Circles of knowledge / subject programs, subject descriptions
(for each unit in the curriculum table)

Circle of knowledge: **Basics of natural sciences** **Credit range** *(max. 12 cr.):* **12** Subjects: 1) **Geomatemathics,** 2) **Geostatistics,** 3) **Modeling of environmental processes**

(1.) Name of the **subject**: **Geomatemathics**	**Credit: 4**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **50** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/28** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing**:** -	
Location of the subject in the Curriculum (semester number): **1**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

Students become thoroughly acquainted with the following areas of geomathematics:
• Plane and spatial coordinate systems.
• Geographical applications of trigonometric functions. Notable lines, distances and surfaces.
• Spherical triangular theorems and their application.
• Possibilities of distance and area measurement, calculation tasks.
• Possibilities of converting the coordinates of ground points. Projection transformations.
• Examination of the accuracy of measurements and calculations.
• Matrices. Matrix operations and their properties.
• Sets, set operations and their properties.
•Probability theory.
• Distributions of continuous probability variables.
• Mathematical statistics - hypothesis testing - fit testing.
• Estimation, correlation and regression calculations.
• Factor analysis, principal component analysis.
• Cluster analysis.
• Discrimination analysis.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Willi Freeden, Clemens Heine, M. Zuhair Nashed : An Invitation to Geomathematics, Springer, 2019
Recommended literature:
Demeter Gábor, Lóki József: Geomatematika, Debrecen, 2009

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

a) knowledge
Knows and uses geomathematical methods with open source and commercial mathematical and statistical software. Comprehensive knowledge and understanding of the most important contexts and concepts in the field of geomathematics. Able to properly interpret and evaluate the results obtained during geomatematics calculations. In his native language, he/she confidently uses the concept and terminology of geomathematics and can adapt it to the concept of geoinformatics.
b) abilities
Able to perform geomathematic calculations to support decision makers. Able to perform problem solving, planning, development, operation, management and consulting tasks with proper interpretation of geomathematic results. Able to initiate initiative, project work and group work with experts in co-sciences and other related fields. Is able to recognize and apply new problem-solving methods and procedures in his / her field and apply what he/she has learned in a diverse, multidisciplinary environment.
c) attitude
He/she monitors professional development in geomathematics. He/she is open to professional cooperation with professionals working in related fields.
(d) autonomy and responsibility
Independent regarding the reflection and elaboration of professional issues and processes in the field of geomathematics. Using the methods of geomathematics, he/she collaborates responsibly with experts in other fields

Responsible for the subject (*name, position, degree*)**: Dr. habil. Tar József Kázmér, assoc. prof., PhD, DSc, CSc**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Dr. Borbély József, assistant professor, PhD

(2.) Name of the **subject**: **Geostatistics**	**Credit: 4**

Subject **classification**: **compulsory**

The degree of theoretical or practical nature of the subject, "training character": **50** (credit%)

Type of lesson: lec. / prac. and **number of lesson hours**: **28/28** in the given semester,

language: *English)*

Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: projekt work

Assessment methods (coll. / mg. / **other**): coll.

Additional (*specific*) **methods** to be used in knowledge testing: -

Location of the subject in the Curriculum (semester number): **1**

Preliminary requirements: -

Course description: a concise but informative description of the knowledge to be acquired

The students will learn about Geospatial Data Science and Analysis with practicals applying descriptive statistics. They acquire knowledge about point pattern analyses, spatial analyses with exploring the Modifiable Area Unit Problem. The students will obtain skills in the domain of Cluster Analysis & Spatial Autocorrelation. They will study advanced interpolation methods and will apply this knowledge in surface analyses.
Students also will acquire knowledge related to the problem of weighting, aggregation.
They get acquainted with the calculation of spatial regression, the study of spatial autocorrelation (Moran's I, Geary c), using two-dimensional methods based on the distance matrix.
They learn how to optimally implement spatial sampling and field data collection when examining different objects.
Within the framework of the course, students interpret the theoretical material through practical examples with the help of built-in modules of specific commercial (eg ArcGIS) and open source (GeoDA, R,) software.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Reuired literature:
Oyana, Tonny. and Margai, Florence., 2016, Spatial Analysis: Statistics, Visualization, and Computational Methods. (CRC Press, Boca Rotan, FL). ISBN 978-1498707633
Wickham, H. and Grolemund, G 2017. R for Data Science
Bruce, P. and Bruce A. Practical Statistics for Data Scientists: 50 essential concepts
Recommended literature:
Christakos, G., 2000. Modern spatiotemporal geostatistics. Oxford University Press, New York.

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

a) knowledge
Students will know and use geostatic methods and technologies, available databases and GIS software, and open source and commercial geoinformatics software.
They will have comprehensive knowledge and understanding of the most important contexts and concepts in the field of geostatistics
They will be able to properly interpret and evaluate the results obtained during geostatic analyzes.
They understand the requirements for planning field data collection and sampling.
They will confidently use the concept and terminology of geostatistics in his native language and can adapt it to the concept of geoinformatics.

b) abilities

They will be able to create geostatistical analyzes to support and assist decision-makers.
They will be able to perform problem-solving, planning, development, operation, management and consulting tasks with the proper interpretation of geostatistical results.
They will be able to initiate collaboration, project work and group work with experts in other related fields.
They will be able to assess the business, market and innovative value of the planned and implemented geoinformatics systems, as well as their compliance with a user and social needs.
They will be able to recognize and apply new problem-solving methods and procedures in their field and apply what they have learned in a diverse, multidisciplinary environment.

c) **attitude**

They will pay attention to professional, technological developments and labour market trends related to geostatistics. Throughout their field and laboratory activities, they are committed to environmentally friendly behaviour. They will share their knowledge and consider it's important to transmit geostatistical professional results. They will be open to professional cooperation with professionals

d) **autonomy and responsibility**

Using the methods of geostatistics, the students collaborate responsibly with professionals in other fields. They will be able autonomously to evaluate questions and processes in the field of geostatistics.

Responsible for the subject (*name, position, degree*)**: Dr. habil. Földváry Lóránt, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Dr. Pődör Andrea, assoc. prof., PhD

(3.) Name of the **subject**: **Modeling of environmental processes**	**Credit: 4**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **75** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **14/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: case studies, thematic presentations	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing: -	
Location of the subject in the Curriculum (semester number): **2**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

The aim of the subject is to provide students with knowledge of the natural and anthropogenic processes in the environment, as well as the possibilities of modelling environmental systems. It introduces the various types of model and the role of modelling in the environmental sciences, shows basic steps of model building, model calibration, validation and uncertainty investigation (simulation of methods e.g. MC). It reviews the methods of integrated modelling, the combination of complex material transportation models, and the application of conservative and soft (Fuzzy) calculation methods in the modelling of environmental problems processes.
The subject combines theoretical and practical sessions. The scope of the practical (computer-based exercises) is to consolidate the theory, to learn & train practical skills and to apply problem-solving methodologies to real-life examples. The practical lessons show the models related to soil-water-air processes and pollution (noise pollution, point and diffuse pollution e.g. eutrophication P-model, RUSLE, SEDIMENTATION model). It provides the student with the software background of the environmental impact assessment and the development of the database required for the investigation.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Turner G. M.- Gardner H. R.- O'neill V. R.: Landscape Ecology in theory and practice. Sprnger-Verlag. ISBN 0-387-95123-7
Takács A. A.-Végső F.: Térinformatikai alkalmazások II, Jegyzet. Székesfehérvár, GEO, 2010. A jegyzet elektronikus változata a Tankönyvtár portálon.
Tamás J. (2000): Térinformatika I., II., Jegyzet. DE ATC
Recommended literature:
Hunsaker C.T.-Goodchild M. F. Friedl M. A. – Case T.J.:Spatial Uncertainty in Ecology. Impications for Remote Sensing and GIS Applications.Springer-Verlag (2001) ISBN 0-387-95129-6

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

e) knowledge
Is familiar with the concepts of environmental modelling, knows the various types of models, data requirements, criteria,
To understand and apply analysis methods, knows conservative and soft calculation methods, their advantages and limitations, their applicability in environmental system modelling,
Has a comprehensive knowledge of the task-solving principles, modelling and simulation of the environmental processes,

Has knowledge of the specific tools of the geoinformatics, is able to apply data management and analysis, as well as interpretation the results,
Know the purpose and methods of calibration, validation and uncertainty investigation,
Is familiar with methods and characteristics for describing multicomponent systems.

f) abilities

Is able to identify environmental problems and explore them to plan and organise the response to situations,
Is able to interpret spatial phenomena, processes and get information,
Is able to describe real systems with scientific environmental models,
Is suitable for describing the processes taking place in environmental systems by means of mathematical and statistical tools,
Understand potentials and constraints of various models.

g) **attitude**

Cooperates with the teacher and teammates in expanding the knowledge,
Expands his / her knowledge by constantly acquiring knowledge,
Monitors professional and technological developments related to his / her professional qualifications in the field of gis,
Open to the use of information technology tools,
Seeks to know and routinely use the tools needed to solve the environmental problems,
Strives to meet deadlines and tries to be efficient at work.
Considers it important to mediate environmentally conscious behaviour, to support sustainable development by using gis tools,
Strives to apply the principle of environmental awareness in solving modelling tasks.

h) **autonomy and responsibility**

Independently identifies and analyses the environmental processes, problems and describes these by using models
Openly accepts substantiated critical remarks,
Co-operates responsibly with team members and professionals of other fields
Applies a systematic approach in his / her thinking, independent of the thinking and elaboration of professional issues and processes,
Feels responsible for meeting deadlines.

