

Course description

Course abbreviation:	KGM/FGE2	Page:	1 / 4
Course name:	Physical Geodesy 2		
Academic Year:	2023/2024	Printed:	03.06.2024 08:52

Department/Unit /	KGM / FGE2			Academic Year	2023/2024
Title	Physical Geodesy 2			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	0 / -	0 / -	0 / -	Repeated registration	NO
Timetable	Yes			Semester taught	Summer 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	0				
Auto acc. of credit	Yes in the case of a previous evaluation 4 nebo nic.				
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 main goal of this subject is to acquire knowledge in the field of theoretical foundations of geodesy. These are mathematical and physical methods and procedures used in geodesy to describe and represent the gravitational field of planetary bodies. Graduates of the course acquired the necessary knowledge needed for modelling the gravitational field from the measurements of the first, second and third spatial derivatives of the potential by using the mathematical apparatus of integral transformations.

Requirements on student

Participants are expected to attend actively all lectures and assignments. Reports with results must be submitted on time, eventual delays are taken into the account during classification. Participants are required to write a short mid-term test to check on their progress. A compulsory written exam concludes the course. Students with all reports submitted on time and without significant deficiencies, with the successfully written mid-term test and final exam, are admitted to a final oral exam during the examining period.

Content

1. Exterior spherical horizontal boundary value problem.
2. Exterior spherical gradiometric boundary value problem.
3. Gravitational tensor of the third order - differential operators and basic properties.
4. Exterior spherical gravitational curvature boundary value problem.
5. Complete Meissl diagram of spherical integral transformations.
6. Effect of the distant zones for integral transformations.
7. Formulation of practical integral estimators.
8. Error propagation in practical integral estimates - analytical formulas.
9. Direct modelling of the gravitational potential and its first-, second-, and third-order derivatives in the spatial domain.
10. Spherical harmonic expansions of the gravitational potential and its first-, second-, and third-order derivatives.
11. Analytical continuation of spherical harmonic series.
12. Spectral combination of gravitational field quantities.

Fields of study

Guarantors and lecturers

- **Guarantors:** Doc. Ing. Michal Šprlák, PhD.

Literature

- **Recommended:** Šprlák, Michal; Hamáčková, Eliška; Novák, Pavel. *Alternative validation method of satellite gradiometric data by integral transform of satellite altimetry data*. Journal of Geodesy ISSN 0949-7714 Vol. 89, no. 8 (. 2015).
- **Recommended:** Novák, Pavel; Pitoňák, Martin; Šprlák, Michal; Tenzer, Robert. *Higher-order gravitational potential gradients for geoscientific applications*. Earth-Science Reviews ISSN 0012-8252 Vol. 198 (201. 2019).
- **Recommended:** Šprlák, Michal; Novák, Pavel. *Integral formulas for computing a third-order gravitational tensor from volumetric mass density, disturbing gravitational potential, gravity anomaly and gravity disturbance*. Journal of Geodesy ISSN 0949-7714 Vol. 89, no. 2 (. 2015).
- **Recommended:** Novák, Pavel; Šprlák, Michal; Tenzer, Robert; Pitoňák, Martin. *Integral formulas for transformation of potential field parameters in geosciences*. Earth-Science Reviews ISSN 0012-8252 Vol. 164 (201. 2017).
- **Recommended:** Burša, M. - Kostelecký, J. *Kosmická geodézie a kosmická dynamika*. MO AČR, 1994.
- **Recommended:** Arfken, G. *Mathematical Methods for Physicists*. Oxford, 1970.
- **Recommended:** Hamáčková, Eliška; Šprlák, Michal; Pitoňák, Martin; Novák, Pavel. *Non-singular expressions for the spherical harmonic synthesis of gravitational curvatures in a local north-oriented reference frame*. Computers and Geosciences ISSN 0098-3004 Vol. 88. 2016.
- **Recommended:** Hofmann-Wellenhof, Bernhard; Moritz, Helmut. *Physical geodesy*. 1st ed. Wien : SpringerWienNewYork, 2005. ISBN 3-211-23584-1.
- **Recommended:** Jekeli, Christopher. *Spectral methods in geodesy and geophysics*. 2017. ISBN 978-1-4822-4525-7.
- **Recommended:** Šprlák, Michal; Novák, Pavel. *Spherical gravitational curvature boundary-value problem*. Journal of Geodesy ISSN 0949-7714 Vol. 90, no. 8 (. 2016).
- **Recommended:** Šprlák, Michal; Novák, Pavel.; Pitoňák, Martin. *Spherical harmonic analysis of gravitational curvatures and its implications for future satellite missions*. Surveys in Geophysics ISSN 0169-3298 Vol. 37, no. 2016.
- **Recommended:** Burša, Milan; Pěč, Karel. *Tíhové pole a dynamika Země*. 1. vyd. Praha : Academia, 1988.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Practical training (number of hours)	26
Contact hours	26
Preparation for comprehensive test (10-40)	10
Preparation for laboratory testing; outcome analysis (1-8)	20
Preparation for an examination (30-60)	50
Total:	132

assessment methods

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

- Oral exam
- Written exam
- Test
- Combined exam

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

Oral exam
Written exam
Combined exam
Test

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

Oral exam
Written exam
Combined exam
Test

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

to explain fundamentals of land surveying
to explain fundamentals of the adjustment calculus
to explain fundamentals of algebra
to explain fundamentals of the mathematical analysis
to explain fundamental of the tensor calculus
to explain fundamentals of the potential theory

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

programming
to make a plot or a map
to interpret results and their uncertainties
symbolic derivations of equations and algebraic manipulations

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
Self-study of literature
Practicum
Task-based study method

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

Self-study of literature
Practicum
Task-based study method

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

Lecture
Self-study of literature
Practicum
Task-based study method

learning outcomes**Knowledge - knowledge resulting from the course:**

to resolve quantities of the gravitational field and to understand their properties

to resolve types of exterior boundary value problems of the potential theory

to resolve types of integral transformations for gravitational field modelling

Skills - skills resulting from the course:

to formulate and solve exterior boundary value problems of the potential theory

to practically compute parameters of the gravitational field

Competences - competences resulting from the course:

N/A

N/A

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.
Geomatics	Postgraduate Master	Full-time	Globální geodézie	1	2023 akr	2023	Povinné předměty - specializace	A	1	LS