UNIVERSITY
WARMIA AND MAZURY IN OLSZTYN

Faculty of Mathematics and Computer Science

Course title: **Non-Euclidean geometries**

ECTS credit allocation (and other scores): **6**

Semester: autumn

Level of study: ISCED-7 - second-cycle programmes (EQF-7)

Branch of science: Natural sciences

Language: English /Polish

Number of hours per semester: 30 lectures + 45 classes = 75 hours

Course coordinator/ Department and e-mail: Erasmus coordinator Anna Szczepkowska/ WMiI, erasmuswmii.uwm.edu.pl

Type of classes: classes and lectures

Substantive content

CLASSES:

Solving problems and issues relating to the content shown in the lecture. Poincare half-plane of hyperbolic plane. The group o transformation. Parallel and ultraparallel lines. The angel of parallelism. The Lobachevsky's function. The construction of common parallel to two rays. Area and angular defect. Pencils of lines. Circles, horocycles and equidistance curves. The classification of isometries.
The models of projective plane from Euclidean plane, linear space and sphere with pairs of antipodal point. Homogeneous and non-homogeneous coordinates. Collineations and projective collineation, homologies and elations, connections with central homotheties, translations and axial affinities. Linear transitive groups of collineations. Affine and projective classification of conics, projective equivalency of an ellipse, a hyperbole and a parabola.
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LECTURES:

Poincare half-plane, Poincare disc and Klein models of hyperbolic plane. Tarski's axioms of absolute and hyperbolic geometry. Basic notions and theorems of absolute geometry. Euclidean axiom and some equivalent theorems. Basic notions and theorems of absolute geometry. Parallel and ultraparallel lines. The angel of parallelism. The Lobachevsky's function. The construction of common parallel to two rays. Area and angular defect. Pencils of lines. Circles, horocycles and equidistance curves. The classification of isometries.
The models of projective plane from Euclidean plane, linear space and sphere with pairs of antipodal point. Homogeneous and non-homogeneous coordinates. The axioms of an affine and a projective planes. The minimal models. Desarguesian and Pappian planes. Hessenberg Theorem. The construction of a field in a line of a Pappian plane. Collineations and projective collineation, homologies and elations, connections with central homotheties, translations and axial affinities. Linear transitive groups of collinetions. Affine and projective classification of conics, projective equivalency of an ellipse, a hyperbole and a parabola.

LEARNING PURPOSE

Introduction to classical absolute, hyperbolic, affine and projective geometries.

On completion of the study programme the graduate will gain:

Knowledge:

The student knows the basic theorems of classical hyperbolic, affine and projective geometry, is familiar with the axiomatics of geometry and models of non-Euclidean geometries, understands the place and significance of this subject among other mathematical subjects and for the didactics of mathematics.

Skills:

The student can formulate theorems and definitions in the field of hyperbolic, affine and projective geometry in a way that is understandable in speech and writing, is able to conduct easy and moderately difficult proofs of theorems.

Social Competencies:

The student is ready for lifelong learning, is able to precisely formulate questions to deepen one's understanding of a given topic or to find missing elements of reasoning.

BASIC LITERATURE

1. H.S.M. Coxeter, *Wstęp do geometrii dawnej i nowej*, Wyd. PWN, R. 1967
2. K. Borsuk, W. Szmielew, *Podstawy geometrii*, Wyd. PWN, R. 1955
3. W. Szmielew, *Od geometrii afinicznej do euklidesowej*, Wyd. PWN, R. 1981
4. M. Kordos, *Podstawy geometrii rzutowej i rzutowo-metrycznej*, Wyd. PWN, R. 1984

SUPPLEMENTARY LITERATURE

The allocated number of ECTS points consists of:

Contact hours with an academic teacher: 2,82 ECTS points,

Student's independent work: 3,18 ECTS points.