**University of Debrecen**
**Faculty of Science and Technology**
**Institute of Earth Sciences**

# EARTH SCIENCES BSC PROGRAM

**2021**

# TABLE OF CONTENTS

# DEAN`S WELCOME

Welcome to the Faculty of Science and Technology!

This is an exciting time for you, and I encourage you to take advantage of all that the Faculty of Science and Technology UD offers you during your bachelor's or master's studies. I hope that your time here will be both academically productive and personally rewarding

Being a regional centre for research, development and innovation, our Faculty has always regarded training highly qualified professionals as a priority. Since the establishment of the Faculty in 1949, we have traditionally been teaching and working in all aspects of Science and have been preparing students for the challenges of teaching. Our internationally renowned research teams guarantee that all students gain a high quality of expertise and knowledge. Students can also take part in research and development work, guided by professors with vast international experience.

While proud of our traditions, we seek continuous improvement, keeping in tune with the challenges of the modern age. To meet our region's demand for professionals, we offer engineering courses with a strong scientific basis, thus expanding our training spectrum in the field of technology. Recently, we successfully re-introduced dual training programmes in our constantly evolving engineering courses.

We are committed to providing our students with valuable knowledge and professional work experience, so that they can enter the job market with competitive degrees. To ensure this, we maintain a close relationship with the most important companies in our extended region. The basis for our network of industrial relationships are in our off-site departments at various different companies, through which market participants - future employers - are also included in the development and training of our students.

Prof. dr. Ferenc Kun
Dean

## UNIVERSITY OF DEBRECEN

**Date of foundation**: 1912 Hungarian Royal University of Sciences, 2000 University of Debrecen

**Legal predecessors**: Debrecen University of Agricultural Sciences; Debrecen Medical University; Wargha István College of Education, Hajdúböszörmény; Kossuth Lajos University of Arts and Sciences

**Number of Faculties at the University of Debrecen**: 14

Faculty of Agricultural and Food Sciences and Environmental Management

Faculty of Child and Special Needs Education

Faculty of Dentistry

Faculty of Economics and Business

Faculty of Engineering

Faculty of Health

Faculty of Humanities

Faculty of Informatics

Faculty of Law

Faculty of Medicine

Faculty of Music

Faculty of Pharmacy

Faculty of Public Health

Faculty of Science and Technology

**Number of students at the University of Debrecen**: 29,405

**Full time teachers of the University of Debrecen:** 1,541

200 full university professors and 1,205 lecturers with a PhD.

# FACULTY OF SCIENCE AND TECHNOLOGY

The Faculty of Science and Technology is currently one of the largest faculties of the University of Debrecen with about 3000 students and more than 200 staff members. The Faculty has got 6 institutes: Institute of Biology and Ecology, Institute of Biotechnology, Institute of Chemistry, Institute of Earth Sciences, Institute of Physics and Institute of Mathematics. The Faculty has a very wide scope of education dominated by science and technology (10 Bachelor programs and 12 Master programs), additionally it has a significant variety of teachers' training programs. Our teaching activities are based on a strong academic and industrial background, where highly qualified teachers with a scientific degree involve student in research and development projects as part of their curriculum. We are proud of our scientific excellence and of the application-oriented teaching programs with a strong industrial support. The number of international students of our faculty is continuously growing (currently 649 students). The attractiveness of our education is indicated by the popularity of the Faculty in terms of incoming Erasmus students, as well.

## THE ORGANIZATIONAL STRUCTURE OF THE FACULTY

Dean: Prof. Dr. Ferenc Kun, Full Professor
E-mail: ttkdekan@science.unideb.hu

Vice Dean for Educational Affairs: Prof. Dr. Gábor Kozma, Full Professor
E-mail: kozma.gabor@science.unideb.hu

Vice Dean for Scientific Affairs: Prof. Dr. Sándor Kéki, Full Professor
E-mail: keki.sandor@science.unideb.hu

Consultant on External Relationships: Prof. Dr. Attila Bérczes, Full Professor
E-mail: berczesa@science.unideb.hu

Dean's Office
Head of Dean's Office: Ms. Katalin Tóth
E-mail: toth.katalin@science.unideb.hu

English Program Officer: Mr. Imre Varga – Applied Mathematics (MSc), Chemical Engineering (BSc/MSc), Chemistry (BSc/MSc), Earth Sciences (BSc), Electrical Engineering (BSc), Geography (BSc/MSc), Mathematics (BSc), Physics (BSc), Physicist (MSc), International Foundation Year, Intensive Foundation Semester
Address: 4032 Egyetem tér 1., Chemistry Building, A/101
E-mail: vargaimre@unideb.hu

English Program Officer: Mrs. Szilvia Gyulainé Szemerédi – Biochemical Engineering (BSc), Biology (BSc/MSc), Envirionmental Science (MSc), Hidrobiology Water Quality Management (MSc)
Address: 4032 Egyetem tér 1., Chemistry Building, A/104
E-mail: szemeredi.szilvia@science.unideb.hu

# DEPARTMENTS OF INSTITUTE OF EARTH SCIENCES

**Department of Meteorology** (home page: https://meteo.unideb.hu)
**4032 Debrecen, Egyetem tér 1, Geomathematics Building**

| Name | Position | E-mail | room |
|---|---|---|---|
| Mr. Dr. Sándor Szegedi, PhD, habil | Associate Professor, Head of Department | szegedi.sandor@science.unideb.hu | 126 |
| Mr. Dr. István Lázár, PhD | Assistant Professor | lazar.istvan@science.unideb.hu | 128 |
| Mr. Dr. Tamás Tóth, PhD | Assistant Professor | toth.tamas@science.unideb.hu | 127 |
| Mr. Dr. Ferenc Wantuch, PhD | Assistant Professor | wantuch.ferenc@nkh.gov.hu | 127 |

**Department of Mineralogy and Geology** (home page: https://zafir.min.unideb.hu)
**4032 Debrecen, Egyetem tér 1, Chemistry Building**

| Name | Position | E-mail | room |
|---|---|---|---|
| Mr. Zsolt Benkó, PhD, habil | Associate Professor, Head of Department | benko.zsolt@atomki.hu | A/25 |
| Mr. Dr Péter Rózsa, PhD, habil | Associate Professor, | rozsa.peter@science.unideb.hu | A/7 |
| Mr. Prof. Dr. Gábor Dobosi, PhD, habil, DSc | University Professor | gabor.dobosi@gmail.com | A/4 |
| Mr. Dr. Tamás Buday, PhD | Assistant Professor | buday.tamas@science.unideb.hu | A/4 |
| Mr. Dr. Árpád Csámer, PhD | Assistant Professor | csamera@unideb.hu | A/6 |
| Mr. Dr. Richard William McIntosh, PhD | Assistant Professor | mcintosh.richard@science.unideb.hu | A/5 |
| Mr. Dr. Attila Virág, PhD | Assistant Professor | viragattila.pal@gmail.com | E/25 |
| Mr. István Simon | Technical Assistant | simon.istvan@science.unideb.hu | A/9 |
| Ms. Judit Vanka | Technical Assistant | vanka.judit@science.unideb.hu | A/8 |

**Department of Landscape Protection and Environmental Geography** (home page: https://tajvedelem.unideb.hu)
**4032 Debrecen, Egyetem tér 1, Geomathematics Building**

| Name | Position | E-mail | room |
|---|---|---|---|
| Mr. Dr. György Szabó, PhD, habil | Associate Professor, Head of Department | szabo.gyorgy@science.unideb.hu | 218 |
| Mr. Prof. Dr. Péter Csorba, PhD, habil, DSc | University Professor | csorba.peter@science.unideb.hu | 217 |
| Mr. Prof. Dr. Attila Kerényi, PhD, habil, DSc | Professor Emeritus | kerenyi.attila@science.unideb.hu | 216 |
| Mr. Dr. Tibor Novák, PhD, habil | Associate Professor | novak.tibor@science.unideb.hu | 221 |
| Mr. Dr. István Fazekas, PhD | Assistant Professor | fazekas.istvan@science.unideb.hu | 219 |
| Mr. Tamás Mester | Assistant Lecturer | mester.tamas@science.unideb.hu | 220 |
| Mrs. Réka Molnárné Bodnár | Assistant Lecturer | bodnar.reka@science.unideb.hu | 220 |
| Mrs. Dr. Borbála Halasi-Kovácsné Benkhard, PhD | Assistant Lecturer | benkhard.borbala@science.unideb.hu | 220 |
| Mrs. Erika Inczefi | Secretary | inczefi.gezane@science.unideb.hu | 216 |

**Department of Social Geography and Regional Development Planning** (home page: https://human.geo.science.unideb.hu)
**4032 Debrecen, Egyetem tér 1, Geomathematics Building**

| Name | Position | E-mail | room |
|---|---|---|---|
| Mr. Prof. Dr. Gábor Kozma, PhD, habil, DSc | University Professor, Head of Department | kozma.gabor@science.unideb.hu | 123 |
| Mr. Dr. János Pénzes, PhD, habil | Associate Professor | penzes.janos@science.unideb.hu | 118 |
| Mr. Dr. Károly Teperics, PhD, habil | Associate Professor | teperics.karoly@science.unideb.hu | 119 |
| Mr. Dr. Ernő Molnár, PhD | Assistant Professor | molnar.erno@science.unideb.hu | 118 |
| Mr. Dr. István Pásztor, PhD | Assistant Professor | pasztor.istvan@kossuth-gimnazium.unideb.hu | 116 |
| Mr. Dr. Zsolt Radics, PhD | Assistant Professor | radics.zsolt@science.unideb.hu | 119 |
| Mrs. Dr. Klára Szilágyiné Czimre | Assistant Professor | czimre.klara@science.unideb.hu | 120 |
| Mr. Gábor Németh | Informatician | nemeth.gabor@science.unideb.hu | 120 |

**Department of Physical Geography and Geoinformatics** (home page: https://geogis.unideb.hu)
**4032 Debrecen, Egyetem tér 1, Geomathematics Building**

| Name | Position | E-mail | room |
|---|---|---|---|
| Mr. Prof. Dr. Szilárd Szabó, PhD, habil, DSc | University Professor, Head of Department Head of Institute | szabo.szilard@science.unideb.hu | 223 |
| Mr. Prof. Dr. József Lóki, PhD, habil, DSc | Professor Emeritus | loki.jozsef@science.unideb.hu | 226 |
| Mr. Prof. Dr. József Szabó, PhD, habil, DSc | Professor Emeritus | | |
| Mrs. Dr. Boglárka Bertalanné Balázs, PhD | Assistant Professor | balazs.boglarka@science.unideb.hu | 222 |
| Mr. Dr. Gábor Négyesi, PhD | Assistant Professor | negyesi.gabor@science.unideb.hu | 227 |
| Mr. Dr. Gergely Szabó, PhD | Assistant Professor | szabo.gergely@science.unideb.hu | 222 |
| Mr. Dr. Zoltán Krisztián Túri, PhD | Assistant Professor | turi.zoltan@science.unideb.hu | 228 |
| Mr. Dr. László Bertalan | Assistant Lecturer | bertalan@science.unideb.hu | 227 |
| Mr. Lóránd Szabó | Research Lecturer | szabo.lorand@science.unideb.hu | 202 |
| Mrs. Krisztina Sósné Mező | Technical Assistant | mezo.krisztina@science.unideb.hu | A/P-6 |
| Ms. Csilla Tóth | Technical Assistant | toth.csilla@science.unideb.hu | A/P-6* |
| Mrs. Zsuzsanna Csatári-Szabó | Research Lecturer | szabo.zsuzsanna@science.unideb.hu | 227 |
| Ms. Oktávia Szabó | Secretary | szabo.oktavia@science.unideb.hu | 224 |
| | | | |

*** -** Chemistry Building

# ACADEMIC CALENDAR

General structure of the academic semester (2 semesters/year):

| | | | |
|---|---|---|---|
| Study period | 1st week | Registration* | 1 week |
| | 2nd – 15th week | Teaching period | 14 weeks |
| Exam period | directly after the study period | Exams | 7 weeks |

*Usually, registration is scheduled for the first week of September in the fall semester, and for the first week of February in the spring semester.

For further information please check the following link:

https://www.edu.unideb.hu/tartalom/downloads/University_Calendars_2021_22/University_calendar_2021-2022-Faculty_of_Science_and_Technology.pdf?_ga=2.196279020.1315409739.1629100510-488342717.1574682820

# EARTH SCIENCES BACHELOR PROGRAM

## Information about the Program

| | |
|---|---|
| Name of BSc Program: | Earth Sciences BSc Program |
| Specialization available: | Geology, Meteorology |
| Field, branch: | Science |
| Qualification: | Earth Scientist |
| Mode of attendance: | Full-time |
| Faculty, Institute: | Faculty of Science and Technology<br>Institute of Earth Sciences |
| Program coordinator: | Dr. Péter Rózsa, Associate Professor |
| Duration: | 6 semesters |
| ECTS Credits: | 180 |

**Objectives of the BSc program:**

The fields of earth sciences study the composition, 5 billion years history, material and energy flows and transformations, utilizable raw materials and hazardous phenomena of Earth as a material evolutionary system with specific and unique endowments. Methods and results of physics, chemistry, biology, mathematics, and geography are used for the above. Earth scientists help in understanding long- and short-term global and regional natural processes and changes. Numerous applied fields of earth sciences (raw material exploration, volcanology, seismology, water base protection, weather forecast, alternative and renewable energy resources, etc.) determine basically our everyday life, technical civilization and relationship with the natural environment.

Hopefully our students have a true interest in natural sciences and would like to learn systems thinking, modelling, utilization and protection of the marvellously complex natural environment.

Our primary aim is to make our students successful in further education as MSc students either in Hungary or abroad and finally become geologists and meteorologists. Not least, we hope that our students will be successful in life with their obtained professional knowledge and skills.

**Professional competences to be acquired**

**An Earth scientist:**

**a) Knowledge:**

- He/she knows the primary relations and laws of earth sciences and the associated simple mathematic and informatic procedures.
- He/she knows the most important theories and models of earth sciences verified on the basis of scientific results.
- He/she knows the potential directions and limits of the development of his/her scientific field.
- He/she has the basics of natural sciences and the knowledge of the elements of practice based on them and is able to systemize them.
- He/she knows and applies field, laboratory and practice material, equipment and methods with which he/she is able to perform his/her professional tasks.
- He/she has the knowledge required to solve practical earth scientific problems related to natural processes, natural resources, organic and inorganic systems.
- He/she knows the most important terminology and nomenclature of natural processes.

**b) Abilities:**

- He/she is able to identify the problems of his/her professional field.
- He/she is able to apply earth scientific theories, paradigms and principles in practice in the course of which he/she applies the field, laboratory and practical materials, tools and methods with which he/she is able to perform profession at a basic level.
- Based on obtained knowledge in his/her profession, he/she is able to evaluate, interpret and document measurement results.
- He/she understands the processes, networks, scientific problems to be studied that are tested by appropriate methods accepted in scientific practice.
- He/she is able to plot measurement results on a map and to their geoinformatic visualization, to create databases for spatial and relational data, to operate and to analyse databases using statistical methods and earth scientific tools.
- Based on his/her knowledge, he/she can argue on the basis of natural scientific grounds.
- He/she is able to understand natural (primarily earth scientific) and associated anthropogenic processes, related data acquisition, processing the data and using the literature required for the processing.
- He/she is able to apply regularities related to natural and associated anthropogenic processes, and to – as a result of a complex approach – identify problems triggered by the interrelationship between nature and society and to outline them for decision makers.
- He/she is able to perform sub-tasks of research projects, carry out laboratory and field measurements.

**c) Attitude:**

- He/she controls and evaluates realistically the results of his/her work.
- He/she aims to understand the relationship between nature and mankind.
- He/she acts in an environmentally responsible manner in field and laboratory activities.
- He/she is open to professional discussion.
- He/she is open to professional cooperation with experts working in the fields of social politics, economy and environmental protection.
- He/she knows the example of the disputant and incredulous natural scientist.
- He/she understands the significance and consequences of scientific statements.
- He/she authentically represents the natural scientific view of the world and is able to transfer it for the professional and non-professional public.

- He/she is open to further education in both natural sciences and non-natural sciences.
- He/she is committed to learn new competencies, to increase knowledge of concepts and the professional field.

**d) Autonomy and responsibility:**
- He/she is able to consider basic professional problems independently and is able to answer on the basis of given sources.
- He/she responsibly accepts the natural scientific view of the world.
- He/she is responsible for cooperating with experts of other scientific fields.
- He/she deliberately accepts the ethical norms of his/her profession.
- He/she evaluates the results of his/her own work realistically and with responsibility.
- He/she independently operates the field and/or laboratory equipment used in research in his/her scientific field.
- He/she works unaided at national and international observation and forecasting services and authorities as employee in the area of earth sciences.
- He/she carries out coordination tasks independently in environmental scientific, resource research, environmental and nature protection positions.

# Completion of the BSc Program

*The Credit System*

Majors in the Hungarian Education System have generally been instituted and ruled by the Act of Parliament under the Higher Education Act. The higher education system meets the qualifications of the Bologna Process that defines the qualifications in terms of learning outcomes: statements of what students know and can do on completing their degrees. In describing the cycles, the framework uses the European Credit Transfer and Accumulation System (ECTS).
ECTS was developed as an instrument of improving academic recognition throughout the European Universities by means of effective and general mechanisms. ECTS serves as a model of academic recognition, as it provides greater transparency of study programs and student achievement. ECTS in no way regulates the content, structure and/or equivalence of study programs.
Regarding each major the Higher Education Act prescribes which professional fields define a certain training program. It contains the proportion of the subject groups: natural sciences, economics and humanities, subject-related subjects and differentiated field-specific subjects.

During the program students have to complete a total amount of 180 credit points. It means approximately 30 credits per semester. The curriculum contains the list of subjects (with credit points) and the recommended order of completing subjects which takes into account the prerequisite(s) of each subject. You can find the recommended list of subjects/semesters in chapter "Model Curriculum of Earth Sciences BSc Program".

Model Curriculum of Earth Sciences BSc Program

| | semesters | | | | | | | | ECTS credit points | evaluation |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1. | 2. | 3. | 4. | 5. | 6. | | | | |
| | contact hours, types of teaching (l – lecture, p – practice), credit points (cr) | | | | | | | | | |
| **Natural sciences basics I subject group** | | | | | | | | | | |
| 1. Fundamentals of mathematics 1 *Zoltán Muzsnay* | 28 l / 3cr. 28 p / 2cr. | | | | | | | | 5 | exam and mid-semester grade |
| 2. Fundamentals of mathematics 2 *Zoltán Muzsnay* | | 28 p /2cr. | | | | | | | 2 | mid-semester grade |
| 3. Fundamentals of informatics *László Bertalan* | 28 p / 2cr. | | | | | | | | 2 | mid-semester grade |
| **Natural sciences basics II subject group** | | | | | | | | | | |
| 4. Fundamentals of physics I *Balázs Ujvári* | 28 l, 14 p / 4cr. | | | | | | | | 4 | exam |
| 5. Fundamentals of physics II *Balázs Ujvári* | | 28 l, 14 p / 4cr. | | | | | | | 4 | mid-semester grade |
| 6. Meteorology in everyday life *Sándor Szegedi* | 14 l, 14 p / 2cr. | | | | | | | | 2 | mid-semester grade |
| **Natural sciences basics III subject group** | | | | | | | | | | |
| 7. Introduction to chemistry I *Katalin Várnagy* | | 28 l / 2cr | | | | | | | 3 | exam |
| 8. Introduction to chemistry I – practice *Linda Bíró* | | 28 l / 2cr | | | | | | | 2 | mid-semester grade |
| 9. Fundamental biology *Ibolya Revák-Markóczi* | 14 l / 1cr | | | | | | | | 1 | exam |
| 10. Basics of ecology *Péter Török* | 28 l / 3cr | | | | | | | | 3 | exam |
| 11. Basic environmental science *Sándor Alex Nagy* | 14 l / 1cr | | | | | | | | 1 | exam |
| 12. History and Structure of European Union *Klára Szilágyi-Czimre* | 14 l / 1cr | | | | | | | | 1 | exam |
| **Mineralogy-petrology and hydrogeology subject group** | | | | | | | | | | |
| 13. Mineralogy and petrology I *Péter Rózsa* | 28 l / 3cr | | | | | | | | 3 | exam |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 14. Mineralogy and petrology I – practice *Tamás Buday* | 28 p / 2cr | | | | | | | | 2 | mid-semester grade |
| 15. Mineralogy and petrology II *Péter Rózsa* | | 28 p / 2cr | | | | | | | 2 | mid-semester grade |
| 16. Hydrology and hydrogeology *Tamás Buday* | | | | 28 l / 3cr, 28 p / 2cr | | | | | 5 | exam and mid-semester grade |
| **Meteorology and astronomy subject group** | | | | | | | | | | |
| 17. Meteorology and climatology I *Sándor Szegedi* | 28 l / 3cr | | | | | | | | 3 | exam |
| 18. Meteorology and climatology II *Sándor Szegedi* | | 14 l / 1cr, 28 p / 2cr | | | | | | | 3 | exam and mid-semester grade |
| 19. The cosmic relations of the Earth *Gergely Szabó* | 28 l / 3cr | | | | | | | | 3 | exam |
| **Physical geography I subject group** | | | | | | | | | | |
| 20. Structural geology I *Richard William McIntosh* | | | 28 p / 2cr | | | | | | 2 | mid-semester grade |
| 21. Fundamentals of physical geography I *Szilárd Szabó* | | 28 l / 3cr | | | | | | | 3 | exam |
| 22. Fundamentals of physical geography II *József Lóki* | | | 28 l / 3cr | | | | | | 3 | exam |
| 23. Fundamentals of physical geography III *József Lóki* | | | | 14 l / 1cr, 28 p / 2cr | | | | | 3 | mid-semester grade |
| **Physical geography II subject group** | | | | | | | | | | |
| 24. Soil geography *Tibor Novák* | | 28 l / 3cr | | | | | | | 3 | exam |
| 25. Soil geography practice *György Szabó* | | 28 p / 2cr | | | | | | | 2 | mid-semester grade |
| 26. Biogeography *György Szabó* | | | 28 l / 3cr | | | | | | 3 | exam |
| 27. General environmental protection *György Szabó* | | 28 l / 3cr | | | | | | | 3 | exam |
| **Physical geology, regional earth sciences and mapping subject group** | | | | | | | | | | |
| 28. Physical and historical geology *Attila Virág* | | 28 l / 3cr | | | | | | | 3 | exam |
| 29. Climatology of Hungary *Sándor Szegedi* | | | | 42 l / 3cr | | | | | 3 | exam |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 30. Geological mapping *Richard William McIntosh* | | | | 28 p / 2cr | | | | | 2 | mid-semester grade |
| 31. Cartography *József Lóki* | | | 28 l, 28 p / 5cr | | | | | | 5 | exam |
| 32. Digital terrain modelling *Gábor Négyesi* | | | | | 28 p / 2cr | | | | 2 | mid-semester grade |
| **Renewable energy resources subject group** | | | | | | | | | | |
| 33. Geothermics *Tamás Buday* | | | | 28 l / 3cr | | | | | 3 | exam |
| 34. Calculations in hydrodynamics and geothermics *Tamás Buday* | | | | | 28 p / 3cr | | | | 3 | mid-semester grade |
| 35. Atmospheric energy sources *István Lázár* | | | 28 l / 3cr | | | | | | 3 | exam |
| 36. Atmospheric energy sources practice *István Lázár* | | | | 28 p / 2cr | | | | | 2 | mid-semester grade |
| Earth sciences fieldwork *Richard William McIntosh* | | 4 days | | | | | | | 4 | mid-semester grade |
| Thesis I | | | | | 5 cr | | | | 5 | mid-semester grade |
| Thesis II | | | | | | 5 cr | | | 5 | mid-semester grade |
| **Optional courses** | | | | | | | | | | |
| Optional courses | | | | | | | | | 9 | |
| ***GEOLOGY SPECIALIZATION*** | | | | | | | | | | |
| **Geophysics and palaeontology informatics subject group** | | | | | | | | | | |
| 1. Methods in geophysics *Tamás Buday* | | | 28 l / 3cr | | | | | | 3 | exam |
| 2. Geophysical data and geological interpretation *Tamás Buday* | | | | | | 28 p / 2cr | | | 2 | mid-semester grade |
| 3. Structural geology II *Richard William McIntosh* | | | | | 14 p / 1cr | | | | 1 | mid-semester grade |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4. Palaeontology I *Attila Virág* | | | | 28 l / 3cr | | | | | 3 | exam |
| 5. Palaeontology II – practice *Attila Virág* | | | | | 28 p / 2cr | | | | 2 | mid-semester grade |
| **Applied geology subject group** | | | | | | | | | | |
| 6. Sedimentology *Árpád Csámer* | | | 28 p / 2cr | | | | | | 2 | mid-semester grade |
| 7. Environmental geology *Árpád Csámer* | | | | | 28 l / 3cr | | | | 3 | exam |
| 8. Applied geology *Árpád Csámer* | | | | | | 28 l, 14 p / 4cr | | | 4 | exam |
| 9. Geological planning and modelling *Árpád Csámer* | | | | | | 28 p / 2cr | | | 2 | mid-semester grade |
| 10. Astrogeology and cosmo-petrography *Árpád Csámer* | | | | | | 28 p / 2cr | | | 2 | mid-semester grade |
| **Geochemistry, mineralogy subject group** | | | | | | | | | | |
| 11. Geochemistry *Zsolt Benkó* | | | | 28 l / 3cr | | | | | 3 | exam |
| 12. Analytical methods in geology *Zsolt Benkó* | | | 42 p / 3cr | | | | | | 3 | mid-semester grade |
| 13. Systematic mineralogy *Zsolt Benkó* | | | | | | 28 p / 2cr | | | 2 | mid-semester grade |
| 14. Rock microscopy *Péter Rózsa* | | | | 28 p / 2cr | | | | | 2 | mid-semester grade |
| 15. Volcanology and petrology *Árpád Csámer* | | | | | | 28 l / 3cr | | | 3 | exam |
| **Soil conservation and geoinformatics subject group** | | | | | | | | | | |
| 16. Soil conservation *György Szabó* | | | | 28 l / 3cr<br>14 p / 1cr | | | | | 4 | exam and mid-semester grade |
| 17. GIS fieldwork and mapping *Gergely Szabó* | | | | | 56 p / 4cr | | | | 4 | mid-semester grade |
| 18. Principles of database management in earth sciences *László Bertalan* | | | 28 p / 2cr | | | | | | 2 | mid-semester grade |
| **Landscape geography subject group** | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 19. Landscape protection *Tibor Novák* | | | | | 28 l / 3cr | | | | 3 | exam |
| 20. Landscape protection – practice *István Fazekas* | | | | | 28 p / 2cr | | | | 2 | mid-semester grade |
| Geology fieldwork *Richard William McIntosh* | | | | 4 days | | | | | 3 | mid-semester grade |
| Geology internship *Péter Rózsa* | | | | | 6 weeks | | | | 4 | mid-semester grade |
| ***METEOROLOGY SPECIALIZATION*** | | | | | | | | | | |
| **Theoretical physics subject group** | | | | | | | | | | |
| 1. Nonlinear phenomena, chaos *Ágnes Nagy* | | | | | 28 l / 3cr | | | | 3 | exam |
| 2. Dynamics of the atmosphere I *Zsolt Schram* | | | | | 42 l, 28 p / 5cr | | | | 5 | exam |
| 3. Dynamics of the atmosphere II *Zsolt Schram* | | | | | | 42 l, 14 p / 4cr | | | 4 | exam |
| **Applied meteorology I subject group** | | | | | | | | | | |
| 4. Synoptic meteorology I. *Ferenc Wantuch* | | | | | 28 l / 3cr | | | | 3 | exam |
| 5. Synoptic meteorology II. *Ferenc Wantuch* | | | | | | 28 p / 2cr | | | 2 | mid-semester grade |
| 6. Aviation meteorology *Ferenc Wantuch* | | | | | 28 l / 3cr | | | | 3 | exam |
| 7. Basics of computer programming *Ferenc Wantuch* | | | | 28 p / 2cr | | | | | 2 | mid-semester grade |
| **Applied meteorology II subject group** | | | | | | | | | | |
| 8. Global climate change *István Lázár* | | | | | | 14 l, 14 p / 2cr | | | 2 | exam |
| 9. Meteorological field measurements *Sándor Szeged* | | | | 14 l, 14 p / 2cr | | | | | 2 | mid-semester grade |
| 10. Meteorological instruments *István Lázár* | | | 28 p / 2cr | | | | | | 2 | mid-semester grade |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. Agrometeorology<br>*Sándor Szegedi* | | | | | 14 l, 28p / 3cr | | | | 3 | mid-semester grade |
| 12. Climate of the Earth<br>*Sándor Szegedi* | | | 28 l / 3cr | | | | | | 3 | exam |
| **Climatology subject group** | | | | | | | | | | |
| 13. Climate history<br>*Sándor Szegedi* | | | | | | 28 l, 14 p / 4cr | | | 4 | exam |
| 14. Environmental climatology<br>*Sándor Szegedi* | | | | | | 28 l / 3cr | | | 3 | exam |
| 15. Statistical climatology<br>*István Lázár* | | | 28 l, 28 p / 5cr | | | | | | 5 | mid-semester grade |
| **Geoecology and geoinformatics subject group** | | | | | | | | | | |
| 16. Geoecology<br>*Tibor Novák* | | | | 14 l, 28p / 3cr | | | | | 3 | mid-semester grade |
| 17. GIS fieldwork and mapping<br>*Gergely Szabó* | | | | | 56 p / 4cr | | | | 4 | mid-semester grade |
| 18. Principles of database management in earth sciences<br>*László Bertalan* | | | 28 p / 2cr | | | | | | 2 | mid-semester grade |
| Meteorology internship<br>*István Lázár* | | | | | 6 weeks | | | | 4 | mid-semester grade |

*Work and Fire Safety Course*

According to the Rules and Regulations of University of Debrecen a student has to complete the online course for work and fire safety. Registration for the course and completion are necessary for graduation. For MSc students the course is only necessary only if BSc diploma has been awarded outside of the University of Debrecen.
Registration in the Neptun system by the subject: MUNKAVEDELEM
Students have to read an online material until the end to get the signature on Neptun for the completion of the course. The link of the online course is available on webpage of the Faculty.

