KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

Projekt współfinansowany przez Unię Europejską w ramach Europejskiego Funduszu Społecznego

UNIA EUROPEJSKA
EUROPEJSKI FUNDUSZ SPOŁECZNY

| Course title | ECTS code |
|---|---|
| Calculus on manifolds | 11.1.0429 |

**Name of unit administrating study**

null

**Studies**

| faculty | field of study | | |
|---|---|---|---|
| Faculty of Mathematics, Physics and Informatics | Mathematics | type | second tier studies (MA) |
| | | form | full-time |
| | | specialty | financial mathematics, mathematics – teacher education |
| | | specialization | all |

**Teaching staff**

dr hab. Jacek Gulgowski; dr Poj Lertchoosakul; prof. UG, dr hab. Andreas Zastrow

**Forms of classes, the realization and number of hours**

**Forms of classes**

Wykład (to translate), Ćw. audytoryjne (to translate)

**The realization of activities**

lectures in the classroom

**Number of hours**

Wykład (to translate): 30 hours, Ćw. audytoryjne (to translate): 30 hours

**ECTS credits**

5

2021/2022 winter semester

**Type of course**

elective (to translate)

**Language of instruction**

- polish
- english

**Teaching methods**

- Rozwiązywanie zadań (to translate)
- Wykład problemowy (to translate)

**Form and method of assessment and basic criteria for eveluation or examination requirements**

**Final evaluation**

- Zaliczenie na ocenę (to translate)
- Egzamin (to translate)

**Assessment methods**

- kolokwium (to translate)
- egzamin pisemny z pytaniami (zadaniami) otwartymi (to translate)
- wykonanie pracy zaliczeniowej - projekt lub prezentacja (to translate)

**The basic criteria for evaluation**

**Sposób weryfikacji założonych efektów kształcenia (DO TŁUMACZENIA)**

| Assumed aims of education | Exam | Test | Student's activity in the classroom |
|---|---|---|---|
| | Knowledge | | |
| M2_W01 | + | + | |
| M2_W02 | + | + | |
| M2_W03 | + | | |
| | Skills | | |
| M2_U01 | + | | |
| M2_U03 | | | + |
| M2_U04 | + | | |
| M2_U05 | + | | |
| M2_U06 | | + | |
| M2_U07 | | | + |
| | | | |
| | | | |
| | | | |

## Required courses and introductory requirements

**A. Formal requirements**

No formal requirements.

**B. Prerequisites**

Classical multivariate calculus.

## Aims of education

The basic concepts and tolls of the theory of differential manifolds will be presented. The most important theorems of the theory will be stated - for some of them proofs will be given.
Students should be able to understand abstract problems stated in the theory of differential manifolds and apply this theory to the mathematical scientific work.

## Course contents

1. Topological and differentiable manifolds, charts, atlas and differential structure.
2. Maps between manifolds, the rank of the map.
3. Submanifolds.
4. Immersions, submersions, embeddings.
5. Tangent space and tangent bundle, the derivative of the map between manifolds.
6. Transversality.
7. Orientation of manifold.
8. Manifolds with boundary.
9. The degree of the map.
10. Forms on manifolds, integration on manifolds and Stoke's theorem.

## Bibliography of literature

1. Morris W. Hirsch, "Differential Topology", Springer
2. John Milnor, "Topology from the differentiable viewpoint"
3. Michael Spivak, "Calculus on manifolds"

## Knowledge

Student who completed the course:

- knows basic definitions and formulate of calculus (analysis) on manifolds; knows examples and counterexamples of defined objects; correctly states and proves basic theorems of calculus on manifolds.

M2_W01, M2_W02, M2_W03

## Skills

Student who completed the course:

- is able to solve basic problems stated by calculus on manifolds by means of standard methods of calculus, algebra and topology, as well as definitions and theorems presented during the course.

| | |
|---|---|
| | M2_U01, M2_U03, M2_U04, M2_U05, M2_U06, M2_U07 |
| | **Social competence** |
| **Contact** | |
| Jacek.Gulgowski@mat.ug.edu.pl | |