Responsible for the subject (*name, position, degree*)**: Verőné Dr. Wojtaszek Malgorzata, assoc. prof., CSc**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Dr. Pődör Andrea, assoc. prof., PhD

Circle of knowledge: **Economic, legal and human knowledge**
Kredittartománya *(max. 12 cr.):* **10**
Subjects: 1) **Business Economics,** 2) **Data protection, data policy,**
3) **GIS applications in spatial planning**

(1.) Name of the **subject**: **Business Economics**	**Credit: 3**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **40** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/14** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing**:** **manuals with technical specifications**	
Location of the subject in the Curriculum (semester number): **1**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

Educational objective: To acquaint the students with the system of macroeconomic conditions for the establishment and operation of enterprises. To interpret the basic concepts of business organization management in the framework of a regulated market economy. To present the main types of corporate strategies, the process and the need for planning. Analyze business processes: marketing, production / service, innovation and asset management, human resource management, logistics, finance and crisis management.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Andrew Gillespie: Business Economics, Oxford, 2010
Recommended literature:
Sloman John: Economics for business, Pearson education limited, 2019, ISBN13 (EAN): 9781292239279

List of the **required professional competencies, competence elements** (*knowledge*, *ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

i) knowledge
Has basic management and leadership skills to perform tasks related to your field.
Knows the possibilities, principles and problems of the application of geoinformatics for state (e-government) and market purposes.
j) abilities
Ability to recognize and apply new problem-solving methods and procedures in their field and apply what they have learned in a diverse, multidisciplinary environment.
Ability to perform problem solving, planning, development, operation, management and consulting tasks in the operation of GIS systems, decision support systems and expert systems. Able to work with decision makers.
k) **attitude**

He/she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with the tools of geoinformatics.
Committed to adhering to and adhering to quality requirements.

l) **autonomy and responsibility**

Independent regarding the reflection and elaboration of professional issues and processes.
Feels responsible for meeting and meeting deadlines. He / she is responsible for the work of himself / herself and his / her staff, as well as his / her staff (working on a project).

Responsible for the subject (*name, position, degree*)**: Dr. Takácsné Prof. Dr. habil. György Katalin, prof., PhD, CSc**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Prof. Dr. Takács István, prof., PhD

(2.) Name of the **subject**: **Data protection, data policy**	**Credit: 3**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **33** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/14** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing**: -**	
Location of the subject in the Curriculum (semester number): **1**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

Concepts: data, information, public service information, open government data, big data, national data asset, national data policy, data protection.
Significance of Data value chain.
International and Hungarian strategic data policy contexts.
Legal environment of national data policy. White Book.
Information security issues
Evolution of basic information rights, the main principles.
The domestic legal practice, administrative requirements related to data management.
Description of the General Data Protection Regulation

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Advisory Board of the National Council for Telecommunications and Information Technology (2016): White Paper on National Data Policy. Budapest: National Council for Telecommunications and Information Technology.
Privacy, Security and Information Management: An Overview, American Bar Association (February 7, 2014), ISBN-10: 1616329777, ISBN-13: 978-1616329778
Recommended literature:
REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

m) knowledge
He / she has basic management and leadership skills to help him perform tasks related to his field.
He / she knows the possibilities, principles and problems of the application of geoinformatics for state (e-government) and market purposes.
n) abilities
Able to initiate initiative with design and development professionals and end users of geoinformatics results. Able to manage processes and projects related to the field of geoinformatics at the managerial level. Able to perform problem solving, planning, development, operation, management and consulting tasks in the operation of GIS systems, decision support systems and expert systems. Able to work with decision makers.
o) **attitude**

He / she accepts and adheres to the ethical principles of work and organizational culture with his / her colleagues, especially with regard to the copyright environment related to GIS.

p) **autonomy and responsibility**

In the operation of geoinformatics systems, he / she can be assigned development-operational responsibility in accordance with professional competencies.

Responsible for the subject (*name, position, degree*)**: Prof. Dr. Rajnai Zoltán, prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

dr. Kovács Miklós, master teacher

(3.) Name of the **subject**: **GIS applications in spatial planning**	**Credit: 4**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **75** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **14/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: thematic presentations	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing: **topic elaboration**	
Location of the subject in the Curriculum (semester number): **3**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

Presentation of the territorial levels of regional development. Temporal and spatial modeling of social, economic and environmental processes across the country and its regions. Decision support in activities to change the spatial structure of society and the economy for certain purposes, such as: coexistence, differentiation, distance and mobility, extent and fragmentation. Advantages of GIS research, methods of spatial data analysis.
Construction of a geoinformatics database using the data of the National Spatial Development and Spatial Planning Information System. Preparation of thematic maps on the spatial distribution of territorial differences. Establishing conclusions, determining development directions. Presentation of case studies to support spatial decisions with geoinformatics methods.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Martin van Maarseveen (Editor), Javier Martinez (Editor), Johannes Flacke (Editor): GIS in Sustainable Urban Planning and Management: A Global Perspective 1st Edition, ISBN-13: 978-1138505551
Editors: Scholten, Henk J., Stillwell, John (Eds.): Geographical Information Systems for Urban and Regional Planning, ISBN 978-94-017-1677-2
Recommended literature:
Ed Ferrari - Alasdair Rae: GIS for Planning and the Built Environment, Macmillan International Higher Education, 2019 - 168 p
J. M. Pogodzinski (Author), Richard M. Kos (Author): Economic Development and GIS, ISBN-13: 978-1589482180

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

q) knowledge
Has complex knowledge of general geographic, cartographic, planning, mathematical and IT principles, rules, contexts required for cultivating the field of geoinformatics, especially in the following topics: knowledge of geographical and spatial processes, collection, editing and analysis of spatial data, geostatistics, modeling, visualization, geoinformatics system construction.
Comprehensive knowledge and understanding of the key contexts and concepts in the field of geoinformatics, especially in the following areas: vector GIS, geoinformatics databases, applied GIS systems.

r) abilities
Able to interpret complex professional problems in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve problems.

Able to interpret geographic / spatial phenomena, processes and information, and to plan, organize, manage and control processes in the geoinformatics field.
Able to understand, plan and implement a quality management system for project-level tasks in the field of geoinformatics.
Able to create geoinformatics systems to support and assist decision makers.

s) **attitude**

Able to interpret complex professional problems in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve problems.
Able to interpret geographic / spatial phenomena, processes and information, and to plan, organize, manage and control processes in the geoinformatics field.
Able to understand, plan and implement a quality management system for project-level tasks in the field of geoinformatics.
Able to create geoinformatics systems to support and assist decision makers.

t) **autonomy and responsibility**

Independent in thinking and elaborating professional issues and processes.
With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Responsible for the subject (*name, position, degree*)**: Dr. Katona János, assistant prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Dr. Udvardy Péter, assoc. prof., PhD

Circle of knowledge: **Photogrammetry**
Credit range *(max. 12 cr.):* **10**
Subjects: 1) **Digital photogrammetry,** 2) **Application of UAV technology**

(1.) Name of the **subject**: **Digital photogrammetry**	**Credit: 5**

Subject **classification**: **compulsory**

The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)

Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester,
language: *English)*
Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: **practical lessons with measurement isntruments**

Assessment methods (coll. / mg. / **other**): coll.
Additional (*specific*) **methods** to be used in knowledge testing**: manuals with technical specifications**

Location of the subject in the Curriculum (semester number): **1**

Preliminary requirements: -

Course description: a concise but informative description of the knowledge to be acquired

The aim of the course is to acquaint students with the data collection methods and requirements of digital photogrammetry. It deals with the planar and spatial aspects of photogrammetric automated data collection and data integration into geoinformatics systems. It covers state-of-the-art sensors and digital photogrammetric workstations that support evaluation. It discusses in detail image processing, adjustment, error filtering methods and algorithms that support automated data acquisition. Through application examples, it presents modern technologies of the final products and evaluation methods that can be produced (orthophoto, line evaluation, digital surface and terrain models, aerial triangulation methods) in a project-oriented way.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Wilfried Linder: Digital Photogrammetry: A Practical Course, Springer (2009), 220 p., ISBN-13: 978-3540927242
Karl Kraus: Photogrammetry - Geometry from Images and Laser Scans,De Gruyter (2007), 459 p., ISBN: 978-3-11-089287-1
Recommended literature:
Thomas Luhmann, Stuart Robson, Stephen Kyle, and Jan Boehm: Close-Range Photogrammetry and 3D Imaging, De Gruyter (2020,), 822 p., ISBN: 978-3-11-060724-6

List of the **required professional competencies, competence elements** (*knowledge, ability,* etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

u) knowledge
Complex knowledge in the following areas: collection, editing and analysis of spatial data, photogrammetric data acquisition. Get acquainted with current theories, models and literature of the science of photogrammetry based on scientific results. It provides insight into the possible directions and boundaries of the field of photogrammetry. Comprehensively learns and understands the most important contexts and concepts in the field of photogrammetry, especially in the following areas, 2- and 3-dimensional GIS modeling, digital image processing, applied GIS systems.
Comprehensively gets acquainted with the problem-solving principles, methodology and procedures of the design, development and operation processes of the photogrammetry field, especially in the

following areas: primary and secondary data collection, 3-dimensional modeling, development of spatial services.
Acquires knowledge of specific tools in the field of photogrammetry, gets acquainted with and uses photogrammetric data collection technologies and cloud-based geoinformatics solutions.
Understands, knows and applies laboratory and practical materials, tools and methods of photogrammetry. He has basic management and leadership skills that will enable him to perform tasks related to his field of expertise. In English, he confidently uses the conceptual framework and terminology describing the data mining processes and can adapt it to the conceptual framework of geoinformatics.

v) abilities

He / she will be able to interpret complex professional problems in the field of photogrammetry and geoinformatics, to explore the necessary theoretical and practical background in order to solve the problems. Able to design, organize, design and control processes in the field of photogrammetry. He / she is able to independently collect data and organize spatial data into a database, as well as organize data with the tools of photogrammetry and geoinformatics. Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them. Able to initiate initiative, project work and group work with experts in co-sciences and other related fields (geology, geography, geodesy, cartography, meteorology, environmental science, earth science, informatics, mathematics, statistics, archeology). Able to initiate cooperation with design and development professionals and end users of photogrammetric results. He / she is able to recognize and apply new problem-solving methods and procedures in his / her field and apply what he / she has learned in a diverse, multidisciplinary environment. Able to advise on photogrammetric applications. He / she is able to use the professional vocabulary of photogrammetry in his native language and in English. Able to work with decision makers.

w) **attitude**

He / she monitors professional, technological developments and labor market trends related to photogrammetry. Throughout his / her field and laboratory activities, he / she is committed to environmentally conscious behavior. He / she shares his / her knowledge and considers it important to convey professional results in photogrammetry. He / she is open to professional cooperation with professionals working in related fields. He / she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with the tools of photogrammetry.