*Internship*

Students studying in the Earth Sciences BSc have to carry out a 6 weeks internship involved in the model curriculum. The internship course must be signed up for previously via the NEPTUN study registration system in the spring semester (4th semester). Its execution is the criteria requirement of getting the pre-degree certificate (absolutorium).

Objective of the internship, competences
Students get acquainted with professional work in conformity with their major at the company or institution and join in the daily working process. They have to resolve tasks independently assigned by their supervisor and gain experiences may be utilized later in the labour market. During the internship common and professional competences may be acquired. Common competences: precise working on schedule either individually or in team, talk shop applying correct technical terms. Professional competences: applying the professional skill gained during the training and acquiring new knowledge.

Places suitable for internship
All organizations, institutions and companies in Hungary or abroad, provide students with the opportunity to acquire proficiency in accordance with their specialization in the field of operation, repairing technology, installation, management and development of different machines and vehicles, may be a suitable place.

*Physical Education*

According to the Rules and Regulations of University of Debrecen a student has to complete Physical Education courses at least in two semesters during his/her Bachelor's training. Our University offers a wide range of facilities to complete them.

*Pre-degree Certification*

A pre-degree certificate is issued by the Faculty after completion of the bachelor's (BSc) program. The pre-degree certificate can be issued if the student has successfully completed the study and exam requirements as set out in the curriculum, the requirements relating to Physical Education as set out in Section 10 in Rules and Regulations, internship (mandatory) – with the exception of preparing thesis – and gained the necessary credit points (180). The pre-degree certificate verifies (without any mention of assessment or grades) that the student has fulfilled all the necessary study and exam requirements defined in the curriculum and the requirements for Physical Education. Students who obtained the pre-degree certificate can submit the thesis and take the final exam.

*Thesis*

The thesis is based on independent work summarizing the performed activities and the results closing the training and proving that students are able to collect and interpret available literature related to a specific problem and based on well-established methods students are able to solve the problem and interpret the observations and results. The minimum length of the thesis is 30 typewritten pages. The topic of the thesis has to be selected in the 4th semester at the latest, however, students may join any research at the departments earlier. Thesis courses have to be completed in semester 5 and 6 with the total credit points of 10. Thesis has to be composed with A/4 paper size, 2.5 cm margins, 12 points Times New Roman letter size and type with 1.5 spacing. Detailed requirements can be downloaded at https://geo.unideb.hu/hu/szakdolgozatok-diplomamunkak.

*Final Exam*

Students may take the final exam if they completed the required 180 credits. At the final exam the obtained knowledge is controlled in an oral exam using questions covering the core material (Questions A) and the specialization material (Questions B). Defence of the thesis is part of the final exam in the form of a short presentation of the results obtained in the thesis work

The grade of the final exam is calculated on the basis of the current Study and Examination Rules. One of the most important specifications is that the exam is only successful if all three grades (two questions and thesis defence) are at least pass.

A final exam can be taken in the forthcoming exam period after obtaining the pre-degree certificate. A final exam has to be taken in front of the Final Exam Board. If a candidate does not pass his/her final exam by the termination of his/her student status, he/she can take his/her final exam after the termination of the student status on any of the final exam days of the relevant academic year according to existing requirements on the rules of the final exam.

Final Exam Board

Board chair and its members are selected from the acknowledged internal and external experts of the professional field. Traditionally, it is the chair and in case of his/her absence or indisposition the vice-chair who will be called upon, as well. The board consists of – besides the chair – at least two members (one of them is an external expert), and questioners as required. The mandate of a Final Exam Board lasts for one year.

Repeating a failed Final Exam

If any part of the final exam is failed it can be repeated according to the rules and regulations. A final exam can be retaken in the forthcoming final exam period. If the Board qualified the Thesis unsatisfactory a student cannot take the final exam and he has to make a new thesis. A repeated final exam can be take twice on each subject.

## Diploma

The diploma is an official document decorated with the coat of arms of Hungary which verifies the successful completion of studies in the Earth Sciences Bachelor Program. It contains the following data: name of HEI (higher education institution); institutional identification number; serial number of diploma; name of diploma holder; date and place of his/her birth; level of qualification; training program; specialization; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the rector's (or vice-rector's) original signature and the seal of HEI. The University keeps a record of the diplomas issued.

In Earth Sciences Bachelor Program the diploma grade is calculated as the average grade of the results of the followings:

- Weighted average of the overall studies at the program (A)
- Average of grades of the thesis and its defense given by the Final Exam Board (B)
- Average of the grades received at the State Exam for the two subjects (C)

Diploma grade = (A + B + C)/3

Classification of the award on the bases of the calculated average:

| | |
|---|---|
| Excellent | 4.81 – 5.00 |
| Very good | 4.51 – 4.80 |
| Good | 3.51 – 4.50 |
| Satisfactory | 2.51 – 3.50 |
| Pass | 2.00 – 2.50 |

# Course Descriptions of Earth Sciences BSc Program

| **Title of course**: Basic mathematics 1<br>**Code**: TTMBE0819_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: 16
- preparation for the exam: 48 hours

Total: 90 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: TTMBG0820_EN

**Topics of course**

The aims of the course include the acquisition of the basic concepts of boundedness, monotonicity and convergence of real valued sequences. Further aims include to make students familiar with fundamental concepts and theorems from differential and integral calculus (such as derivative of a real valued function, application of the differential calculus, the concept of the primitive function, Riemann integration, Newton-Leibniz formula, application of the Riemann integral). Furthermore, an important goal the understanding of some basic concepts of matrices with real elements (such as operations with matrices, system of linear equations), as well as the acquisition of some computational methods in connection with matrices (e. g. Gaussian elimination).

**Literature**

Dennis D. Berkey – Paul Blanchard: Calculus, Forth Worth Saunders College Publ., 1992

**Schedule:**

*1st week*

Real numbers. Monotonicity, boundedness, convergence. Limits of sequences.

*2nd week*

One variable real functions. Monotonicity and boundedness of functions. Graphics of functions.

*3rd week*

Continuity and limits of one variable real functions.

*4$^{th}$ week*

Differentiation of one variable real functions. The derivative and its meaning in geometry. Differentiation of elementary functions. Rules of derivation.

*5$^{th}$ week*

Application of differentiation calculus I: solving tasks, L'Hospital rule.

*6$^{th}$ week*

Application of differentiation calculus I: complete study of one variable real functions.

*7$^{th}$ week*

Primitive function of one variable real functions. Indefinite integral. Primitive functions of elementary functions.

*8$^{th}$ week*

Elementary characteristics of indefinite integration. Rules of integration.

*9$^{th}$ week*

Riemann (definite) integral of one variable real functions. Some criteria of Riemann integration.

*10$^{th}$ week*

Elementary characteristics and calculation of Riemann integral. Newton-Leibniz rule.

*11$^{th}$ week*

Integration rules for Riemann integral. Partial and substitution Riemann integral.

*12$^{th}$ week*

Some application of Riemann integral.

*13$^{th}$ week*

Operations with matrixes. Characteristics of operations. Matrix algebra.

*14$^{th}$ week*

Linear equation systems. Description of the solutions of a linear equation system using Gaussian elimination.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

- *for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Zoltán Muzsnay, associate professor, PhD

**Lecturer:** Dr. Zoltán Muzsnay, associate professor, PhD

| **Title of course**: Basic mathematics 1 – practice<br>**Code**: TTMBG0819_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 8 hours
- preparation for the exam: -
- preparation for tests: 24 hours

Total: 60 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The aims of the course include the acquisition of the basic concepts of boundedness, monotonicity and convergence of real valued sequences from the point of view of applications. Further aims include to make students familiar with fundamental concepts and applications of differential and integral calculus (such as application of the differential calculus, application of the Riemann integral). Furthermore, an important goal the understanding of some basic concepts of matrices with real elements (such as operations with matrices, system of linear equations), as well as the application of some computational methods in connection with matrices (e. g. Gaussian elimination).

**Literature**

- Dennis D. Berkey – Paul Blanchard: Calculus, Forth Worth Saunders College Publ., 1992

**Schedule:**

*1st week*

Studying the boundedness, monotonicity and convergence of real sequences.

*2nd week*

Injective, surjective and bijective functions. Calculation of the inverse of invertible functions. Depicting functions.

*3rd week*

Examples of continuous functions. Examples of functions not continuous at a given point.

*4th week*

Calculation of the derivative of one variable real functions at a given point. Applying the derivatives of elementary functions and derivation rules in calculating the derivative functions.

*5th week*

Application of differential calculations I.

*6th week*

Application of differential calculations II.

*7th week*

Test 1

*8th week*

Primitive functions of elementary functions.

*9th week*

Practice of more complex versions of integration.

*10th week*

Application of Newton-Leibniz rule for calculating the Riemann integral of some simple functions.

*11th week*

Application of Riemann integral.

*12th week*

Operations with matrixes. Matrix algebra.

*13th week*

Solving linear equation systems with Gaussian elimination.

*14th week*

Test 2

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Zoltán Muzsnay, associate professor, PhD

**Lecturer:** Dr. Zoltán Muzsnay, associate professor, PhD

**Title of course**: Basic mathematics 2
**Code**: TTMBG0820_EN

**ECTS Credit points:** 2

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture:
- practice: 28 hours
- laboratory: -
- home assignment: 16 hours
- preparation for the exam:
- preparation for tests: 16 hours

Total: 60 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: TTMBE0819

**Further courses built on it**: -

**Topics of course**

The aims of the course include the acquisition of the basic concepts of ordinary differential equations. Further aims include to make students familiar with various applications of ordinary differential equations occurring in geography and Earth science. Furthermore, an important goal is the understanding of some basic concepts of probability theory and statistics, as well as the application of some computational methods from probability theory and statistics.

**Literature**

- Jeffrey R. Chasnov: Introduction to Differential Equations, Hong Kong University of Science and Technology, 2009

**Schedule:**

*1st week*

Common first order explicit differential equations. Cauchy tasks.

*2nd week*

Solution of simple first order explicit differential equations.

*3rd week*

Application of separable differential equations.

*4th week*

Solution and application of simple first order differential equations.

*5th week*

Solution and application of first order inhomogeneous linear differential equations in geo-processes.

*6th week*
Combinatorics.

*7th week*
Test 1

*8th week*
Probability calculations.

*9th week*
Elementary characteristics of probability. Conditional probability. Bayes' theorem, independence.

*10th week*
Probability variables, distribution function, density function, discrete and continuous distributions.

*11th week*
Common probability distributions.

*12th week*
Elements of mathematical statistics. Statistical tests. The u, t and khi^2 tests and their application in practice.

*13th week*
Regression calculations.

*14th week*
Test 2.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Zoltán Muzsnay, associate professor, PhD

**Lecturer:** Dr. Zoltán Muzsnay, associate professor, PhD

| **Title of course**: Fundamentals of informatics<br>**Code**: TTGBL7002_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: -
- laboratory: 2 hours/week

**Evaluation:** practical grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: -
- laboratory: 28 hours
- home assignment: 16 hours
- preparation for the exam: 16 hours

Total: 60 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Basic terminology of informatics. Hardware, operation systems, software. File management in Windows Browser and Total Commander. Data types. File zipping and extraction. Basic terminology of the internet. Introduction to text editing. Words and character formatting, finding and replacing. Formatting paragraphs. Page settings, margins, styles and formatting. Tabulators, page numbering, running head. Inserting and formatting tables, figures, images. Microsoft Excel tools. Printing the results. Complex functions: copy, delete, insert, find, replace, grouped fill. Clustered cell management, hiding fields. Links, naming, functions. Defining dates, statistical functions, database and text editing functions. Diagrams. Basics of PowerPoint.

**Literature**

- MS Office Support – https://support.office.com/
- Galeso, M. (2017): Microsoft Word 2017: An Easy Guide for Begginers.
- Galeso, M. (2017): Microsoft Excel 2017: An Easy Guide to Learning the Basics.
- Frandsen, T.L. (2010): Microsoft Office Excel 2007. URL: http://web.mef.hr/web/images/pdf/ms_o_exc.pdf
- Galeso, M. (2017): Microsoft Power Point 2017: An Easy Guide to Learning the Basics.
- Library And Learning Services: Working With Microsoft Powerpoint. URL: http://www2.eit.ac.nz/library/Documents/Working_With_PowerPoint_Combined.pdf

**Schedule:**

*1st week* – Introduction to the course. IT terminology. Hardware, operation systems, software. Data types. File managing. Windows Browser, Total Commander.

*2nd week* – Nomenclature of internet. Danger of Internet. Viruses. Webpages, addressing, references, backlinks, downloads. Favourite websites. Searching, e-mail, browsers.

*3rd week* – Introduction to word editing. Creating documents. Test insert, correction, formatting paragraphs: alignment, indentations, spacers, spacing, text placement. Page size, margin settings. Styles and Formatting I.

*4th week* – Font formatting: font type, style, size, etc. Special options. Formatting paragraphs: alignment, indentations, spacers, spacing, text placement. Page size, margin settings. Styles and Formatting II.

*5th week* – *Classification*, numbering. Applying Tabs. Page numbering and options. Use live heads, page numbering in headers.

*6th week* – Insert tables, diagrams, images, size, and characteristics. Spreading and splitting.

*7th week* – I. practical grading – MS Word.

*8th week* – MS EXCEL menu system and toolbar. Worksheet display, export-import options. Move within the table and between tables. Cells and Data Types (Numbers, Date, Text). Easy data entry, repair data formats and setup options. Print results, page setup, header, footnote, margins. Complex operations: copying, deleting, inserting, searching, exchanging, group filling. Group handling of cells. Hide.

*9th week* – References, names, formulas, and functions. Managing Functions and Function Groups. Date management, statistical functions, and database and text management functions.

*10th week* – Create or modify charts. Subtitles, texts, explanations, links, graphical elements display format (background, dimension, gridlines, axes) Types of charts, parameterization and graphical settings. Representation function. Concept of template.

*11th week* – II. practical grading – MS Excel.

*12th week* – Presentations. PowerPoint features (screen layout, menu, window management, views, toolbars, etc.). Use built-in layouts. Creating a slide show, inserting objects, using template templates. Drawing drawings. Animations.

*13th week* – Action Buttons. Projection options. Impact enhancement tools (custom animations, transitions, timings, music sequences, etc.). Hyperlinks. Printing.

*14th week* – III. practical grading – MS PowerPoint.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Judit Boda Kissné, assistant lecturer

**Lecturer:** Dr. László Bertalan, assistant lecturer, PhD

| **Title of course**: Fundamentals of physics I<br>**Code**: TTFBE2101 | **ECTS Credit points:** 4 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: 1 hours/week
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: 14 hours
- laboratory: -
- home assignment: 30 hours
- preparation for the exam: 48 hours

Total: 120 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -TTFBE2103

**Topics of course**

Terms of physics, quantities in physics. Description of the movement of materials. Mass and momentum. Newton's law. Galilei's relativity. Angular momentum. The term temperature and temperature scales. Statistical analysis of entropy.

**Literature**

**Schedule:**

*1st week*

Relationship between physics and other natural sciences and also mathematics. Quantities and dimensions in physics. SI dimensions, vectors and coordinate systems.

*2nd week*

Mathematical basics, matrixes, functions, differentiation and integral.

*3rd week*

Kinematics. Angular velocity, angular acceleration.

*4th week*

Dynamic descriptions. Mass and relationships. Newton axioms, Galilei's relativity. The rule of conservation of momentum.

*5th week*

Force rules. Differentiation equations and elementary solution methods. Gravity, friction, harmonic movements, vibration.

*6th week*

Work, kinetic energy, performance. Positional and mechanical energy.

*7th week*

Angular momentum theorem, the conservation of angular momentum. Kinematic and dynamic characteristics of rigid bodies. Movement equations.

*8th week*

Deformable bodies, Hooke's rule, elastic stress. Balance of liquids and gases. Hydrostatic pressure. Flow, Bernoulli's principle. Wave equation.

*9th week*

Wave phenomena, Doppler effect. The limits of Newton's mechanics. Elements and consequences of the special relativity theory.

*10th week*

The term temperature, thermodynamic systems. Ideal gas, temperature scales. First law of thermodynamics, heat capacity, specific heat.

*11th week*

Direction of processes in thermodynamics. Second law of thermodynamics. Thermodynamic definition of entropy. Third law of thermodynamics.

*12th week*

Elements of statistic mechanics, the kinetic gas model. Probability distributions, calculation of expected values. Maxwell-Boltzmann distribution.

*13th week*

Statistical interpretation of entropy. Heterogeneous systems, phase equilibrium.

*14th week*

Summary of the material of the semester, consultation.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the

| |
|---|
| EDUCATION AND EXAMINATION RULES AND REGULATIONS. |
| **Person responsible for course:** Dr. Balázs Ujvári, assistant professor, PhD |
| **Lecturer:** Dr. Balázs Ujvári, assistant professor, PhD |

**Title of course**: Fundamentals of physics II
**Code**: TTFBE2103

**ECTS Credit points:** 4

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice: 1 hours/week
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice: 14 hours
- laboratory: -
- home assignment: 30 hours
- preparation for the exam: 48 hours

Total: 120 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: TTFBE2101

**Further courses built on it**: -

**Topics of course**

Electricity: electric force, electric charge. Electric phenomena and material. Conductors and non-conductors in the electrostatic field. Stationary electric current. Ohm's law, simple circuits. Electromagnetic induction. Light as electromagnetic wave, interference, polarization. Structure of atoms, the periodic table, chemical bonding, X-ray radiation. Radioactive radiation, the rule of decay. Cosmology.

**Literature**

**Schedule:**

*1st week*

Electrostatics, Coulomb's law and Gaussian laws.

*2nd week*

Conductors and non-conductors, electric polarization, Capacity of condensators, electric susceptibility.

*3rd week*

Energy density of the electrostatic field. Electric dipol's field, potential energy.

*4th week*

Stationary electric current, Ohm's law. Specific resistance, simple circuits.

*5th week*

Magnetostatic basic phenomena in vacuum and in materials. Lorentz strength, magnetic momentum.

*6th week*

Electric current and coils magnetic field, Ampére's law. Electromagnetic induction. Mass spectrometry.

*7th week*

Electromagnetic vibrations, effective values. Impedance, transformators.

*8th week*

Formation and movement of electromagnetic waves, Maxwell equations.

*9th week*

Electromagnetic spectrum. Light as wave, fracture, reflectance. Complementary theory.

*10th week*

Quantum nature of light, temperature radiation, black body.

*11th week*

Development of atomic models, Rutherford's experiment, Bohr's model. The formation of quantum physics.

*12th week*

Electron structure of atoms, the periodic table. The formation of x-Ray radiation.

*13th week*

Radioactive decay, decomposition and fusion, the operation of nuclear power plants. Nuclear power and its risks.

*14th week*

Elementary parts and their characteristics, basic interactions. Cosmology.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Balázs Ujvári, assistant professor, PhD

**Lecturer:** Dr. Balázs Ujvári, assistant professor, PhD

| **Title of course**: Meteorology in everyday life<br>**Code**: TTGBE5504_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: 1 hours/week
- practice: 1 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: 14 hours
- practice: 14 hours
- laboratory: -
- home assignment: 32 hours
- preparation for the exam: -

Total: 60 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**:

**Further courses built on it**:

**Topics of course**

The aim of the course is to provide knowledge on the meteorological background, dynamics and impacts of weather and climate phenomena known from everyday life. The course covers the following topics: the Sun as the source of energy of the climate system; „space weather", solar eruptions, geomagnetic storms and their effects; atmospheric optics: rainbow, fata morgana; atmospheric electronics: lightings; meteorological basics of the utilization of renewable energy sources energy and water cycles; paleo- and historical climatology in brief; fundaments of human meteorology; development of meteorological instruments from barometers to satellites, SODAR, LIDAR and RASS and other modern instruments; development of numeric weather forecasting from the storm of Balaklava till today; air quality and meteorology; extraterrestrial climates.

**Literature**

Compulsory literature:

C. D. Ahrens: Meteorology Today: An Introduction to Weather, Climate, and the Environment, Cengage Learning; 9th edition (2008) ISBN-10:0495555738

Additional literature:

J. M. Wallace – P. W. Hobbs: Atmospheric Science: An Introductory Survey (International Geophysics), Academic Press; 2 edition (2006) ISBN-10:012732951X

**Schedule:**

*1st week* – The Sun as the source of energy of the climate system – „space weather" – solar eruptions, geomagnetic storms and their effects.

*2nd week* – Atmospheric optics: rainbow, fata morgana.

*3rd week* – Atmospheric electronics: lightings

*4th week* – Climate changes and climate fluctuations.

*5th week* – Paleo- and historical climatology in brief.

*6th week* – Meteorological basics of the utilization of renewable energy sources1: energy cycles.

*7th week* – Meteorological basics of the utilization of renewable energy sources 2: water cycles.

*8th week* – Weather forecasting 1: Development of numeric weather forecasting from the storm of Balaklava till today.

*9th week* – Weather forecasting 2: Weather forecasting models.

*10th week* – Air quality and meteorology.

*11th week* – Development of meteorological instruments from barometers to satellites, SODAR, LIDAR and RASS instruments.

*12th week* – Fundaments of human meteorology meteoropathy.

*13th week* – Extraterrestrial climates 1: climates of the inner planets of the Solar System.

*14th week* – Extraterrestrial climates 2: climates of the outer planets and moons of the Solar System.

**Requirements:**
Attendance at **lectures** is recommended, but not compulsory.

- *for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Sándor Szegedi, associate professor, PhD

**Lecturer:** Dr. Sándor Szegedi, associate professor, PhD

| **Title of course**: Introduction to chemistry I<br>**Code**: TTKBE0141_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment:
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: TTKBL0141_EN

**Topics of course**

History and development of chemistry and its relation to other natural sciences, the development of atomic and molecular theory. The structure of atom. Basics of radioactivity. Discovery of the periodic table and periodically changing properties. Introduction to quantum chemistry. Primary and secondary chemical bonds. Description of gaseous, liquid and solid states of matter. Phase changes. Chemical equilibrium. Acid-base theories. Basics of thermochemistry, reaction kinetics and electrochemistry.

**Literature**

- John McMurry – Robert C. Fay: Chemistry, 7th ed., Prentice Hall ISBN: 0321943171.
- Darrell D. Ebbing: General Chemistry, 9th ed. Belmont, CA, ISBN: 1-4390-4982-9
- James E. Brady, Gerard E. Humiston: General chemistry: principles and structure, 3rd ed., New York, Wiley, ISBN: 0471808164

**Schedule:**

*1st week*

Atomic structures.

*2nd week*

First and second order chemical bonds.

*3rd week*

The periodic system and periodically varying characteristics.

*4th week*

Gases, liquids and solid material.

*5th week*

Changes of state, mixtures, description of gas mixtures.

*6th week*

Solution and concentration, mixtures of liquids.

*7$^{th}$ week*

Chemical rections, rection kinetics, thermochemical terms, reactions resulting in equilibrium.

*8$^{th}$ week*

Acid-base reactions, calculation of pH. Buffers and salt solutions. Processes forming complexes.

*9$^{th}$ week*

Redoxi reactions, electric chemistry. Galvanic elements, electrolysis, radiochemistry.

*10$^{th}$ week*

Occurrence of elements, general methods of formation. Gases of the sun: hydrogen, helium (noble gases).

*11$^{th}$ week*

Constituents of the atmosphere: oxygen (ozone), nitrogen. An essential compound: water. An energy resource: carbon. Compounds of carbon in the ground, in water and in the air: limestone (scaling, dripstone), compounds causing the hardness of water, carbon dioxide (carbon monoxide).

*12$^{th}$ week*

Air pollutants: sulphur oxides, hydrogen sulphide, nitrogen oxides. Useful and hazardous: halogens (chlore, bromide, iodide) and their compounds.

*13$^{th}$ week*

Most important acids, hydrochloric acid, sulphuric acid, nitric acid, artificial fertilizers. Artificial fertilizing.

*14$^{th}$ week*

Metals, transitional metals.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

| |
|---|
| If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. |
| **Person responsible for course:** Dr. Katalin Várnagy, university professor, PhD, DSc |
| **Lecturer:** Dr. Attila Forgács, research assistant, PhD |

| **Title of course**: Introduction to chemistry I – practice<br>**Code**: TTKBE0141 | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 32
- preparation for the exam:

Total: 60 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: TTKBE0141

**Further courses built on it**: -

**Topics of course**

The objective of the laboratory work is to introduce first-year students of different background to laboratory work, the use of basic laboratory equipment, simple laboratory operations and measurements. In addition, students are expected to prepare certain simple chemicals and run various basic experiments to familiarize themselves with chemical laboratory work. The seminar involves solving exercises and problems.

<u>General laboratory work will be introduced, such as:</u>

Weighing on analytical and standard laboratory balances. Introduction to the measurement of volume: pipette, burette, volumetric flask. Students will calibrate a volume measurement devise (pipette/burette/volumetric flask) and calculate the percentage difference between the nominal and actual volume. General introduction to grinding and preparation of solution. Density measurement, use of the pycnometer. Preparation of a standard solution from crystalline solid and measuring its density: determination of the density of the prepared solution with pycnometer, calculation of the weight percent composition. General introduction to separation techniques: decantation, centrifuging, filtration. Students will see a demonstration regarding the proper and safe use of laboratory gas cylinders, preparation of gases under laboratory conditions, Kipp's apparatus. Students will carry out the purification of a benzoic acid sample contaminated with sodium chloride. Students will see a demonstration of an acid-base titration and will carry out the concentration determination of a NaOH solution.

<u>Basic calculation perоblems will be solved considering:</u>

Determination of atomic weight, molecular weight, empirical formula, molecular formula, amount of substance. Determination of empirical formula based on weight percent composition and on elemental analysis. General introduction to the units of concentration. Interconversion of units. Calculation problems connected to solution preparation. Introduction of the SI system. Mass concentration, molarity, mass percent composition, molar percent composition.

Interconversion of concentration units. Density measurements. Mixing equations. Theoretical background of crystallization. Exercises calculation problems of crystallization. Acid-base equilibria. Theory of acid-base reactions and titrations. Exercises based on acid-base titrations. Stoichiometric calculations based on chemical equations. Determination of molar weight based on titration results.

**Literature**

- Introduction to chemistry laboratory practice (laboratory manual, available at inorg.unideb.hu)
- The collection of calculation problems will be available at inorg.unideb.hu
- Darrell Ebbing, Steven D. Gammon: General Chemistry 10th edition

**Schedule:**

*1st week*

Faults of measurements and calculations, listing and describing,

*2nd week*

Stoichiometric calculations related to the mass of atoms and molecules.

*3rd week*

Calculation of concentration units and mixed concentration tasks. Formulae and reaction equations.

*4th week*

Miscellaneous tasks related to concentration and stoichiometric calculations.

*5th week*

Calculation of pH in the solutions of strong acids and basics. Titration.

*6th week*

-

*7th week*

-

*8th week*

-

*9th week*

-

*10th week*

-

*11th week*

-

*12th week*

-

*13th week*

-

*14th week*

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

- *for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Linda Bíró, assistant professor, PhD

**Lecturer:** Dr. Linda Bíró, assistant professor, PhD

| **Title of course**: Fundamental biology<br>**Code**: TTBBE0001 | **ECTS Credit points:** 1 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 1 hour/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 14 hours<br>- practice: -<br>- laboratory: -<br>- home assignment: -<br>- preparation for the exam: 16 hours<br>Total: 30 hours | |
| **Year, semester**: 1st year, 1st semester | |
| **Its prerequisite(s)**: - | |
| **Further courses built on it**: - | |

**Topics of course**

Founding the learning of knowledge important for obtaining knowledge.

