

Course description

Course abbreviation:	KMA/GM1	Page:	1 / 5
Course name:	Geometric Modelling 1		
Academic Year:	2023/2024	Printed:	03.06.2024 07:55

Department/Unit /	KMA / GM1			Academic Year	2023/2024
Title	Geometric Modelling 1			Type of completion	Exam
Accredited/Credits	Yes, 5 Cred.			Type of completion	Combined
Number of hours	Lecture 2 [Hours/Week] Tutorial 2 [Hours/Week]			Course credit prior to	YES
Occ/max	Status A	Status B	Status C	Counted into average	YES
Summer semester	0 / -	0 / -	0 / -	Min. (B+C) students	1
Winter semester	8 / -	3 / -	0 / -	Repeated registration	NO
Timetable	Yes			Semester taught	Winter semester
Language of instruction	Czech			Internship duration	0
Optional course	Yes			Ev. sc. – cred.	S N
Evaluation scale	1 2 3 4				
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	KIV/GAM				

Course objectives:

The main aim of this course is to give students a thorough introduction to geometric methods used in modern computer graphics, CAx and GIS systems. Furthermore, the practical experience with using geometric and mathematical software is developed.

The course gives a short overview of fundamentals of (differential, algebraic, projective) geometry for geometric modelling, especially from the point of view of modelling with curves, surfaces and solids. Then it focuses on the basic theory of Bézier, B-spline and NURBS curves and surfaces, spline curves and surfaces (Coons patches), barycentric coordinates and triangular patches.

The course also aims at showing the students various possibilities of applications of geometric modelling e.g. in computer graphics or in engineering practise.

Requirements on student

Credit: more than 50% of possible points for the following activities:

- Preparation and presentation of a paper on the basis of literature,
- Successful completion of prescribed practical exercises undertaken in the team.

The written part of the examination consists from questions and examples from the basic curriculum of the course. The time limit for working is 90 minutes. The oral part of the examination deals with the general context.

Content

Spline function, cubic spline curve, splines of higher degree, spline under tension, nonlinear spline. Bézier curve - Bernstein polynomials, de Casteljau algorithm. B-spline bases, de Boor algorithm, features of B-spline curves. Rational Bézier curves and NURBS (non-uniform rational B-spline) curves. Tensor product surfaces - spline surfaces, Bézier surfaces, B-spline and NURBS surfaces. Coons interpolation - bilinear, bicubic and Ferguson patch, patching. Barycentric coordinates, interpolation on a triangle. Applications of geometric modelling.

Fields of study

Guarantors and lecturers

- **Guarantors:** Doc. Ing. Bohumír Bastl, Ph.D. (100%)
- **Lecturer:** Doc. Ing. Bohumír Bastl, Ph.D. (100%)
- **Tutorial lecturer:** Doc. Ing. Bohumír Bastl, Ph.D. (100%)

Literature

- **Recommended:** Marsh, Duncan. *Applied geometry for computer graphics and CAD*. 2nd ed. London : Springer, 2005. ISBN 1-85233-801-6.
- **Recommended:** Farin, Gerald; Kim, Myung-Soo; Hoschek, Josef. *Handbook of computer aided geometric design*. 1st ed. Amsterdam : Elsevier, 2002. ISBN 0-444-51104-0.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Contact hours	52
Team project (50/number of students)	20
Presentation preparation (report in a foreign language) (10-15)	15
Preparation for an examination (30-60)	45
Total:	132

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:

- Seminar work
- Individual presentation at a seminar

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

- Individual presentation at a seminar
- Seminar work

prerequisite

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

- orientovat se v základních pojmech lineární algebry
- orientovat se v základních pojmech analytické geometrie v rovině a v prostoru, výhodou je také zvládnutí základních vlastností křivek a ploch metodami diferenciální geometrie

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

- aplikovat metody diferenciálního počtu

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

N/A

teaching methods

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

Lecture
Lecture supplemented with a discussion
Interactive lecture
Practicum
Project-based instruction
Task-based study method
Students' portfolio