x) **autonomy and responsibility**

He / she is independent regarding the thinking and elaboration of professional issues and processes in the field of photogrammetry. With his / her geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Responsible for the subject (*name, position, degree*)**: Dr. habil. Jancsó Tamás, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Balázsik Valéria, master teacher

(2.) Name of the **subject**: **Application of UAV technology**	**Credit: 5**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: **practical lessons with measurement isntruments**	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing: **manuals with technical specifications**	
Location of the subject in the Curriculum (semester number): **2**	
Preliminary requirements: Digital photogrammetry	

Course description: a concise but informative description of the knowledge to be acquired

The aim of the course is to acquaint students with the data collection methods and requirements of UAV technology. It deals with the possibilities of automated data collection of UAV technology, data integration into geoinformatics systems. It covers state-of-the-art sensors, software that supports flight mission plans and evaluation. It discusses in detail image processing, adjustment, error filtering methods and algorithms that support automated data acquisition. It introduces cloud-based services related to UAV technology and the end products that can be produced. It presents the entire technological process through complex, project-based practical examples.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
James S. Aber, Irene Marzolff, Johannes Ries, Susan Elizabeth Ward Aber: Small-Format Aerial Photography and UAS Imagery: Principles, Techniques and Geoscience Applications 2nd Edition, Elsevier (2019), 394 p., ISBN-13: 978-0128129425
Recommended literature:
David R. Green, Billy J. Gregory, Alexander Karachok: Unmanned Aerial Remote Sensing: UAS for Environmental Applications, Taylor & Francis (2020), 363 p., ISBN-13: 978-1482246070

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

y) knowledge

Complex knowledge in the following areas: collection, editing and analysis of spatial data, data acquisition with UAV technology. Get acquainted with current theories, models and literature of UAV technology based on scientific results. It provides insight into the possible development directions and limits of UAV technology. Comprehensive knowledge and understanding of the most important contexts and concepts of UAV technology, especially in the following areas, 2- and 3-dimensional GIS modeling, digital image processing, applied GIS systems.
Comprehensively learns the problem-solving principles, methodology and procedures of the design, development and operation processes of UAV technology, especially in the following areas: primary and secondary data collection, 3-dimensional modeling, development of spatial services.
Acquires knowledge of specific devices of UAV technology, learns and uses data collection technologies with unmanned devices, cloud-based geoinformatics solutions.
Understands, knows and applies laboratory and practical materials, tools and methods of UAV technology.

z) abilities

He / she will be able to interpret complex professional problems in the field of geoinformatics of UAV technology, to explore the necessary theoretical and practical background and to solve the problems. Able to design, organize, manage, and control processes related to UAV technology. He / she is able to independently collect data and organize spatial data into a database, as well as organize data with the tools of photogrammetry and geoinformatics. Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them. Able to initiate initiative, project work and group work with experts in co-sciences and other related fields (geology, geography, geodesy, cartography, meteorology, environmental science, earth science, informatics, mathematics, statistics, archeology). Able to initiate initiative with design and development professionals and end users of UAV technology results. Able to advise on photogrammetric applications. Able to use the professional vocabulary of UAV technology in their native language and in English. Able to work with decision makers.

aa) **attitude**

He / she monitors professional, technological developments and labor market trends related to UAV technology. Throughout his field and laboratory activities, he / she is committed to environmentally conscious behavior. He / she shares his knowledge and considers it important to convey professional results. He / she is open to professional cooperation with professionals working in related fields. He / she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with aerial photogrammetry tools.

bb) **autonomy and responsibility**

He / she is Independent in the field of thinking and elaboration of professional issues and processes in the field of UAV technology. With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Responsible for the subject (*name, position, degree*)**: Dr. habil. Jancsó Tamás, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Dr. habil. Molnár András, assoc. prof., PhD

Circle of knowledge: **Remoste sensing**

Credit range *(max. 12 kr.):* **9**

Subjects: 1) **Remote sensing and its applications,** 2) **Earth observation and advanced analysis of spatial data**

(1.) Name of the **subject**: **Remote sensing and its applications**	**Credit: 4**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **50** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/28** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: case studies, thematic presentations	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing**: case studies, reports**	
Location of the subject in the Curriculum (semester number): **3**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

The aim of the subject is to provide the student with concepts of remote sensing, principle RS techniques, and up-to-date remote sensing sensors and applications, this subject aims at broadening students knowledge with traditional and more advanced image processing methods and principles of automated analysis of remotely sensed images. It focusses on the theory, methods and practical application of most recent semi-automated image data analysis and image information extraction processes used by professional Earth and Environmental system science researchers in order to provide reliable and reproducible information about human and physical earth environments. The subject introduces to the up-to-date research and recent innovations in remote sensing technology and image data analysis techniques.
Main topics: The interaction of electromagnetic energy and the Earth's surface. Data acquisition, possibilities of obtaining remote sensing data, aspects of data selection. How to handle data of different resolutions and formats, data integration. Software (open source, commercial), methods (pixel-based procedures, OBIA) that can be used to evaluate remote sensing data. Digital image analysis, segmentation and classification schemes to obtain spatial information. Typical application of remote sensing data: case studies.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:

Lillesand T. M. et al. (2007): Remote sensing and image interpretation, John Wiley & Sons, Inc. ISBN 978-0-470-05245-7
Verőné Wojtaszek M. et all (2020): IRSEL (Innovation on Remote Sensing Education and Learning) some modules of electronic Learning Materials. The LM will be available from November 2020 on the website of ÓE AMK. It was developed within the framework of the ERASMUS + international project.

Recommended literature:

Verőné Wojtaszek M. (2010): Fotointerpretáció és Távérzékelés, moduláris jegyzet, Szfvár, NymE GEO, TÁMOP
Verőné Wojtaszek M. – Tóth Z. (2015): Digitális képelemzés. Elektronikus jegyzet. Székesfehérvár, Óbudai Egyetem, 60 p.

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

cc) knowledge

Is familiar with the physical principles of remote sensing, technics of data gathering, the interaction of electromagnetic energy with the atmosphere and the earth,
Is familiar with open source satellite databases,
Has comprehensive knowledge of digital image analysis: preprocessing and classification methods, algorithms,
Students know about the rs problem solving circle and can apply several methods and tools of a semi-automated workflow design and typical remote sensing project management,
Is familiar with open source and professional image processing software as well as online image processing options.
Students have practical experience in multi sensor data analysis and challenges of scale, and the global, regional and local applications of remote sensing

dd) abilities

Able to search for open source remote sensing data taking into account the purposes of the application and organize spatial data into a database,
Able to use commercial and open source image analysis software,
Student can apply standardised image processing and basic classification techniques,
Able to creatively and methodically process, evaluate, interpret, analyse measurements and draw conclusions from them,
Has a comprehensive knowledge of the application possibilities, advantages and limitations of remote sensing.

ee) **attitude**

Cooperates with the teacher and teammates in expanding the knowledge,
Expands his / her knowledge by constantly acquiring knowledge,
Monitors professional and technological developments related to his / her professional qualifications in the field of rs,
Open to the use of the technology tools,
Seeks to know and routinely use the tools of image processing,
Seeks to understand and practice the potential of remote sensing,
Strives to meet deadlines and tries to be efficient at work,
Tries to support sustainable development by using gis/rs tools.

ff) **autonomy and responsibility**

Independently identifies and analyses tasks and problems based on remote sensing,
Openly accepts substantiated critical remarks,
Co-operates responsibly with team members and professionals of other fields,
Applies a systematic approach in his / her thinking, independent of the thinking and elaboration of professional issues and processes,
Feels responsible for meeting deadlines.

Responsible for the subject (*name, position, degree*)**: Verőné Dr. Wojtaszek Malgorzata, assoc. prof., CSc**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Dr. habil. Vekerdy Zoltán, assistant prof., scientific advisor, PhD

(2.) Name of the **subject**: **Earth observation and advanced analysis of spatial data**	**Credit: 5**
Subject **classification**: **compulsory**	
The degree of theoretical or <u>practical</u> nature of the subject, "training character": **75** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: **case studies, thematic presentations**	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing**: case studies, reports**	
Location of the subject in the Curriculum (semester number): **4**	
Preliminary requirements: Remote sensing and its applications	

Course description: a concise but informative description of the knowledge to be acquired

The subject is divided into theoretical part and some practical real-world application components in order to train students to process standardized, accurate, reproducible, reliable and relevant environmental information of the land cover. Case studies and project assignments provide proficiency in the field. Within the framework of the subject, students will gain a comprehensive knowledge of the latest, advanced methods and practical application of image processing. Specific topics of this subject include radiometric correction and normalization methods, statistics of indices and accuracy assessment, multi-sensor and multi-temporal data analysis.
Main topics: an overview of global earth observation satellite systems, open source remote sensing data. ESA space research program (Copernicus). Digital data processing: object-oriented image analysis (OBIA) and Machine Learning algorithms. The role of segmentation in remote sensing: algorithms of segmentation. Hard and soft classification procedures (Fuzzy logic, member functions, advanced classifiers e.g. SWM, FT, CART). GIS post-processing of data derived from remote sensing.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Lillesand T. M. et al. (2007): Remote sensing and image interpretation, John Wiley & Sons, Inc. ISBN 978-0-470-05245-7
Verőné Wojtaszek M. et all (2020): IRSEL (Innovation on Remote Sensing Education and Learning) some modules of electronic Learning Materials. The LM will be available from November 2020 on the website of ÓE AMK. It was developed within the framework of the ERASMUS + international project.
Blaschke T., Lang S., Hay G. J.: Object-Based Image Analysis, Springer, 2008, ISBN: 978-3-540-77057-2
Recommended literature:
Verőné Wojtaszek M. – Tóth Z. (2015): Digitális képelemzés. Elektronikus jegyzet. Székesfehérvár, Óbudai Egyetem, 60 p.
Verőné Wojtaszek M.: Objektum-alapú képelemzés. Elektronikus jegyzet. Székesfehérvár, Óbudai Egyetem (2015), 55 p.