**Literature**

- C. A. Ville, C. E. Martin, L, R. Berg, P. W. Davis (2008): Biology. Saunders College Publishing, Philadelphia

**Schedule:**

*1st week*

Biology as a science. Criteria of life. C Linné and C. Darwin. System of life. Taxonomic terms and the system. Viruses, cyanobacteria, algae, mushrooms and moss.

*2nd week*

Plants and plant tissues. Organs and functions of plants. Plant divisions in taxonomy.

*3rd week*

Elements and compounds composing a living system. Biogenic elements. Physical, chemical and biological specifics of water. Diffusion and osmosis.

*4th week*

Metabolism processes in the cell. Intermediary metabolism. Assimilation, dissimilation. Photosynthesis.

*5th week*

The term of a cell. Prokaryotes and eukaryotes. Cell core, cell centre, probably cell cycle.

*6th week*

Tissues of animal and human organs. Life operations. Reproduction.

*7th week*

Self-sustaining processes. Evolution of feeding and respiration. Respiration of humans, transport of humans.

*8th week*

Self-control. Hormones and their effects. Lead and control in life. Somatic and vegetative control.

*9th week*

Terms of gene, genetic type. DNA duplication. Control of genes.

*10th week*

Mendel's equilibrium. Heritance bounded to women.

*11th week*

Population genetics. Ideal and real populations. Factors of evolution. Mutation, selection, adaptation.

*12th week*

Life and its surroundings. Ecology, self-reproduction of material. Energy flow. Ecological pyramid, biomass.

*13th week*

Bioms. Environmental and nature protectional knowledge.

*14th week*

Evaluation and control.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

| |
|---|
| If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. |
| **Person responsible for course:** Dr. Revák Gyuláné, associate professor, PhD |
| **Lecturer:** Dr. Revák Gyuláné, associate professor, PhD |

| **Title of course**: Basics of Ecology<br>**Code**: TTBBE0003_EN | **ECTS Credit points: 3** |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The course provides an introduction to the basic ecological processes and their effects on the environment and nature. The course introduces the state-of-art theoretical background, and provides case studies to each topic in order to reveal practical aspects. The main topics: aspects of vegetation succession; global and local effects of land use changes, habitat loss and fragmentation; ecological processes in urban habitats; ecosystem services and estimation of the ecological footprint; application of remotely sensed data in environmental and conservational projects.

**Literature**

- Pásztor L., Botta-Dukát Z., Magyar G., Czárán T., Meszéna G. (2016) Theory-Based Ecology A Darwinian approach. Oxford University Press, pp. 301. ISBN: 978-01-995-7785-9
- Robert J. Whittaker, José María Fernández-Palacios (2007): Island Biogeography Ecology, evolution, and conservation Oxford University Press, USA ISBN 978-01-985-6612-0

**Schedule:**

*1st week* Introduction to the course

*2nd week* Classical island biogeography

*3rd week* Conservational, cultural importance of habitat islands. Connected ecosystem services.

*4th week* Biological invasions

*5th week* Remote sensing in ecology

*6th week* Ecosystem services and ecological footprint

*7th week:* Mid-term test

*8th week* Succession. Primary and secondary succession. Role of succession in conservation.

*9th week* Conservation and management of grasslands

*10th week* Urban ecology, global patterns

*11th week* Ecosystem engineering species

*12th week* Sustainable land use

*13th week* Natural habitats in human transformed landscapes

*14th week* End-term test

**Requirements:**

*- for a signature*
Participation at classes is compulsory. A student must attend the classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. In case of more than three absences, a medical certificate needs to be presented.

*-an offered grade:*

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week. The offered grade is the average of them.

The minimum requirement for the tests (and also for the examination) is 60%. The grade for the tests and the examination is given according to the following table:

| Score | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

*- for a grade*
The course ends in a written exam. For the grades please refer the table above.

**Person responsible for course:** Dr. Péter Török, university professor, PhD

**Lecturer:** Dr. Péter Török, university professor, PhD
Prof. Dr. Tóthmérész Béla, university professor, DSc

| **Title of course**: Basic environmental science<br>**Code**: | **ECTS Credit points:** 1 |
|---|---|

**Type of teaching, contact hours**
- lecture: 1 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 14 hours
- practice: -
- laboratory: -
- home assignment:
- preparation for the exam: 16 hours

Total: 30 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Environmental science thinking, populations. Global environmental systems and problems. Continental, global, local and regional thinking with the environment at the focus. State and protection of environmental systems. Sustainability, energy efficiency, recycling material. Effects of global climate change on the biosphere. Biodiversity. Earth as a habitat, air, water and soil. Nature and society.

**Literature**

- Attila Kerényi – Richard McIntosh (2019): Sustainable development in the complex Earth system – Springer

**Schedule:**

*1st week*

Environmental science thinking, populations.

*2nd week*

Global environmental systems and problems.

*3rd week*

Local and regional environmental thinking.

*4th week*

Continental and global environmental thinking.

*5th week*

Biotic and abiotic environmental factors.

*6th week*

State and protection of environmental systems

*7th week*

Sustainability, energy efficiency, reuse of materials, ecological footprint.

*8th week*

Effects of global climate change on the biosphere.

*9th week*

Environmental problems, Environmental load.

*10th week*

Biological indications, biodiversity.

*11th week*

Earth as a place to live.

*12th week*

Air, water, soil.

*13th week*

Nature and society.

*14th week*

Consulting.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. István Gyulai, assistant professor, PhD

**Lecturer:** Dr. István Gyulai, assistant professor, PhD

| **Title of course**: EU studies<br>**Code**: TTTBE0030_EN | **ECTS Credit points:** 1 |
|---|---|

**Type of teaching, contact hours**
- lecture: 1 hour/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 14 hours
- practice: -
- laboratory: -
- home assignment:
- preparation for the exam: 16 hours

Total: 30 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The aim of the course is to give an overall picture for the students of the history of the development of the Community and the operation of its institutional system. It also aims at introducing the students to the enlargement process and the most important cooperation areas. On the level of EU policies, the issues of agriculture, regional policy, Economic and Monetary Union and the Schengen Area are discussed. The primary goal is that the future diploma holders have realistic knowledge about the functioning of the European Union, and of the international background of the Hungarian EU membership.

**Literature**

- Bergmann, Julian – Niemann, Arne (2013): Theories of European Integration and their Contribution to the Study of European Foreign Policy, *Paper prepared for the 8th Pan-European Conference on International Relations, Warsaw 2013. p22.*
- Ott, Andrea – Vos, Ellen (eds.) (2009): Fifty Years of European Integration: Foundations and Perspectives. T.M.C. Asser Press, Springer. 480pp. ISBN: 978-90-6704-254-3

**Schedule:**

**Schedule:**

*1st week*

**History of the Integration.** Integration theories, stages of integration around the world. Specific features of the European integration process before the Second World War. Impacts of the Second World War on the history of the cooperation. Predecessors, impacts of the European Coal and Steel Community (ECSC) on the foundation of the European Economic Community. Steps towards the European Union.

*2nd week*

**Process of the enlargement of the organisation.** Preconditions of the enrolment of new members. Events of the period prior to the First Enlargement (1973). Steps, principles, causes and consequences of the Enlargements. Relationships between the decision-making mechanism and the Enlargement.

*3rd week*

**Specific features of the enlargements after the turn of the millennium.** Transformation of East Central Europe, and the unique features of its membership. Copenhagen criteria, pre-accession funds, prolonged negotiation process. Brexit.

*4th week*

**History and principles of the creation of the institutional system.** Taking-over the institutional system of the European Coal and Steel Community. Tasks of the most important institutions, operational mechanism, democratic deficit. Reform process of the institutional system, concepts laid down in the Constitutional Treaty. Decision-making in the EU.

*5th week*

**Agricultural policy.** History of the development of the CAP. The most important tools and sources of the funds. Horizontal measures. Current state of the common agricultural policy and its expected future. Reform attempts in agriculture. Hungary and common agricultural policy. Sharing the fish stocks of the seas.

*6th week*

**Regional policy in the European Union.** History of the regional policy. Regionalism – regionalisation in the EU Member States. General features of the regional policy. NUTS nomenclature. Regional disparities in the Community. Funds and main objectives. Decision-making in regional policy. Hungary and the regional policy.

*7th week*

**Economic and Monetary Union (EMU).** History of the European monetary co-operation. The European Monetary System (EMS). Role of the Maastricht Treaty in the monetary co-operation. Stages on the development of the Monetary Union. Convergence criteria. The euro and the currency market. Hungary and the Monetary Union.

*8th week*

**Judicial co-operation in the Community.** Legal order in the European Union. Role of the primary EU legislation in the European Community. European Community justice. Institutions serving the needs of judicial co-operation.

*9th week*

**History of co-operations in home affairs.** Schengen Convention. Regulations related to crossing state borders. Border checks. Checks between state borders, migration policy.

*10th week*

**External relations.** Principles of the common foreign trade policy. Autonomous import and export regulation. Issues related to the impediment to trade. External relations: African, Caribbean and Pacific Group of States (ACP), Global Mediterranean Policy, associated countries.

*11th week*

**EU Budget: revenue side.** Components of the EU budget and recent changes in the proportions. History of the EU budget. Budget revenues: duties, value-added tax (VAT), gross national product (GNP) sources.

*12th week*

**Expenditures:** agricultural policy, structural funds, external aid, research and development, pre-accession assistances, administrative expenditures. Economic characteristics. Budget procedure.

*13th week*

**Migration and the European Union.** Theoretical background to the migration crisis in 2015and its practical consequences. History of the migration routes and movements. Natural and social (political) causes contributing to the crisis situation.

*14th week*

**Common vision for the European co-operation.** Possible development paths in the future of

| |
|---|
| the European Union. Federal Europe or Europe of Nations? Reform options. Problem-solving attempts. Brexit. |
| **Requirements:**<br>- *for a signature*<br>Attendance at **lectures** is recommended, but not compulsory.<br>- *for a grade*<br>The course ends in a **written examination**. |
| **Person responsible for course:** Dr. Károly Teperics, associate professor, PhD |
| **Lecturer:** Dr. Klára Szilágyi-Czimre, assistant professor, PhD |

| **Title of course**: Mineralogy and Petrology I<br>**Code**: TTGBE5007_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: 10 hours
- preparation for the exam: 52 hours

Total: 90 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: TTGBG5008_EN, TTGBG5014_EN

**Topics of course**

The aims of the course is to introduce crystal system, point groups, symmetry elements and crystal forms; basic s of crystal chemistry (most important ionic crystals, particularly the silicates; the most important covalent and metal bonding crystals; to demonstrate the principal physical features (hardness, optical properties, etc.) of crystals; to introduce to the students the genetic and chemical system of minerals, and the most important minerals of the mineral formation phases.

**Literature**

*Compulsory:*
W. D. Nesse: Introduction to Mineralogy. Oxford University Press. Oxford-New York, 2012 (2nd edition)
*Recommended:*
H.-R. Wenk – A. Bulakh: Minerals. Their Constitution and Origin. Cambridge University Press, Cambridge, 2016 (2nd edition)
M. Okrusch – H. Frimmel: Mineralogy. An Introduction to Minerals, Rocks, and Mineral Deposits. Springer Textbooks in Earth Sciences, Geography and Environment. Springer Verlag, 2018.

**Schedule:**

*1st week* – Definition of crystal, mineral, rock, and soil; their interconnections. Basic laws of crystallography. Types of unit cells.

*2nd week* – Symmetry elements (reflection, rotation, inversion, and improper rotation); their appearance and identification.

*3rd week* – Definition types of crystal forms.

*4th week* – Stereographic projection. Crystal classes.

*5th week* – Basic crystal chemistry. Ionic lattices. AB, $AB_2$, $ABO_3$, $AB_2O_4$ structures.

*6th week* – Silicate structures. The Bowen's reaction series. Anisodesmic ionic lattices.

*7th week* – Covalent bonding lattices. Metal bonding lattices.

*8th week* – Basic crystal physics. Hardness, translation, cleavage.

*9th week* – Optical properties of crystals. Refractive index. Isotropy and anisotropy. Double refraction. Uniaxial and biaxial crystals.

*10th week* – Chemical classification of minerals. Native elements, sulphides, oxides, hydroxides.

*11th week* – Silicate minerals, $SiO_2$ minerals.

*12th week* – Halides, carbonates, nitrates, borates.

*13th week* – Sulphates, phosphates, organic minerals.

*14th week* – Genetic classification of minerals.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*

The course ends in a writing **examination**.

The minimum requirement for the writing test the examination respectively is 50%. The grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of the test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Péter Rózsa, associate professor, PhD

**Lecturer:** Dr. Péter Rózsa, associate professor, PhD

| **Title of course**: Mineralogy and petrology I – practice<br>**Code**: TTGBG5008_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 12 hours
- preparation for the exam: 20 hours

Total: 60 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: TTGBG5009_EN, TTGBE5003_EN, TTGBG5010_EN, TTGBG7505_EN, TTGBG5014_EN, TTGBE5017_EN

**Topics of course**

Principal knowledge about crystal morphology – crystallographic axes, types of symmetry, crystal forms. Cognition of the minerals and parageneses which are important by mineralogy, petrology, volcanology, regional geology applied geology and environmental geology. Acquirement of simple mineral identification methods.

**Literature**

*Compulsory:*
- Nesse, W.D. (2000): Introduction to Mineralogy, Oxford University Press, 442 p.
- Perkins, D. (2014): Mineralogy, Pearson Education, 561 p.

*Recommended:*
- Mason, J. (2015): Introducing Mineralogy, Dunedin, 118 p.
- Mukherjee, S. (2011): Applied Mineralogy. Applications in Industry and Environment, Springer, 575 p.

**Schedule:**

*1st week* – Concept, properties, inner structure of crystals, unit cells. Practice of identification of unit cell and crystallographic axes on crystal models. Classification the models to crystal systems.

*2nd week* – Identification the symmetry of crystals. Classification the models to crystal classes. Projection of faces, axes, symmetry elements.

*3rd week* – Written test about the theoretical content of the previous lessons. Faces identification, Miller-index. Crystal forms and their combination, open and closed forms. Main crystal forms in the classes of triclinic, monoclinic and orthorhombic crystal systems.

*4th week* – Main crystal forms in the classes of tetragonal, hexagonal, trigonal and isometric crystal systems. Practice on crystal models.

*5th week* – Written test about the practical content of the previous lessons. Crystal forms in the lower symmetry classes of triclinic, monoclinic and orthorhombic crystal systems.

*6th week* – Crystal forms in the lower symmetry classes of tetragonal, hexagonal, trigonal and isometric crystal systems.

*7th week* – Mid-term test about the crystal morphology.

*8th week* – Basic concepts about bounds, crystal lattices and structures. Ionic structures and silicates. Characteristic crystal forms derived from these structures.

*9th week* – Metallic structures and structures with complex ions. Characteristic crystal forms derived from these structures.

*10th week* – Written test about the bounds, lattices and structures. Physical properties of minerals, principals of the identification of minerals.

*11th week* – Paragenesis of minerals. Minerals of the precrystallization phase. Mineral forming processes in the main crystallization phase, silicate structures, Bowen's reactions series. Minerals of the pegmatitic-pneumatolitic phase.

*12th week* – Minerals of the hydrothermal phase and their forming processes.

*13th week* – Sedimentary and metamorphic minerals and their forming processes.

*14th week* – End-term text about mineral identification.

**Requirements:**

*- for a signature*

Attendance at **practice** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

*- for a grade*

During the semester there are five tests. The minimum requirement for each test is 50%. The grade for the tests is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-69 | satisfactory (3) |
| 70-79 | good (4) |
| 80-100 | excellent (5) |

If the score of any test is below 50, students must take a retake test during the semester.

The grade of the practice is the average of the five grade (two tasks and one presentation) modified by the activity of the student in the course (by maximum 1 grade).

**Person responsible for course:** Dr. Tamás Buday, assistant professor, PhD

**Lecturer:** Dr. Tamás Buday, assistant professor, PhD,
Dr. Richard William McIntosh, assistant professor, PhD

| **Title of course**: Mineralogy and Petrology II<br>**Code**: TTGBE5009_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 32 hours
- preparation for the exam: -

Total: 60 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: TTGBE5007_EN, TTGBE5008_EN

**Topics of course**

The aims of the course is to introduce students into the formation processes of rocks, and their system, mineral and major element composition, textural pattern; the course includes the establishment of determination of different basic igneous, sedimentary and metamorphic rock types through their macro- and microscopic features. This way, the students will be familiar with main rock types, and they will be able to identify the most important rock types in the field and the laboratory.

**Literature**

*Compulsory:*
L.A. Raymond: Petrology. The Study of Igneous, Sedimentary, and Matemorphic Rocks. Waveland Press, Long Grove, 2002 (2nd ed.)
*Recommended:*
H. Blatt – R.J. Tracy – B.E. Owens: Petrology: igneous, sedimentary, and metamorphic. Freeman, New York, 2006 (3rd ed.)
W.S. MacKenzie – A.E. Adams – K.H. Brodie: Rocks and Minerals in Thin Section: A Colour Atlas. Taylor and Francis Group, London. 2016(rev. 2nd ed.)

**Schedule:**

*1st week* – Definition of magma; its composition and principal physical properties. Texture of igneous rocks, intrusive and extrusive igneous rocks. Chemical and mineralogical classification of igneous rocks. QAPF and TAS diagrams.

*2nd week* – Main features of ultrabasic and basic rocks. Peridotite, gabbro, basalt. Intermediate igneous rocks. Diorite, andesite.

*3rd week* – Felsic rocks. Granite, granodiorite, rhyolite. Alkali and tholeiitic rocks.

*4th week* – Pyroclastic rocks. Their textures, and classification.

*5th week* – Test 1

*6th week* – Erosion, transportation, accumulation, diagenesis. Classification of sedimentary rocks.

*7th week* – Clastic sediments. Conglomerates and breccias. Sandstones. Mudsrocks.

*8th week* – Chemical sedimentary rock. Clays, laterites, bauxite. Carbonates, evaporates. Other chemical sedimentary rocks.

*9th week* – Biochemical sedimentary rocks. Coal, cherts. Oil and gas.

*10th week* – Test 2.

*11th week* – Definition of metamorphism. Contact (local) and dynamo-thermal (regional) metamorphism. Metamorphic textures.

*12th week* – Anchi, epi-, meso and katametamorphic rocks.

*13th week* – Metamorphic facies.

*14th week* – Test 3

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*

The minimum requirement for the writing tests the examination respectively is 50%. The grade for the tests is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Péter Rózsa, associate professor, PhD

**Lecturer:** Dr. Péter Rózsa, associate professor, PhD
Dr. Richard William McIntosh, assistant professor, PhD
Dr. Árpád Csámer, assistant professor, PhD.

| **Title of course**: Hydrology and hydrogeology<br>**Code**: TTGBE5005_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 2nd year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Water types, its principal physical, chemical, structural properties. Basic concepts of hydrostatics and hydrodynamics by practical aspects. Important hydrometeorological and hydrogeographic concepts connecting water resource determination and water management with its measuring and calculation methods. Laws of water-rock interactions, run-off, infiltration, storage, karst forming processes, water movement in the surface and under the surface. Concept of porosity, hydraulic conductivity, permeability, portion of infiltration and contamination sensitivity. Groundwater including shallow groundwater, water source protection, thermal and medical waters. Production, utilization and supply from water resource. Regional water management.

**Literature**

*Compulsory:*
- Ward, A. D. – Trimble, S. W. (2003): Environmental Hydrology, Lewis Publishers, 464 p.
- Kay, M. (2007): Practical Hydraulics. – Taylor & Francis, 253 p.

*Recommended:*
- Gribbin, J. E. (2014):Introduction to Hydraulics and Hydrology with Applications for Stormwater Management, Delmare Cengage Learning, 543 p.
- Fetter, C. W. (2001): Applied Hydrogeology, Prentice-Hall, 598 p.
- Boyd, C. E. (2015): Water Quality, Springer, 357 p.

**Schedule:**

*1st week* – Basic concepts of hydrology, its subjects and role. Origin, importance of the hydrosphere, distribution of water on the Earth and hydrologic cycle. Water reserves, water types and global challenges. Relationship between the mankind and water.

*2nd week* – Chemical properties of the water (structure, constituent parts), isotopes in hydrology. Phase change, dissociation, pH. Constituent parts and behaviour of natural solutions.

*3rd week* – Physical and physicochemical properties of water: density, melting point, boiling point, enthalpy of melting and boiling, specific heat capacity, thermal conductivity, dynamic and kinematic viscosity. Surface tension and connecting phenomena.

*4th week* – Basic concepts of hydrostatics. Pascal's law, hydrostatic and absolute pressure, communicating vessels, buoyancy and Archimedes' principle.

*5th week* – Basic concepts of hydrodynamics. Mass continuity, Bernoulli's equation in theory and practice. Laminar and turbulent flow.

*6th week* – Elements of hydrometeorology and water budget (conditions, measurement, seasonal changes etc.), precipitation and evapotranspiration. Characterization of drainage basins.

*7th week* – Run-off and infiltration (conditions, measurement, seasonal changes etc.). Stream processes. Lakes.

*8th week* – Water in the rocks, force and tension between the solids and fluids. Voids and fractures in the rocks, porosity. Classification of groundwater and reservoirs. Behaviour of shallow groundwater in the unsaturated zone. Groundwater-surface interactions.

*9th week* – Groundwater in the saturated zone. Hydraulic continuity in sedimentary basins. Groundwater of karstic systems.

*10th week* – Laws of groundwater movement: defining and measuring of hydraulic conductivity. Hydrometrics and hydrography in practice.

*11th week* – Water production from different sources - historical and technological aspects. Water production from surface water bodies. Springs of different geological units. Dug wells, driven wells, drilled wells and collector wells: installation and operation.

*12th week* – Hydrogeology of Europe: the extent and characteristic of the most important aquifers. Mineral and medical waters.

*13th week* – Water Framework Directive and river basin management plans, European and national level.

*14th week* – Hydrological and hydrogeological modelling: theoretical and practical considerations.

**Requirements:**

*- for a signature*
Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*
The course ends in a written **examination**.

The minimum requirement for the examination is 60%. The grade for the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of any test is below 60 %, students can take a retake test in conformity with the Education and examination rules and regulations.

**Person responsible for course:** Dr. Tamás Buday, assistant professor, PhD

**Lecturer:** Dr. Tamás Buday, assistant professor, PhD

| **Title of course**: Hydrology and hydrogeology – practice<br>**Code**: TTGBG5006_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 12 hours
- preparation for the exam: 20 hours

Total: 60 hours

**Year, semester**: 2nd year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Water qualification. Basic concepts of hydrostatics and hydrodynamics by practical aspects. Measuring and calculation methods related to water resource determination and water management. Laws of water-rock interactions, water movement in the surface and under the surface, porosity, hydraulic conductivity and related calculations. Shallow and deep groundwater and its movements. Production, utilization and supply from water resource. Regional water management.

**Literature**

*Compulsory:*
- Ward, A. D. – Trimble, S. W. (2003): Environmental Hydrology, Lewis Publishers, 464 p.
- Kay, M. (2007): Practical Hydraulics. – Taylor & Francis, 253 p.

*Recommended:*
- Gribbin, J. E. (2014): Introduction to Hydraulics and Hydrology with Applications for Stormwater Management, Delmare Cengage Learning, 543 p.
- Fetter, C. W. (2001): Applied Hydrogeology, Prentice-Hall, 598 p.
- Boyd, C. E. (2015): Water Quality, Springer, 357 p.

**Schedule:**

*1st week* – Introduction to the course, task discussion. Sampling in hydrology and hydrogeology.

*2nd week* – The most important measurable physical and chemical parameters. Presentation of the hydrological, hydrogeological data, type and dimension of data, type of diagrams.

*3rd week* – Basic concepts of hydrostatics. Pressure, hydrostatic pressure, buoyancy and related calculations.

*4th week* – Basic concepts of hydrodynamics. Bernoulli's principle and its practical applications.

*5th week* – Reynolds number, flow patterns. Determination of flow velocity in tubes and open channels.

*6th week* – Mid-term test.

*7th week* – Hydrological, hydrogeological aspects of catchment analysis, principals of run-off and *infiltration*.

*8th week* – Basic concepts describe the presence of water under the surface. Shallow and deep groundwater, karstic water. Calculation and laboratory determination of the porosity, effective porosity, water content and saturation.

*9th week* – Depth and height of groundwater level.

*10th week* – Movement of the groundwater. Measuring hydraulic conductivity and permeability in field and laboratory. Well hydraulics.

*11th week* – Measuring with permeameter, hydraulic conductivity of samples with different grain size distribution.

*12th week* – Oral presentations.

*13th week* – End-term test.

*14th week* – Oral presentations. Close of the practice.

**Requirements:**

*- for a signature*
Attendance at **practice** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

*- for a grade*
During the semester there are two tests: the mid-term test in the 6th week and the end-term test in the 13th week. The course contains an oral **presentation** also about themes discussed with the lecturer.

The minimum requirement for each test is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-69 | satisfactory (3) |
| 70-79 | good (4) |
| 80-100 | excellent (5) |

If the score of any test is below 50, students must take a retake test during the semester.

The grade of the practice is the average of the three grades (two tasks and one presentation).

**Person responsible for course:** Dr. Tamás Buday, assistant professor, PhD

**Lecturer:** Dr. Tamás Buday, assistant professor, PhD

| **Title of course**: Meteorology and Climatology 1<br>**Code**: TTGBE5501_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**:

**Further courses built on it**: TTGBE5502_EN

**Topics of course**

The series of lectures are based on the topics of technical drawing and mechanics. It reviews the fundamental relations of the sizing procedure of machineries (stress analysis for static combined loads; dimensioning on strength at harmonically varying loads, fatigue and life of members) and the concept of manufacturing tolerance and fitting. After that it deals with connections between components (connection with force transmission by friction, positive connections, bolted joints, weldings), gaskets, elastic connections (metal springs, rubber springs) beds for machine eg. rolling bearings, plain journal bearings. In the laboratory, being connected with the lectures machine elements are studied and tests of them are carried out. In seminars there are two design tasks to elaborate: a welded machinery base, and a hydraulic cylinder.

**Literature**

Compulsory literature:

C. D. Ahrens: Meteorology Today: An Introduction to Weather, Climate, and the Environment, Cengage Learning; 9th edition (2008) ISBN-10:0495555738

Recommended literature:

J. M. Wallace – P. W. Hobbs: Atmospheric Science: An Introductory Survey (International Geophysics), Academic Press; 2 edition (2006) ISBN-10:012732951X

R. V. Rohli: Climatology Academic Press; 2 edition (2006) ISBN-10:128411998X

**Schedule:**

*1st week* – Introduction: definition of meteorology; its development position within the system of sciences and its terminology.

*2nd week* – The structure and composition of the atmosphere. Alterations in the composition of the atmosphere. The atmospheric aerosol and its meteorological effects.

*3rd week* – Fundaments of actinometry: basic physical laws of electromagnetic radiation.

*4th week* – Thermodynamics of dry air and its vertical movements. Changes in the physical parameters of dry air with height

*5th week* – Adiabatic processes of moist air. Stability conditions in the atmosphere.

*6th week* – Condensation in the atmosphere. Cloud types

*7th week* – Processes and types of precipitation. Acid precipitation

*8th week* – Horizontal movements of the air in the free atmosphere

*9th week* – Effects of friction on wind, wind profile.

*10th week* – Air masses, atmospheric fronts 1

*11th week* – Air masses, atmospheric fronts 2

*12th week* – Isobar maps.

*13th week* – Fundamental forms of barometric field 1.

*14th week* – Fundamental forms of barometric field 2.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*

The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Sándor Szegedi, associate professor, PhD

**Lecturer:** Dr. Sándor Szegedi, associate professor, PhD

| **Title of course**: Meteorology and Climatology II<br>**Code**: TTGBE5502_EN | **ECTS Credit points:** 1 |
|---|---|

**Type of teaching, contact hours**
- lecture: 1 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 14 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: TTGBE5501_EN

**Further courses built on it**: TTGBE5502_EN

**Topics of course**

The series of lectures are based on the topics of technical drawing and mechanics. It reviews the fundamental relations of the sizing procedure of machineries (stress analysis for static combined loads; dimensioning on strength at harmonically varying loads, fatigue and life of members) and the concept of manufacturing tolerance and fitting. After that it deals with connections between components (connection with force transmission by friction, positive connections, bolted joints, weldings), gaskets, elastic connections (metal springs, rubber springs) beds for machine eg. rolling bearings, plain journal bearings. In the laboratory, being connected with the lectures machine elements are studied and tests of them are carried out. In seminars there are two design tasks to elaborate: a welded machinery base, and a hydraulic cylinder.

