Obciążenie pracą studenta**

|  |               |
|--|---------------|
| Forma aktywności studenta                  | Liczba godzin |
| Liczba godzin kontaktowych z nauczycielem  | 90            |
| Liczba godzin indywidualnej pracy studenta | 60            |

**VIII. Literatura**

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| Literatura podstawowa  |
| Lecture notes and lecture notes in electronic form as well as <ol style="list-style-type: none"> <li>1. M. Raussen, <i>Elementary Differential Geometry: Curves and Surfaces</i>, Aalborg University, Denmark.</li> <li>2. M. P. do Carmo, <i>Differential Geometry of Curves and Surfaces</i>, Prentice–Hall, Inc, Englewood Cliffs, New Jersey.</li> <li>3. J. Opera, <i>Geometria różniczkowa i jej zastosowania</i>, Wyd. Nauk. PWN, Warszawa 2002.</li> <li>4. K. Radziszewski, <i>Wstęp do współczesnej geometrii różniczkowej</i>, PWN, Warszawa 1973.</li> <li>5. P. G. Walczak, <i>Wstęp do geometrii różniczkowej</i>, <a href="http://www.math.uni.lodz.pl/~pawelwal/Dg-wstep.pdf">www.math.uni.lodz.pl/~pawelwal/Dg-wstep.pdf</a></li> </ol>   |
| Literatura uzupełniająca   |
| <ol style="list-style-type: none"> <li>1. J. W. Robbin, D. A. Salamon, <i>Introduction to Differential Geometry</i>.</li> <li>2. T. Shifrin, <i>Differential Geometry: A First Course in Curves and Surfaces</i>.</li> <li>3. B. Csikós, <i>Differential Geometry</i>, Eötvös Loránd University.</li> <li>4. P. G. Walczak i W. Waliszewski, <i>Geometria różniczkowa w zadaniach</i>, PWN, Warszawa 1981.</li> <li>5. A. Goetz, <i>Geometria różniczkowa</i>, PWN, Warszawa 1965.</li> <li>6. R. Sikorski, <i>Wstęp do geometrii różniczkowej</i>, PWN, Warszawa 1972.</li> <li>7. J. Gancarzewicz, <i>Geometria różniczkowa</i>, PWN, Warszawa 1987.</li> <li>8. M. Skwarczyński, <i>Geometria rozmaitości Riemanna</i>, PWN, Warszawa 1993.</li> <li>9. G. Fichtenholz, <i>Rachunek różniczkowy i całkowy</i>, PWN, 2005.</li> <li>10. R. Sulanke i P. Wintgen, <i>Geometria różniczkowa i teoria wiązek</i>, PWN, Warszawa 1977.</li> <li>11. L. Auslander i R. E. Mac Kenzie, <i>Rozmaitości różniczkowalne</i>, PWN, Warszawa 1969.</li> </ol> |