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

gg) knowledge
Has complex knowledge of rs data sources and digital image analysis, evaluates the data quality of remote sensing products,

Is familiar with the principles of calibration and image processing of satellite and aerial sensors,
Knows classical and advanced image processing algorithms and application possibilities (advantages, limitations),
Has advanced theoretical and practical knowledge of digital image analysis, evaluation and analysis data from satellites using advanced image processing methods
Identifies the specific fields and tasks where remote sensing can be used as a basic data resource, systematically collects, understands, critically analyzes and applies the results of certain disciplines.

hh) abilities

Able to explain the principles of calibration and image processing for satellite and airborne sensors,
Competently able to process and interpret remotely sensed images,
Evaluate data quality in remote sensing products,
Has advanced skills in analysing, integrating and managing spatial data,
Identify specific applications where remote sensing may be used as a tool for monitoring and research, collect systematically, understand, analyse critically and apply the results of a significant field of science
Has ability to critically evaluate existing theories and technologies and identify the needs for improvement,
Able to creatively and methodically process, evaluate, interpret, analyze measurements and draw conclusions from them.

ii) **attitude**

Cooperates with the teacher and teammates in expanding the knowledge,
Expands his / her knowledge by constantly acquiring knowledge,
Monitors professional and technological developments related to his / her professional qualifications in the field of rs,
Open to the use of the technology tools,
Seeks to know and routinely use the tools of image processing,
Seeks to understand and practice the potential of remote sensing,
Strives to meet deadlines and tries to be efficient at work,
Tries to support sustainable development by using gis/rs tools.

jj) **autonomy and responsibility**

Independent in thinking and elaborating professional issues and processes,
Independently identifies and analyses tasks and problems based on remote sensing,
Openly accepts substantiated critical remarks,
Co-operates responsibly with team members and professionals of other fields,
Applies a systematic approach in his / her thinking, independent of the thinking and elaboration of professional issues and processes,
Feels responsible for meeting deadlines.

Responsible for the subject (*name, position, degree*)**: Verőné Dr. Wojtaszek Malgorzata, assoc. prof., CSc**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Circle of knowledge: **Data science**
Credit range *(max. 12 cr.):* **10**
Subjects: 1) **Data science,** 2) **Data mining**

(1.) Name of the **subject**: **Data science**	**Credit: 5**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing**: -**	
Location of the subject in the Curriculum (semester number): **2**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

Relation databases and the SQL. Simple and complex SQL queries. Data Definition and Data Manipulation Language of SQL. NoSQL databases. Data access and storing methods. Using of PostgreSQL databases. Fuzzy logic and fuzzy sets. Machine learning, and optimalisation. (neural netwoks, etc.)

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom: Database systems
PostgreSQL Documentation: https://www.postgresql.org/docs/
Recommended literature:
Michael Nielsen: Neural Networks and Deep Learning, http://neuralnetworksanddeeplearning.com

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

kk) knowledge
SQL queries
Nosql databses
Big data tools
Machine learning and optimalisation
ll) abilities
Planning databases
Made queries
mm) **attitude**
Create well structured data
nn) **autonomy and responsibility**
Cooperation with database experts

Responsible for the subject (*name, position, degree*)**: Dr. habil. Orosz Gábor Tamás, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Dr. Nagy Gábor József, assistant prof., PhD

(2.) Name of the **subject**: **Data mining**	**Credit: 5**
Subject **classification**: **compulsory**	
The degree of theoretical or <u>practical</u> nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing**: -**	
Location of the subject in the Curriculum (semester number): **3**	
Preliminary requirements: Data science	

Course description: a concise but informative description of the knowledge to be acquired

Introduction: The concept of data mining, its components; datasets, structures, goodness functions, optimization; measures and data; measuring scales, distance measures. Principles and techniques of data visualization; basic statistics, one- and bivariate case, multivariate case; multidimensional scaling (MDS) ;. Regression: linear models; generalized linear models; sample search; dynamic programming; Clustering: basic concepts, measures ; hierarchical algorithms; dendrogram. Probability algorithms: G-PAS, fuzzy C-mean, k-mean. Machine learning methods in data analysis. Data mining methods on data streams.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Zhao Janchang: R and Data Mining: RDataMining.com http://www.rdatamining.com/
Charu C. Aggarwal: Data Mining: The Textbook, Springer (2015), 763 pp., ISBN-13 : 978-3319141411
Recommended literature:
Pang-Ning Tan: Introduction to Data Mining, Pearson (2005), 792 pp. ISBN-13 : 978-0321321367

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

oo) knowledge
Comprehensive knowledge of the problem-solving principles, methodology and procedures of the planning, development and operation processes of the geoinformatics field, especially in the following areas: database management, Big Data - data mining.
He / she has knowledge of the consequences of Industry 4.0-based operation and technological knowledge, cyber-physical systems, self-organizing mechanisms

pp) abilities
He / she is able to collect data independently and organize spatial data into a database, as well as to organize the data with the tools of geoinformatics. Able to perform operations and create models with independently organized databases.
Able to creatively and methodically process, evaluate, interpret, analyze measurements and draw conclusions from them.

qq) **attitude**
He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
Committed to adhering to and adhering to quality requirements.

rr) **autonomy and responsibility**
Independent in thinking and elaborating professional issues and processes.

With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.
Responsible for the subject (*name, position, degree*)**: Nagyné Dr. Hajnal Éva, assoc. prof., PhD**
Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:** **Dr. Nagy Gábor József, assistant prof., PhD**

Circle knowledge: **Data collection**
Credit range *(max. 12 cr.):* **10**
Subjectsi: 1) **Spatial data collection,** 2) **Geomatics**

(1.) Name of the **subject**: **Spatial data collection**	**Credit: 5**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing**: test**	
Location of the subject in the Curriculum (semester number): **1**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

The goal of the subject is to introduce the students the requirements of the field and mapping data collection methods in geoinfromatics. It deals with the direct and indirect (e.g. Remote sensing) ways of data collection. It explains also the data matching aspects including special GIS functions in view of geometry and content. It introduces the specific needs and problems of databases (environmental studies, archeology, etc.). The subject also discusses most recent technologies, such as integrated mobil mapping systems (its historical overview, system components: scanner, camera, GNSS, INS, the principle of inertial instruments, pointcloud processing). It deals with the economic issues in data collection including the performance factors as well.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
James B. Campbell – Randolph H. Wynne: Introduction to Remote Sensing, The Guilford Press Kiadó, New York, p. 667, 2011. ISBN: 978-1-60918-176-5
Karl Krauss: Photogrammetry, Walter de Gruyter Berlin, p. 459, 2000. ISBN:978-3-11-019007-6
Kurt Menke – Richard Smith Jr. – Luigi Pirelli – John Van Hoesen: Mastering QGIS, Packt Publishing, Birmingham, pp. 388., 2015. ISBN: 978-1-78439-868-2
Recommended literature:
C. Vincent Tao, Jonathan Li: Advances in Mobile Mapping Technology ISPRS Book Series, 2007.
Charles K. Chui, Guanrong Chen: Kalman Filtering with Real-Time Applications, Springer, 2009.

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

ss) knowledge
Geographical, spatial data collection
Knowledge of geographical and spatial processes, collection, editing and analysis of spatial data
Geographic location based data collection technologies
Apply field survey procedures, data management and analysis, and imaging solutions
tt) abilities

Able to interpret complex professional problems in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve problems.
Able to interpret geographic / spatial phenomena, processes and information, and to plan, organize, manage and control processes in the geoinformatics field.
He / she is able to collect data independently and organize spatial data into a database, as well as to organize the data with the tools of geoinformatics.
Able to creatively and methodically process, evaluate, interpret, analyze measurements and draw conclusions from them.
Able to initiate initiative, project work and group work with experts in co-sciences and other related fields (geology, geography, geodesy, cartography, meteorology, environmental science, earth science, informatics, mathematics, statistics, archeology).
Is able to use the professional vocabulary of geoinformatics in his mother tongue and in English.
Able to manage processes and projects related to the field of geoinformatics at the managerial level.
Able to perform problem solving, planning, development, operation, management and consulting tasks in the operation of GIS systems, decision support systems and expert systems. Able to work with decision makers.

uu) **attitude**

He / she accepts and adheres to the ethical principles of work and organizational culture with his / her colleagues, especially with regard to the copyright environment related to GIS.
He / she shares his / her knowledge and considers it important to communicate professional results in geoinformatics. He / she is open to professional cooperation with professionals working in related fields.

vv) **autonomy and responsibility**

Independent in thinking and elaborating professional issues and processes.
With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Responsible for the subject (*name, position, degree*)**: Dr. Szücs László, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Dr. Tarsoly Péter, assistant prof., PhD

Dr. Tóth Zoltán, assoc. prof., PhD

(2.) Name of the **subject**: **Geomatics**	**Credit: 5**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **42/28**in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing: -	
Location of the subject in the Curriculum (semester number): **2**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

Azimuthal, cylindrical and conic projections of the sphere.
Distortion metrics based on the projection equations.
Pseudocylindrical and pseudoconic projections.
Azimuthal and conic projections of the ellipsoid.
Cylindrical projections of the ellipsoid.
Map transformations.
Adjustment of two-dimensional and three-dimensional transformations.
Adjustment of three-dimensional networks (GPS, photogrammetry)
Robust estimates, filtering of error.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Grafarend, E.W., Krumm, F.W.: Map projections, Springer-Verlag Berlin Heidelberg, 2006.
Charles K. Chui, Guanrong Chen: Kalman Filtering with Real-Time Applications, Springer, 2009.
Recommended literature:
Bjerhammar: Theory Of Errors and Generalized Matrix Inverses, Elsevier, 1973.