**Literature**

Compulsory literature:

R. V. Rohli: Climatology Academic Press; 2 edition (2006) ISBN-10:128411998X

Additional literature:

J. M. Wallace – P. W. Hobbs: Atmospheric Science: An Introductory Survey (International Geophysics), Academic Press; 2 edition (2006) ISBN-10:012732951X

W. F. Ruddiman: Earth's Climate: Past and Future Freeman/Worth (2013) ISBN-10:1429255250

**Schedule:**

*1st* week – Introduction: definition of climatology; its position within the system of sciences and its terminology.

*2nd* week – Climate forming factors 1.1, extraterrestrial factors: radiation output of the sun.

*3rd* week – Climate forming factors 1.2: effects of the changing position of the Sun and the Earth. Impacts of the modifications in the elements of Earth’s orbit.

*4th* week – Climate forming factors 1.3. Terrestrial effects: impacts of latitude on the angle and length of irradiation.

*5th* week – Climate forming factors 2. Factors that influence energy and material transport processes between the surface and atmosphere: material and cover types of the surface.

*6th* week – Climate forming factors 3.1. Material and energy transport processes in the ocean-atmosphere system: the global circulation system.

7th *week* – Climate forming factors 3.2. Climate forming effects of Ocean currents and monsoon circulations.

*8th week* – Climate forming factors 4. Relief as a climate modifying factor: the impacts of elevation and relief forms on climate.

*9th* week – Climate forming factors 5. Human impacts on climate.

*10th week* – Anomalies in the functioning of the climate system: the El Niño (ENSO) phenonmenon, climate changes and fluctuations.

*11th week* – Temporal patterns of climate elements on the Earth1. Annual courses and geographic types of solar irradiance, temperature, air pressure and winds.

*12th week* – Temporal patterns of climate elements on the Earth 2. Annual courses and geographic types of evaporation, cloud cover and precipitation.

*13th* week – Spatial patterns of climate elements on the Earth1. Spatial patterns of solar irradiance, temperature, air pressure and winds.

*14th week* – Temporal patterns of climate elements on the Earth2. Spatial patterns of evaporation, cloud cover and precipitation.

**Requirements:**

*- for a signature*
Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Sándor Szegedi, associate professor, PhD

**Lecturer:** Dr. Sándor Szegedi, associate professor, PhD

| **Title of course**: Meteorology and Climatology II – practice<br>**Code**: TTGBG5503_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**

- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**

- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 32 hours
- preparation for the exam: -

Total: 60 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: TTGBE5501_EN

**Further courses built on it**: -

**Topics of course**

The aim of the course is to introduce the students of the course into the methods of climatological data collection, data base building and management; data processing, analyses and presentation. The course enables students to prepare and analyze climate diagrams, to recognize climate types and characterize the climate zones of the Earth.
The following topics are discussed in the frame of the course: collection of climatological data; data base building and management; data processing, data screening methods, conversions between measures, presentation of datasets in diagrams; preparation and analyses climate diagrams; identification of climate types using Walter-Lieth diagrams; description of the climate zones of the Earth.

**Literature**

Compulsory literature:

R. Snow – M Snow – J. E. Oliver: Exercises in Climatology. Pearson (2002) ISBN-10:0130354694

Additional literature:

J. M. Wallace – P. W. Hobbs: Atmospheric Science: An Introductory Survey (International Geophysics), Academic Press; 2 edition (2006) ISBN-10:012732951X

W. F. Ruddiman: Earth's Climate: Past and Future Freeman/Worth (2013) ISBN-10:1429255250

http://www.klimadiagramme.de

**Schedule:**

*1st week* – Climatological data collection,

*2nd week* – Data base building and management; data screening methods, conversions between measures.

*3rd week* – Calculation of base climate statistics.

*4th week* – Presentation of datasets in diagrams 1.

*5$^{th}$ week* – Presentation of datasets in diagrams 2.

*6$^{th}$ week* – Preparation and analyses climate diagrams; Walter-Lieth climate diagrams.

*7$^{th}$ week* – Identification of climate types using Walter-Lieth diagrams.

*8$^{th}$ week* – Climate classification systems.

*9$^{th}$ week* – The Köppen climate classification system 1.

*10$^{th}$ week* – The Köppen climate classification system 2.

*11$^{th}$ week* – Identification of climate types using Walter-Lieth diagrams 1.

*12$^{th}$ week* – Identification of climate types using Walter-Lieth diagrams 2.

*13$^{th}$ week* – Description of the climate zones of the Earth 1.

*14$^{th}$ week* – Description of the climate zones of the Earth 2.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*

The course ends in a **practice grade**.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Sándor Szegedi, associate professor, PhD

**Lecturer:** Dr. István Lázár, assistant professor, PhD

| **Title of course**: The cosmic relations of the Earth<br>**Code**: TTGBE7003_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 2 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 28 hours<br>- practice: -<br>- laboratory: -<br>- home assignment: -<br>- preparation for the exam: 62 hours<br>Total: 90 hours | |
| **Year, semester**: 1st year, 1st semester | |
| **Its prerequisite(s)**: - | |
| **Further courses built on it**: - | |

**Topics of course**

The aim of the course to gain comprehensive knowledge of the narrower and wider cosmic environment of the Earth as well as our planet as part of the Solar System to reveal the identities and differences of the characteristics and evolution of the cosmic bodies.

**Literature**

Freedman, R.A. – Geller, R. – Kaufmann, W.J. (2014): Universe: The Solar System. ISBN 9781464135286.

Vita-Finzi, C. – Fortes, A.D. (2013): Planetary Geology: An Introduction. ISBN 9781780460154

**Schedule:**

*1st week* – Introduction

*2nd week* – Altering of point of view of the society, during the ceturies

*3rd week* – The structure of the Solar System

*4th week* – The Venus

*5th week* – The Mars – I.

*6th week* – The Mars – II.

*7th week* – Common features of outer planets. The Jupiter and it's moons

*8th week* – The Saturn and it's moons

*9th week* – Uranus, Neptune, and their moons

*10th week* – The Pluto

*11th week* – The dwarf planets and other minor bodies

*12th week* – The Moon

*13th week* – Comets and meteorites

*14th week* – The evolving Solar System

**Requirements:**

Attendance at **lectures** is recommended, but not compulsory.

The course ends in an **examination**.

The minimum requirement for the examination is 60%. Based on the score of the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Gergely Szabó, assistant professor, PhD

**Lecturer:** Dr. Gergely Szabó, assistant professor, PhD

| **Title of course**: Structural geology I<br>**Code**: TTGBG5004_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: -
- preparation for the tests: 32 hours

Total: 60 hours

**Year, semester**: 2nd year, 1st semester

**Its prerequisite(s)**: Introduction to geology

**Further courses built on it**: Structural geology II

**Topics of course**

The aims of the course include the establishment of a modern dynamic view for the students that make the understanding of the difficult and variable material and crust development system of the earth and the recognising of the processes of general and local significance. Further aims include to make students familiar with structural geological features, to make them capable of measuring the most important structural elements in the field and understanding illustration techniques used in the literature, reading the structural geological figures and diagrams.

Over the practicals the students will learn the formation of earth type planets and the most important structural and geophysical conditions of the earth. The general interior structure of our planet is discussed together with the structural results (faults and folds) of the movements occurring in the mantle. In the second half of the semester the major phases of plate tectonics (riftogenesis, tectogenesis, orogenesis, cratonisation) are discussed reflecting on the associated volcanism and formation of igneous rocks. The relationship between orogenic mega-cycles and sedimentary depositional environments are also interpreted. Finally, a general outline of the structural conditions and tectonic development of the Alp-Carpathian region and the Pannonian Basin is also given.

**Literature**


*Compulsory:*

Fossen H. (2016): Structural geology – Cambridge University Press, 524 p.

*Recommended:*

McIntosh R.W. – Püspöki Z. (2005): Chapters from structural geology – textbook, Department of Mineralogy and Geology, University of Debrecen, 100 p.


**Schedule:**

*1st week* – Tectonics and structural geology as scientific fields. Geotectonics, global tectonics, regional tectonics and microtectonics. Development of Earth like planets. The role of element migration and differentiation in the formation of a spherical structure.

*2nd week* – Interior structure of Earth. Ways to explore the interior structure and composition.

Characteristics and material conditions of the core, mantle and the crust. The magnetic field of Earth.

*3rd week* – Parts and behaviour of the lithosphere and its relationship with the mantle. Mechanical behaviour of minerals and rocks. Forms of stress and resultant deformations. Compression, tension and shear stress fields, elastic modulus, Poisson's ratio and other strength conditions.

*4th week* – Stress, its forms and calculation. Types of strain, its measurement and calculation. Relationship between deformation and stress and deformation and passed time. Inner (material, grain size, crystal water content and oriented texture) and outer (pressure, temperature, water content in fractures and velocity of deformation) factors influencing deformation.

*5th week* – Structural elements of brittle deformation. Lithoclases, diaclases, paraclases. Joints and faults. Mohr and Riedel joint systems, classification of faults, transpression, transtension, positive and negative flower structures. Blocks and flexures.

*6th week* – Structural elements of ductile deformation. Description and classification of folds. Schistosity, boudins, and nappe formation. Vergence, autochthonous and allochthonous rock masses.

*7th week* – Measurement, description, illustration and reconstruction of structural elements. Identification and measurement of dip direction, dip angle and strike using a geological compass. Rose diagrams and stereograms.

*8th week* – Test I

*9th week* – Fundamentals of plate tectonics and the orogenic megacycles. Major lithospheric plates, plate boundaries, evidence of plate tectonics and the concept of moving continents.

*10th week* – The process of rifting. Divergent plate boundaries, processes at mid-oceanic ridges. Structure and development of the oceanic crust. Palaeomagnetic stripes in the oceanic crust and their formation at mid-oceanic ridges. Hot-spot volcanoes and mantle plumes.

*11th week* – Development of subduction zones along convergent plate boundaries. Formation and structure of island-arc systems, typical subduction zones on Earth.

*12th week* – Orogenesis and orogenic zones. Suture, uplift, craton development. Volcanism, ore formation isostatic uplift in orogenic zones.

*13th week* – Structural conditions and development of the Alpine-Carpathian region. Formation and structural conditions of the Pannonian Basin.

*14th week* – Test II

**Requirements:**

*- for a signature*

Attendance at **practicals** is compulsory, absence of students shall not exceed three occasions.

*- for a grade*

Grades are given on the basis of two tests in the study period. Both tests are composed of two parts the scores of which are calculated a bit differently:

- basic terms I: 20% basic terms II: 20%
- test I: 30% test II: 30%

The grade for the course is given according to the following table:

| Test Score (%) | Grade | basic terms Score (%) | Grade |
|---|---|---|---|
| 0-50 | fail (1) | 0-65 | fail (1) |
| 50-59 | pass (2) | 65-74 | pass (2) |

| | | | |
|---|---|---|---|
| 60-74 | satisfactory (3) | 75-84 | satisfactory (3) |
| 75-87 | good (4) | 85-94 | good (4) |
| 88-100 | excellent (5) | 95-100 | excellent (5) |

If the score of student result is below 50, students can re-take the tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Richard William McIntosh, assistant professor, PhD

**Lecturer:** Dr. Richard William McIntosh, assistant professor, PhD

| **Title of course**: Fundamentals of physical geography I. (Hydrogeography)<br>**Code**: TTGBE7008_EN | **ECTS Credit points: 3** |
|---|---|

**Type of teaching, contact hours**

- lecture:  2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Students learn the water cycle, oceans, seas, lakes and rivers with their processes and forming factors. Physical and chemical features of the water. Water cycle. Oceand seas. Waves, currents, temperature, ice formation in the seas, tidal waves. Terminology of rivers, types, tributaries, estuaries and spring heads. Extent, river density, morphometrical indices, riverbed patterns. Physics of water flow, laminar and turbulent flow, riverbed formation. Floods. Lakes: exogenic and endogenic lake beds. Lake types: water budget, temperature, biology. Lake extinction. Groundwater, aquiers and aquitards.

**Literature**


- Calow, P. - Petts, G.E. (1994): The Rivers Handbook, Blackwell Science Ltd, 528 p. ISBN: 978-0-632-02985-3
- Jaya, R.R.P. (2005): A Text Book of Hydrology. Firewall Media, 530 p.
- Butzer, K.W. (1976): Geomorphology from the earth, New York, Harper and Row, 463 p.


**Schedule:**

*1st week* Water cycle and water courses of the Earth.

*2nd week* Horizontal and vertical structure of seas.

*3rd week* Geographical distribution of the chemical characteristics, temperature and the ice.

*4th week* Movements of the seas: waves.

*5th week* Movement of the seas: currents, tidal waves.

*6th week* Rivers, wells, estuaries.

*7th week* Catchments, watersheds, morphometrical indices, network-patterns.

*8th week* Runoff, floods.

*9th week* Genetical lake types.

*10th week* Water budget types for lakes.

*11th week* Geometric and attribute data collection and extraction.

*12th week* Types of undersurface waters.

*13th week* Remote sensing in hydrology.

*14th week* Grade-offering exam.

**Requirements:**

Lecture:

The minimum requirement for the examination is 50% from the midterm and closing tests. Based on the summarized score of the test the grade for the examination is given according to the following table:

| Score | Grade |
|---|---|
| 0-49% | fail (1) |
| 50-59% | pass (2) |
| 60-72% | satisfactory (3) |
| 73-84% | good (4) |
| 85-100% | excellent (5) |

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Prof. Dr. Szilárd Szabó, university professor, DSc

**Lecturer:** Prof. Dr. Szilárd Szabó, university professor, DSc

**Title of course**: Fundamentals of physical geography II. (Geomorphology)
**Code**: TTGBE7009_EN

**ECTS Credit points: 3**

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 2nd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Students know the driving forces of geomorphology: surficial processes; physiography. Rock weathering and erosion. Glacial processes and glacial landforms. Mass wasting: gravity driven processes (e.g. landslides), Eolian processes. Groundwater activity: hydrothermal, volcanic. Karst systems.

**Literature**

Huggett, R. (2016): Fundamentals of Geomorphology, Taylor and Francis, 578 p.
Huggett, R. (2009): Physical Geography: The Key Concepts, Routledge, 224 p.
Ritter, D.F. - Kochel, R.C. - Miller, J.R. (2011): Process Geomorphology, Wm. C. Brown, 546 p.

**Schedule:**

**Requirements:**
Lecture:

The minimum requirement for the examination is 50% from the midterm and closing tests. Based on the summarized score of the test the grade for the examination is given according to the following table:

| Score | Grade |
|---|---|
| 0-49% | fail (1) |
| 50-59% | pass (2) |
| 60-72% | satisfactory (3) |
| 73-84% | good (4) |
| 85-100% | excellent (5) |

| |
|---|
| If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. |
| **Person responsible for course:** Prof. Dr. József Lóki, university professor, DSc |
| **Lecturer:** Prof. Dr. Szilárd Szabó, university professor, DSc |

| **Title of course**: Fundamentals of physical geography III. (Anthropogenic geomorphology)<br>**Code**: TTGBG7010_EN | **ECTS Credit points: 3** |
|---|---|

**Type of teaching, contact hours**
- lecture: 1 hours/week
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: 14 hours
- practice: 28 hours
- laboratory: -
- home assignment: 7 hours
- preparation for the exam: 41 hours

Total: 90 hours

**Year, semester**: 2nd year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The system based approach of the anthropogenic geomorphological processes and forms. Types and tipization of the processes and forms. Industry initiated forms. forms initiated by agricultural activity. Connection to the landscape. Risks. Surveying techniques.

**Literature**


- Szabó, J. - Dávid, L. - Lóczy, D. (eds). (2010): Anthropogenic Geomorphology. Springer,
- Li, J. - Yang, L. - Pu, R. - Liu, Y. (2017): A review on anthropogenic geomorphology. Jornal of Geographical Sciences 27: 109-128.
- Goudie, A. (2001): The Human Impact on Natural Enviroment, MIT Press,


**Schedule:**

1st week

Lecture: History of fluvial geomorphology

Practice: Measures in fluvial geomorphology I. Impoundment of watersheds. Morphometrical analyses on maps: drainage density and maturity examinations of channels.

2nd week

Lecture: Movement and sediment transport of channels.

Practice: Measures in fluvial geomorphology II. Ordering examinations, channel shape measures.

3rd week

Lecture: Erosional and depositional forms along channels.

Practice: Measures in fluvial geomorphology III. Channel shape measures. Hydrological measures on the field.

4th week

Lecture: River terraces, formation and types of fluvial valleys.

Practice: Fluvial laboratory experiments.

5th week

Lecture: Physical foundation of wind erosion.

Practice: Examinations of alluvial and eolian sediments. Sample collection on the field,

6th week

Lecture: Sand transport by the wind.

Practice: Examination of physical properties of sediments. Methods of measuring of grains size, grain size nomenclatures. Graphical representation and evaluation of grains size distribution.

7th week

Lecture: Morphology and morphometry of major dune types.

Practice: Morphometrical analyses of grains, properties of grain surface, application of microscopes in sediment analyses.

8th week

Lecture: Paleoenvironments and dunes.

Practice: Examination of chemical properties of sediments: measuring the pH-value, $CaCO_3$- and organic matter content in laboratory

9th week

Lecture: Origin of loesses. Loess in Hungary.

Practice: I. writing test. Wind tunnel measurements.

10th week

Lecture: The geomorphologic synthesis. Mono- and biogenetic theories in geomorphology.

Practice: Examination of organic matters in sediments. Application of malacology in geomorphology.

11th week

Lecture: The geomorphologic synthesis. Climatical, polygenetic theories in geomorphology.

Practice: Applications of palynology in geomorphology.

12th week

Lecture: The study and system of anthropogenic geomorphology I.

Practice: Application of dendrology in geomorphology.

13th week

Lecture: The study and system of anthropogenic geomorphology II.

Practice: Determining the age of sediments. Relative and absolute age-dating methods.

14th week

Lecture: Grade-offering exam.

Practice: 2. writing test.

**Requirements:**

Practice:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there is one practical test. It can be completed in the 14th week.

The minimum score is 50%. Based on the score of the test, the grade for the test is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

Lecture:

The minimum requirement for the examination is 50% from the midterm and closing tests. Based on the summarized score of the test the grade for the examination is given according to the following table:

| Score | Grade |
|---|---|
| 0-49% | fail (1) |
| 50-59% | pass (2) |
| 60-72% | satisfactory (3) |
| 73-84% | good (4) |
| 85-100% | excellent (5) |

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

| |
|---|
| **Person responsible for course:** Prof. Dr. Lóki József, emeritus professor, DSc |
| **Lecturer:** Prof. Dr. Szilárd Szabó, university professor, DSc<br>László Bertalan, assistant lecturer |

| **Title of course**: Soil geography<br>**Code**: TTGBE6001_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: 12 hours
- preparation for the exam: 50 hours

Total: 90 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**:

**Topics of course**

The aim of the course is to get acquainted with the main areas of the science of soil geography. The course deals with the following topics: The concept of soil, soil forming factors, the history of the soil research. The importance and functions of soils. Composition of soils, soil-forming rocks. Soil-forming minerals. Physical, chemical and biological features, pedogenic minerals. Organic materials in soil, the process of humus formation. Colloids in soil. Physical properties of soils. The concepts of genetic and diagnostic soil classification. The soils of Central Europe: skeletal soils, lithogenic soils, soils with clay illuviation, chernozems, meadow soils, salt affected soils, fluvial soils, marshes, forested bogs soils.

**Literature**

*Compulsory:*

- European Soil Burea Network, European Commission 2005. Soil Atlas of Europe, Luxembourg, Office for Official Publications of the European Communities. 128.p. /https://esdac.jrc.ec.europa.eu/Projects/Soil_Atlas/Download/Atlas.pdf
- Blum, W., Schad, P., Nortcliff, S. 2018. Essentials of Soil Science. Soil formation, functions, use and classification (World Reference Base, WRB). Schweizerbart, Stuttgart, 171 p. ISBN 978-3-443-01090-4

*Recommended:*

- *Świtoniak, M.; Kabała, C.; Karklins, A.; Charzyński, P.; Hulisz, P.; Mendyk, Ł., Michalski, A.; Novák, T. J.; Penížek, V.; Reintam, E.; Repe, B.; Saksa, M.; Vaisvalavičius, R.; Waroszewski,* J. 2018. Guidelines for Soil Description and Classification Central and Eastern European Students' Version. ISBN 978-83-934096-6-2, Polish Society of Soil Science, Torun, Poland 286 pp

**Schedule:**

*1st week*

The pedosphere. Definition, extent, genesis and functions.

*2nd week*

Methods for study of soils. The base concept of the pedon.

*3rd week*

The components of soils. Soil as a three phase system.

*4th week*

Solid phase of soils. Minerals in soild phase of soils. Weathering processes of soil minerals. Pedogenic mineral transformations.

*5th week*

Fluid phase of soils. Moisture state and water regime of soils.

*6th week*

The gas phase of the soils. Pore volume, bulk density.

*7th week*

Physical characteristics of soils: texture, structure, colour, skeletal parts, pore volume.

*8th week*

Chemical characteristics of soils: pH, conductivity, redox-potential, carbonates, cation exchange complex, base saturation. Nutrients for plants..

*9th week*

Organic matter in soils. Forms, quantification, relevance.

*10th week*

The soil forming factors and their spatial distribution. Soil forming processes.

*11th week*

Taxonomy of soils. Diagnostic and genetic conceptions.

*12th week*

Classification of soils. US Soil Taxonomy, WRB and national classifications.

*13th week*

Distribution of soil types around the Earth.

*14th week*

Conservation and reclamation of soils. Endangering factors of soil resources.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*

During the semester students have to write an essay dealing with a selected subject of course focussing attention on their home country.

The course ends in a written **examination**. Based on the result of examination and the quality of essay, the final grade is calculated as an average of them:

- the quality of the essay (15%)
- the result of the examination (85%)

The grade for the course is given according to the following table:

| Score | Grade |
|---|---|
| 0-50 | fail (1) |
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-87 | good (4) |

| |
|---|
| 88-100 excellent (5)<br>If the score of student result is below 50, students can take a new written examination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.<br>*-an offered grade:* |
| **Person responsible for course:** Dr. Tibor Novák, associate professor, PhD |
| **Lecturer:** Dr. Tibor Novák, associate professor, PhD |

| **Title of course**: Soil geography - practice<br>**Code**: TTGBG6002_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 22 hours
- laboratory: 6 hours
- home assignment: 10 hours
- preparation for the exam: 22 hours

Total: 60 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Students will get acquainted with field soil sampling and testing methods, they will be able to take soil samples and prepare soil profiles. They are familiar with the physical, chemical properties required for the characterization of soils (e.g. soil texture, structure, pH) and field methods (e.g. Finger test) and tools (e.g. Munsell scale). They will be able to delineate these by field definition and name the genetic horizons, to recognize different concretions. They familiarize and apply different laboratory tests to determine basic soil properties (e.g. pH, Humus and OC content, $CaCO_3$ content, texture) and water management properties. Based on field and laboratory test results, students are able to draw conclusions on the use and management of soils.

**Literature**

*Compulsory:*
- FAO (2006): Guidelines for soil description, Roma, ISBN: 92-5-105521-1.
- S. Logsdon, D. Clay, D. Moore, T. Tsegaye, editors, 2008. Soil Science Step-by-Step Field Analysis. SSSA, Madison, WI.

*Recommended:*
-Soil Survey Staff. 2014. Soil Survey Field and Laboratory Methods Manual. Soil Survey - Investigations Report No. 51, Version 2.0. R. Burt and Soil Survey Staff (ed.). U.S. Department of Agriculture, Natural Resources Conservation Service.

**Schedule:**

*1st week*

Description of the semester theme. Presentation of the theoretical background of the fieldwork. Soil sampling methods and establisment of soil profiles. Methods of preparation soil reports.

*2nd week*

Physical and chemical properties of soils. Theoretical background of the determination of these properties on the field. Methods and tools required for the measurements. Methodological preparation of field work.

*3rd week*

Fieldwork. Practical application of soil sampling methods.

*4th week*

Fieldwork. Field test methods (Finger test, determination of Munsell color, field pH measurement, estimation of CaCO3 content with 10% HCl solution, humus quality estimation).

*5th week*

First written examination. Methodological preparation of laboratory practices. Creating 3 student groups that will perform laboratory exercises in the following weeks.

*6th week*

Getting acquainted with the Geography Institute's lab. Preparation of soil samples for laboratory measurements. Acquire the use of tools for preparation (eg analytical balance).

*7th week*

Laboratory test for determination of soil texture. Evaluating results, deducting conclusions.

*8th week*

Testing the water resistance of the structural elements in flowing water and still water. Evaluating results, deducting conclusions.

*9th week*

Investigating the water management properties of the soil. Evaluating results, deducting conclusions.

*10th week*

Determination of soil pH ($H_2O$, KCl) under laboratory conditions. Evaluating results, deducting conclusions.

*11th week*

Determination of the $CaCO_3$ content of soils in laboratory conditions. Exercise the use of Scheibler's calcimeter, measuring the $CaCO_3$ content of soil samples. Evaluating results, deducting conclusions.

*12th week*

Determination of the humus content of soils under laboratory conditions. Description and practical application of the Tyurin method. Performing and practicing titration. Evaluating results, deducting conclusions.

*13th week*

Second written examination. Submitting protocols.

*14th week*

The evaluation of the semester work, description and justification of the practice notes.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*

During the semester there are two tests. The final grade is calculated as an average of the grades of

the tests.
Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

| Score | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. György Szabó, associate professor, PhD

**Lecturer:** Tamás Mester, assistant lecturer

| **Title of course**: Biogeography<br>**Code**: TTGBE7011_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 2 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 28 hours<br>- practice: -<br>- laboratory: -<br>- home assignment: 12 hours<br>- preparation for the exam: 50 hours<br>Total: 90 hours | |
| **Year, semester**: 2nd year, 1st semester | |
| **Its prerequisite(s)**: - | |
| **Further courses built on it**: - | |

**Topics of course**

The aim of the course to introduce the ecological and geographical background of the biogeography as an interdisciplinary science. The course provide knowledge on the relationship between wildlife and its geographical environment, tolerance, adaptation, spread of species, distribution patterns of wildlife, vikarism, pseudovikarism, zonality, biodiversity, flora and fauna empires and biogeographical empires. Besides this the aim of the course the characterization of the environmental conditions and the zonal, intrazonal wildlife of the individual biomes: tropical rainforest, savannah, tropical monsoon, tropical deserts, Mediterranean hardwood forest, subtropical monsoon forest, deciduous forest, steppe, moderate desert and semi-desert, tajga and tundra. Finally, the course introduces the vertical zonality of tropical and moderate zone mountains.

**Literature**


Mark Lomolino, Brett Riddle, Rober J. Whittaker (2017): Biogeography. Sinauer. ISBN 978-1-6053-5472-9

Andrew Millington, Mark Blumler, Udo Schickhoff (eds.) (2011): The SAGE Handbook of Biogeography. SAGE Publications Ltd. London. ISBN: 978-1-4129-1951-7


**Schedule:**

*1st week* – Introduction to the course.

*2nd week* – Place of biogeography in the system of the sciences.

*3rd week* – Ecological and biogeographical basics.

*4th week* – Relationship between wildlife and its geographical environment, tolerance, adaptation.

*5th week* – Spread of species, distribution patterns of wildlife.

*6th week* – Vikarism, pseudovikarism.Vertical and horizontal distribution of the wildlife on Earth, zonality, intra- and extrazonality, biodiversity.

*7th week* – The vertical zonality of tropical and moderate zone mountains.

*8th week* – Flora and fauna empires, biogeographical empires.

*9th week* – Characterization of the environmental conditions and the zonal wildlife of the tropical rainforest and savanah.

*10th week* – Characterization of the environmental conditions and the zonal wildlife of the tropical monsoon forest and tropical deserts.

*11th week* – Characterization of the environmental conditions and the zonal wildlife of the Mediterranean hardwood forest, subtropical monsoon forest and deciduous forest.

*12th week* – Characterization of the environmental conditions and the zonal wildlife of the steppe, moderate semi-desert and desert.

*13th week* – Characterization of the environmental conditions and the zonal wildlife of thetajga and tundra.

*14th week* – Test. Questions.

**Requirements:**

Attendance at lectures is recommended, but not compulsory.

- *for a grade*

The course ends in an examination. The minimum requirement for the examination is 50%. The grade for the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

Students can take a retake test in conformity with the education and examination rules and regulations.

- *an offered grade:*

It may be offered for students if the test written in the 14th week is at least satisfactory (3).

