

M005	Obligatory - Semester 3	Elementary Geometry	L+P+S 2+2+0	ECTS 5
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Course objectives. Students will systemize and expand their knowledge of elementary, synthetic geometry (without much involvement in the axiomatic construction of geometry). Classical geometrical contents will be processed and presented by means of software of dynamic geometry.

Course prerequisites. Secondary school knowledge.

Syllabus.

1. Introduction to planimetry. The basic concepts of the geometry of the plane. Axioms of the Euclidean geometry of the plane. Axiom of parallels.
2. Some prominent sets of the points in the plane.
3. Congruence of triangles. Characterization of a parallelogram and rhomb. The triangle midsegment theorem. Characteristic points of a triangle. Circumscribed and inscribed circle. The trapezoid midsegment theorem.
4. Perimeter and area. The perimeter and area of polygons. The area of a square, parallelogram, triangle, trapezoid and the quadrilateral with perpendicular diagonals. Heron's formula. The formula for the relationship between the area of a triangle and the radius of its inscribed circle. Exscribed circles of a triangle. The formula for the relationship between the area of a triangle and the radius of its exscribed circle. The area of a circle. The perimeter of a circle.
5. Similarity of triangles. *Thales' theorem* (the basic *proportionality* theorem). Triangle angle bisector theorem. Theorems of triangle similarity. Pythagoras theorem and its converse. Euclid's triangle theorem. Ceva's and Menelay's theorem.
6. Circle theorems. Central angle theorem. Thales' circle theorem. The formula for the relationship between the area of a triangle and the radius of its circumscribed circle. Tangential and cyclic quadrilateral. Ptolemy's theorem. Power of a point with respect to the circle. Euler's theorem. Euler's circle and Feuerbach's theorem.
7. Mappings of the plane. Isometries of a plane. Homothecy. Euler's line. *Similarities of the plane. Inversion.*
8. Introduction to stereometry. The basic objects in the geometry of space. Axioms of the Euclidean geometry. Determination of the plane and line in three-dimensional space. Half-space. Parallelism of lines and planes. Perpendicularity of lines and planes. The theorem of three verticals.
9. Angles between lines and planes. The angle between two lines. The angle between a line and a plane. The angle between planes.
10. Distance in space. The distance from a point to a plane. The distance from a point to a line. The shortest distance between two skew lines.
11. Isometries and some mappings of three-dimensional space.
12. Polyhedra. The concept of a polyhedron. Some types of polyhedra. Euler's formula for polyhedra. Regular polyhedra (Platonic solids). Volume and surface area of polyhedra: cuboids, parallelepipeds, prisms, pyramids and truncated pyramids. Cavalieri's principle.
13. Cylinder. Cone. Sphere. Volume and surface area of cylinder, cone and sphere.

Expected learning outcomes

After completing the course, students are expected to:

- demonstrate the understanding of fundamental concepts of planimetry and stereometry;
- derive the formulas of planimetry and stereometry;
- demonstrate the knowledge of the proof and application of basic theorems of planimetry and stereometry;
- use appropriate software packages while performing geometric constructions;
- develop spatial abilities;
- be able to use the adopted mathematical claims and formulas in problem solving;
- implement mathematical proofs of the foundation of the procedures and formulas encountered in this course.

Teaching methods and student assessment. Geometric contents will be actualized by demonstrations by means of software of dynamic geometry during lectures and practical work. Lectures and exercises are obligatory. The final exam follows after the completion of lectures and exercises and it consists of two parts, a written and an oral exam. During the semester students have two mid-term exams which cover the whole material. Acceptable mid-term exam scores replace the written examination

Can the course be taught in English: Yes.

Basic literature:

1. D. Palman, Trokut i kružnica, Element, Zagreb, 1994.

Recommended literature:

1. B. Pavković, D. Veljan, Elementarna matematika 1, Školska knjiga, Zagreb, 2003.
2. H.S.M. Coxeter, S.L. Greitzer, Geometry Revisited, The Mathematical Association of America, Washington, 1967.
3. B. Pavković, D. Veljan, Elementarna matematika 2, Školska knjiga, Zagreb, 1995.
4. A. Marić, Planimetrija - zbirka riješenih zadataka, Element, Zagreb, 1998.