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

ww) knowledge
Has complex knowledge of general geographic, cartographic, planning, mathematical and IT principles, rules, contexts required for cultivating the field of geoinformatics,
He / she has knowledge of the specific tools of the field of geoinformatics, is able to apply field survey procedures, data management and analysis, and imaging solutions.
Knows and uses spatial data collection technologies, available databases and GIS software, as well as open source and commercial geoinformatics software, cloud-based geoinformatics solutions.
xx) abilities
Able to interpret complex professional problems in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve problems.
Able to creatively and methodically process, evaluate, interpret, analyze measurements and draw conclusions from them.
Is able to recognize and apply new problem-solving methods and procedures in his / her field and apply what he / she has learned in a diverse, multidisciplinary environment.
yy) **attitude**

Open and committed to critical feedback and evaluation based on self-examination.
Committed to adhering to and adhering to quality requirements
zz) **autonomy and responsibility**
Independent in thinking and elaborating professional issues and processes.
With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Responsible for the subject (*name, position, degree*)**: Dr. habil. Földváry Lóránt, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Dr. Tóth Zoltán, assoc. prof., PhD

Circle of knowledge: **Mapping**
Credit range *(max. 12 cr.):* **4**
Subjects: 1) **Informatics in cadastre**

(1.) Name of the **subject**: **Informatics in cadastre**	**Credit: 4**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/28** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing**: -**	
Location of the subject in the Curriculum (semester number): **3**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

Digital Base Map, conceptual model.
Concepts: cadastre, data, base data, state base data, databases, digital base map, data security, data capture, data consistency, data model, data protection, subparcel, parcel, additional independent property, land demarcation, building, environs of settlement, survey, parcel number, relationship, metadata, technical framework map, non-cultivated land, nature of usage, object, object class, object group, land quality class, change management of objects.
Geometric primitives.
Structural primitives.
Thematic structure of DAT, relations.
DAT systems and programs.
Data retrieval from DAT database.
Possibilities and solutions of 3D cadastre.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Digital Maps. Part 1: Digital Base Map. Conceptual Model.
Yomralioglu, Tahsin, McLaughlin, John (Eds.): Cadastre: Geo-Information Innovations in Land Administration, Springer International Publishing AG., 2017. ISBN 978-3-319-51215-0, 978-3-319-51216-7.
Cadastral Data Content Standard for the National Spatial Data Infrastructure, v1.3, NSDI, 2003.
Recommended luterature:
Dr. Szabolcs Mihály HUNGARIAN STANDARD PROPOSAL Digital Base Map (DAT). Conceptual Modelhttp://lazarus.elte.hu/gb/standard/standind.htm

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

aaa) knowledge
He / she has knowledge of the specific tools of the field of geoinformatics, is able to apply field survey procedures, data management and analysis, and imaging solutions. Knows and uses spatial data

collection technologies, available databases and GIS software, as well as open source and commercial geoinformatics software, cloud-based geoinformatics solutions.
He / she knows the possibilities, principles and problems of the application of geoinformatics for state (e-government) and market purposes.
In his native language, he / she confidently uses the conceptual system and terminology describing natural processes and can adapt it to the conceptual framework of geoinformatics.

bbb) abilities

He / she is able to collect data independently and organize spatial data into a database, as well as to organize the data with the tools of geoinformatics. Able to perform operations and create models with independently organized databases.
Able to initiate initiative, project work and group work with experts in co-sciences and other related fields (geology, geography, geodesy, cartography, meteorology, environmental science, earth science, informatics, mathematics, statistics, archeology).

ccc) **attitude**

He / she shares his / her knowledge and considers it important to communicate professional results in geoinformatics. He / she is open to professional cooperation with professionals working in related fields.

ddd) **autonomy and responsibility**

With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Responsible for the subject (*name, position, degree*)**: Dr. Tóth Zoltán, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Circle of knowledge: **GIS development**
Credit range *(max. 12 cr.):* **10**
Subjects: 1) **Data integration,** 2) **GIS project management**

(1.) Name of the **subject**: **Data integration**	**Credit: 4**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **75** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **14/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: **Effective use of various GIS software in the field of database building.**	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing**:** **dissertation, report**	
Location of the subject in the Curriculum (semester number): **1**	
Preliminary requirements: Spatial data collection	

Course description: a concise but informative description of the knowledge to be acquired

The aim of the course is for the student to analyze the properties and relationships of geographical data, to get acquainted with the practical implementation of the integration of geographical and descriptive data. To do this, we review the basics of system design and the theoretical and practical implementation of databases. After mastering the subject, the student should be able to integrate different types of geographic data into a GIS database, link descriptive and other data to them.
Topics:

- Basics of system design (model types, methodologies, tools, UML)
- Database management (DBMS system, Data modeling, SQL)
- GIS data integration (Basic GIS concepts, Spatial data types, data formats, summary of data models, Database building issues, GIS basic operations, GIS software)
- Case study (GIS modeling)

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Maguire, D., Goodchild, M.F. and Rhind, D.W. (Eds.): Geographical Information Systems, New York (US), Longman, 1991.
Zeiler, M.: Modeling Our World, Redlands (US), ESRI Press, 1999.
Bernhardsen, T.: Geographic Information Systems, Arendal (NO), Viak IT and Norwegian Mapping Authority, 1992.
Recommended literature:
Kulcsár A.: Automatic GIS Data Quality Assessment for Non-experts, University of Salford (UK) MSc Dissertation, 2001

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

eee) knowledge
Has complex knowledge of general geographic, cartographic, planning, mathematical and IT principles, rules, contexts required for cultivating the field of geoinformatics, especially in the following topics:

geographical, spatial data collection, use of cartographic procedures, knowledge of geographical and spatial processes, collection, editing and analysis of spatial data, remote sensing, photogrammetry, geostatistics, modeling, visualization, geoinformatics system construction.
Comprehensive knowledge and understanding of the key contexts and concepts in the field of geoinformatics, especially in the following areas: geographic location based data collection technologies, 2- and 3-dimensional GIS modeling, geovisualization, spatial data infrastructures, geoinformatics programming and application development, vector GIS, raster GIS, digital image processing, web GIS solutions, geoinformatics databases, applied GIS systems.
He / she has knowledge of the specific tools of the field of geoinformatics, is able to apply field survey procedures, data management and analysis, and imaging solutions. Knows and uses spatial data collection technologies, available databases and GIS software, as well as open source and commercial geoinformatics software, cloud-based geoinformatics solutions.
He / she knows the possibilities, principles and problems of the application of geoinformatics for state (e-government) and market purposes.

fff) abilities

Able to interpret geographic / spatial phenomena, processes and information, and to plan, organize, manage and control processes in the geoinformatics field.
He / she is able to collect data independently and organize spatial data into a database, as well as to organize the data with the tools of geoinformatics. Able to perform operations and create models with independently organized databases.
Ability to design value-added services, especially in earth observation.
Able to assess the business, market and innovative value of planned and implemented geoinformatics systems, as well as their compliance with user and social needs.

ggg) **attitude**

He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
Open and committed to critical feedback and evaluation based on self-examination.
He / she accepts and adheres to the ethical principles of work and organizational culture with his / her colleagues, especially with regard to the copyright environment related to GIS.
He / she shares his / her knowledge and considers it important to communicate professional results in geoinformatics. He / she is open to professional cooperation with professionals working in related fields.

hhh) **autonomy and responsibility**

Independent in thinking and elaborating professional issues and processes.

Responsible for the subject (*name, position, degree*)**: Dr. habil. Orosz Gábor Tamás, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Nagyné Dr. Hajnal Éva, assoc. prof., PhD

(2.) Name of the **subject**: **GIS project management**	**Credit: 5**

Subject **classification**: **compulsory**

The degree of theoretical or <u>practical</u> nature of the subject, "training character": **70** (credit%)

Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester,
language: *English)*
Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: **Process case studies. Complex GIS project design.**

Assessment methods (coll. / mg. / **other**): coll.
Additional (*specific*) **methods** to be used in knowledge testing**: -**

Location of the subject in the Curriculum (semester number): **4**

Preliminary requirements: Spatial databases

Course description: a concise but informative description of the knowledge to be acquired

The course starts with an overview of the basic concepts of GIS management. Within this, we address the importance of the environment: internal, company-specific and external environment. Students become acquainted with the concept of GIS project management as a profession-specific variant of management, from project planning, through project marketing to the monitoring of the completed project. During the semester, we go through the process of implementing a GIS: from project idea to commissioning. This includes user needs assessment, information needs-based planning, and parts of the work. The most important element of the object and the projects is the logical framework matrix, which can be used in sufficient detail to derive the complete project documentation, on the basis of which the Gantt diagram of the project is also made. We delve into data and IT management and deal in detail with the return aspects of the project based on a cost-benefit analysis. Quality assurance. Change management. The place, role and effects of GIS in the organization. Development trends.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Reuired literature:
Márkus Béla: Geoinformation management, NyME GEO jegyzet, Székesfehérvár, 2013.
Recommended literature:
Peter L. Croswell, PMP, GISP, CMS: The GIS Management Handbook - Second Edition 2019, ISBN13: 978-0-9824093-1-2

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

iii) knowledge
Has complex knowledge of general geographic, cartographic, planning, mathematical and IT principles, rules, contexts required for cultivating the field of geoinformatics, especially in the following topics: geographical, spatial data collection, use of cartographic procedures, knowledge of geographical and spatial processes, collection, editing and analysis of spatial data, remote sensing, photogrammetry, geostatistics, modeling, visualization, geoinformatics system construction.
He / she is familiar with the current theories, models and literature of the science of geoinformatics based on scientific results. He / she is aware of the possible development directions and limits of the field of geoinformatics.
He / she has basic management and leadership skills to help him perform tasks related to his field.
jjj) abilities

Able to interpret complex professional problems in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve problems.
Able to interpret geographic / spatial phenomena, processes and information, and to plan, organize, manage and control processes in the geoinformatics field.
Able to initiate initiative with design and development professionals and end users of geoinformatics results.
Able to assess the business, market and innovative value of planned and implemented geoinformatics systems, as well as their compliance with user and social needs.
Able to understand, plan and implement a quality management system for project-level tasks in the field of geoinformatics.
kkk) **attitude**
He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
Committed to adhering to and adhering to quality requirements.
lll) **autonomy and responsibility**
Independent in thinking and elaborating professional issues and processes.
He / she feels responsibility to meet deadlines. He / she is responsible for the work of his / her own staff and those working with him / her or with him / her (working on a project).
With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.
In the operation of geoinformatics systems, he / she can be assigned development-operational responsibility in accordance with professional competencies.