**Person responsible for course:** Dr. György Szabó, associate professor, PhD

**Lecturer:** Dr. György Szabó, associate professor, PhD

| **Title of course**: Bases of environmental protection<br>**Code**: TTGBE6003-EN | **ECTS Credit points: 3** |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 2 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 28 hours<br>- practice: -<br>- laboratory: -<br>- home assignment: -<br>- preparation for the exam: 62 hours<br>Total: 90 hours | |
| **Year, semester**: 1st year, 2nd semester | |
| **Its prerequisite(s)**: - | |
| **Further courses built on it**: - | |

**Topics of course**

The basis of the system theory, the Earth as a unified system. The basic environmental problem and environmental protection. Sustainable development and environmental protection. The role of sciences in environmental protection. The relationship between demographical processes and the natural environment. The ecologycal footprint and the carrying capacity of the Earth. The urban environment, the city as a system, green cities. The impact of production on the environment and human health. The impact of consumption on the environment and human health. Environmental pollution. Waste management. The destruction of wildlife. Environmental Principles.

**Literature**

**Compulsory literature:**
Cocks, D. (2013) Global Overshot – Contemplating the World’s Converging Problems. Springer Science, 414 p.

**Recommended literature:**
Environmental Change and Sustainability. Edited by Steven Silvern and Stephen Young, InTech, 312 p., ISBN 978-953-51-1094-1, DOI: 10.5772/46198
https://www.intechopen.com/books/environmental-change-and-sustainability

**Schedule:**

*1st week* Introduction to the course

*2nd week* The basis of the system theory, the Earth as a unified system.

*3rd week* The basic environmental problems and environmental protection.

*4th week* Sustainable development and environmental protection.

*5th week* The role of sciences, economy and education in environmental protection.

*6th week* The relationship between demographical processes and the natural environment.

*7th week* Carrying capacity of the Earth.

*8th week* The city as an environmental system. The main characteristics and problems of the urban environment. The green cities.

*9th week* The impact of production and consumption on the environment and human health.

*10th week* The pollution of the atmosphere, hydrosphere and pedosphere.

*11th week* The environmental consequences of the waste management.

*12th week* The destruction of wildlife.

*13th week* Environmental Principles in practice.

*14th week* Evaluation of the course, instructions for the exam.

**Requirements:**

Attendance at **lectures** is recommended, but not compulsory.

The minimum requirement for the examination is 51%. Based on the score of the test, the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-50% | fail (1) |
| 51-60% | pass (2) |
| 61-70% | satisfactory (3) |
| 71-85% | good (4) |
| 86-100% | excellent (5) |

If the score of any test is below 51%, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. György Szabó, associate professor, PhD

**Lecturer:** Dr. György Szabó, associate professor, PhD

**Title of course**: Physical and historical geology
**Code**: TTGBE5003_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment:
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: Introduction to geology

**Further courses built on it**: -

**Topics of course**

The aims of the course include the establishment of a modern dynamic view for the students that make the understanding of the difficult and variable material and crust development system of the earth and the recognising of the processes of general and local significance. Further aims include making students familiar with structural geological features, making them capable of measuring the most important structural elements in the field and understanding illustration techniques used in the literature, reading the structural geological figures and diagrams.

Over the practicals the students will learn the formation of earth type planets and the most important structural and geophysical conditions of the earth. The general interior structure of our planet is discussed together with the structural results (faults and folds) of the movements occurring in the mantle. In the second half of the semester the major phases of plate tectonics (riftogenesis, tectogenesis, orogenesis, cratonisation) are discussed reflecting on the associated volcanism and formation of igneous rocks. The relationship between orogenic mega-cycles and sedimentary depositional environments are also interpreted. Finally, a general outline of the structural conditions and tectonic development of the Alp-Carpathian region and the Pannonian Basin is also given.

**Literature**

*Compulsory:*

- Earle S. (2015): Physical geology – BC Campus Open Textbook, 720 p.
- Wicander R. – Monroe J.S. (2012): Historical geology – Cengage Learning, 448 p.

*Recommended:*

-

**Schedule:**

*1st week* – Discussing the terms of sedimentology, bedding and facies. Methods of facies correlation.

2nd *week* – Fundamentals of stratigraphy, age determinations, principles of lithostratigraphy and biostratigraphy. Formation, taxon, Oppel zone, micropalaeontology, chronostratigraphy.

*3rd week* – Siliciclastic sedimentary systems. Walther's facies law, parasequences, sequence stratigraphy.

*4th* week – Carbonaceous sedimentary systems. Textural variations, Wilson's facies belts.

*5th* week – Orogene megacycles. Plate tectonics, early divergence, rifting, early convergence, subduction, tectogenesis, orogenesis, cratonisation.

*6th* week – Development of the crust and life in the Precambrian.

*7th* week – Development of the crust and the flora in the Palaeozoic.

*8th* week – Development of animals in the Palaeozoic I.

*9th* week – Development of animals in the Palaeozoic II.

*10th* week – Development of the crust in the Mesozoic.

*11th* week – Development of life in the Mesozoic.

*12th* week – Development of the crust and the flora in the Cenozoic.

*13th* week – Development of animals in the Cenozoic.

*14th week* – Development and events in the Quaternary.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*

The course ends in a written and oral complex **examination** that is composed of two parts: 10 basic questions, out of a list given to the students at the start of the semester and an oral examination based on a randomly chosen topic. The final grade is calculated as below:

- the result of the basic questions: 20%
- the result of the oral examination (80%)

The grade for the course is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-50 | fail (1) |
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

If the score of student result is below 50, students can re-take the exam in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Attila Virág, assistant professor, PhD

**Lecturer:** Dr. Attila Virág, assistant professor, PhD

| **Title of course**: Climatology of Hungary<br>**Code**: TTGBE5505_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 3 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 42 hours<br>- practice: -<br>- laboratory: -<br>- home assignment:<br>- preparation for the exam: 48 hours<br>Total: 90 hours | |
| **Year, semester**: 2nd year, 2nd semester | |
| **Its prerequisite(s)**: - | |
| **Further courses built on it**: - | |

**Topics of course**

The aim of the course is to provide knowledge passive and active climate forming factors that shape the climate of Hungary; the temporal and spatial patterns of climate parameters of the country; special characteristics of the climate in the regions of Hungary and the climate change scenarios for the country.

**Literature**

Compulsory literature:

G. Boyle: Renewable Energy: Power for a Sustainable Future Oxford University Press (2012) ISBN-10:0199545332

Additional literature:

V. Sivaram: Taming the Sun: Innovations to Harness Solar Energy and Power the Planet The MIT Press (2018) ISBN-10: 0262037688

Mohamed A. El-Sharkawi: Wind Energy: An Introduction1st Edition CRC Press; (2015) ISBN-10**:** 1482263998

M. Doeden Finding Out About Hydropower. Searchlight Books. Lerner Classroom (2014) ISBN-10: 1467745553

C- Pinto McCarthy: The Science of Biomass Energy (Science of Renewable Energy) Referencepoint Pr Inc (2018) ISBN-10: 1682823016

**Schedule:**

*1st* week – General characteristics, active and passive forming factors of the climate of Hungary. Synoptic weather types.

*2nd* week – Spatial and temporal (diurnal and seasonal) variability of climate parameters in Hungary 1: spatial and temporal characteristics of radiation in Hungary: potential and effective irradiance, photosynthetically active irradiation, albedo, radiation balance.

*3rd week* – Spatial and temporal (diurnal and seasonal) variability of climate parameters in Hungary 2: soil temperatures. Annual and diurnal courses of temperatures in different depths in the soil. Soil frost.

*4th* week – Spatial and temporal (diurnal and seasonal) variability of climate parameters in Hungary 3: Characteristics of air temperatures. Annual and monthly mean temperatures in the coldest and warmest months, annual course of temperatures. Air temperature extremes; spatial pattern in the number of winter and summer threshold days.

*5th week* – Spatial and temporal (diurnal and seasonal) variability of climate parameters in Hungary 4: Evapotranspiration, air humidity fog and cloudiness. Spatial and temporal patterns of potential and effective evapotranspiration, fog and cloudiness.

*6th week* – Spatial and temporal (diurnal and seasonal) variability of climate parameters in Hungary 5: precipitation1. Seasonal and spatial patterns of the intensity of summer period precipitation and the number of rainy days, droughts, hails, thunderstorms. Relationships between precipitation and soil erosion.

*7th week* – Spatial and temporal (diurnal and seasonal) variability of climate parameters in Hungary6: precipitation 2. Characteristics of winter precipitation. Spatial patterns in the number of snowy and snow cover days, the thickness of snow cover. Characteristics of hoar-frost.

*8th week* – Spatial and temporal (diurnal and seasonal) variability of climate parameters in Hungary 7: Diurnal and seasonal changes, spatial pattern of atmospheric pressure, relationships between spatial patterns of air pressure and formation of winds.

*9th* week – Spatial and temporal (diurnal and seasonal) variability of climate parameters in Hungary 8: Diurnal and seasonal changes, spatial pattern of, wind directions and wind speeds. Dominant wind directions and wind direction regions of the country.

*10th week* – Climatic regions of Hungary according to the Köppen, Trewartha, the Kakas and the Péczely system.

*11th* week – Characteristics of the macro regions of Hungary 1: the climate of the great Hungarian Plain, the Little Hungarian Plain, and the Foothills of the Alps.

*12th* week – Characteristics of the macro regions of Hungary 2: the climate of the Transdanubian hills, the Transdanubian mountain ranges and the North Hungarian Mountains.

*13th* week – The global warming and Hungary 1: monitoring and forecasting climate change; global climate warming scenarios and their down scaling to the Carpathian basin.

*14th week* – The global warming and Hungary 2: The global warming in the Carpathian basin so far. Possible developments till the end of the 21st century on the base of the scenarios. Mitigation measures.

**Requirements:**
Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

| |
|---|
| **Person responsible for course:** Dr. Sándor Szegedi, associate professor PhD |
| **Lecturer:** Dr. Sándor Szegedi, associate professor PhD |

| **Title of course**: Geological mapping<br>**Code**: TTGBG5010_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 8 hours
- preparation for the test: 24 hours

Total: 60 hours

**Year, semester**: 2nd year, 2nd semester

**Its prerequisite(s)**: Mineralogy and petrology II

**Further courses built on it**: -

**Topics of course**

The aims of the course include the presentation of the most important tasks and methods of geological, applied geological and geophysical research, the knowledge of the construction principles of maps and profiles to be drawn based on the databases obtained via the above research, and also of their important information content and application possibilities.
Thematic, target research, regional geological, geophysical and other issues are discussed for the solution of which traditional and modern mapping and profiling, borehole and aerial photo interpretation techniques can be applied. Students become familiar with national and international mapping scales, the most important data requirements according to scale, construction principles and legend basics. Students also models the basics of map and profile drawing, practices the techniques of map reading and interpretation together with their applicability via test tasks.
Special focus is also given to derived, applied and engineering geological map types.

**Literature**

*Compulsory:*

Mc Clay K. (1995): The mapping of Geological Structures. Geolog. Soc. of London Handbook – John Wiley Sons, Chichester, New York, Brisbane, Toronto, Singapore

*Recommended:*

Erdélyi M. – Gálfi J. (1988): Surface and subsurface mapping in Hydrogeology – Academic Press, Budapest

**Schedule:**

*1st week* – History of geological mapping, the system of geological and geology related maps. Traditional, resultant and applied geological maps.

*2nd week* – Traditional geological maps and map series of Hungary. Steps, preparations, devices and results of practical geological mapping. Using the geological compass for measuring dip direction, dip angle, strike and calculating apparent dip. Sampling in the course of geological mapping, the use of shallow geological mapping boreholes.

*3rd week* – Basic examination methods used in the course of geological mapping, their limits of application and possibilities in Hungary.

| |
|---|
| *4th week* – The system of legends for traditional geological maps. Numbers, colours and symbols used in geological mapping, especially in representing geological formations.<br>*5th week* – Studying and analysing traditional geological maps: Covered and uncovered geological maps of Hungary. System and elements of the International Chronostratigraphic Chart. Colours of geological eras, periods and ages.<br>*6th week* – Preparing applied geological maps like slope stability maps. Measuring and estimating unconfined compressive strength (UCS) as rock strength. Strength of loose sediments, water content, plasticity index and consistency index. Engineering geological and construction geological maps and atlases.<br>*7th week* – The relationship between rock strength values and land development. Rock strength and rock mass strength. UCS measurements, RQD value, Rock Mass Rating and Rock Mass Index.<br>*8th week* – Applied geological maps: considered factors, their weighing in relation to pollution sensitivity maps. General and specific pollution sensitivity maps, vulnerability maps.<br>*9th week* – Geophysical map (e.g. magnetic anomaly, Bouguer anomaly, seismic) classification, basic conditions, parameters, and construction, their application and reliability.<br>*10th week* – Geochemical map classification, basic conditions, parameters, and construction, their application and reliability.<br>*11th week* – Test in writing<br>*12th week* – Geological profile and section construction at a given scale on the basis of three observation points in colour.<br>*13th week* – Drawing of a folded structure in colour on the basis of observations and measurements made at ten points.<br>*14th week* – Drawing of the lithology sequence of a borehole and preparing a cross section based on several borehole lithology series at a given scale using graphical symbols. |
| **Requirements:**<br>*- for a signature*<br>Attendance at **practicals** is compulsory, absence of students shall not exceed three occasions.<br>*- for a grade*<br>Grades are given on the basis of one test and at least two drawings in the study period. The share of the tasks in the final grade is the following:<br>test: 40% drawing I: 35% drawing II: 25%<br>The grade for the test is given according to the following table:<br>Test Score (%) – Grade<br>0-50 – fail (1)<br>50-59 – pass (2)<br>60-74 – satisfactory (3)<br>75-87 – good (4)<br>88-100 – excellent (5)<br>If the score of student result is below 50, students can re-take the test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. |
| **Person responsible for course:** Dr. Richard William McIntosh, assistant professor, PhD |
| **Lecturer:** Dr. Richard William McIntosh, assistant professor, PhD |

| **Title of course**: Cartography<br>**Code**: TTGBE7001_EN | **ECTS Credit points: 5** |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: 2 hours/week
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: 28 hours
- laboratory: -
- home assignment: 24 hours
- preparation for the exam: 70 hours

Total: 150 hours

**Year, semester**: 1st year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: Geoinformatics I.

**Topics of course**

Students learn the main coordinate reference systems (world and national projections) and the fundamental knowledge for map editing, map reading, map types and the possibilities of digital cartography. Map elements, frame, legend, scale bar, northing, searching net, scale number. Map types: topographyc, thematic; new map types: dynamic maps, story map.

**Literature**

Compulsory literature:

Slocum, T.A. - McMaster, R.B. - Kessler, F.C. - Howard, H.H. (2014): Thematic Cartography and Geovisualization. Pearson, 620 p.

Monmonier, M. - de Blij, H.J. (1996): How to lie with maps. The University Chicago Press

Robinson A.H. (1995): Elements of Cartography. Wiley, 674 p

**Schedule:**

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

**-** *for a grade*
The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
| --- | --- |
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Szilárd Szabó, university professor, DSc

**Lecturer:** Dr. Szilárd Szabó, university professor, DSc

| **Title of course**: Digital terrain modelling<br>**Code**: TTGBG7020-EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**

- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**

- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 16 hours
- preparation for the exam: 16 hours

Total: 60 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The course aims to give the students an overview of DEM applications and analysis in geo-scientific research and investigation. You will gain experience in working with different digital tools for geographical information handling. This course focuses on the generation, analysis, classification and application of digital elevation models (DEMs) in combination with remotely sensed data on environmental topics like landform distribution, slope hazards and other processes, both terrestrial and sub-marine. The course gives specialised lectures and training in: geomorphometrical description of the earth surface, generation of DEMs and interpolation procedures, terrain parameterisation, topographic classification, applications of topographic analysis on geomorphological processes and slope hazard.

**Literature**

*Compulsory:*

- Li, Z. - Zhu, C. – Gold, C. (2005): Digital terrain modelling: principlies and methodology. CRC Press. p. 340
- Wilson, J.P. – Gallant J.C. (2000): Terrain analysis: principles and Applications. John Wiley and Sons Inc., p. 520.

*Recommended:*

- Hengl, T. – Reuter, H.I. (2008): Geomorphometry – Concepts, Software, Applications. Elsevier, p. 722.

**Schedule:**

1st week

Introduction, theoretical background. Study and aims of geomorphometrical analyses, clarify of fundamental concepts, trends and aspects in terrain analyses.

2nd week

Morphometrical parameters, choosing and combination of parameters, relative qualifying methods, operations with sets, choosing of resolutions. Types of status, process and potential maps. Classical, one-factor morphometrical mapping.

3rd week

Types, analyses and legend of geomorphological maps. Evaluating geomorphological maps (morphometrical, morphogenetical).

4th week

Special (derived and complex) geomorphological maps (hydrological, forecast about meander wandering, geomorphological relief qualification).

5th week

Landscape and field rating (methods, factors, agricultural and forestry rating maps).

6th week

Interpretation of digital terrain models, possible types of DTM-s. Visualization possibilities of DTMs (contour maps, hypsometrical representation, shaded relief, 3D-visualization). Preparing of digital terrain models.

7th week

Global database of DTMs (SRTEN, ASTER, AUDAM) and their features.

8th week

Software applications I. Introduction to applied software and basic user steps. Downloading DTMs from the WEB. Visualization of DTMs, implementation raster and topological analyses.

9th week

Software applications II. Visualization of basic morphometrical parameters (aspect, slope), reclassifying parameters. The connection between geomorphic features and derived parameters. Preparing path profile.

10th week

Software applications III. Raster analyses: area and perimeter calculations, examination of elevation data distribution with histogram. Visibility analyses. Using of different neighborhood filters (max., min., median).

11th week

Software application IV. Hydrological analyses (generating streamline structure, watershed analyses, 3D visualisation and analyses, flood modeling).

12th week

Software applications V. Computing of complex geomorphometrical parameters (Hammond-index, HWI-index, TPI-index).

13th week

Practice, systematization of knowledge, discussing of problems.

14th week

Written exam.

**Requirements:**

*- for a grade*

Attendance at **lectures** is compulsory.

A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to **submit all the two designing tasks** as scheduled minimum on a sufficient level.

During the semester there are two tests: the mid-term test in the 8$^{th}$ week and the end-term test in the 15$^{th}$ week. Students have to sit for the tests.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

| Score | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Gábor Négyesi, assistant professor, PhD

**Lecturer:** Dr. Gábor Négyesi, assistant professor, PhD
Dr. Boglárka Balázs, assistant professor, PhD

| **Title of course**: Geothermics<br>**Code**: TTGBE5011_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: TTGBG5004_EN

**Further courses built on it**: -

**Topics of course**

Physical definition of energy, heat, temperature and its measurement, principal phenomena of thermodynamics, heat generation, specific heat capacity, heating value, thermal expansion, heat transfer, heat flux density. Source of heat on the Earth, the role of heat in the energy transfer and particle movement of outer and inner geospheres, in forming of minerals, rock, raw materials, Relation between the magmatism, tectonism and geothermal energy. Temperature and heat flux density field of the Earth. Geothermal methods in geological and geophysical research. Hyperthermal areas, areas with high enthalpy and low enthalpy, geothermal systems, thermal karst areas, thermal water fields, geysers, thermal springs, etc. Possibilities of the heat production from deep reservoirs, hot dry rocks and springs. Thermal wells, borehole heat exchangers, heat pumps, geothermal power plants, heating and warming sanitary hot water, heat losses, communal and agricultural utilization in domestic and international examples.

**Literature**

*Compulsory:*
- Banks, D. (2008): An Introduction to Thermogeology. Ground Source Heating and Cooling, Blackwell Publishing, 339 p.
- Pasquale, V. – Verdoya, M. – Chiozzi, P. (2014): Geothermics. Heat Flow in the Lithosphere, Springer, 119 p.
- Stober, I. – Bucher, K. (2013): Geothermal Energy. From Theoretical Models to Exploration and Development, Springer, 291 p.

*Recommended:*
- Eppelbaum, L. – Kutasov, I. – Pilchin, A. (2014): Applied Geothermics, Springer, 751 p.
- Watson, A. (2013): Geothermal Engineering. Fundamentals and Applications, Springer, 336 p.
- Ochsner, K. (2007): Geothermal Heat Pumps. A Guide for Planning and Installing, Earthscan, 146 p.
- DiPippo, R. (2015): Geothermal Power Plants (Fourth Edition). Principles, Applications, Case Studies and Environmental Impact, Elsevier, 762 p.

**Schedule:**

*1st week* – Subject of geothermics, the role of the renewable energy sources of the primary energy demand of the World. Global problems of the energy usage and possible answers.

*2nd week* – The most important thermodynamic state quantities, laws of thermodynamics. Usage of different fuels and sources, depend on its energy density.

*3rd week* – Transfer of heat. Radiation and its physical description. Thermal conduction, laws of Fourier. Measuring thermal conductivity.

*4th week* – Heat convection in geothermics. Local and global heat balance. Radiogenic heat production

*5th week* – Thermodynamic phenomena in geology: stability, crystal lattice, phase diagram. Thermal expansion, heating value and specific heat capacity in geological aspect.

*6th week* – Possible definition of geothermal energy (temperature distribution, geothermal gradient, heat flux density) and its relation with the plate tectonics. Geothermal characteristics of divergent plate boundaries and hot spots.

*7th week* – Geothermal characteristics of convergent plate boundaries, environments with sedimentary rocks and sediments. Classification of geothermal reservoirs. Geological exploration for geothermal energy utilization.

*8th week* – Technological conditions of the geothermal energy production in closed and open systems. Geothermal resource assessment.

*9th week* – Methods for utilization of geothermal energy I: Lindal diagram, geological condition and realization of installation of geothermal power plant types. Heating, balneological, agricultural use of thermal water.

*10th week* – Methods for utilization of geothermal energy II: Heat pumps. Geological condition and realization of installation of ground loop in heat pump systems. World tendencies of geothermal energy utilization.

*11th week* – Presentation of the most important geothermal energy using countries: Italy, New-Zealand, United States of America, Iceland.

*12th week* – Geology of Europe in the aspects of geothermal energy utilization. Realized geothermal energy usage, statistics. Possible ways of progress and their terms.

*13th week* – Effects of geothermal energy utilization on the environment in closed and open systems. Sustainable geothermal energy utilization.

*14th week* – Anthropogenic thermal pollution and their reduction: effective industrial and residential energy use. Future of the geothermal energy utilization.

**Requirements:**

*- for a signature*
Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*
The course ends in a written **examination**.

The minimum requirement for the examination is 60%. The grade for the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |

| | |
|---|---|
| 90-100 | excellent (5) |

If the score of the test is below 60 %, students can take a retake test in conformity with the Education and examination rules and regulations.

**Person responsible for course:** Dr. Tamás Buday, assistant professor, PhD

**Lecturer:** Dr. Tamás Buday, assistant professor, PhD

| **Title of course**: Calculations in hydrodynamics and geothermics<br>**Code**: TTGBG5030_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 13 hours
- preparation for the exam: 19 hours

Total: 60 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: TTGBG5006_EN

**Further courses built on it**: -

**Topics of course**

Introduction to hydrodynamic and geothermal problems. Main equations (Darcy's law, Fourier's law) and its analytical resolutions in special cases. Numerical modelling in hydrogeology, heat flow, water and heat production. Introduction to MODFLOW, SHEMAT, FEFLOW modelling software.

**Literature**

*Compulsory:*
- Chiang W-H. – Kinzelbach W (2001): 3D-Groundwater Modeling with PMWIN, Springer, Berlin, Heidelberg, New York
- Banks, D. (2008): An Introduction to Thermogeology. Ground Source Heating and Cooling, Blackwell Publishing, 339 p.
- Pasquale, V. – Verdoya, M. – Chiozzi, P. (2014): Geothermics. Heat Flow in the Lithosphere, Springer, 119 p.

*Recommended:*
- Kovács B. (2004): Hidrodinamikai és transzportmodellezés (Processing MODFLOW környezetben) I. Gáma-Geo, Miskolc, 159 p.
- Kovács B. – Szanyi J. (2005): Hidrodinamikai és transzportmodellezés (Processing MODFLOW környezetben) II. Gáma-Geo, Miskolc, 209 p.

**Schedule:**

*1st* week – Basic concepts of model building. Solid models in hydrogeology and geothermics. Principles of analytical, numerical, finite difference and finite element methods.

*2nd* week – Basic relations of the movement of groundwater, hydrodynamics equations, Darcy's law. One dimensional steady-state seepage.

*3rd* week – Groundwater movement around producing and injection wells (analytical solutions).

*4th* week – Groundwater movement determined by numerical methods – data collection and management, model building

*5th week* – Groundwater movement determined by numerical methods – calibration of the models, running of the models

*6th week* – Mid-term test. Elaboration of the student's research plans in the topic of solid models and hydrodynamic models.

*7th* week – Basic relations of the heat transport, phenomena of heat conduction and heat convection, role of heat transfer coefficient in calculations.

*8th* week – Analytical solution of simple heat conduction processes.

*9th* week – Heat transfer in pipes (producing wells, borehole heat exchangers, etc.)

*10th week* – Numerical modelling of heat transfer I. – data collection and management, model building

*11th week* – Numerical modelling of heat transfer II.– calibration of the models, running of the models

*12th week* – End-term test. Elaboration of the student's research plans in the topic of heat transport models.

*13th week* – Analytical or numerical calculations in the chosen topic.

*14th week* – Presentations of the students' tasks.

**Requirements:**

*- for a signature*

Attendance at **lectures** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

*- for a grade*

During the semester there are two tests: the mid-term test in the 6th week and the end-term test in the 12th week. The course contains a practice task (model building) also.

The minimum requirement for each tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of any test is below 60, students can take a retake test during the semester.

The grade of the practice is the average of the three grade (two tasks and one presentation).

**Person responsible for course:** Dr. Tamás Buday, assistant professor, PhD

**Lecturer:** Dr. Tamás Buday, assistant professor, PhD

**Title of course**: Atmospheric energy sources
**Code**: TTGBE5506_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 2nd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The aim of the course is to introduce students into theoretical issues of the utilization of atmospheric energy sources. Types and main features of different atmospheric energy sources are discussed. Natural basics and technologies of their utilization are discussed in the frame of the course. Students learn how to evaluate feasibility of renewable energy projects from financial and social aspects. Students gain comprehensive knowledge on theoretical issues of solar, wind, hydropower and biomass energy production and utilization.

**Literature**

Compulsory literature:

G. Boyle: Renewable Energy: Power for a Sustainable Future Oxford University Press (2012) ISBN-10:0199545332

Additional literature:

V. Sivaram: Taming the Sun: Innovations to Harness Solar Energy and Power the Planet The MIT Press (2018) ISBN-10: 0262037688

Mohamed A. El-Sharkawi: Wind Energy: An Introduction1st Edition CRC Press; (2015) ISBN-10**:** 1482263998

M. Doeden Finding Out About Hydropower. Searchlight Books. Lerner Classroom (2014) ISBN-10: 1467745553

C- Pinto McCarthy: The Science of Biomass Energy (Science of Renewable Energy) Referencepoint Pr Inc (2018) ISBN-10: 1682823016

**Schedule:**

1st week – Definition of atmospheric energy sources, their types and position within the system of renewable energy sources. General characteristics, ways of utilization and tendencies in the World, in Europe and in Hungary with special respect to the possibilities of utilization of solid biomass.

2nd week – Definition of biogenic energy sources, their types and position within the system of renewable energy sources. General characteristics, ways of utilization and tendencies in the World, in Europe and in Hungary.

3rd week – Types of biogas. Technologies of biomass production. Ways of gaseous biomass utilization in energy production and tendencies in the World, in Europe and in Hungary.

4th week – Types of bio fuels. Technologies of bio fuel production. Ways of biomass utilization in fuel production and tendencies in the World, in Europe and in Hungary.

5th week – Development of air flows. General characteristics of wind from the aspect of energy production. instruments of energetic wind speed measurements, analyses of wind energy maps

6th week – History and development of the instruments and technologies of wind energy production. Legal conditions of the establishment of wind turbines. Characteristics of windmills, wind generators and wind turbine types.

7th week – Review of the utilization of wind energy in the World, in Europe and in Hungary. The future of wind energy utilization in Hungary.

8th week – Physical characteristics of the Sun. Forms of solar radiation, its energetic characteristics, losses of solar radiation in the atmosphere.

9th week – Possibilities of the passive and active utilization of solar energy. Solar energy utilization in architecture, heat absorber and insulating materials. Characteristics and opportunities of solar spaces and passive houses.

10th week – Opportunities for heat production from solar energy.Types forms and technical characteristics of solar collectors. Application opportunities of different solar collector types.

