Physical Geodesy and Gravimetry - BMEEOAFMF61

I. Subject Specification

1. Basic Data

1.1 Title

PHYSICAL GEODESY AND GRAVIMETRY

1.2 Code

BMEEOAFMF61

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	2
Seminar	1

1.5 Evaluation

Midterm grade

1.6 Credits

4

1.7 Coordinator

name	Dr. Földváry Lóránt
academic rank	Associate professor
email	foeldvary.lorant@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/node/15943?language=en
https://edu.epito.bme.hu/course/view.php?id=4883

1.10 Language of instruction

english

1.11 Curriculum requirements

Recommended elective in the Land Surveying and Geoinformatics (MSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2022

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2. Objectives and learning outcomes

2.1 Objectives

The determination of the gravity field of the Earth provides a tool for understanding its spatial structure based on terrestrial and satellite-borne gravity measurements. The subject aims to acquire knowledge on the theoretical and practical aspects of gravimetric observations, the corresponding processing techniques, available gravity data base, the global geoid, and the determination of the fine structure of the gravity field. Information on the geoid can be derived by determination of the equipotential surfaces of the Earth based on gravity observations using terrestrial, air-borne and satellite-borne methods of gravimetry and grafiometry. By completing this course, the students will be familiar with the most up-to-date physical geodetic methods of the determination of the geoid.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Familiar with the technical terms of physical geodesy.
2. Knows the concept of absolute and relative gravimetry, gradiometry, and the calibration of the instruments.
3. Knows the observation concept of the air-borne and satellite-borne gravimetric missions (CHAMP, GRACE, GOCE).
4. Knows the theory of the operation of the torsion balance.
5. Knows about the temporal non-tidal variations of the gravity field.
6. Knows the physical geodetic methods of the geoid determination.
7. Familiar with the geodetic reference frames.
8. Knows the different descriptions of the geoid making use of the spherical harmonics, Stokes-series, and calculation of the absolute defelection of the vertical.
9. Familiar with the practical applications of the gradiometry.
10. Knows the combined methods of geoid determination.
11. Knows the fundamentals of the gravimetric levelling.
12. Familiar with the methods of interpolation of the deflection of the vertical.
13. Familiar with the inversion methods of gravity field determination.
14. Has an overview of the software used in physical geodesy.
15. Familiar with the basics of space-borne quantum gravimetry.

B. Skills

1. Able to perform terrestrial gravimetric measurements, process and adjust the measurements.
2. Able to determine the parameters of a geodetic reference frame based on graviry measurements.
3. Able to apply the Fast Fourier Transformation (FFT) method in physical geodesy.

C. Attitudes

1. Recognises the potential of modern computational techniques in physical geodesy.
2. Recognises the relevance of knowledge of gravity fields and the importance of geoid determination.

D. Autonomy and Responsibility

1. Independently investigates problems raised in lectures and exercises.

2.3 Methods

Lectures, and practicals with measurement and computations.

2.4 Course outline

Hét	Előadások és gyakorlatok témaköre
1.	The gravity field generated by gravitation, centrifugal and tidal forces. Gravity field and acceleration. The relevance of gravity field in geodesy.
2.	Absolute and relative gravimetry. Calibration of

	gravimeters. Gradiometry. practical: terrestrial gravimetry measurement.
3.	Air-borne and satellite-borne gravimetry and gradiometry (CHAMP, GRACE, GOCE), basic concepts.
4.	Processing and adjustment of terrestrial gravimetric measurements. practical: measurement with torsion balance.
5.	Temporal non-tidal variations of the gravity field.
6.	Mathematical and physical background of physical geodesy. Physical geodetic methods of geoid determination. pracctical: 1st mid-term test.
7.	Geodetic reference frames. Determination of the parameters of a geodetic reference frame.
8.	Description of the geoid by spherical harmonics, Stokes-series, calculation of the absolute defelection of the vertical. practical: determination of the parameters of a geodetic reference frame using gravity data.
9.	Application of the measurements of gradiometry.
10.	Combined methods of geoid determination. Fundamentals of the gravimetric levelling. practial: interpolation of the deflection of the vertical.
11.	Application of the Fast Fourier Transformation (FFT) method in physical geodesy.
12.	Inversion methods of gravity field determination. practical: overview of the software used in physical geodesy.
13.	Basics of space-borne quantum gravimetry.
14.	Summary. practical: 2nd mid-term test.

The above programme is tentative and subject to changes due to calendar variations and other reasons specific to the actual semester. Consult the effective detailed course schedule of the course on the subject website.

2.5 Study materials

- Heiskanen - Moritz: Physical Geodesy
- Torge - Müller: Geodesy
- Torge: Gravimetry

2.6 Other information

1. Attendance at the lectures is compulsory. Students who miss four or more lectures will not receive ECTS for the course.
2. All students are required to submit original work (their own) for the assignments and tests. Copying, cheating, plagiarism in any form is not acceptable. Anyone who violates the relevant provisions of the BME Code of Conduct will receive an unsatisfactory(1) final grade, will not be allowed to make up the course and will be reported to the Dean's Office.

2.7 Consultation

As indicated on the department's website or by e-mail with the lecturer; e-mail: foldvary.lorant@epito.bme.hu

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This Subject Datasheet is valid for:

2025/2026 semester I

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment is done in accordance with 2.2, and is based on the result of 2 tests and the homework assignment.

3.2 Assessment methods

Teljesítményértékelés neve (típus)	Jele	Értékelt tanulási eredmények
Home Work	HW	B.2
Activity on field measurement	FM	A
1st midterm-test	MT1	A.1-A.5; B.1
2nd midterm-test	MT2	A.6-A.15; B.2-B.3; C.1-C.2; D.1

The dates of deadlines of assignments/homework can be found in the detailed course schedule on the subject's website.

3.3 Evaluation system

Jele	Részarány
HW	completion
FM	active attendace
MT1	33%
MT2	67%
Összesen	**100%**

3.4 Requirements and validity of signature

The signature can be obtained
- by attending 79% of the lectures and 79% of the exercises,
- by active participation in the Field Measurement (as described in point 3.3),
- and by successfully solving the Home Work.

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	85-100%
jó (4)	72.5-85%
közepes (3)	65-72.5%
elégséges (2)	50-65%
elégtelen (1)	below 50%

3.6 Retake and repeat

1. Retake of MTs is possible during the repetition week, which is free of charge for the first attempt.
2. If the student fails the retake, he/she may attend a re-retake of MTs for a fee specified in the regulations.
3. HW submitted and accepted before the deadline can be corrected for free of charge.
4. HW can be submitted with some delay until 16:00 on the last day of the repetition week or sent electronically until 23:59, s for a fee specified in the regulations.
5. HW with late submission and without showing it at the last class may be graded of satisfactory.
6. Due to the nature of the assessment, FM cannot be substituted or corrected.

3.7 Estimated workload

Tevékenység	Óra/félév
attendace	14×3=42
preparation for classes	14×2=28
completion of HW	5
preparation for MTs	15+30=45

Összesen	**120**

3.8 Effective date

1 September 2022

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