Responsible for the subject (*name, position, degree*)**: Dr. Pődör Andrea, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
László Gergely Tibor, teaching assistant

Circle of knowledge: **programming**
Credit range *(max. 12 cr.):* **10**
Subjects: 1) **GIS programming,** 2)**Geoinf Programming of GIS systems**

(1.) Name of the **subject**: **GIS programming**	**Credit: 5**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing**: -**	
Location of the subject in the Curriculum (semester number): **1**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

Programming in Python. Creating object-oriented programs. General and GIS algorithms. Basic tools for design programs (e.g., UML class diagram, other UML diagrams) and algorithms (e.g., flowchart, various types of text descriptions). Developing application to solve simple GIS programming tasks using open source modules. Introduction of WKT and GeoJSON formats, and using in programs.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Iványi A. (ed.): Algorithms of Informatics. Vol. 1. Foundations. 2007. mondAT Kiadó.
Iványi A. (ed.): Algorithms of Informatics. Vol. 2. Applications. 2007. mondAT Kiado.
Iványi A. (ed.): Algorithms of Informatics. Vol. 3. Selected topics 2013. Mondat Kft.
Recommended literature:
Peter Wentworth, Jeffrey Elkner,Allen B. Downey and Chris Meyers: How to Think Like a Computer Scientist, Learning with Python 3 (RLE)

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

mmm) knowledge
Software developement for simple gis cases
Spatial algorithms
Spatial formats
Tools of software developement
nnn) abilities
Make simple programs for simple gis cases
Contribution in a software development process
ooo) **attitude**
Open for the gis development
ppp) **autonomy and responsibility**
Estimate the volume of a developing process

Responsible for the subject (*name, position, degree*)**: Dr. Nagy Gábor József, assistant prof., PhD**
Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:** **Dr. Tóth Zoltán, assoc. prof., PhD**

(2.) Name of the **subject**: **Programming of GIS systems**	**Credit: 5**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing: -	
Location of the subject in the Curriculum (semester number): **2**	
Preliminary requirements: GIS programming	

Course description: a concise but informative description of the knowledge to be acquired

The subject is based on the development of specific commercial (e.g. AutoCad MAP-Api) and open source (e.g. QGIS) environments - from the view of GIS, through the data collection, processing, visualization and analysis. We are particularly concerned with the possibilities of automating data collection and mapping. We also look at the algorithmization capabilities of GIS operations in this environments.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Gary Sherman(2014):The PyQGIS Programmer's Guide - Extending QGIS with Python
Kurt Menke (2019): Discover QGIS 3.x A workbook for Classroom or Independent Study
Recommended literature:
AutoDesk Inc(2018):AutoLISP Developer's Guide

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

qqq) knowledge
Comprehensive knowledge of the problem-solving principles, methodology and procedures of the planning, development and operation processes of the geoinformatics field, especially in the following areas: database management, Big Data - data mining, primary and secondary data collection, earth observation, spatial and temporal data analysis, process modeling and simulation, network analysis, 3-dimensional modeling, geovisualization, geostatistical solutions, web geoinformatics services, spatial services development, geoinformatics programming, GIS application development, open source GIS.
Knows and uses spatial data collection technologies, available databases and GIS software, as well as open source and commercial geoinformatics software, cloud-based geoinformatics solutions
Comprehensive knowledge and understanding of the key contexts and concepts in the field of geoinformatics, especially in the following areas: geographic location based data collection technologies, 2- and 3-dimensional GIS modeling, geovisualization, spatial data infrastructures, geoinformatics programming and application development, vector GIS, raster GIS, digital image processing, web GIS solutions, geoinformatics databases, applied GIS systems.
rrr) abilities
Able to create geoinformatics systems to support and assist decision makers.
Able to perform problem solving, planning, development, operation, management and consulting tasks in the operation of GIS systems, decision support systems and expert systems.

Able to initiate initiative with design and development professionals and end users of geoinformatics results
Able to assess the business, market and innovative value of planned and implemented geoinformatics systems, as well as their compliance with user and social needs.
Is able to recognize and apply new problem-solving methods and procedures in his / her field and apply what he / she has learned in a diverse, multidisciplinary environment.
sss) **attitude**
He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
Committed to adhering to and adhering to quality requirements.
ttt) **autonomy and responsibility**
Independent in thinking and elaborating professional issues and processes.
In the operation of geoinformatics systems, he / she can be assigned development-operational responsibility in accordance with professional competencies.

Responsible for the subject (*name, position, degree*)**: Dr. Tóth Zoltán, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Dr. Nagy Gábor József, assistant prof., PhD

Circle of knowledge: **Storage and modeling of spatial data**
Credit range *(max. 12 cr.):* **9**
Subjects: 1) **Spatial databases,** 2) **Digital terrain modeling**

(1.) Name of the **subject**: **Spatial databases**	**Credit: 5**
Subject **classification**: **compulsory**	
The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/42** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing**: -**	
Location of the subject in the Curriculum (semester number): **3**	
Preliminary requirements: Data integration, Data science	

Course description: a concise but informative description of the knowledge to be acquired

Spatial databeses according to the OGC 06-104 standard. (SpatiaLite, PostGIS). Complex spatial queries by SQL. Spatial functions, DE-9IM. Spatial reference systems. Spatial formats: KML, GML, GeoPackage. WMS and WFS services.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
OGC 06-104 („OpenGIS Implementation Specification for Geographic information - Simple feature access - Part 2: SQL option")
OGC 07-36 („OpenGIS Geography Markup Language (GML) Encoding Standard")
Nagy Gábor: Spatial Databases by Open Standards and Software, NymE-GEO, Székesfehérvár, 2010
Recommended literature:
PostGIS manual (http://postgis.net/documentation/)

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

uuu) knowledge
Spatial databases, spatial queries
Spatial data formats
Spatial data services
vvv) abilities
Planning and creating spatial databases
Creating and setting spatial data services
www) **attitude**
Open for the database development
xxx) **autonomy and responsibility**
Choose database solutions

Responsible for the subject (*name, position, degree*)**: Dr. habil. Molnár András, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Dr. Nagy Gábor József, assistant prof., PhD

(2.) Name of the **subject**: **Digital terrain modeling**	**Credit: 4**
Subject **classification**: **compulsory**	
The degree of theoretical or <u>practical</u> nature of the subject, "training character": **50** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **28/28** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: project work	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing**:** **presenting theoretical knowledge with practical examples and repeating the examples as independent work**	
Location of the subject in the Curriculum (semester number): **3**	
Preliminary requirements: Geomatemathics	

Course description: a concise but informative description of the knowledge to be acquired

During the lectures, students will get acquainted with the theoretical background and technologies of digital topography and surface modelling, based on their topographic knowledge, and with the modern data acquisition possibilities that can be used for modelling.
The achievable accuracy of different data acquisition methods will be analysed to evaluate that a certain accuracy in which specific field such as industrial engeneering, field survey. agricultural use, inland water and flood risk management can be applied.
During the practice students will gain knowledge about the usage of open source and commercial software (QGIS, SURFER) in processing low and high resolution data files. The students will learn about the advantages, disadvantages of different model types and also about the derived product such as slope, aspect, hillshade, watershed delmitation.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Reuired literature:
Naser El-Sheimy, Caterina Valeo, Ayman Habib: Digital Terrain Modeling - Acquisition, Manipulation and Applications, 2005 ISBN 1-58053-921-1
Michael J de Smith - Michale F Goodchild – Paul A Lanley: Geospatial Analysis - 6th edition, 2018 - Immediate download. 602 pages, 26Mbytes
Recommended literature:
Geospatial Analysis 6th Edition, 2020 update
https://www.spatialanalysisonline.com/HTML/index.html
https://www.spatialanalysisonline.com/extractv6.pdf

List of the **required professional competencies, competence elements** (*knowledge, ability,* etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

yyy) knowledge
Knows the theory of digital spatial modelling, including the possibilities of modelling irregular surfaces with approximating surfaces.
Aware of the accuracy inherent in each data collection technology.
Knows the individual model types, their advantages and disadvantages.
Aware of the additional digital products and data that can be derived from the models and the information that can be obtained from them.

Knows the professional vocabulary of digital terrain modeling, including the necessary topographic concepts.
Knows the different visualization methods.

zzz) abilities

Able to apply the acquired theoretical knowledge in practice, so:
Select data collection technology that meets the accuracy and other specific needs of the task,
Apply the appropriate model type and produce the model,
Derive additional data from the model, extracting information,
Integrate the model into a complex database,
Support decision-makers in a given field with an adequate presentation of the model from different perspectives,
Collaborate with professionals in the field of design and development and users of digital terrain and surface models.

aaaa) **attitude**

The course is adapted to the needs of the labour market, takes into account the modern technological tools and methods of the field, and is open to feedback and evaluations.
Emphasis on environmentally conscious behaviour in field activities typical of the practical training of digital terrain modeling.
It always encourages professional cooperation that promotes development.
The quality and requirements of the training provided during the course clearly indicate the quality expectations of the field.

bbbb) **autonomy and responsibility**

The geoinformatics specialists are comprehensively able to handle complex engineering tasks and make independent decisions on professional issues.
Suitable for demanding, managerial tasks.
Takes responsibility with staff and professionals in other fields who work with him/her.
They will aspire for innovation in its activities

Responsible for the subject (*name, position, degree*)**: Dr. Pődör Andrea, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Balázsik Valéria, master teacher

Circle of knowledge: **Optional subjects**

Credit range *(max. 12 cr.):* **6 (minimum optional)**

Subjects: 1) **GIS application development,** 2) **Geovisualization,** 3) **Modern GIS instruments,** 4) **Web mapping workshop,** 5) **Digital image processing,** 6) **Rural development in EU,** 7) **Urban analytics,** 8) **Land valuation on the basis of GIS**

(1.) Name of the **subject**: **GIS application development**	**Credit: 3**
Subject **classification**: **optional**	
The degree of theoretical or practical nature of the subject, "training character": **75** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **14/28** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: **online education is possible (Google Classroom)**	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing**: manuals with technical specifications**	
Location of the subject in the Curriculum (semester number): **4**	
Preliminary requirements: Programming of GIS systems	

Course description: a concise but informative description of the knowledge to be acquired

Providing theoretical and practical knowledge to develop thinking in system. To introduce system development as a special form of problem solving. Introduce students to the need for methodicality. Introduce and apply different methods and methodologies of system design. Introduce the design of systems with the help of the available CASE tool. Design and development of geoinformatics processing software through some examples.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:

Effy Oz, Ken Sousa: Management Information Systems, Course Technology (2014), 592 pp., ISBN-13 : 978-1285186139

George Reynolds, Ralph Stair: Fundamentals of Information Systems, Course Technology (2017), 560 pp., ISBN-13 : 978-1337097536

Scott W. Ambler: The Elements of UML™ 2.0 Style, Cambridge University Press (2005), 202 pp., ISBN-13 : 978-0521616782

Recommended literature:

Keri E. Pearlson: Managing and Using Information Systems: A Strategic Approach, Wiley (2019), 368 pp., ISBN-13 : 978-1119560562

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

cccc) knowledge

He/she has knowledge of the specific tools of the geoinformatics field, is able to apply field survey procedures, data management and analysis, and representation solutions.