11th week – Opportunities for electric power production from solar energy.Types forms and technical characteristics of photovoltaic panels. Application opportunities of different photovoltaic panel types.

12th week – Meteorological-climatological basics of hydropower utilization. Hydropower plant types and the most important technologies applied.

13th week – History of hydropower utilization. Position of hydropower utilization in the World, in Europe and in Hungary.

14th week – Socio-economic characteristics of atmospheric energy sources; perspectives of their utilization in the World, in Europe and in Hungary. Review on the tenders available for the utilization of atmospheric energy sources.

**Requirements:**
Attendance at **lectures** is recommended, but not compulsory.
*- for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. István Lázár, assistant professor, PhD

**Lecturer:** Dr. István Lázár, assistant professor, PhD

| **Title of course**: Atmospheric energy sources – practice<br>**Code**: TTGBG5507_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 32 hours
- preparation for the exam: -

Total: 60 hours

**Year, semester**: 2nd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The aim of the course is to introduce students into practical issues of the utilization of atmospheric energy sources. Types and main features of different atmospheric energy sources are discussed. Natural basics and technologies of their utilization are discussed in the frame of the course. Students learn how to calculate renewable energy potentials, evaluate feasibility of renewable energy projects from financial and social aspects. Students gain comprehensive knowledge on practical issues of solar, wind, hydropower and biomass energy production and utilization.

**Literature**

Compulsory literature:

G. Boyle: Renewable Energy: Power for a Sustainable Future Oford University Press (2012) ISBN-10:0199545332

Additional literature:

V. Sivaram: Taming the Sun: Innovations to Harness Solar Energy and Power the Planet The MIT Press (2018) ISBN-10: 0262037688

Mohamed A. El-Sharkawi: Wind Energy: An Introduction1st Edition CRC Press; (2015) ISBN-10**:** 1482263998

M. Doeden Finding Out About Hydropower. Searchlight Books. Lerner Classroom (2014) ISBN-10: 1467745553

C- Pinto McCarthy: The Science of Biomass Energy (Science of Renewable Energy) Referencepoint Pr Inc (2018) ISBN-10: 1682823016

**Schedule:**

*1st week* – Review of solid biomass used for heat generation (potential, sources). Availability of raw materials, potential logistical problems.

*2nd week* – Technologies of the chopped wood, wooden fuel cake and pellet production. Opportunities of their application on household and local scales.

*3rd week* – Opportunities for the use of solid biomass for energy production. Review on the projects materialized, and analyses of the tendencies in that field.

*4th week* – Workplaces created by biomass production transportation and procession. Spared cost 1.

*5th week* – Workplaces created by biomass production transportation and procession. Spared cost 2.

*6th week* – Mathematical formulas for the determination of wind speeds at different heights. Determination of the Hellman index and specific wind power, exercises for calculation of efficiency.

*7th week* – Comprehension of technical parameters of wind turbines according to producer, types and size. Legal conditions of the establishment of wind turbine projects.

*8th week* – Impacts of wind turbines on living and inert environment via Hungarian and international examples with a special respect to animals, noise and landscapes.

*9th week* – Review on the meteorological background of solar energy. Calculation methods of solar energy potential for different expositions.

*10th week* – Technical characteristics and structures of solar collector systems. Application issues of different solar collector types.

*11th week* – Technical characteristics and structures of photovoltaic panels systems. Application issues of different photovoltaic panel types.

*12th week* – Methods for the determination of natural and technical hydropower potentials.

*13th week* – Natural, economic and social impacts of hydropower utilization 1. Environmental hazards during the construction and working of different technology, size and capacity hydropower plants.

*14th week* – Natural, economic and social impacts of hydropower utilization 2. Evaluation of advantages disadvantages and hazards during the construction and working different technology, size and capacity hydropower plants.

**Requirements:**

**-** *for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

**-** *for a grade*

The course ends in a **practice grade**.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |

| | |
|---|---|
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. István Lázár, assistant professor, PhD

**Lecturer:** Dr. István Lázár, assistant professor, PhD

| **Title of course**: Earth sciences fieldwork<br>**Code**: TTGBG7505_EN | **ECTS Credit points:** 4 |
|---|---|

**Type of teaching, contact hours**

- lecture: -
- practice: 4 days
- laboratory: -

**Evaluation:** one tests towards the end of the fieldwork

**Workload (estimated), divided into contact hours:**

- lecture: -
- practice: 48 hours
- laboratory: -
- home assignment: -
- preparation for the tests: 72 hours

Total: 120 hours

**Year, semester**: 1st year, 2nd semester

**Its prerequisite(s)**: Mineralogy and petrology I, Meteorology and climatology I

**Further courses built on it**: -

**Topics of course**

The aim of the course is to enable students to test the learnt earth scientific methods and to get to know and study the geological, geographical and meteorological conditions of northeastern Hungary.

**Literature**

*Compulsory:*

- Budai T. – Gyalog L. (eds.)(2009): Geological map of Hungary – Geological Institute of Hungary, Budapest, 248 p.
- Haas J. – Budai T. (eds.) (2014): Explanatory notes to the Pre-Cenozoic geological map of Hungary – Geological and Geophysical Institute of Hungary, Budapest, 73 p.

*Recommended:*

- Haas J. (2013): Geology of Hungary – Springer-Verlag, Berlin-Heidelberg, 246 p.

**Schedule:**

*not relevant*

**Requirements:**

- *for a signature*

Attendance at **the fieldwork** is compulsory.

- *for a grade*

Grades are given on the basis of active participation and one test.

The grade for the course is given according to the following table:

| Test Score (%) | Grade |
|---|---|
| 0-50 | fail (1) |

| | |
|---|---|
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

If the score of student result is below 50, students can improve the result of their test by the quality of their rock collection and also by answering additional test questions in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Richard William McIntosh, assistant professor, PhD

**Lecturer:** Dr. Richard William McIntosh, assistant professor, PhD

| **Title of course**: Methods in geophysics<br>**Code**: TTGBE5012_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 2nd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: TTGBG5013_EN

**Topics of course**

Subject of geophysics. Theoretical base of the geophysical methods and general steps of analysis of geophysical data. Physical base of gravity method, possible applications, separation the regional and local anomalies. Physical base of seismic methods, possible applications of reflected and refracted waves. Magnetic and electrical field of the Earth, its temporal and spatial changes. Electromagnetic methods, base of vertical electric sounding, constant separation traversing, multi-electrode arrays. Theoretical base of well-logging, borehole and its surrounding, connection to the surface geophysical surveys, the most important logs. Complex geophysical surveys, the position of the geophysics in the researches in the field of structure geology, mineral resources, engineering geology and environmental geology.

**Literature**

*Compulsory:*
- Musset, A. E. – Khan, A. E. (2009): Looking into the Earth. An introduction to geological geophysics, Cambridge University Press, 470 p.
- Reynolds, J. M. (2011): An introduction to applied and environmental geophysics, Wiley–Blackwell, 696 p.

*Recommended:*
- Ellis, D. V. – Singer, J. M. (2008): Well logging for Earth Scientists, Springer, 692 p.
- Asquith, G. – Krygowski, D. (2004): Basic Well Log Analysis, AAPG Methods in Exploration Series, No. 16, AAPG, Tulsa, 244 p.
- Gadallah, M. R. – Fisher, R. (2009): Explorational geophysics. An Introduction, Springer, 262 p.
- Pethő G. – Vass Péter (2011): Geophysics. – digital textbook, University of Miskolc

**Schedule:**

*1st week* – Subject, aim and subdivisions of geophysics. Steps of geophysical survey (data collection, analysis and interpretation).

*2nd week* – Basic physical concepts of gravity methods. Measurement of gravity, role of Eötvös in the early geophysics. Corrections to gravity observations, interpretations. Gravity in the studies of Earth structure.

*3rd week* – Basic physical concepts of seismic methods. Seismic wave types, reflection and refraction. Seismic energy sources, detection of seismic waves. Seismic records.

*4th week* – Reflection data processing and interpretation. Seismic profiles and geological settings.

*5th week* – Studies of the Earth's structure by seismology and seismic tomography.

*6th week* – Basic physical concepts of geoelectrical methods. Presentation of the measurement ways and applicability of the most important active and passive methods.

*7th week* – Aim and role of electrical resistivity methods in geological research. Modes of deployment and their applicability (VES, CST, scanned array).

*8th week* – Basic physical concepts of geomagnetic methods. Magnetic field of the Earth. Magnetic surveying and interpretation. Electromagnetic methods.

*9th week* – Basic physical properties of radiation. Radioactive decay, particles and radiation. Measuring and geological interpretation of radiation. Radiation in historical geology and geothermics.

*10th week* – Conditions of using well-logs and relation between the surface and subsurface geophysical methods. Effects of the drilling on the geological medium. Measuring and interpretation of resistivity, self-potential and radioactivity logs.

*11th week* – Technological measurements in wells. Temperature, porosity and density determination in wells.

*12th week* – Case studies: geoelectrical resistivity measurements in coal industry; magnetic measurements for archaeological purposes.

*13th week* – Seismic sections and basin analysis - theory and case studies.

*14th week* – Case studies: well-logs in sequence stratigraphy based basin analysis and water resource management.

**Requirements:**

*- for a signature*
Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*
The course ends in a written **examination**.

The minimum requirement for the examination is 50%. The grade for the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-69 | satisfactory (3) |
| 70-79 | good (4) |
| 80-100 | excellent (5) |

If the score of the test is below 50 %, students can take a retake test in conformity with the Education and examination rules and regulations.

**Person responsible for course:** Dr. Tamás Buday, assistant professor, PhD

**Lecturer:** Dr. Tamás Buday, assistant professor, PhD

| **Title of course**: Geophysical data and geological interpretation<br>**Code**: TTGBG5013_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: 21 hours
- preparation for the exam: 11 hours

Total: 60 hours

**Year, semester**: 3rd year, 2nd semester

**Its prerequisite(s)**: TTGBE5012_EN

**Further courses built on it**: -

**Topics of course**

Processing of gravity data, its usability in geology. Interpretation of the seismic data, drawing ray path, data processing. Geological interpretation of seismic sections (structural geology, basin analysis). Processing of surface geoeletrical data: pseudo sections, maps. Quick method of well-log analysis. Shape of the electrical and radiometric logs showing different palaeoenvironments. Determining the lithological column based on well-log data. Correlation between well-logs. complex analysis of seismic and well-log data (depth-time transformation). Complex geophysical surveys, the position of the geophysics in field of structure geology, mineral resources, engineering geology and environmental geology.

**Literature**

*Compulsory:*
- Musset, A. E. – Khan, A. E. (2009): Looking into the Earth. An introduction to geological geophysics, Cambridge University Press, 470 p.
- Reynolds, J. M. (2011): An introduction to applied and environmental geophysics, Wiley–Blackwell, 696 p.

*Recommended:*
- Ellis, D. V. – Singer, J. M. (2008): Well logging for Earth Scientists, Springer, 692 p.
- Asquith, G. – Krygowski, D. (2004): Basic Well Log Analysis, AAPG Methods in Exploration Series, No. 16, AAPG, Tulsa, 244 p.
- Gadallah, M. R. – Fisher, R. (2009): Explorational geophysics. An Introduction, Springer, 262 p.
- Pethő G. – Vass Péter (2011): Geophysics. – digital textbook, University of Miskolc

**Schedule:**

*1st week* – Subject and structure of the course. Forming working groups. Basin analysis by gravity methods.

*2nd week* – Interpretation of seismic reflection surveying data, raypath analysis.

*3rd week* – Software for analysis the seismic reflection surveying data. Preparing simple task on digital seismic database.

*4th week* – Seismic stratigraphy, sequence stratigraphy in basin analysis.

*5th week* – Data analysis based on vertical electrical sounding, determining the possible geological strata.

*6th week* – Data analysis based on vertical electrical sounding and automated array scanning in environmental geophysics, engineering geophysics and archaeology.

*7th week* – Studying magnetic anomalies in detailed geophysical and geological maps.

*8th week* – Well-log analysis based on archive (printed or drawn) logs.

*9th week* – Well-log analysis based on digital database.

*10th week* – Electrofacies and sedimentary structure in fluvial and delta environments.

*11th week* – Correlation between boreholes based on well-log data.

*12th week* – Relationship between seismic and well-log data. Velocity determination and vertical seismic profiling.

*13th week* – Geophysical background of complex geological researches. Summary of the tasks.

*14th week* – End-term test.

**Requirements:**

**-** *for a signature*

Attendance at **practice** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

*- for a grade*

During the curse the students have to prepare tasks, which are graded.

The course ends in a written **examination**.

The minimum requirement for the examination is 50%. Based on the score of the tests separately, the grade for the tasks and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-69 | satisfactory (3) |
| 70-79 | good (4) |
| 80-100 | excellent (5) |

If the score of the test is below 50, students can take a retake.

The grade of the course is the average of the obtained grades.

**Person responsible for course:** Dr. Tamás Buday, assistant professor, PhD

**Lecturer:** Dr. Tamás Buday, assistant professor, PhD

| **Title of course**: Structural geology II<br>**Code**: TTGBG5024_EN | **ECTS Credit points:** 1 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 1 hour/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 14 hours
- laboratory: -
- home assignment: -
- preparation for the tests: 16 hours

Total: 30 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: Structural geology I

**Further courses built on it**: -

**Topics of course**

The most important topics of structural geology are overviewed in the practicals: data forming the basis of structural analysis, deformation, stress and strain, brittle deformation, joints, faults, ductile deformation, folds, foliation, schostosity, lineation and boudins, shear zones and horizontal faults and finally microtectonic features and palaeosoic reconstructions are discussed.

**Literature**

*Compulsory:*
- Fossen H. (2016): Structural geology – Cambridge University Press, 524 p.

*Recommended:*
- Passchier C.W. – Trouw R.A.J. (2005): Microtectonics – Springer-Verlag, Berlin-Heidelberg, 366 p.

**Schedule:**

*1st week* – Structural geological view, identification of the problem, structural analysis, structural data, databases, field data, seismic data, numerical modelling, other data sources. Visualisation of data, diagrams.

*2nd week* – Types of deformation. Simple shear, pure deformation. Deformation history in deformed rocks. Stress and strain. Mohr circle and Mohr diagram, strain analysis. Stress in the lithosphere.

*3rd week* – Brittle deformation. Conditions of failure, reactivation of faults, deformed belts in porous rock. Fault orientation, fault distribution and fault density. Faults and fluid flow.

*4th week* – Practicing the identification and description of joints and faults on images and practical tasks.

*5th week* – Folds and the mechanism of folding. Interference fold, re-folded folds. Development and identification of foliation and schistosity.

*6th week* – Lineation terminology, basic features, appearance in the cases of brittle and ductile deformation. Development and identification of boudins.

*7th week* – Occurrence of shear zones and mylonites. Studying mylonites in core samples and in thin section. Sigma and delta clasts, pressure solution, pressure shadow zones.

*8th week* – Test I

*9th week* – Horizontal faults. Transfer faults, characteristics of transpression and transtension, the development of positive and negative flower structures.

*10th week* – Studying structural features and elements in seismic profiles. Acquisition of seismic profiles, their visualisation and analysis.

*11th week* – Studying structural features and elements under the microscope. Crystal transformations, pressure twinning, micro-structures.

*12th week* – Kinematics and palaeostress reconstruction. Determination of stress based on fault analysis. Structural elements of compression and tension.

*13th week* – Test II

*14th week* – Measurement of rock strength parameters and rock mass strength parameters together with spacing characteristics in the field.

**Requirements:**

*- for a signature*
Attendance at **practicals** is compulsory, absence of students shall not exceed three occasions.

*- for a grade*
Grades are given on the basis of two tests in the study period. Both tests have an equal share in the final grade.

The grade for the course is given as follows:

| Test Score (%) | Grade |
|---|---|
| 0-50 | fail (1) |
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

If the score of student result is below 50, students can re-take the tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Richard William McIntosh, assistant professor, PhD

**Lecturer:** Dr. Richard William McIntosh, assistant professor, PhD

| **Title of course**: Palaeontology I<br>**Code**: TTGBE5018_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: 20 hours
- preparation for the exam: 42 hours

Total: 90 hours

**Year, semester**: 2nd year, 2nd semester

**Its prerequisite(s)**: General and Historical Geology

**Further courses built on it**: -

**Topics of course**

The aim of the course is to introduce the students to the basics of Paleontology. It contains introduction to fossils; the conditions and processes of fossilization. Topics include advances in paleoecology, taphonomy, paleopathology, paleoichnology, paleobiogeography, biostratigraphy, history of extincions, macroevolutionary patterns in fossil record, significant fossil finding localities in Hungary and in abroad, the activity of famous Hungarian and foreign paleontologists.

**Literature**

*Compulsory:*

Benton M.J. – Haper D.A.T. (2009): Introduction to Paleobiology and the Fossil Record – Wiley-Blackwell, Oxford, pp. 1–203.

*Recommended:*

- Főzy I. – Szente I. (2014): Fossils of the Carpathian region, Indiana University Press, Bloomington, p. 483.

Jones, R.W. 2006. Applied palaeontology. Cambridge University Press, Cambridge, p. 452.

McKerrow, W.S. (ed.) (1978): The Ecology of Fossils an illustrated guide, The MIT Press, Cambridge, Massachusetts, p. 384.

McMenamin, M.A.S. (2016): Dynamic Paleontology; Using Quantification and Other Tools to Decipher the History of Life, Springer Geology series, Springer International Publishing, Switzerland, p. 251.

**Schedule:**

*1st week – Fossils and fossilization*

| |
|---|
| *2nd week – Palaeoecology 1.*<br><br>*3rd week – Palaeoecology 2.*<br><br>*4th week – Taphonomy*<br><br>*5th week – Palaeopathology*<br><br>*6th week – Palaeoichnology*<br><br>*7th week – Palaeobiogeography*<br><br>*8th week – Biostratigraphy*<br><br>*9th week – History of Extinctions*<br><br>*10th week – Macroevolutionary patterns in fossil record*<br><br>*11th week – Significant fossil finding localities in Hungary*<br><br>*12th week – Significant fossil finding localities in abroad*<br><br>*13th week – The activity of famous Hungarian palaeontologists*<br><br>*14th week – The activity of famous foreign palaeontologists.* |
| **Requirements:**<br>*- for a signature*<br>Attendance at **lectures** is recommended, but not compulsory. |
| **Person responsible for course:** Dr. Attila Virág, assistant professor, PhD |
| **Lecturer:** Dr. Attila Virág, assistant professor, PhD |

| **Title of course**: Palaeontology II – practice<br>**Code**: TTGBG5019_EN | **ECTS Credit points:** 2 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: -<br>- practice: 2 hours/week<br>- laboratory: - | |
| **Evaluation:** mid-semester grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: -<br>- practice: 28 hours<br>- laboratory: -<br>- home assignment: 32 hours<br>- preparation for the exam: -<br>Total: 60 hours | |
| **Year, semester**: 3rd year, 1st semester | |
| **Its prerequisite**: Palaeontology I | |
| **Further courses built on it**: - | |

**Topics of course**

Methods of fossil collecting, preparation, determination and description. Fossil classification and determination. Examination of the selected representatives of the fossil plants, fungi, and animals on the basis of the following characteristics: systematic order, structure, way of life, phylogeny, geological significance, important finding places in Hungary.

**Literature**

*Compulsory:*

- Benton M. J. (2005): Vertebrate Paleontology, Blackwell Publishing, Oxford, p. 455. ISBN 0-632-05637-1

Clarkson, E. N. K. - Twitchett, R. - Smart, C. (2016 ): Invertebrate Palaeontology and Evolution, Blackwell Science, Oxford, p. 463

Williams, K. J. & McElwain, J.C. (2002): The Evolution of Plants, Oxford University Press, Oxford, p. 378.

*Recommended:*

Főzy I. – Szente I. (2014): Fossils of the Carpathian region, Indiana University Press, Bloomington, p. 483.

Lieberman, B. S. &Kaesler, R. (2010): Prehistoric Life (Evolution and the Fossil Record), Wiely-Blackwell, Oxford, p. 385.

**Schedule:**

*1st week – Methods of fossil collecting and preparation*

*2nd week – Methods of fossil classification and determination*

*3rd week – Development of biogenic structures*

| |
|---|
| *4th week – The evolution of plants I.*<br><br>*5th week – The evolution of plants and fungi*<br><br>*6th week – The Protozoa*<br><br>*7th week – Porifera, Archaeocyatha, Cnidaria*<br><br>*8th week – Vermes*<br><br>*9th week – Mollusca*<br><br>*10th week – Arthropoda*<br><br>*11th week – Tentaculata*<br><br>*12th week – Echinodermata and Hemicordata*<br><br>*13th week – Vertebrata I*<br><br>*14th week – Vertebrata II* |
| **Requirements:**<br>**-** *for a signature*<br>Attendance at **lectures** is recommended, but not compulsory. |
| **Person responsible for course:** Dr. Attila Virág, assistant professor, PhD |
| **Lecturer:** Dr. Attila Virág, assistant professor, PhD |

| **Title of course**: Sedimentology<br>**Code**: TTGBG5016_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** term mark

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 32 hours
- preparation for the exam: -

Total: 60 hours

**Year, semester**: 2nd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The course discusses the definition of sediment, sedimentary geology, principals of sediment generation, processes of erosion, transport and deposition of sediments by water, ice and wind. During the course the main types of sedimentary basin will be reviewed, in addition, the roles of global plate tectonics, production and transport of clastic material, the topography and climate also will be discussed. The student will be able to recognize the sedimentary palaeo-environments by the textural and structural features. Basics of the sedimentary fluid dynamics and the processes of sediment gravity flows also will be introduced. The distribution of sedimentary processes in space and time, and the nature of sediment supply, finally the depositional facies, e.g. alluvial, deltaic, coastal, shallow-marine, slope, deep-marine glacial and aeolian settings are all discussed.

**Literature**

*Compulsory:*

Nichols, G. 2009: Sedimentology and Stratigraphy. A John Wiley & Sons, Ltd., Publication

Stow, D.A.V. 2005: Sedimentary Rocks in the Field. A Color Guide. Academic Press

*Recommended:*

Leyrite, H., Montenat, C. (eds.) 2000: Volcaniclastic rocks from magmas to sediments. Gordon and Breach Science Publisher

Galloway, W.E., Hobday, D.K. 1983: Terrigenous Clastic Depositional Systems Applications to Petroleum, Coal and Uranium Exploration. Springer-Verlag

**Schedule:**

*1st week* – Term and topic of sedimentology. Rock cycle, sediment and sedimentary rock. Weathering, diagenesis, cementation, compaction.

*2nd week* – Facies, lithofacies, biofacies Bedding and lamination.

*3rd week* – Nature and terminology for geometry of bedding and lamination. Basic measurements and data records. Field and laboratory techniques.

*4th week* – Parallel non-parallel and cross- beddings. Types of grading. Depositional features, wavy, lenticular and flaser laminations. Deformation structures, bioturbation.

*5th week* – Sedimentary environments in general. Desert-eolian environment. Alluvial-fluvial environment, lacustrine environment, glacial environment. Near-shore environments.

*6th week* – Shallow and deep marine environments.

*7th week* – Mid-term test. Siliciclastic sediments. Grain size, sorting. Grain morphology: shape, roundness and sphericity.

*8th week* – Sediment fabric. Textural maturity. Chemical and mineralogical characteristics of sediments.

*9th week* – Determination of grain-size: sieve analysis.

*10th week* – Determination of grain-size: hydrometer analysis.

*11th week* – Grain-size distribution, grain-size distribution curves, grading characteristics.

*12th week* – Carbonate rocks: definition, range of types and principal sedimentary characteristics: structure, fabric, texture, composition. Classification of limestones: Folk and Dunham schemes.

*13th week* – Cherts and siliceous sediments, phosphates, ironstones, evaporates, coal and oil.

*14th week* – End-term test.

**Requirements:**

*- for a signature*

Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring a notebook to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two tests, roughly at the half time and the end of the semester.

*- for a grade*

The course ends in a term mark based on the average of the tests.

The minimum requirement for the tests is 50%. Based on the score of the tests the grade is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-61 | pass (2) |
| 62-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

If the score of test is below 50, students can take a retake test in conformity with the education and examination rules and regulations.

*-an offered grade:*

grade cannot be offered for students during the course.

| |
|---|
| **Person responsible for course:** Dr. Árpád Csámer, assistant professor, PhD |
| **Lecturer:** Dr. Árpád Csámer, assistant professor, PhD |

| **Title of course**: Environmental Geology<br>**Code**: TTGBE5020_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 2 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 28 hours<br>- practice: -<br>- laboratory: -<br>- home assignment: 20 hours<br>- preparation for the exam: 42 hours<br>Total: 90 hours | |
| **Year, semester**: 3rd year, 1st semester | |
| **Its prerequisite(s)**: - | |
| **Further courses built on it**: TTGBG5026_EN | |

**Topics of course**

The environmental geology, as a discipline is dealing with the interactions between human population and the physical environment (the spheres of the Earth). The aim of the course is to provide comprehensive knowledge about the environmental problems of the Earth crust and surface, and their geological background. The students are introduced to geological and geophysical investigation methods during the process of the examination and resolving of environmental problems, in addition, current researches focusing on areas of metal and hydrocarbon pollutions, landslide and earthquake predictions and mitigations are emphasized.

**Literature**

*Compulsory:*

Foley, D. et al. 2009: Investigations in environmental geology, Prentice Hall, Upper Saddle River N.J.

Reichard, J.S. 2009: Environmental Geology. McGraw-Hill

*Recommended:*

US. EPA 2007: Introduction to Environmental Geophysics (165.20) Student Manual

White, W.M. 2007: Geochemistry. John Hopkins University Press

**Schedule:**

*1st week* – Origin of the Solar System. Earth and Earth materials: evolution of litho-, atmo-, hydro-, bio- and noosphere. Characterization of lithosphere: Earth's materials. Igneous rocks

*2nd week* – Weathering processes and sedimentary rocks. Metamorphosis and metamorphic rocks.

*3rd week* – Rock cycle. Earth's interior. Plate tectonics, deformation of lithosphere.

*4th week* – Hazardous Earth processes. Volcanoes and volcanic hazards.

*5th week* – Earthquakes and related hazards.

*6th week* – Mass wasting and their hazards. Slope stability, landslides, avalanches, land subsidence.

*7th week* – Streams, floods and their hazards. Fluvial erosion. Coastal processes and hazards. Soils and soil denudation.

*8th week* – Elements of hydrologic cycle. Basics of hydrology and hydrogeology. Surface and ground waters. Sources of freshwater.

*9th week* – Pollution and contamination. Various types of contaminants, their physical-chemical properties and effects on human health and ecosystem.

*10th week* – Transport processes: contaminants in surface water and groundwater, soil and soil gas. Human health and ecological risk assessment.

*11th week* – Soil, soil gas, surface water and groundwater sampling techniques and strategies. Drilling techniques, well installing. Investigation methods in field and laboratory.

*12th week* – Introduction to sustainability. Geological resources resource planning. Environmental impact assessment, environmental site assessment, remediation.

*13th week* – Remediation techniques and technologies for cleaning up contaminated sites.

*14th week* – Solid and liquid wastes. Waste disposal regarding geological and hydrogeological backgrounds. Effects of mining.

**Requirements:**

*- for a signature*
Attendance at lectures is recommended, but not compulsory.

Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to submit a course paper as scheduled minimum on a sufficient level.

*- for a grade*
The course ends in an examination. Based on the grades of the course paper and the examination, the exam grade is calculated as follows:

- written exam in 90%,
- course paper in 10%

The minimum requirement for the written exam is 50%. Based on the score the grade for the written exam is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-61 | pass (2) |
| 62-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

**Person responsible for course:** Dr. Árpád Csámer, assistant professor, PhD

**Lecturer:** Dr. Árpád Csámer, assistant professor, PhD

| **Title of course**: Applied Geology<br>**Code**: TTGBE5021_EN | **ECTS Credit points:** 4 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: 1 hour/week
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: 14 hours
- laboratory: -
- home assignment: 40 hours
- preparation for the exam: 38 hours

Total: 120 hours

**Year, semester**: 3rd year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The aims of the course are to introduce the student to various fields of applied geology, which were not trained during the programme yet. Hence, the student will make familiar with economic geology, mining geology, non-metallic and ore mineral deposits and geology of fossil energy resources. The most important field, analytical and statistical methods of geological exploration also will be taught. Another emphatic part of the course is the principals of the engineering geology, which are essential to develop and maintain built environment. Syllabus of the course will be enriched with the basics of the archaeometry, which can be regarded as a fruitful and progressive section of the archaeology and earth sciences.

**Literature**

*Compulsory:*

Moon, C.M., M.K.G. Whateley, A.M. Evans 2009: Introduction to Mineral Exploration. Wiley-Blackwell, 496 p.