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

Practicum
Task-based study method

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

Task-based study method
Students' portfolio

learning outcomes

Knowledge - knowledge resulting from the course:

rozumět teoretickým základům reprezentace křivek a ploch v moderních CAX, GIS a dalších graficky orientovaných systémech
definovat interpolační spline křivku a umět ji použít
definovat Bézierovy, B-spline a NURBS křivky a plochy a umět je použít
definovat Coonsovy pláty a spline plochy a umět je použít

Skills - skills resulting from the course:

umět sestavit geometrický model pro složité jevy v souladu s moderními požadavky CAGD (Computer Aided Geometric Design)
používat matematický software pro práci s objekty moderního geometrického modelování, pro tvorbu geometrických modelů a pro odvozování jejich důležitých vlastností
připravit referát na odborné téma s problematikou geometrického modelování na základě odborné literatury

Competences - competences resulting from the course:

N/A

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Civil Engineering	Bachelor	Full-time	Land-use Planning	1	2017	2023	Povinné předměty	A	3	ZS
Civil Engineering	Bachelor	Full-time	Land-use Planning	1	2020	2023	Povinné předměty	A	3	ZS
Computer Science and Engineering	Postgraduate Master	Full-time	Computer Graphics	1	2018	2023	Povinné předměty	A	1	ZS
Geomatics	Postgraduate Master	Full-time	Geoinformatika	1	2023 akr	2023	Povinné předměty	A	1	ZS
Geomatics	Postgraduate Master	Full-time	Globální geodézie	1	2023 akr	2023	Povinné předměty	A	1	ZS
Geomatics	Postgraduate Master	Full-time	Zeměměřictví a katastr nemovitostí	1	2023 akr	2023	Povinné předměty	A	1	ZS
Geomatics	Postgraduate Master	Full-time	Geomatics	1	2020	2023	Oborové předměty	A	1	ZS

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Informatika a její specializace	Postgraduate Master	Full-time	Počítačová grafika	1	2022 akr	2023	Povinné předměty specializační	A	2	ZS
Mathematics and its Applications	Bachelor	Full-time	Matematika a její aplikace	1	2018 akr	2023	Povinné předměty - matematika	A	3	ZS
Mathematics and its Applications	Bachelor	Full-time	Matematika a její aplikace	1	2023	2023	Povinné předměty - matematika	A	3	ZS
Computer Modelling in Mechanics	Bachelor	Full-time	Computer Modelling in Mechanics	1	2020	2023	Povinné volitelné předměty - skupina 4 (typ B)	B	3	ZS
Computer Modelling in Mechanics	Bachelor	Full-time	Computer Modelling in Mechanics	1	2023	2023	Povinné volitelné předměty - skupina 4 (typ B)	B	3	ZS
Design	Bachelor	Full-time	Design, specialization Industrial Design	1	4	2023	Blok geometrie	B	2	ZS
Design and Applied Arts	Bachelor	Full-time	Industrial Design	1	1	2023	B2 - doplňující blok	B		ZS
Mathematics	Postgraduate Master	Full-time	Training Teachers of Mathematics at Higher Secondary Scholls	1	2018	2023	Matematika - profilující předměty	B	2	ZS
Učitelství matematiky pro střední školy	Postgraduate Master	Full-time	Secondary School Education Mathematics - Maior	1	2020	2023	Matematika - odborné doplňující předměty	B	2	ZS
Učitelství matematiky pro střední školy	Postgraduate Master	Full-time	Secondary School Education Mathematics - Minor	1	2020	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Biology	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Biology	1	2021	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Biology	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Biology	1	2023	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Biology	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Biology	1	2022	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Biology	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Biology	1	2020	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Geography	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Geography	1	2022	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Geography	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Geography	1	2020	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Geography	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Geography	1	2023	2023	Matematika - odborné doplňující předměty	B	2	ZS

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Upper Secondary School Teacher Training in Geography	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Geography	1	2021	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Chemistry	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Chemistry	1	2023	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Chemistry	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Chemistry	1	2022	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Chemistry	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Chemistry	1	2020	2023	Matematika - odborné doplňující předměty	B	2	ZS
Upper Secondary School Teacher Training in Chemistry	Postgraduate Master	Full-time	Upper Secondary School Teacher Training in Chemistry	1	2021	2023	Matematika - odborné doplňující předměty	B	2	ZS