He/she knows and uses spatial data collection technologies, available databases and GIS software, as well as open source and commercial geoinformatics software, cloud-based geoinformatics solutions.

dddd) abilities
He/she is able to assess the business, market and innovative value of the planned and implemented geoinformatics systems, as well as their compliance with user and social needs.
Ability to recognize and apply new problem-solving methods and procedures in their field and apply what they have learned in a diverse, multidisciplinary environment.
Ability to understand, plan and implement a quality management system for project-level tasks in the field of geoinformatics.
Ability to advise on the operation of geoinformatics applications and to operate such a business.
eeee) **attitude**
He / she monitors professional, technological developments and labor market trends related to photogrammetry. Throughout his / her field and laboratory activities, he / she is committed to environmentally conscious behavior. He / she shares his / her knowledge and considers it important to convey professional results in photogrammetry. He / she is open to professional cooperation with professionals working in related fields. He / she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with the tools of photogrammetry.
ffff) **autonomy and responsibility**
He / she is independent regarding the thinking and elaboration of professional issues and processes in the field of photogrammetry. With his / her geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Responsible for the subject (*name, position, degree*)**: Dr. Nagy Gábor József, assistant prof. PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Dr. habil. Czimber Kornél, assoc. prof., PhD, CSc, DLA

(2.) Name of the **subject**: **Geovisualization**	**Credit: 3**
Subject **classification**: **optional**	
The degree of theoretical or practical nature of the subject, "training character": **60** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **14/28** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: project work	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing**: -**	
Location of the subject in the Curriculum (semester number): **4**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

The aim of the course is that student to understand the definition of geovisualization, to be able to distinguish between different ways of geovisualization.
Identify the characteristics of the geovisualization process and link these characteristics to contemporary's mapping systems and map use.
The students will acquire knowledge in the following domains: use and user issues in geovisualization; Geovisualization, exploration, and insight; Dynamic interface design; Multimedia visualization; Visual perception and cognition, Principles of interaction, Web-based geovisualization platforms.
They will get to know the relevant abilities and skills needed for successful work in the geovisualization environment.
They will be able to

- create visualizations using and combining spatial and non-spatial data;
- analyze and categorize available techniques in terms of quality, efficiency, and suitability for a particular data type,
- understand current issues in design in geovisualization
- analyse and process geodata within a geovisualization context;

Within the framework of the course, students interpret the theoretical material through practical examples with the help of built-in modules of specific commercial (eg ArcGIS, Tableau) and open source (R,) software.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Reuired literature:
Smith, M. J., Hillier, J. K., Otto, J. C., & Geilhausen, M. (2013). Geovisualization. In Treatise on Geomorphology (Vol. 3, pp. 299-325). Elsevier Inc.. https://doi.org/10.1016/B978-0-12-374739-6.00054-3
Dykes, J., MacEachren, A. M., & Kraak, M. J., (Eds.), (2004). Exploring geovisualization. Amsterdam: Elsevier.
Recommended literature:
Dodge, M., McDerby, M., & Turner, M. (Eds.). (2011). Geographic visualization: Concepts, tools and applications. John Wiley & Sons.

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

gggg) knowledge
Knowledge and ability to use geovisualization methods and technologies,

Comprehensive knowledge and understanding of the contexts and concepts of geovisualization
Ability to explore the connections between different data with the help of scientific visualization tools.
Ability to construct a combination of appropriate geovisualization tools that allows lay people to interpret multivariate data as well.
Know the possible applications of different visualization tools, the possibility of misinterpretation due to improper representation.

hhhh) abilities

Ability to create a geovisualisation to support decision-makers.
Ability to perform problem-solving, planning, development, operation, management and consulting tasks with the appropriate application of geovisualization.
Ability to initiate collaboration, project work and group work with experts in co-sciences and other related fields.
Ability to assess the business, market and innovative value of the planned and implemented geovisualization applications, as well as their compliance with a user and social needs.
Ability to recognize and apply new problem-solving methods and procedures in his / her field and apply what he/she has learned in a diverse, multidisciplinary environment.

iiii) **attitude**

Continuous monitoring of the field of geovisualisation to be able to apply new technologies, as well to evaluate the possible application field of its

jjjj) **autonomy and responsibility**

Independence in elaboration and processes in the field of geovisualisation. Applying the proper geovisualisation methods the students will be able to adequately collaborate with other experts

Responsible for the subject (*name, position, degree*)**: Dr. Pődör Andrea, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

Dr. Katona János, assistant prof., PhD

(3.) Name of the **subject**: **Modern GIS instruments**	**Credit: 3**

Subject **classification**: **optional**

The degree of theoretical or practical nature of the subject, "training character": **50** (credit%)

Type of lesson: lec. / prac. and **number of lesson hours**: **14/28** in the given semester,
language: *English)*
Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: use of electronic teaching materials, thematic personalized tasks - project.

Assessment methods (coll. / mg. / **other**): mg.
Additional (*specific*) **methods** to be used in knowledge testing**: -**

Location of the subject in the Curriculum (semester number): **4**

Preliminary requirements: -

Course description: a concise but informative description of the knowledge to be acquired

The instruments, stations and equipment currently used in geodesy use electronic, optical, mechanical and IT solutions, the understanding of which is important for the users of the devices in connection with the applied measurement and calibration tasks and possibilities. Each of these devices has strong embedded IT and info-compliant support.
In connection with optical sensors, we get acquainted with the CCD, CMOS, PIN and LED, LLED light sources, the possibilities of the electronic system, the application criteria, the coincidence principle and the moire phenomenon. We get to know MEMS-based position-, speed- and acceleration sensors, various temperature measurement methods. In the case of actuator-side methods, we learn about the various methods used for position control, such as motors, electrostatic and electrodynamic (MEMS) devices, their possibilities, their control criteria, and their integration into the system. We get to know the principles of position and displacement control, their electronic solutions at the level of block diagrams.
We cover the principles of analog and digital circuits, get to know a specific microcontroller (MC), its elementary (firmware) programming steps, the most commonly used algorithmic, digital solutions.
As an independent field, we introduce the students to the various communication techniques of radio frequency, wired, optics, their application possibilities and limitations.
Within the framework of the course, students can get acquainted with interdisciplinary attitudes (supplemented with physical and optical knowledge where necessary), measurement technology, regulation, control, principles, concepts and solutions, supported by a practical, laboratory environment based on the experience of success.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Selected chapters (drawings, block sketches, diagrams) of;
Dr. György Györök, Számítógép perifériák I. Budapest, Magyarország : Óbudai Egyetem (2013), 254 p., ISBN: 9786155018572
Jörg Haus, Optical Sensors: Basics and Applications, John Wiley & Sons, 2010.
Hartmut Janocha, Actuators: Basics and Applications, Springer, 2013
Han-Way Huang: PIC Microcontroller: An Introduction to Software and Hardware Interfacing, Microchip, 2005
Recommended literature:
Tarmo Anttalainen, Ville Jaaskelainen, Introduction to Communication Networks, Artech House Boston, 2014
Sensor networks subject handout materials (Dr. György Györök).

List of the **required professional competencies, competence elements** (*knowledge, ability,* etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

kkkk) knowledge
Has complex knowledge in the field of general IT principles, rules and relations necessary for the cultivation of the field of geoinformatics.
Comprehensively knows and understands the most important connections in the field of geoinformatics.
Has knowledge of specific tools in the field of geoinformatics.
llll) abilities
Comprehensively knows and understands the most important connections in the field of geoinformatics.
Has knowledge of the specific tools of the field of geoinformatics.
mmmm) **attitude**
He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
He / she shares his / her knowledge and considers it important to communicate professional results in geoinformatics. He / she is open to professional cooperation with professionals working in related fields.
nnnn) **autonomy and responsibility**
With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.
In the operation of geoinformatics systems, he / she can be assigned development-operational responsibility in accordance with professional competencies.

Responsible for the subject (*name, position, degree*)**: Prof. Dr. Györök György, prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
Beszédes Bertalan, teaching assistant

(4.) Name of the **subject**: **Web mapping workshop**	**Credit: 3**
Subject **classification**: **optional**	
The degree of theoretical or practical nature of the subject, "training character": **70** (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: **14/28** in the given semester, **language**: *English)* Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: Web application development	
Assessment methods (coll. / mg. / **other**): mg. **Additional** (*specific*) **methods** to be used in knowledge testing**: -**	
Location of the subject in the Curriculum (semester number): **4**	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

Overview of different web applications. And based on these, create your own application exercises. Learn about ArcGIS Online and the QGIS cloud platform. Creating thematic web maps: Create your own based on Story Maps patterns in geographic, geological, climate change, population, financial, environmental topics. QGIS Online map design, construction.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
Introducing ArcGIS Online, 2012, Esri
QGIS Cloud documentation, 2016, Sourcepole AG
Recommended literature:
Story Maps, 2016, ESRI

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

a) knowledge
Has complex knowledge of general geographic, cartographic, planning, mathematical and IT principles, rules, contexts required for cultivating the field of geoinformatics, especially in the following topics: geographical, spatial data collection, use of cartographic procedures, knowledge of geographical and spatial processes, collection, editing and analysis of spatial data, remote sensing, photogrammetry, geostatistics, modeling, visualization, geoinformatics system construction.

b) abilities
Able to interpret geographic / spatial phenomena, processes and information, and to plan, organize, manage and control processes in the geoinformatics field.
He / she is able to collect data independently and organize spatial data into a database, as well as to organize the data with the tools of geoinformatics. Able to perform operations and create models with independently organized databases.

c) **attitude**
He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
Committed to adhering to and adhering to quality requirements.

d) **autonomy and responsibility**
Independent in thinking and elaborating professional issues and processes.
He / she feels responsibility to meet deadlines. He / she is responsible for the work of his / her own staff and those working with him / her or with him / her (working on a project).