Stoneley, R. 1995: Introduction to Petroleum Exploration for Non-geologists. Oxford University Press, ISBN 0 19 854856 7

*Recommended:*

Rapp, G. 2009: Archaeomineralogy, 2nd ed. Natural Science in Archaeology, Springer-Verlag Berlin 2. Heidelberg, 348 p.

**Schedule:**

*1st week* – Mineral resources, ores, non-metallic minerals, fossil energy materials.

*2nd week* – Main types of magmatic ore occurrences.

*3rd week* – Main types of sedimentary ore occurrences.

*4th week* – Non-metallic mineral resources and industrial minerals.

*5th week* – Petroleum and natural gas.

*6th week* – Basics of mineral exploration.

*7th week* – Mid-term test. Geological examinations in fields.

*8th week* – Exploration drillings. Rotary, RAB, RC etc. drilling techniques.

*9th week* – Sample handling and QA/QC of ore, rock, water and soil samples. Geochemical analysis and assay of geological samples. Well and downhole logging.

*10th week* – Basic mechanics of soils. Soil density, moisture, grain-size distribution. Consistency limits.

*11th week* – Analysis of stress and strain. Special stress and strain states. Slope stability, foundation design.

*12th week* – Groundwater and its effects on soil.

*13th week* – Mechanical behaviour of rock and rock masses. Laboratory and field testing. Geological methods for archaeology. Archaeometry.

*14th week* – End-term test.

**Requirements:**

*- for a signature*

Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two tests, roughly at the half time and the end of the semester.

*- for a grade*

The course ends in an exam.

Based on the average of the grades of the tests and the examination, the exam grade is calculated as the follows:

- the average grade of the two tests in 33%
- the result of the examination in 66%

The minimum requirement for the tests and exam is 50%. Based on the score of the tests the grade is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-61 | pass (2) |
| 62-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

If the score of test is below 50, students can take a retake test in conformity with the education and examination rules and regulations.

| |
|---|
| **Person responsible for course:** Dr. Árpád Csámer, assistant professor, PhD |
| **Lecturer:** Dr. Árpád Csámer, assistant professor, PhD |

| **Title of course**: Geological planning and modelling<br>**Code**: TTGBG5026_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 32 hours
- preparation for the exam: -

Total: 60 hours

**Year, semester**: 3rd year, 2nd semester

**Its prerequisite(s)**: Environmental Geology TTGBE5020_EN

**Further courses built on it**: -

**Topics of course**

The aim of the course is to introduce the main steps of the geological modelling used in the process of geological planning. The syllabus includes specialist knowledge acquired from case studies and project works coming from various parts of mineral exploration and exploitation campaigns and environmental geological projects. The modelling exercises will be resolved using by modelling software widely used in the geosciences, as well as the process will also require team work and individual research.

**Literature**

*Compulsory:*

Grunsky, E.C. 2010: The interpretation of geohemical survey data. Geochemisrty: Exploration, Environment, Analysis 10, 27-74.

Marjoribanks, R. 2010: Geological Methods in Mineral Exploration and Mining. Springer Heidelberg Dordrecht London New York

*Recommended:*

Olea, R.A. 2008: Basic statistical concepts and methods for earth scientists. Open-File Report 2008–1017, U.S. Geological Survey, Reston, Virginia

Culshaw, M G, H J Reeves, I Jefferson and T Spink 2009: Engineering Geology for Tomorrow's Cities. The Geological Society, ISBN 978-1-86239-290-8

**Schedule:**

*1st week* – Geological modelling: the beginning. Data collecting, databases.

*2nd week* – Geological, hydrogeological maps, borehole and well logs

*3rd week* – Geochemical, geophysical datasets. Geophysical databases: seismic, gravity, borehole log, magnetic, magnetotelluric, airborne surveys. Remote sensing, imaging systems, photogeology.

*4th week* – Changes in land use based on 1st 2nd, 3rd military surveys, Corine Land Cover and Copernicus Land Monitoring Programmes. Public utility maps.

*5th week* – Topographical maps. Digital Terrane Models. Usage of topography and DTM data, georeferencing and digitizing.

*6th week* – DTM data processing using GIS applications: raster dataset and TIN models. Aspect, slope maps.

*7th week* – Exercises in Surfer: volume calculation based on simple models.

*8th week* – Exercises in Surfer: data processing, statistical evaluation, layout. Examples for hydrogeological application.

*9th week* – Exercises in Surfer: data processing, statistical evaluation, layout. Examples for mass and concentration calculation based on simple models.

*10th week* – Utilization of geological, geochemical, geophysical datasets in RockWorks.

*11th week* – Grid-based and solid models. Interpolation techniques.

*12th week* – Mass, volume and concentration calculations using RockWorks.

*13th week* – Solution of hydrogeological exercises in RockWorks.

*14th week* – End-term test.

**Requirements:**
*- for a signature*
Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring a notebook to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.
Students have to submit two modelling exercises as scheduled minimum on a sufficient level.
During the semester there is one test at the end of the semester (end-term test in the 14th week).

*- for a grade*
The course ends in a term mark based on the average of the modelling exercises and the end-term test.

The minimum requirement for the exercises and the test respectively is 50%. Based on the score of the test the grade is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-61 | pass (2) |
| 62-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

If the score of test is below 50, students can take a retake test in conformity with the education and examination rules and regulations.

**Person responsible for course:** Dr. Árpád Csámer, assistant professor, PhD

**Lecturer:** Dr. Árpád Csámer, assistant professor, PhD

| **Title of course**: Astrogeology and Cosmopetrography<br>**Code**: TTGBE5114_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 32 hours
- preparation for the exam: -

Total: 68 hours

**Year, semester**: 3rd year, 2nd semester

**Its prerequisite(s)**: Rock microscopy TTGBG5014_EN

**Further courses built on it**: -

**Topics of course**

The course discusses the main and miscellaneous objects of the Solar System (planets, moons, comets, asteroids, dwarf planets). The astrogeology or so called exogeology is one of the most progressive interdisciplinary subject of earth and planetary science. During the course the main features of terrestrial planets, gas and icy giants and their moons and their surfaces' evolution are reviewed. The evolution, geochemical properties and rock types of the Moon also are introduced. Main types, characteristics of extraterrestrial rock and their analytical methods are all discussed.

**Literature**

*Compulsory:*

Faure, G, Mensing, T.M. (2007): Introduction to Planetary Science, The Geological Perspective. Springer

Vita-Finzi, C. (2013):Planetary Geology: An Introduction. Dunedin Academic Press Ltd.

*Recommended:*

Barlow, N. (2008): Mars: An Introduction to its Interior, Surface and Atmosphere. Cambridge University Press

Carr, C.H. ed. (1984): The geologyof theterrestrial planets. NASA Scientific and Technical Information Branch, Washington DC.

**Schedule:**

*1st week* – Introduction to the evolution of astronomy and space research.

*2nd week* – Formation and parts of the Solar System.

*3rd week* – General surface characteristics. Surface of the planets, relative ages of planetary surfaces. Planetary stratigraphy.

*4th week* – Geology of terrestrial planets: characteristics of inner planets. Mercury and Venus

*5th week.* – Geology of Mars.

*6th week* – Similarities and differences in the structure of gas giants. Geology of Jupiter and Galilean moons

*7th week* – Geology of Saturn and its moons.

*8th week* – Geology of Uranus and its moons.

*9th week* – Geology of Neptune and its moons.

*10th week* – Main types and characteristics of meteorites. 'Fallen stars': famous meteorites of the world.

*11th week* – Main types and chemical-mineralogical composition of impactites. Formation of tectites and spherules. Impact craters on Earth.

*12th week* – Geology of the Moon. Mineralogy and geochemistry of the Moon's rocks.

*13th week* – Geology ofminor planets: dwarf planets, asteroids, trojans.

*14th week* – The past, the present and the future of the space research. Missions to the Moon, Mars and other celestial objects. Exoplanet explorations.

**Requirements:**

*- for a signature*

Attendance at lectures is recommended, but not compulsory.

Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to prepare an oral presentation about a chosen topic in the field of astrogeology and cosmopetrography.

During the semester there is one test (end-term test at the end of the semester).

*- for a grade*

The course ends in a term mark. Based on the grade of the end-term test and the oral presentation the term grade is calculated as follows:

80% - test,
20% - oral presentation

The minimum requirement for the written exam is 50%. Based on the score the grade for the written exam is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of test is below 50, students can take a retake test in conformity with the education and examination rules and regulations.

**Person responsible for course:** Dr. Árpád Csámer, assistant professor, PhD

**Lecturer:** Dr. Árpád Csámer, assistant professor, PhD

| **Title of course**: Geochemistry I<br>**Code**: TTGBE5017_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 2 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 28 hours<br>- practice: -<br>- laboratory: -<br>- home assignment: 12 hours<br>- preparation for the exam: 50 hours<br>Total: 90 hours | |
| **Year, semester**: 2nd year, 2nd semester | |
| **Its prerequisite(s)**: TTGBG5009_EN, TTGBE5007_EN, TTGBE5008_EN | |
| **Further courses built on it**: - | |

**Topics of course**

Students will have a basic insight to the origin, abundance and distribution of the elements in the solar system and in the different spheres of the Earth (core, mantle, crust, hydrosphere and atmosphere). The course provide a theoretical and practical insights into the geochemical classification and properties of the elements and their fractionation during igneous and sedimentary processes. Students will learn about the trace elements, the stable isotope and radiogenic isotope ratios and different age determination methods. Anthropogenic influences and mineralization processes are briefly discussed.

**Literature**

*Compulsory:*

- Albarède F. Geochemistry. Cambridge University Press 2012. ISBN 978-0-521-70693-3

*Recommended:*

- Gill R. Chemical Fundamentals of Geology and Environmental Geoscience. WILEY Balckwell 2015. ISBN 978-0-470-65665-5
- Misra K.C. Introduction to Geochemistry. WILEY Balckwell 2012. ISBN 978-1-4443-5095-1

**Schedule:**

*1st week* – The subject and brief history of geochemistry. Electronic structure of the atoms and the periodic properties of the elements. The Periodic Table. Ionic and covalent bonding and crystal lattices.

*2nd week* – The formation of the chemical elements. Meteorites and the solar system abundance of the elements.

*3rd week* – The Formation of the Solar System. Condensation sequences and the cosmochemical classification of the elements. The formation of the Earth and the Moon.

*4th week* – The geochemical classification of the elements. The composition and differentiation of the Earth and it's geospheres.

*5th week* – Major and trace elements. Rules of element substitution. The partition coefficients and element fractionation during igneous processes.

*6th week* – The geochemistry of the most important elements. Alkali and alkali earth metals, high field strength elements and rare earth elements.

*7th week* – Stable isotope geochemistry. Fractionation of oxygen, hydrogen and carbon isotopes.

*8th week* – Radiogenic isotope geochemistry. Radioactive decay. Rb-Sr and Sm-Nd isotope systems in geology.

*9th week* – Age determination and geochronology. K/Ar method, zircon dating and radiocarbon dating.

*10th week* – The chemical weathering of minerals and rocks. Formation of secondary minerals, sedimentary rocks and soils.

*11th week* – The origin of the atmosphere and hydrosphere. The geochemistry of oceans.

*12th week* – The geochemical cycles of the biogenic elements. The carbon, nitrogen and sulphur cycles.

*13th week* – Principles of environmental geochemistry. Anthropogenic effects and climate change.

*14th week* – Geochemical anomalies and mineralization. Principles of ore forming processes.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*

The course ends in an **oral examination**. The grade for the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score is below 60 (grade fail), students can take a retake examination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Zsolt Benkó, associate professor, Phd

**Lecturer:** Dr. Zsolt Benkó, associate professor, Phd

| **Title of course**: Analytical methods in geology<br>**Code**: TTGBG5022_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: -<br>- practice: 3 hours/week<br>- laboratory: - | |
| **Evaluation:** mid-semester grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture:<br>- practice: 42 hours<br>- laboratory: -<br>- home assignment: 30 hours<br>- preparation for the exam: 18 hours<br>Total: 90 hours | |
| **Year, semester**: 2$^{nd}$ year, 2$^{nd}$ semester | |
| **Its prerequisite(s)**: TTGBG5009_EN | |
| **Further courses built on it**: - | |

**Topics of course**

Students will have a basic insight into the instrumental methods used in the practice of geology in form of interactive seminars/laboratory practices. Topics to be discussed are the followings: Thermal analytical methods, TG, DTG, DTA, DSC, their principals, usage in geology. Aspects and rules of sampling, sample preparation methods. Types of measurement errors and ways of their elimination. Precision, accuracy, reprepsentation of measurement results. Spectroscopy. Emission and absoption techniques (UV-Vis, ICP-AES, AAS), application of X-ray fluorescence spectroscopy (XRF) for the determination of concentration of major and minor elements. Electron microprobe. Nuclear techniques (neutron activation). Application of mass spectrometric techniques for the determination of ratios of stabile and radiogen isotopes and for geological chronology. Coupled techniques (LA-ICP-MS, EGA-MS).

**Literature**

*Compulsory:*

Gill R. (Ed) Modern Analytical Geochemistry. Longman 1997. ISBN 978-0-582-09944-9

*Recommended:*

Reed S.J.B. Electron Microprobe Analysis. Cambridge University Press 2005. ISBN 978-0-521-84875-6

**Schedule:**

*1$^{st}$ week* – Introduction to the course, discussion of the requirements. Thermal analysis. The most important methods in thermal analysis (TG, DTG, DTA, DSC), theoretical principles, possible applications in geological analytics.

*2$^{nd}$ week* – Thermal analysis (practice). Introduction to derivatograph. Way of measurement, thermal study of real and modell samples, the evaluation and discussion of the results.

*3$^{rd}$ week* – Elemental analysis, major, minor and trace elements, isotope ratioes and their determinations. Ways of sampling, sample preparation methods. Error of measurement, precision, accuracy.

*4th week* – Electromagnetic radiation, spectroscopy. Development of UV-vis spectra, emission spectra, absorption spectra from atoms, ions, molecules. Optical emission spectroscopy, ICP-AES.

*5th week* – Atomic absorption spectroscopy. Other spectroscopical techniques.

*6th week* – Atomic spectroscopy (practice). Introduction to modern instruments of atomic spectroscopy (FAAS, GFAAS, FES, ICP-AES). Way of measurements, data evaluaton, discussion.

*7th week* – Development of X-Ray radiation. X-Ray fluorescent spectroscopy. Calibration and concentration calculation from count numbers.

*8th week* – X-Ray fluorescent spectroscopy (practice). Powder pellet pressing, measurement, data evaluation, discussion.

*9th week* – Methods based on electron beams, electron microprobe. Evaluation of X-Ray and electron imaging sepctra. Calculation of molecular formula from the electron microprobe measurement data.

*10th week* – Nuclear methods, neutron activation technique, PIXE measurements.

*11th week* – Mass spectrometry, determination of stable and radiogen isotopes, geological applications.

*12th week* – ICP-MS. Evaluation of trace element reports, calculations for conversion of concentration units. LA-ICP-MS. SIMS.

*13th week* – Other in situ techniques, coupled techniques. Zircon chronology. Evolved gas analysis-thermal analysis (practice).

*14th week* – End-term test covering thermal analysis, spectroscopy (based on interaction of matter and electromagnetic radiation), mass spectroscopy, geological applications

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there is one test, the end-term test, that is in the 14th week. Students have to sit for the tests

*- for a grade*

The final grade for the course will be determined according to the followings: it is based on the grade of end-term test in 90 %, and based on the class-activity and performance of students, (the quality of practice reports) in 10 %.

The minimum requirement for the end-term tests is 50%. The examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-87 | good (4) |

| | |
|---|---|
| 88-100 | excellent (5) |

If the score of the test is below 49, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

- *an offered grade:*
it may be offered for students if the grade is at least satisfactory (3).

**Person responsible for course:** Dr. Zsolt Benkó, associate professor, Phd

**Lecturer:** Dr. Zsolt Benkó, associate professor, Phd

| **Title of course**: Systematic mineralogy<br>**Code**: TTGBG5025_EN | **ECTS Credit points:** 2 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: -<br>- practice: 2 hours/week<br>- laboratory: - | |
| **Evaluation:** mid-semester grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: -<br>- practice: 28 hours<br>- laboratory: -<br>- home assignment: 20 hours<br>- preparation for the exam: 12 hours<br>Total: 60 hours | |
| **Year, semester**: 3rd year, 2nd semester | |
| **Its prerequisite(s)**: TTGBE5007_EN, TTGBE5008_EN | |
| **Further courses built on it**: - | |

**Topics of course**

The course will introduce the students into the classification of minerals based on their crystal structures and chemical composition. They will learn about the properties, crystallization conditions, occurrences and associations of different groups of minerals, as sulphides, oxydes, silicates and carbonates. The most importan rock-forming minerals and economic minerals will discussed in details.

**Literature**

*Compulsory:*

- Perkins D. Mineralogy. Pearson Education Limited 2014. ISBN 978-1-292-03911-4

*Recommended:*

- Demange M. Mineralogy for Petrologists. CRC Press 2012. ISBN 978-1-4665-5006-3
- Vaughan DJ (Ed) Sulfide mineralogy and geochemistry. Mineralogical Society of America and the Geochemical Society, 2006. ISBN 0-939950-73-1

**Schedule:**

*1st week* – Principles of mineral classification. Chemical composition and crystal sructure. Solid solutions and element substitutions.

*2nd week* – Phase diagrams. Formation and stability of minerals. Native elements.

*3rd week* – Sulphides, selenides, tellurides and arsenides.

*4th week* – Sulphosalts. Sulphide paragenesis.

*5th week* – Oxides and hydroxides. Spinels and perovskites.

*6th week* – Hydroxides, bauxite minerals. Silicate structures and classification.

*7th week* – Orthosilicates or nesosilicates. Olivine, garnet group, zircon, titanite and epidote group

*8th week* – Sorosilicates and cyclosilicates. Turmaline and melilite group. Chain silicates (inosilicates). Pyroxene structure, composition and classification.

*9th week* – Phase relations of pyroxenes. Amphibole structure, composition and classification.

*10th week* – Sheet silicates (phyllosilicates). Micas, biotite and muscovite. Chlorite group and serpentine minerals. Mafic silicates in igneous systems.

*11th week* – Clay minerals.

*12th week* – Framework silicates (tectosilicates). Feldspars and zeolites.

*13th week* – Phosphates, sulphates and carbonates. Halogenides and evaporites.

*14th week* – Minerals in space and time.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Active participation is evaluated by the teacher.

During the semester there several (more than 10) short tests, and a final test in the 15th week. Students have to sit for the tests

*- for a grade*

The minimum requirement for the mid-term short and end-term tests is 60%. The grade for the tests is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-59 | fail (1) |
| 60-69 | pass (2) |
| 70-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Zsolt Benkó, associate professor, Phd

**Lecturer:** Dr. Zsolt Benkó, associate professor, Phd

| **Title of course**: Rock microscopy<br>**Code**: TTGBG5014_EN | **ECTS Credit points: 2** |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: -<br>- practice: 2 hours/week<br>- laboratory: - | |
| **Evaluation:** mid-semester grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: -<br>- practice: 28 hours<br>- laboratory: -<br>- home assignment: 32 hours<br>- preparation for the exam: -<br>Total: 60 hours | |
| **Year, semester**: 2nd year, 2nd semester | |
| **Its prerequisite(s)**: TTGBE5007_EN, TTGBE5008_EN, TTGBG5009_EN | |
| **Further courses built on it**: - | |

**Topics of course**

The aims of the course is to introduce basic optical elements, principal optical features of rock-forming minerals; to demonstrate main igneous, sedimentary, and metamorphic rock types (their mineralogical composition and texture) in thin section under the microscope. The students will learn protocol of basic determination methods of main rock types by using polarizing microscope.

**Literature**

*Compulsory:*

W.S. MacKenzie – A.E. Adams – K.H. Brodie: Rocks and Minerals in Thin Section: A Colour Atlas. Taylor and Francis Group, London. 2016(rev. 2nd ed.)

*Recommended:*

A.J. Barker: A Key for Identification of Rock-Forming Minerals in Thin Section. Taylor and Francis Group, London. 2014.

W.S. MacKenzie – C. Guilford: Atlas of the Rock-Forming Minerals in Thin Section. Routledge, New York, 2013

**Schedule:**

*1st week* – Elements of optical mineralogy. Optical properties of crystals. The polarizing microscope.

*2nd week* – Study on minerals in thin section by using single nicol prism. Pleochroism and pseudo-pleochroism; cleavage and fracture.

*3rd week* – Study on minerals in thin section by using crossed nicol prisms. Types of extinction. Axial figures.

*4th week* – Optical properties of rock-forming minerals I (olivine, pyroxene, amphibole, biotite, muscovite, plagioclase, potassium feldspars, quartz, calcite, etc.); their identification in polarizing microscope.

*5th week* – Elements of ore microscopy.

*6th week* – Test 1

*7th week* – Texture of igneous rocks: glassy, hyalopilitic, pilotaxitic, microholocrystalline, granitic

*8th week* – Intrusive and extrusive igneous rocks under the microscope.

*9th week* – Study on pyroclastic rocks in thin section.

*10th week* – System of sedimentary rocks. Microscopy in sediment petrology.

*11th week* – Siliciclastic and carbonate rocks under the microscope.

*12th week* – Metamorphic textures; the most important metamorphic minerals.

*13th week* – Study on some metamorphic rocks under the microscope.

*14th week* – Test 2

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*

The minimum requirement for the writing tests the examination respectively is 50%. The grade for the tests is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Péter Rózsa, associate professor, PhD

**Lecturer:** Dr. Péter Rózsa, associate professor, PhD;
Dr. Richard William McIntosh, assistant professor, PhD
Dr. Árpád Csámer, assistant professor, PhD

| **Title of course**: Volcanology and Petrology<br>**Code**: TTGBE5015_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 2 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 28 hours<br>- practice: -<br>- laboratory: -<br>- home assignment: 20 hours<br>- preparation for the exam: 42 hours<br>Total: 90 hours | |
| **Year, semester**: 3rd year, 2nd semester | |
| **Its prerequisite(s)**: Structural geology TTGBG5004_EN | |
| **Further courses built on it**: - | |

**Topics of course**

The aim of the course is to provide information about the volcanism as a global geological phenomenon. During the course the types of the volcanic activities, the circumstances of development and formation of volcanoes, as well as the main types of volcanic rocks are introduced. Principal applied investigation methods (field and laboratory methods) of lava and volcaniclastic rock, volcanic activity, volcanic hazard and mitigation also are presented.

**Literature**

*Compulsory:*

McPhie, J., M. Doyle, R. Allen 1993: Volcanic Textures, A guide to the interpretation of textures in volcanic rocks. Centre for Ore Deposit and Exploration Studies, University of Tasmania

Sigurdsson, H. (ed.) 2000: The Encyclopedia of Volcanoes. Elsevier

*Recommended:*

Fisher, R.V. and H-U. Schmincke 1984: Pyroclactic rocks. Springer-Verlag

Lockwood,J.P. and R. W. Hazlett 2010: VolcanoesGlobal Perspectives. A John Wiley & Sons, Ltd., Publication

**Schedule:**

*1st week* – Term of volcanism. History of volcanology.

*2nd week* – Origin of volcanic activity. Heat and material. Heat of the Earth’s interior. Origin of Solar System and the chondritic Earth model.

*3rd week* – Main minerals and rocks with igneous origin. Classification of volcanic rocks by their chemical and mineralogical compositions. Streckeisen and TAS diagrams. Classification of pyroclastics and pyroclastic rocks.

*4th week* – Global plate tectonics and volcanism. The structure of Earth’s interior: chemical, mineralogical compositions and P/T conditions of the core, the mantle and the crust.

*5th week* – Divergent plate boundaries and volcanic activity. Rifts, rift valley, mid-oceanic ridges, continental rift valley and ophiolite succession.

*6th week* – Convergent plate boundaries and volcanic activity: subduction and arc volcanism.

*7th week* – Hot spots and mantle plumes beneath continental and oceanic plates. Ocean islands and seamounts Volcanic activity and climate change.

*8th week* – Silicate magma as molten rock. Physical and chemical properties of magma and lava. Magma differentiation and magma mixing.

*9th week* – Volcanic Eruption Index. Effusive volcanic activity. Mafic and intermediate lavas and lava flows.

*10th week* – Dacitic and rhyolitic lava flows. Carbonatite lava, sulfur volcanism. Submarine volcanoes: pillow basalts, hyaloclastites.

*11th week* – Explosive volcanic eruption: magmatic, phreatomagmatic and phreatic explosions. Magma vesiculation and fragmentation Fuel-coolant interaction. Classification of volcaniclastic rocks. Main components of pyroclastic rocks.

*12th week* – Types of explosive volcanic eruption. Pyroclastic fall deposits. Isopach and isopleth maps. Classification based on Walker-diagram. Hawaiian and Strombolian-type eruptions.

*13th week* – Vulcanian- Plinian- and Surtseyan-type eruptions Pyroclastic flows and pyroclastic density deposits. Characteristics of pumice and ash flow deposits, ignimbrites.

*14th week* – Block and ash flow deposits: nuée ardente. Origin and characteristics of pyroclastic surge deposits.

**Requirements:**

*- for a signature*

Attendance at lectures is recommended, but not compulsory.

Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to submit a course paper as scheduled minimum on a sufficient level.

*- for a grade*

The course ends in an examination. Based on the grades of the course paper and the examination, the exam grade is calculated as follows:

- written exam in 90%,
- course paper in 10%

The minimum requirement for the written exam is 50%. Based on the score the grade for the written exam is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-61 | pass (2) |
| 62-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

**Person responsible for course:** Dr. Árpád Csámer, assistant professor, PhD

**Lecturer:** Dr. Árpád Csámer, assistant professor, PhD

| **Title of course**: Soil conservation<br>**Code**: TTGBE6012 | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice:
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice:
- laboratory: -
- home assignment: 22
- preparation for the exam: 40

Total: 90 hours

**Year, semester**: 2nd year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: TTGBG6013

**Topics of course**

Subject and significance of soil protection. Degradation factors threatening soils. Compaction and soil structure degradation. Acidification, sodification. Pollution threats. Deflation, soil erosion. Biological and agrotechnological protection against soil erosion.

**Literature**

**Schedule:**

*1st week*

Significance and subject of soil protection.

*2nd week*

Degradation factors threatening soils. Compaction and deterioration of soil structure.

*3rd week*

Acidification and possible protection methods.

*4th week*

Secondary sodification and possible protection methods.

*5th week*

Major soil pollution sources. Effects of pollution on life in soils and the productivity of soils. Possible protection methods against pollution.

*6th week*

Deflation and possible protection methods.

*7th week*

Factors enhancing soil erosion. The role of the quantity, length, and intensity of precipitation, drop size and slope parameters in erosion.

*8th week*

Types of areal erosion and also of linear erosion.

*9th week*

Role of geological and pedological conditions in erosion.

*10th week*

Role of vegetation cover, and humans in erosion.

*11th week*

Biological soil protection.

*12th week*

Agrotechnological methods in soil protection.

*13th week*

Technological soil protection.

*14th week*

Consulting.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Prof. József Posta, emeritus professor, DSc

**Lecturer:** Prof. József Posta, emeritus professor, DSc

| **Title of course**: Soil conservation – practice<br>**Code**: | **ECTS Credit points: 1** |
|---|---|

**Type of teaching, contact hours**
- lecture:
- practice: 1 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture:
- practice: 14 hours
- laboratory: -
- home assignment: 16
- preparation for the exam:

Total: 30 hours

**Year, semester**: 2nd year, 2nd semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Basic legislation of soil protection. Soil protection monitoring and sampling. TIM system. Soil protection plan. Soil protection databases, laboratories. Water erosion, wind erosion, secondary sodification, soil compaction.

**Literature**

**Schedule:**

*1st week*

Basic legislation related to soil protection.

*2nd week*

Rules of soil protection monitoring and sampling. TIM system.

*3rd week*

Soil protection plan.

*4th week*

Soil protection databases, laboratories.

*5th week*

Soil protection institutions, expert background in Hungary.

*6th week*

Effects, indicators of water erosion, its measurement methods. Water erosion in Hungary, in Europe and in the world.

*7th week*

Effects, indicators of wind erosion, its measurement methods. Wind erosion in Hungary, in Europe and in the world.

*8th week*

Effects, indicators of secondary sodification, its measurement methods. Secondary sodification in Hungary, in Europe and in the world.

*9th week*

Effects, indicators of soil compaction, its measurement methods. Soil compaction in Hungary, in Europe and in the world.

*10th week*

Effects, indicators of organic matter reduction, its measurement methods. Organic matter reduction in Hungary, in Europe and in the world.

*11th week*

Effects of soil cover because of building-up, road construction. Effects, indicators of soil cover, its measurement methods. Soil cover in Hungary, in Europe and in the world.

