Automated Survey Systems - BMEEOAFMB61

I. Subject Specification

1. Basic Data

1.1 Title

Automated Survey Systems

1.2 Code

BMEEOAFMB61

1.3 Type

Module with associated contact hours

1.4 Contact hours

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

1.5 Evaluation

Midterm grade

1.6 Credits

4

1.7 Coordinator

name	Bence Takács
academic rank	Associate professor
email	takacs.bence@emk.bme.hu

1.8 Department

Department of Geodesy and Surveying

1.9 Website

https://epito.bme.hu/BMEEOAFMB61
https://edu.epito.bme.hu/course/view.php?id=3567

1.10 Language of instruction

english

1.11 Curriculum requirements

Recommended elective in the Construction Information Technology Engineering (MSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

This course's primary purpose is to present automated solutions to civil engineering problems, especially in construction control, land surveying, and geoinformatics. Students apply the essential knowledge and skills in informatics gained in their previous courses by completing data acquisition, processing, and conversion tasks with automation in Python environment. Students are expected to be able to use existing programs, read and interpret their source code and adjust them to their own projects. Students become familiar with automated measuring systems applied for movement detection, monitoring, and robotic machine control in this course. Their benefits are realised through project-based learning.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. has an overview of the source code of programs used in land surveying to load, process and evaluate measurements and data,
2. understands the algorithms and the structures of the programs involved in the materials,
3. knows the basics of batch programming,
4. knows the basics of python modules to process text files,
5. has a general knowledge of opportunities to apply land surveying instruments and other sensors in movement detection as well as monitoring,
6. has a general knowledge of opportunities to apply land surveying instruments and other sensors in machine control for civil engineering tasks,
7. knows the basics of programming total stations, understands the fundamentals of serial line communication,
8. understands the principles of tunnel measurements and their processing to investigate its ovality and compare the actual and designed geometry

B. Skills

1. read text files in a mathematical environment, carry out simple computations on the data,
2. routinely produce figures in python environment and modify them in line with the requirements,
3. ability to download files automatically from servers (e.g. using a terminal window),
4. prepare, execute and adjust simple python scripts for their own projects,
5. ability to automatically convert text files containing observations. For this job, the student is able to prepare simple scripts and adjust existing ones to their own projects,
6. uses APIs (Application Programming Interface) to manage surveying instruments and other relevant sensors as well. The student can test, and contribute to the development and documentation of such systems.

C. Attitudes

1. recognizes the benefits and opportunities offered by automated measurements and data processing,
2. is open to automated and command-prompt solutions,
3. is susceptible toward elegant and effective program codes,
4. documents programming and gives explicit comments in the source code

D. Autonomy and Responsibility

1. individually investigate the tasks and problems in the automation of surveying measurements and their processing as well as their solution based upon available sources and examples,
2. Openly receives well-founded critical comments, accepts the proposals and integrates them during further work,
3. In some situations - as part of a team - collaborates with other students in solving tasks.

2.3 Methods

Lectures, practises with instruments and computers. Especially the application of programming, its practice individually. Presentation of an individual project.

2.4 Course outline

Week	**Topics of lectures and/or exercise classes**
1.	Load text files, simple calculations, statistics, plots
2.	Processing text files 1. Load NMEA files to generate a coordinate list. Visualization in GIS. Regular expressions.
3.	Processing text files 2. Load Leica GSI file, generating coordinate list and dxf file. Processing binary files.
4.	Section of a point cloud. Using CloudCompare command-line interface (CLI) and graphical user interface (GUI). Homogenous coordinates. Use of python scripts.
5.	Tunnel ovality check.
6.	Processing GNSS measurements with RTKLIB GUI and CLI. OEM GNSS receivers
7.	Total station programming. Terminal emulator
8.	Introduction to ULYXES. Applications and development of ULYXES
9.	Digital image processing. Using OpenCV and python. Movement detection using digital images
10.	Geodetic networks in tunnel constructions. Guiding Tunnel Boring Machines
11.	Measurements of bridge movements and deformations
12.	Processing of bridge measurements
13.	Control of civil engineering machines with land surveying instruments.
14.	Application of laser interferometry in surveying. Presentations, evaluation

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

online materials

1. Relevant manuals, tutorials, forums
2. Tutorials available at the github of OSGeoLab operated by the Department of Geodesy and Surveying: https://github.com/OSGeoLabBp/tutorials
3. Documentation and demos of the Ulyxes frame API: http://www.agt.bme.hu/ulyxes/index.html
4. Handouts in the education framework of the Faculty

2.6 Other information

1. Only open-source and free software is used. Most of the programs used and developed in the course can be run both under Windows and Linux OS.
2. Attendance at the lectures and practices is obligatory. It is not allowed to miss more than four practices or lectures.
3. Use of your own laptop is recommended. Necessary software must be installed in advance upon instructions. In the lack of own devices, all of them are provided by the department.

2.7 Consultation

Appointments: As specified on the department's website, or in consultation with the course instructors 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 assessment of the learning outcomes specified in clause 2.2 above, and the evaluation of student performance occurs via a written exam, two homeworks and the activity presented during the whole course. The second homework should be presented during the last practice. Student's activity is measured via short (10-minute) online tests at the beginning of the practices or lectures covering the main points of the previous topic. In addition to measuring the student's activity, the goal of these tests is to give feedback to students and make sure that they master knowledge needed to understand the following topic. Online test practices are available to revise the topics and to prepare for the online tests.

3.2 Assessment methods

Evaluation form	**Abbreviation**	**Assessed learning outcomes**
written exam	E	A.1-A.8; B.1-B.6; C.1-C.4; D.1-D.2
1st homework	HW1	A.1-A.2, A.8; B.1-B.2
2nd homework	HW2	A.5-A.7; B.1-B.6; C.3-C.4; D.2-D.3
activity	A	A.1-A.8; B.1-B.6; C.1-C.4; D.1-D.3

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

3.3 Evaluation system

Abbreviation	**Score**
HW1	10%
HW2	30%
A	10%
Total achievable during the semester:	50%
E	50%
Sum	**100%**

All the evaluations are graded by 1-5 mark

3.4 Requirements and validity of signature

The condition for obtaining a signature is that the student achieves at least pass grade of each evaluation during the semester education part.

3.5 Grading system

The final grade is the weighted average of the evaluations according to the clause 3.3.

3.6 Retake and repeat

1. Homeworks can be submitted after their deadline specified in the detailed course pro-gramme until 11:59 pm on the last day of the completion week. In this case, the student must pay the pre-determined fee.
2. Submitted and accepted home works can be corrected until the deadline given in point 1) without paying a fee.

3. Delayed and not presented second homework must be considered by a pass grade at most.
4. Student's activity – due to its nature - cannot be retaken or compensated.

3.7 Estimated workload

Activity	**Hours/semester**
contact hours	14×3=42
preparation for the practices and lectures	14×1=14
preparation of home works	6+24=30
preparation for the exam	34
Sum	**120**

3.8 Effective date

1 September 2022

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Inactive courses