With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.
In the operation of geoinformatics systems, he / she can be assigned development-operational responsibility in accordance with professional competencies.

Responsible for the subject (*name, position, degree*)**: Dr. Pődör Andrea, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**
László Gergely Tibor, teaching assistant

(5.) Name of the **subject**: **Digital image processing**	**Credit:3**
Subject **classification**: **optional**	
The degree of theoretical or practical nature of the subject, "training character": 60 (credit%)	
Type of lesson: lec. / prac. and **number of lesson hours**: 14/28 in the given semester, **language**: English Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: -	
Assessment methods (coll. / mg. / **other**): coll. **Additional** (*specific*) **methods** to be used in knowledge testing**:** -	
Location of the subject in the Curriculum (semester number): 4	
Preliminary requirements: -	

Course description: a concise but informative description of the knowledge to be acquired

The aim of the course is to acquaint students with the basics and methods of digital image processing. During the course, students will get an overview of the following topics: digital (commercial and open source) image processing programs and software packages, using OpenCV, digital image properties, compression methods, histogram generation, histogram transformations, calculation of image properties and its parameters, image filtering procedures, geometric transformations , interpolation methods, shape detection, segmentation, automated recognition of characteristic points, edges, shapes, image correlation.
Through application examples, state-of-the-art technologies for image processing products and evaluation methods are presented in a project-based manner.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Required literature:
R.C. Gonzales, R.E. Woods: Digital Image Processing, Pearson; 4th Edition (2017), ISBN-13 : 978-0133356724
Recommended literature:
Chris Solomon: Fundamentals of Digital Image Processing, John Wiley & Sons (2010), ISBN: 0470844736

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

a) knowledge
Complex knowledge in the following areas: digital image processing.
Comprehensive knowledge of the methodology and procedures of digital image processing.
In his/her native language, he/she confidently uses the conceptual framework and terminology describing digital image processing and can adapt it to the conceptual framework of geoinformatics.

b) **abilities**
He/she will be able to combine complex professional problems in the field of geoinformatics with digital image processing methods.
He/she is able to recognize and apply new problem-solving methods and procedures in his / her field and apply what he / she has learned in a diverse, multidisciplinary environment.

c) **attitude**

He/she monitors professional and technological developments related to digital image processing. Throughout his/her field and laboratory activities, he/she is committed to environmentally conscious behavior. He/she shares his knowledge and considers it important to communicate the professional results

of digital image processing. It is open to professional cooperation with professionals working in related fields. He considers it important to mediate environmentally conscious behavior and to support sustainable development.

d) **autonomy and responsibility**

He / she is independent regarding the thinking and elaboration of professional issues and processes in the field of image processing. With his / her geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Responsible for the subject (*name, position, degree*)**: Dr. habil Jancsó Tamás, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

(7.) Name of the **subject**: **Urban Analytics**	**Credit: 3**

Subject **classification**:

The degree of theoretical or practical nature of the subject, "training character": 50 (credit%)

Type of lesson: lec. / prac. . and **number of lesson hours**: **14/28** in the given semester,

language: *English*

Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: **project work.**

Assessment methods (coll. / mg. / **other**): coll.

Additional (*specific*) **methods** to be used in knowledge testing**:** -

Location of the subject in the Curriculum (semester number): 4

Preliminary requirements :Geostatistics

Course description: a concise but informative description of the knowledge to be acquired

The aim of the course is to intorduce Urban Analytics to students. Cities and urbanization are playing an increasingly important role in the life of the mankind, so special GIS solutions related to this field are essential for students getting job at the labour market.
For understanding cities better , it is necessary to interpret contemporary data sets in the given area, using different statistical and IT knowledge to process the data properly.
The student will gain a comprehensive knowledge of the special areas of urban GIS:
They get acquainted with sensor networks, processing and analyzing the data obtained from them. One of the main task is to properly understand and acquire data the integration of like weather, population statistics etc. Students will design and implement crowdsourcing procedures.They will examine the quality and reliability of the data obtained with crowdsourcing, compare them with official data, Analyze the possibilities of data integration. The main task of the students will be to integrate the official data of a sample area and the data obtained through community data acquisition and to analyze them with the most accepted methods of spatial statistics.
Within the course, built-in modules of specific commercial (eg ArcGIS) and open source (GeoDA, R,) software are used.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

Reuired literature:
. Singleton, Alex, Spielman, Seth E., Folch, David C. 2018. Urban Analytics. Thousand Oaks, CA: SAGE Publications Ltd.
Recommended literature:
Ripley, B.D., 1981. Spatial statistics. John Wiley & Sons, New York.

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

a) knowledge

-Students will know and use urban analytics methods and technologies, available databases and GIS software, and open source and commercial geoinformatics software.
- They will have comprehensive knowledge and understanding of the most important contexts and concepts in the field of urban analytics.
- They will be able to properly interpret and evaluate the results obtained during GIS analyzes.
-They understand the requirements for planning field data collection and sampling.
- They will confidently use the concept and terminology of urban analytics and can adapt it to the concept of geoinformatics.

b) **abilities**

- They will be able to create analyzes to support and assist decision-makers.
- They will be able to perform problem-solving, planning, development, operation, management and consulting tasks with the proper interpretation of the results of urban analytics.
- They will be able to initiate collaboration, project work and group work with experts in other related fields.
- They will be able to assess the business, market and innovative value of the planned and implemented geoinformatics systems, as well as their compliance with a user and social needs.
- They will be able to recognize and apply new problem-solving methods and procedures in their field and apply what they have learned in a diverse, multidisciplinary environment.

c**) attitudes**

They will pay attention to professional, technological developments and labour market trends related to urban analytics. Throughout their field and laboratory activities, they are committed to environmentally friendly behaviour. They will share their knowledge and consider it's important to transmit professional results. They will be open to professional cooperation with professionals working in related fields.

c) autonomy and responsibilities abilities

Using the methods of urban analytics, the students collaborate responsibly with professionals in other fields. They will be able autonomously to evaluate questions and processes in the field of urban analytics.

Responsible for the subject (*name, position, degree*)**: Dr. Andrea Pődör, assoc. prof., PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**

(8.) Name of the **subject**: **Land valuation on the basis of GIS**	**Credit: 3**

Subject **classification**: **compulsory**

The degree of theoretical or <u>practical</u> nature of the subject, "training character": 67% (credit%)

Type of lesson: lec. / prac. and **number of lesson hours**: **14 / 28** in the given semester,
language: *english*
Additional (*specific*) **ways** and **characteristics** to be used in the transfer of the given knowledge: **thematic presentations**

Assessment methods (coll. / mg. / **other**): interim report
Additional (*specific*) **methods** to be used in knowledge testing **:** **topic elaboration**

Location of the subject in the Curriculum (semester number): **4**

Preliminary requirements: -

Course description: a concise but informative description of the knowledge to be acquired

Presentation of the peculiarities of the agricultural land market. Possible objectives of land valuation. Methods of land valuation. Description of the requirements of international standards. Content and form requirements of the expert opinion. Evaluation of arable land by market comparison. Land valuation with yield calculation. Analysis of value-modifying factors on the basis of GIS: shape, form, area size, location, location, accessibility, road conditions, topography and slope conditions, order of waterways, objects inhibiting cultivation, probability of frost, ice, game damage, irrigation, irrigation, irrigation subsistence income conditions, demographic conditions, natural protection of land. Generate a value map. At the end of the course, the student must independently evaluate a farmland property, prepare an expert opinion, and finally present it.

List of the **2-5** most important *required* or *recommended* **literature** (notes, textbooks) with bibliographic data (author, title, publication data, (possibly pages), ISBN)

required literature:
European Valuation Standards (EVS)
RICS Értékbecslési Szabványok (Royal Institution of Chartered Surveyors 2010)
International Valuation Standards (IVS)
recommended literature:
G. Thrall, GIS Applications in Real Estate and Related Industries, Business Journal of Housing Research 2010
Sesli, F. A., Creating real estate maps by using GIS: A case study of Atakum-Samsun/Turkey. Acta Montanistica Slovaca, 20(4), 1-12., 2015

List of the **required professional competencies, competence elements** (*knowledge, ability*, etc., *KKK point 8*), **to the development of which the subject typically contributes substantially**

e) knowledge
- Has complex knowledge of general geographic, cartographic, planning, mathematical and IT principles, rules, contexts required for cultivating the field of geoinformatics, especially in the following topics: knowledge of geographical and spatial processes, collection, editing and analysis of spatial data, geostatistics, modeling, visualization, geoinformatics system construction.
- Comprehensive knowledge and understanding of the key contexts and concepts in the field of geoinformatics, especially in the following areas: vector GIS, geoinformatics databases, applied GIS systems.

f) **abilities**
- Able to interpret complex professional problems in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve problems.

- Able to interpret geographic / spatial phenomena, processes and information, and to plan, organize, manage and control processes in the geoinformatics field.
- Able to understand, plan and implement a quality management system for project-level tasks in the field of geoinformatics.
- Able to create geoinformatics systems to support and assist decision makers.

g) attitude
- He / she accepts and adheres to the ethical principles of work and organizational culture with his / her colleagues, especially with regard to the copyright environment related to GIS.
- He / she shares his / her knowledge and considers it important to communicate professional results in geoinformatics. He / she is open to professional cooperation with professionals working in related fields.

h) autonomy and responsibility
- Independent in thinking and elaborating professional issues and processes.
- With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Responsible for the subject (*name, position, degree*)**: Dr. Katona János, assistant professor, PhD**

Teacher (s) involved in the teaching of the subject, if any (*name, position, degree*)**:**