Course description

Department/Unit /	KMA / VKG			**Academic Year**	2023/2024
Title	Selected Topics in Geometry			**Type of completion**	Exam
Accredited/Credits	Yes, 6 Cred.			**Type of completion**	Combined
Number of hours	Lecture 3 [Hours/Week] Tutorial 1 [Hours/Week]				
Occ/max	Status A	Status B	Status C	**Course credit prior to**	YES
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	YES
Winter semester	1 / -	0 / -	0 / -	**Min. (B+C) students**	1
Timetable	Yes			**Repeated registration**	YES
Language of instruction	Czech, English			**Semester taught**	Winter semester
Optional course	Yes			**Internship duration**	0
Evaluation scale	1|2|3|4			**Ev. sc. – cred.**	S|N
No. of hours of on-premise					
Auto acc. of credit	No				
Periodicity	K				
Substituted course	None				
Preclusive courses	N/A				
Prerequisite courses	N/A				
Informally recommended courses	N/A				
Courses depending on this Course	N/A				

Course objectives:

The course is focused on selected current topics of geometry and geometric modelling that are important from a theoretical point of view but from time and content limitations are not discussed in the compulsory courses. The main aim of this course is to explain the fundamental principles and methods of higher geometry. The topicality, practical aspects of applications and usage in solving particular non-trivial problems will be emphasized.

Requirements on student

During semester, students have to write several homework assignments which will demonstrate knowledge of theory, constructions, applications, and proofs. In addition, students elaborate a non-trivial individual assigned project.
The final examination is in the form of a written exam (70% of the grade) which is supplemented by an oral examination (30% of the grade). All assessment tasks will assess the learning outcomes, especially, the ability to provide logical and coherent proofs of chosen theoretical results and to use the methods from the course on solving given non-trivial problems.

Content

Major topics of this course include which are not scheduled in standard geometric courses.: projective algebraic geometry, finite geometry, geometric algebra, spherical and line geometries, higher differential geometry, up-to-date topics of computer aided geometric design etc. Considerable attention is given to the modern alliance of geometry with linear and abstract algebra and topology.

Fields of study

Guarantors and lecturers

- **Guarantors:** Doc. RNDr. Jan Vršek, Ph.D.
- **Lecturer:** Doc. RNDr. Jan Vršek, Ph.D. (100%)
- **Tutorial lecturer:** Doc. RNDr. Jan Vršek, Ph.D. (100%)

Literature

- **Basic:** Smith, Karen E. *An invitation to algebraic geometry*. New York : Springer, 2000. ISBN 0-387-98980-3.
- **Basic:** Pottmann, Helmut; Wallner, Johannes. *Computational line geometry*. Berlin : Springer-Verlag, 2001. ISBN 3-540-42058-4.
- **Basic:** Toth, Gabor. *Glimpses of algebra and geometry*. [1st ed.]. New York : Springer, 1998. ISBN 0-387-98213-2.
- **Basic:** Farin, Gerald; Kim, Myung-Soo; Hoschek, Josef. *Handbook of computer aided geometric design*. 1st ed. Amsterdam : Elsevier, 2002. ISBN 0-444-51104-0.
- **Recommended:** Sommer, Gerald. *Geometric computing with Clifford algebras : theoretical foundations and applications in computer vision and robotics : with 89 figures and 16 tables*. Berlin : Springer, 2001. ISBN 3-540-41198-4.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Contact hours	52
Presentation preparation (report) (1-10)	10
Preparation for an examination (30-60)	50
Graduate study programme term essay (40-50)	50
Total:	**162**

assessment methods

Knowledge - knowledge achieved by taking this course are verified by the following means:

Combined exam

Seminar work

Individual presentation at a seminar

Skills - skills achieved by taking this course are verified by the following means:

Combined exam

Seminar work

Skills demonstration during practicum

Competences - competence achieved by taking this course are verified by the following means:

Combined exam

Seminar work

Individual presentation at a seminar

prerequisite

Knowledge - students are expected to possess the following knowledge before the course commences to finish it successfully:

to understand the basic principles of linear algebra, projective affine and Euclidean geometry

to understand the basic principles of differential geometry

to understand the basic principles of the theory of algebraic structures

to learn the basics of geometric object representation and geometric modelling

Skills - students are expected to possess the following skills before the course commences to finish it successfully:

to apply the learned procedures to selected geometric problems in n-dimensional projective, affine and Euclidean spaces

to solve problems using knowledge of differential geometry

to use the apparatus of algebraic structures

to formulate and solve basic geometric modelling problems

Competences - students are expected to possess the following competences before the course commences to finish it successfully:

N/A

N/A

teaching methods

Knowledge - the following training methods are used to achieve the required knowledge:

Lecture

Lecture supplemented with a discussion

Interactive lecture

Task-based study method

Self-study of literature

Skills - the following training methods are used to achieve the required skills:

Lecture

Lecture with visual aids

Interactive lecture

Task-based study method

Self-study of literature

Competences - the following training methods are used to achieve the required competences:

Lecture

Lecture supplemented with a discussion

Interactive lecture

Task-based study method

Self-study of literature

learning outcomes

Knowledge - knowledge resulting from the course:

to orient in selected parts of higher geometry and geometric modelling

to understand the proofs of important theorems of the theory under study

to understand and describe the tools and methods of selected geometric disciplines

Skills - skills resulting from the course:

to use appropriate geometric models, tools and methods

to carry out proofs of selected important theorems of the theory under study

to demonstrate the basic propositions of an abstract theory using an appropriate combination of examples and counterexamples, look for analogies and make generalisations

to algorithmise basic methods, use appropriate numerical-symbolic computer software

Competences - competences resulting from the course:

N/A

N/A

to actively specialise more in the field of geometry and geometric modelling, especially in relation to the topic of the thesis

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Mathematics and its Applications	Postgraduate Master	Full-time	Geometrie a geometrické modelování	1	2018 akr	2023	Geometry and Geometric Modelling	A	2	ZS
Mathematics and its Applications	Postgraduate Master	Full-time	Matematika a její aplikace	1	2018 akr	2023	Geometry and Geometric Modelling	A	2	ZS
Mathematics and its Applications	Postgraduate Master	Full-time	Diskrétní matematika a algebra	1	2018 akr	2023	Discrete Mathematics and Algebra - Optional Courses	C	2	ZS
Mathematics and its Applications	Postgraduate Master	Full-time	Matematika a její aplikace	1	2018 akr	2023	Discrete Mathematics and Algebra - Optional Courses	C	2	ZS