Theory and Application of GNSS - BMEEOAFMF-1

I. Subject Specification

1. Basic Data

1.1 Title

Theory and Application of GNSS

1.2 Code

BMEEOAFMF-1

1.3 Type

Module with associated contact hours

1.4 Contact hours

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

1.5 Evaluation

Exam

1.6 Credits

5

1.7 Coordinator

name	Dr. Rózsa Szabolcs
academic rank	Associate professor
email	rozsa.szabolcs@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOAFMF-1
https://fiek2.mywire.org/course/view.php?id=3481

1.10 Language of instruction

english

1.11 Curriculum requirements

Compulsory in the Land Surveying and Geoinformatics (MSc) programme

1.12 Prerequisites

Recommended prerequisites:

- Numerical methods (BMEEOFTMK51)

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The course aims to introduce the operational background of the global navigation satellite systems (GNSS), to discuss the mathematical models, systematic error sources and the standaridzed data formats of satellite positioning. The students gain extensive knowledge on the applications of GNSS positioning in geodesy, geomatics, civil engineering navigation, precision agriculture, geodynamics, meteorology, hydrology). The course enables students to process GNSS obsrvations for navigation as well as highly accurate positioning and to analyse GNSS observations and results to obtain valuable information for Earth observation.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. overviews and understands the mathematical background of the GNSS observation processing for geodetic and GIS applications
2. overviews and understands the mathematical background of the GNSS observation processing for geodetic and GIS applications
3. knows the reference systems and frames used for GNSS positioning and their relationships
4. knows the systematic error affecting GNSS observations and understands the methods of their mitigation
5. has an outlook to the wide area of application of GNSS observations with a special focus on applications in civil engineering and earth sciences

B. Skills

1. able to understans the whole process of GNSS positioning
2. able to design the optimal realization of GNSS measurements
3. able to understand, interpret and use the standard data structures of GNSS
4. able to develop algorithms for GNSS data processing
5. able to link the positioning result to the proper reference system
6. able to solve coordinate transoformation problems between reference systems
7. able to do literature research, process the information and present it in a short presentation

C. Attitudes

1. realizes the importance of GNSS observations for other branches of science
2. open to the creative application of GNSS measurements
3. open to the systematic way of thinking
4. thrives to create elegant and effectice programming codes
5. thrives to document the program codes

D. Autonomy and Responsibility

1. carries out GNSS observation acquisition and observation processing calculations individually
2. eager to receive feedback on the submitted homeworks/assessments
3. processes the literature on his/her own and prepares a presentation on the topic

2.3 Methods

Lectures, instrumental observations and practicals in computer lab. individual literature research homework on proposed topics and summarizing the results in an oral presentation.

2.4 Course outline

Hét	**Előadások és gyakorlatok témaköre**
1.	History and development of global navigation satellite systems. Introduction of the systems.
2.	Reference systems and their relationships.
3.	GNSS time systems, satellite orbits and the calculation of satellite coordinates.
4.	Planning GNSS observations.
5.	Standard data formats of GNSS observations, data and coordinate solutions.
6.	The error sources of GNSS positioning (clock and orbit error, relativistic effects, propagation error, reception error)
8.	Accurate GNSS positioning techniques used for surveying, geodesy and geodynamics.
9.	Linear combinations of observations and their applications.
10.	Transformation of coordinates between reference systems
11.	The structure and the services of GNSS infrastructure. Ground Based and Satellite Based Augmentation Systems (GBAS and SBAS). The International GNSS Service and its services.
12.	Positioning using pseudoranges (SPP, DGPS, systematic error sources, corrections, data processing)
13.	Application of GNSS observation (civil engineering, agriculture, meteorology, hydrology, geodynamics, power grids, financial markets)
14.	GNSS observation processing for applications in geodynamics

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

a) Downloadable material:

1. Manuals, handouts of the applied software and algorithms.
2. Lecture notes and syllabus of practicals on the website of the course.

b) Textbook:

1. Bernhard Hofmann-WellenhofHerbert LichteneggerElmar Wasle: GNSS - Global Navigation Satellite Systems, Springer Verlag, ISBN: 978-3-211-73017-1

2.6 Other information

Attendance requirement on both the lectures and practicals is 70%.

2.7 Consultation

Personal consultation in the consultation hours defined on the course webpage or upon personal appointment request via e-mail.

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The learning outcomes defined in Section 2.2 are assessed with an oral exam, 5 homeworks and a midterm test. The results of the literature research (HW 2) is presented in an oral presentation on the lecture specified in the detailed course plan. Lecture notes and handouts are available for download on the course webpage for continuous studying.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Oral exam (summarizing assessment)	E	A.1-A.5; B.1-B.3, B.5-B.6; C.1-C.3; D.2
Midterm test	MT	A.1-A.4
Homework 1	HW1	A.1; B.2; D.1-D.2
Homework 2	HW2	A.5; B.7; C.1-C.3; D.1-D.3
Homework 3	HW3	A.1-A.3; B.3-B.4; C.4-C.5; D.1-D.2
Homework 4	HW4	
Homework 5	HW5	

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
Összesen	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Érdemjegy	Pontszám (P)
jeles (5)	
jó (4)	
közepes (3)	
elégséges (2)	
elégtelen (1)	

3.6 Retake and repeat

3.7 Estimated workload

Tevékenység	Óra/félév

Összesen	150

3.8 Effective date

1 September 2022

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