*12th week*

Effects of soil pollution because of building-up, road construction. Effects, indicators of soil pollution, its measurement methods. Soil pollution in Hungary, in Europe and in the world.

*13th week*

Soil protection relations, effects, indicators of irrigation, its measurement methods. Irrigation in Hungary, in Europe and in the world.

*14th week*

Nature protection of soils. Soil as a source of data, natural and cultural value.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

| |
|---|
| **Person responsible for course:** Dr. Tibor Novák, associate professor, PhD |
| **Lecturer:** Dr. Tibor Novák, PhD, associate professor, PhD |

| **Title of course**: GIS fieldwork and mapping<br>**Code**: TTGBL7023_EN | **ECTS Credit points:** 4 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 4 hours/week
- laboratory: -

**Evaluation:** practical grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 56 hours
- laboratory: -
- home assignment: 64 hours
- preparation for the exam: -

Total: 120 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The theory of the geoid and its important measurable parameters. Overview of national and international map projections. Horizontal measurements, the theory of triangulation, the structure of the horizontal baseline network. Types of altitude measurements. Structure of the elevation baseline network and persistence of the points. The main parts of geodetic field surveyor instruments for horizontal and altitude measurements, the principle of their operation, their practical use. Processing, mapping and analysis of field data in a software environment. Theory and practice of Global Positioning System.

**Literature**

Joel McNamara 2004. GPS for Dummies. Wiley Publishing, Inc. Indianapolis.
Wolfgang Torge 2001. Geodesy. Walter de Gruyter, Berlin – New York. ISBN: 3-11-017072-8 http://fgg-web.fgg.uni-lj.si/~/mkuhar/Zalozba/Torge-Geodesy(2001).pdf

**Schedule:**

*1st week* – Introduction

*2nd week* – Basics of field surveying

*3rd week* – Field survey methods – the classical methods

*4th week* – Field survey with classical surveying equipment – the levelling surveyor

*5th week* – Field survey with classical surveying equipment – the theodolite

*6th week* – Field survey methods –contemporary methods

*7th week* – Field survey with modern surveying equipment – the GPS

*8th week* – Mid-term test. Field survey with modern surveying equipment – the total station

*9th week* – Field survey with modern surveying equipment – the terrestrial laser scanner

*10th week* – Processing of collected data – I.

*11th week* – Processing of collected data – II.

*12th week* – Editing maps from collected data – I.

*13th week* – End-term test. Editing maps from collected data – II.

*14th week* – Questions

**Requirements:**

- *for a signature*

Attendance at classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks, drawing instruments and calculator of the course to each practice class.

- *for a grade*

Students have to submit a homework, which contains a self-surveyed and mapped area or object with description, in a document. The grade based on the quality of this paper.
During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 13th week. The final grade is calculated as an average of the grades of the tests.
The minimum requirement for the mid-term and end-term respectively is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-86 | good (4) |
| 87-100 | excellent (5) |

If the score of any test is below 50, students can take a retake test in the 14th week.
If the score of test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Gergely Szabó, assistant professor, PhD

**Lecturer:** Dr. Gergely Szabó, assistant professor, PhD

| **Title of course**: Principles of database management in earth sciences<br>**Code**: TTGBL7012_EN | **ECTS Credit points:** 2 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: -<br>- practice: 2 hours/week<br>- laboratory: - | |
| **Evaluation:** exam, practical grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: -<br>- practice: 28 hours<br>- laboratory: -<br>- home assignment: 16 hours<br>- preparation for the exam: 16 hours<br>Total: 60 hours | |
| **Year, semester**: 2nd year, 1st semester | |
| **Its prerequisite(s)**: - | |
| **Further courses built on it**: - | |

**Topics of course**

Hydrological and hydro-meteorological data collection and basic terminology. Data collection from digital sources. Data collection from yearbooks. Grouping, debugging and corrections. Correction-making functions. Enhanced conditional-statements. Automatization of value search by function statements. Data analysis toolset. Validation menu. Drop-down lists. Error messages.

**Literature**

- https://www.tutorialspoint.com/advanced_excel/advanced_excel_tutorial.pdf
- http://web.mef.hr/web/images/pdf/ms_o_exc.pdf
- https://www.saylor.org/site/textbooks/How%20to%20Use%20Microsoft%20Excel.pdf

**Schedule:**

*1st week* – Introduction to the course

*2nd week* – Introduction to the methods of hydrological and hydro-meteorological data collection.

*3rd week* – Data collection from yearbooks

*4th week* – Joint data

*5th week* – Grouping, debugging and fixing. Use of debugging statements I.

*6th week* – Grouping, debugging and fixing. Use of debugging statements II.

*7th week* – Application of enhanced conditional statements

*8th week* – Data analysis tools, validation menu, drop-down lists, error messages.

*9th week* – Practical test I.

*10th week* – Cross-reference between data sheets

*11th week* – Data tabulation, sub-total compositions

*12th week* – Complex and special filtering. Diagram templates.

*13th week* – Summary of the semester knowledge. Practice for the Practical test II.

*14th week* – Practical test II.

**Requirements:**

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there is two practical test. First is at 9th week then second is at 14th week.

The minimum score is 50%. Based on the score of the test, the grade for the test is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-86 | good (4) |
| 87-100 | excellent (5) |

**Person responsible for course:** Dr. László Bertalan, assistant lecturer, PhD

**Lecturer:** Dr. László Bertalan, assistant lecturer, PhD

| **Title of course**: Landscape protection<br>**Code**: | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice:
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice:
- laboratory: -
- home assignment:
- preparation for the exam: 62

Total: 90 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Most important terms in landscape protection and landscape ecology basics. Landscape element types and functions. Tasks of landscape protection in different landscape types.

**Literature**

**Schedule:**

*1st week*

Subject of landscape protection: natural and cultural landscapes. Landscape protection as a social activity.

*2nd week*

Landscapes as ecological systems. Material and energy flows in a landscape. Structure and operation of landscapes. Landscape forming elements and factors. Landscape functions. Landscape ecological principles and their application in landscape protection.

*3rd week*

Landscapes as patch mosaics. Patches, corridors and matrixes. Types and operation of landscape ecological patches. Types and operation of landscape ecological corridors.

*4th week*

Diversity of landscapes. Landscape structure and landscape diversity as values to be protected.

*5th week*

Management, maintenance and handling for landscape protection. Landscape protection relations of the management of forests. Most frequent landscape protection problems related to forests.

*6th week*

Landscape protection management, maintenance and handling. Management of grasslands and wetlands. Handling grasslands and wetlands.

*7th week*

Landscape potential and its term. The theory of multi-functional landscapes.

*8th week*

Fragmentations and the effects of margins.Conflicts of anthropogenic potential and landscape ecological networks.

*9th week*

Landscape matrix, modelling the ecological operation of patch complexes.

*10th week*

Analysis and interpretation of landscape changes. Indicators, typical processes and regional differences of landscape changes.

*11th week*

Typifying landscapes. Landscape types and landscape changing tendencies in Hungary.

*12th week*

Landscape as an aesthetic value. Landscape protection based on landscape architecture and aimed at aesthetics.

*13th week*

Landscape in practice and national institutes responsible for landscape protection. Consulting.

*14th week*

Case-studies and landscape protection projects.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Tibor Novák, associate professor, PhD

**Lecturer:** Dr. Tibor Novák, associate professor, PhD

| **Title of course**: Landscape protection – practice<br>**Code**: TTGBG6016 | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture:
- practice: 28 hours
- laboratory: -
- home assignment: 32 hours
- preparation for the exam: -

Total: 60 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

Legal framework of landscape protection and related institutions. Practice of sustainable landscape use and land-use for landscape protection (forest, grassland, arable land, wetlands) and land-use optimisation.

**Literature**

**Schedule:**

*1st week*

Aims of landscape protection in practice and its place in decision making processes. Landscape protection basic terms, standards.

*2nd week*

Legal regulations of landscape protection. Content of standards related to landscape protection.

*3rd week*

Natura 2000 network and its landscape protection relations.

*4th week*

Individual landscape values and their cadastre.

*5th week*

Basic documents of landscape protection: urban plans, nature protection management plans, impact assessment.

*6th week*

Specifications for areas to be built-up and those to be not built-up.

*7th week*

Databases related to landscape protection in Hungary and their application in practice.

*8th week*

Application of landscape metric indicators in practice.

*9th week*

Case-studies: increasing intensity of landscape use: expanding settlements, expanding areas for industrial operations and transport.

*10th week*

Case studies: increasing intensity of the use of mostly agricultural areas.

*11th week*

Case-studies: landscape protection problems of mining and industrial areas.

*12th week*

Case-studies: landscape protection issues of abandoned areas and those with reduced intensity land-use.

*13th week*

Case-studies: landscape protection and landscape management issues of protected areas and nature reserves.

*14th week*

Institutes associated with landscape protection. Landscape protection planning and authority tasks in practice.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are three practical grading. Students have to attend.

*- for a grade*

The final grade is calculated as an average of the three practical grading.

The minimum requirement for the examinations respectively is 50%. Based on the score of the grading separately the grade is given according to the following table:

| Score | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-72 | satisfactory (3) |
| 73-84 | good (4) |
| 85-100 | excellent (5) |

If the score of any task is below 50, students can take a retake in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Tibor Novák, associate professor, PhD

**Lecturer:** Dr. Tibor Novák, associate professor, PhD

| **Title of course**: Geology fieldwork<br>**Code**: TTGBG5027_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: -<br>- practice: 4 days<br>- laboratory: - | |
| **Evaluation:** mid-semester grade (one tests towards the end of the fieldwork) | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: -<br>- practice: 48 hours<br>- laboratory: -<br>- home assignment: -<br>- preparation for the tests: 42 hours<br>Total: 90 hours | |
| **Year, semester**: 2nd year, 2nd semester | |
| **Its prerequisite(s)**: Structural geology I | |
| **Further courses built on it**: - | |

**Topics of course**

The aim of the course is to enable students to test the learnt earth scientific methods and to get to know and study the geological conditions of noartheastern Hungary and to visit professional companies carrying our geological work

**Literature**

*Compulsory:*

- Budai T. – Gyalog L. (eds.) (2009): Geological map of Hungary – Geological Institute of Hungary, Budapest, 248 p.
- Haas J. – Budai T. (eds.) (2014): Explanatory notes to the Pre-Cenozoic geological map of Hungary – Geological and Geophysical Institute of Hungary, Budapest, 73 p.

*Recommended:*

- Haas J. (2013): Geology of Hungary – Springer-Verlag, Berlin-Heidelberg, 246 p.

**Schedule:**

*not relevant*

**Requirements:**

- *for a signature*

Attendance at **the fieldwork** is compulsory.

- *for a grade*

Grades are given on the basis of active participation, giving lectures focusing on certain stops during the fieldwork and one test.

The grade for the course is given according to the following table:

Test Score (%) Grade

| | |
|---|---|
| 0-50 | fail (1) |
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

If the score of student result is below 50, students can improve the result of their test by the quality of their rock collection and also by answering additional test questions in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Richard William McIntosh, assistant professor, PhD

**Lecturer:** Dr. Richard William McIntosh, assistant professor, PhD

| **Title of course**: Nonlinear phenomena, chaos<br>**Code**: TTFBE2201_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 2 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 28 hours<br>- practice: -<br>- laboratory: -<br>- home assignment: 7 hours<br>- preparation for the exam: 55 hours<br>Total: 90 hours | |
| **Year, semester**: 3rd year, 2nd semester | |
| **Its prerequisite(s)**: | |
| **Further courses built on it**: - | |

| **Topics of course** |
|---|
| Stability analysis. Poincare map. Bifurcations. Fractals. Chaos in conservative and dissipative systems. Strange attractor. Entropies. Lyapunov exponents. Lorentz model. |
| **Literature** |
| *Compulsory:*<br>- Tél, T – Gruiz, M.., Chaotic Dynamics. An IntroductionBased on Classical mechanics (Cambridge University, Cambridge, 2006)<br>- Thompson J.M.T – Stewart, H. B., Nonlinear Dynamics and Chaos (John Wiley, New York, 1986)<br>*Recommended:*<br>- McCauley J. L., Chaos, Dynamics and Fractals, an algorithmic approach to deterministic chaos (Cambridge Univ. Press.,1994) |

**Schedule:**

*1st week* – Introduction, examples for regular and chaotic motions. System of ordinary first-order differential equations. Examples. Newton equations.

*2nd week* – Canonical formalism, Hamiltonian equations. Conservative systems. Phase space. Trajectory. Liouville theorem.

*3rd week* – Stability, instability, asymptotic and orbital stability. Examples. Linear stability analysis. Singular points and their stability in 2 dimension.

*4th week* – Motion around stable and instable singular points. Examples: pendulum, damped harmonic oscillator. Bifurcation.

*5th week* – The Poincaré map. Fixed points and limit cycles. Stability analysis. Stable and unstable fixed points.

*6th week* – Probability in chaotic systems. Information. Shannon information. Fractals. Fractal

| |
|---|
| dimension. Selfsimilarity.<br>*7th week* – One-dimensional maps. Logistic map. Control-parameter. Bifurcations to chaos. Sensitivity to the initial conditions. Lyapunov exponent.<br>*8th week* – Chaos in dissipative systems. Chaotic attractors. Instable manifolds. Cycles. Baker's map.<br>*9th week* – Multifractals. Generalized dimensions.. Information dimension. Topological and Kolmogorov entropies.<br>*10th week* – Properties of chaotic motion. Range of predictability. Determinism and chaos. Link between statics and dynamics.<br>*11th week* – Examples for chaotic attractors, Henon and Lorentz models.<br>*12th week* – Chaos in conservative systems. Integrable and non-integrable Hamiltonian systems.<br>*13th week* – Quasi-periodic motion on torus. KAM theorem.<br>*14th week* – Henon-Heiles model. Standard model. Chaos in the solar system. |
| **Requirements:**<br>*- for a signature*<br>Attendance at **lectures** is recommended, but not compulsory.<br>*- for a grade*<br>The course ends with an **examination**. |
| **Person responsible for course:** Prof. Dr. Ágnes Nagy, university professor, DSc |
| **Lecturer:** Prof. Dr. Ágnes Nagy, university professor, DSc |

| **Title of course**: Dynamics of the Atmosphere I<br>**Code**: TTFBE2202_EN | **ECTS Credit points:** 5 |
|---|---|

**Type of teaching, contact hours**
- lecture: 3 hours/week
- problems: 2 hours/week
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 42 hours
- problems: 28 hours
- laboratory: -
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 150 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: Fundamentals of physics II

**Further courses built on it**: Dynamics of the Atmosphere II

**Topics of course**

The course gives a theoretical background for describing atmospheric dynamics. In particular, the basics of thermodynamics, the properties of static atmosphere and the kinematics of atmospheric motion are discussed as listed in the following topics:
Physical and mathematical concepts of describing processes in the atmosphere. Vector algebra and analysis, tensors. Differential operators in physics, integrals. Coordinate systems and coordinate transformations. Ideal gases, gas mixtures. The basics of atmospheric thermodynamics. Moist air, van der Waals equation. Phase transitions, condensation, saturation. The Clausius-Clapeyron equation. Vertical structure of the static atmosphere, pressure and temperature distributions, stability conditions. Basics of fluid dynamics, kinematic variables, decomposition of linear velocity fields.

**Literature**

*Compulsory:*
- Holton, J.R.: An Introduction to Dynamic Meteorology, Elsevier 2004
- Saha, K.: The Earth's Atmosphere, Springer 2008

*Recommended:*
- Dutton, J. A.: The Ceaseless Wind: An introduction to the Theory of Atmospheric Motion, Dover 1986.
- Zdunkowski, W. – Bott, A.: Dynamics of the Atmosphere, Cambridge 2003.
- Zdunkowski, W. – Bott, A.: Thermodynamics of the Atmosphere, Cambridge 2004.

**Schedule:**

*1st week* – Physical and mathematical concepts of describing atmospheric processes. Vector algebra and vector analysis, tensors.

*2nd week* – The fundamentals of mechanics. Differential operators in physics, integrals. Coordinate systems and coordinate transformations. Accelerating reference systems, time derivatives.

*3rd week* – The basics of atmospheric thermodynamics. The equation of state, ideal gas, gas mixtures. The first law of thermodynamics and its form used in meteorology. Internal energy, heat capacity, specific heat.

*4th week* – The second law of thermodynamics. Entropy. Thermodynamic potentials, Gibbs-Helmholtz relations. Thermodynamic properties of ideal gases.

*5th week* – Thermodynamic processes of ideal gases. Piezotropic fluids, polytropic processes. Specific thermodynamic changes (isobaric, adiabatic, etc.), as particular cases of polytropy.

*6th week* – Thermodynamic equilibrium of heterogeneous systems, chemical potential. The Gibbs phase rule. Phase transitions. The Clausius-Clapeyron equation.

*7th week* – Adiabatic changes in dry air, potential temperature.

*8th week* – Water vapor and moist air. The equation of state for water vapor. Saturation vapor pressure, phase transitions, triple point. Latent heat, Kirchhoff equation. Equation of state for moist air, virtual temperature.

*9th week* – Water vapor and moist air. The thermodynamic properties of moist air, moisture variables. Adiabatic processes of moist air, model assumptions.

*10th week* – Moist adiabatic processes of moist air: moistsaturated and pseudo-adiabatic process. Temperatures defined by the pseudo-adiabatic changes in moist air.

*11th week* – Forces in the static atmosphere. Gravitational and centrifugal force, geopotential. Pressure gradient force. The equation of hydrostatic balance.

*12th week* – Basic models of the static atmosphere. Polytropic (isothermal, homogeneous, adiabatic) models. Standard atmospheres.

*13th week* – The fundamentals of atmospheric kinematics. Helmholtz theorem, decomposition of linear velocity fields. Invariants. Representation of flow fields, special cases. Equilibrium conditions.

*14th week* – Overview of the semester's material, consultation.

**Requirements:**
*- for a signature*
Attendance at **lectures** is recommended, but not compulsory.

Participation at **problems classes** is compulsory. A student must attend the problems classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at problems classes will be recorded by the class leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed problems classes should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student’s behaviour or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation

*- for a grade*
The course ends in an **oral examination**. Two different topic from the semester’s material should be discussed. Based on the student’s presentation the following guidelines are applied:

-knowledge of fundamental laws, theorems and definitions: *sufficient (2)*

- in addition, ability to prove the fundamental theorems: *average (3)*

- in addition, knowledge of the proofs and derivations presented during the lectures: *good (4)*

- in addition, knowledge of applications discussed during problems classes: *excellent (5)*

**Person responsible for course:** Dr. Zsolt Schram, associate professor, PhD

**Lecturer:** Dr. Zsolt Schram, associate professor, CSc, PhD habil.

| **Title of course**: Dynamics of the Atmosphere II<br>**Code**: TTFBE2203 | **ECTS Credit points:** 4 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 3 hours/week<br>- problems:1 hours/week<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 42 hours<br>- problems: 14 hours<br>- laboratory: -<br>- home assignment: 34 hours<br>- preparation for the exam: 30 hours<br>Total: 120 hours | |
| **Year, semester**: 3rd year, 2nd semester | |
| **Its prerequisite(s)**: Dynamics of the Atmosphere I | |
| **Further courses built on it**: - | |

**Topics of course**

The course gives a theoretical background for describing atmospheric dynamics. In particular, the interactions and forces in the atmosphere and the dynamics of atmospheric motion are discussed as listed in the following topics:
Flow of ideal and viscous fluids, Euler and Navier-Stokes equations. The equations of motion in general coordinate systems. The equations in systems using different vertical coordinates. Simpler solutions of the equations of motion, different types of flow configurations (geostrophic, gradient etc. wind). Vorticity and circulation, circulation theorems. Wave motion in the atmosphere, wave equations. Boundary conditions. Basics of describing turbulent systems.

**Literature**

*Compulsory:*
- Holton, J.R.: An Introduction to Dynamic Meteorology, Elsevier 2004
- Saha, K.: The Earth’s Atmosphere, Springer 2008

*Recommended:*
- Dutton, J. A.: The Ceaseless Wind: An introduction to the Theory of Atmospheric Motion, Dover 1986.
- Zdunkowski, W. – Bott, A.: Dynamics of the Atmosphere, Cambridge 2003.
- Zdunkowski, W. – Bott, A.: Thermodynamics of the Atmosphere, Cambridge 2004.

**Schedule:**

*1st week* – The basics of atmospheric kinematics, Eulerian and Lagrangian description of fluid mechanics. Connection between the two descriptions.

*2nd week* – The fundamentals of atmospheric dynamics. Systems with infinite degrees of freedom. Mechanical principles, axioms.

*3rd week* – Atmospheric forces. Internal friction, viscosity. Ideal and Newtonian fluids. The connection between the velocity field and the stress tensor.

*4$^{th}$ week* – Thehydrodynamic equations of motion in an inertial reference system. (Euler equations, Navier-Stokes equations.

*5$^{th}$ week* – The Navier-Stokes equations in general coordinates (spherical coordinate system). Scale analysis of the equations of motion.

*6$^{th}$ week* – The equations of motion in isobaric and isentropic vertical coordinates. Fundamental energy forms and their transformations in the atmosphere.

*7$^{th}$ week* – Simplified soéutions to the equations of motion. The hydrostatic approximation. The geostrophic wind and its properties.

*8$^{th}$ week* – The ageostrophic component of the horizontal motion. Isallobaric wind.

*9$^{th}$ week* – The gradient wind. Comparison of geostrophic and gradient wind. The thermal wind.

*10$^{th}$ week* – Circulation and vorticity. Kelvin's and Bjerkness' circulation theorem.

*11$^{th}$ week* – Vorticity equation and its interpretation. The equation in different vertical coordinates. Potential vorticity.

*12$^{th}$ week* – Wave motions and their typical forms in the atmosphere. Wave equations, simple solutions. Rossby waves.

*13$^{th}$ week* – Discontinuity surfaces in the atmosphere. Inclination of frontal surfaces. The planetary boundary layer.

*14$^{th}$ week* – Overview of the semester's material, guidance for further studies, consultation.

**Requirements:**
*- for a signature*
Attendance at **lectures** is recommended, but not compulsory.

Participation at **problems classes** is compulsory. A student must attend the problems classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at problems classes will be recorded by the class leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed problems classes should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation.

*- for a grade*
The course ends in an **oral examination**. Two different topic from the semester's material should be discussed. Based on the student's presentation the following guidelines are applied:

- knowledge of fundamental laws, theorems and definitions: *sufficient (2)*

- in addition, ability to prove the fundamental theorems: *average (3)*

- in addition, knowledge of the proofs and derivations presented during the lectures: *good (4)*

- in addition, knowledge of applications discussed during problems classes: *excellent (5)*

**Person responsible for course:** Dr. Zsolt Schram, associate professor, PhD

**Lecturer:** Dr. Zsolt Schram, associate professor, PhD

| **Title of course**: Synoptic meteorology 1<br>**Code**: TTGBE5515_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**
- lecture:2 hours/week
- practice: -
- laboratory: -

**Evaluation:** practice grade

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**:

**Further courses built on it**:

**Topics of course**

The aim of the course is to provide knowledge on the history of weather forecasting, the principles of modern weather forecasting; possibilities and limits of numeric forecasting of atmospheric processes and up-to-date forecasting models. Modern remote sensing instruments and techniques are presented such as weather radars lighting localization networks and satellite images. Atmospheric processes of different time and special scales with their forecasting methods are discussed as well. Methods of posterior evaluation, verification of weather forecasts based on international recommendations and characteristics of hazardous weather elements are presented as well.

**Literature**

Compulsory literature:

G. Lackman: Midlatitude Synoptic Meteorology: Dynamics, Analysis, and Forecasting. American Meteorological Society (2012) ISBN-10: 1878220101

Additional literature:

T. Vasquez: Weather Analysis and Forecasting Handbook Weather Graphics Technologies (2011) ISBN-10: 0983253307

**Schedule:**

*1st week* – Beginnings of the understanding of atmospheric processes, basic movements of the atmosphere. Scales of atmospheric movements and their processes. Dispersion of kinetic energy input in the atmosphere.

*2nd week* – The phenomenon of convection. Thermal and dynamic convection. The Bernoulli effect. Cloud development cloud types.

*3rd week* – Development of wind systems. Hill-valley winds, winds at the banks of waterbodies, air currents over and behind obstacles. Circulation systems of the Earth, the Headly cell, the effects of

Coriolis force. Jets.

*4th week* – Large scale horizontal eddies of the mid latitudes. The process of cyclone genesis, structures of cyclones and anticyclones, development and termination of cyclones. Air masses.

*5th week* – Seasonal differences in the weather generated by cyclones and anticyclones. Cyclone families. Cyclone paths. First and second type cold fronts, warm fronts, occluded front. Stationary winter anticyclones.

*6th week* – Beginnings of synoptic meteorology. Development of weather forecasts based on isobaric systems using extrapolation and analogies. Isobaric formations and their weather patterns.

*7th week* – Development of the weather observation system. Characteristics of the modern weather observation system. Weather observation telegrams: the SYNOP and the TEMP telegrams.

*8th week* – Beginnings of numeric prognostics. Elements and resolvability of the quasi deterministic hydro-thermodynamical equation system. Characteristics of the numeric models.

*9th week* – Interpretation and presentation of ensemble forecasts: the torch and the spaghetti diagram.

*10th week* – Atmospheric electronics. Mechanisms of charge dissociation. Lightning detection systems. Features of lightning.

*11th week* – Weather information provided by weather radars and sattelites.

*12th week* – Mathematical background of the quality of forecasts. ME, MAE, RMSE and other statistical parameters and contingency tables.

*13th week* – Short term forecasting methods. Storm forecasting at the Balaton and hail defense systems. Review of dangerous weather phenomena: characteristics of the tornadoes, tropical cyclones, single cell, multicell and supercell thunderstorms

*14th week* – Processes of fog development. Characteristics of cold air pools. Imperfections of the weather forecasting models.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*

The course ends in an **examination**. The exam grade is the result of the examination

The minimum requirement is 50%. the grade for the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Ferenc Wantuch, assistant professor, PhD

**Lecturer:** Dr. Ferenc Wantuch, assistant professor, PhD

| **Title of course**: Synoptic meteorology 2<br>**Code**: TTGBG5516_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 32 hours
- preparation for the exam: -

Total: 60 hours

**Year, semester**: 3rd year, 2nd semester

**Its prerequisite(s)**: TTGBE5515_EN

**Further courses built on it**:

**Topics of course**

The aim of the course is to introduce students into the analyses of weather maps. They analyze surface and three height level weather maps independently during the practice. They interpret the weather situation and draw data, signs and codes into the map. Finally they carry out a front analysis. The final part is the weather lab practice, where students prepare their forecasts and verify them independently.

**Literature**

Compulsory literature:

G. Lackman: Midlatitude Synoptic Meteorology: Dynamics, Analysis, and Forecasting. American Meteorological Society (2012) ISBN-10: 1878220101

Additional literature:

T. Vasquez: Weather Analysis and Forecasting Handbook Weather Graphics Technologies (2011) ISBN-10: 0983253307

**Schedule:**

*1st week* – Identification and verbal analyses of weather patterns using weather maps.

*2nd week* – Drawing of upper level isohypse charts, height and humidity analyses for the 500 hpa level.

*3rd week* – Drawing of upper level isohypse charts, temperature analyses for the 500 hpa level.

*4th week* – Drawing of upper level isohypse charts, height and humidity analyses for the 850 hpa level.

*5th week* – Drawing of upper level isohypse charts, temperature analyses for the 850 hpa level.

*6th week* – Drawing of upper level isohypse charts, height and humidity analyses for the 700 hpa level.

*7th week* – Drawing of upper level isohypse charts, temperature analyses for the 700 hpa level.

*8th week* – Drawing of surface pressure charts, analyses of isobars and isallobars.

*9th week* – Identification of formations, areas of high temperature gradients, barotropic and baroclinic areas in surface pressure charts and upper level chart.

*10th week* – Frontal analyses, individual and teamwork.

*11th week* – Weather forecasting practice. Charts of the forecasted fields. Forecasting weather patterns.

*12th week* – Individual weather forecasting. Justification of the forecasts.

*13th week* – Verification of the forecasts. Preparation of ME, MAE RMSE and other statistical parameters and contingency tables in a frame of a forecasting competition.

*14th week* – Complementation of missing charts. Presentation of the completed chart series.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*

The course ends in a **practice grade**.

The minimum requirement is 50%. the grade for the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Ferenc Wantuch, assistant professor, PhD

**Lecturer:** Dr. Ferenc Wantuch, assistant professor, PhD

| **Title of course**: Aviation meteorology<br>**Code**: TTGBG5513_EN | **ECTS Credit points: 3** |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: TTGBE5501_EN

**Further courses built on it**:

**Topics of course**

The aim of the course is to introduce students into aviation meteorology what is a special field of meteorology. The following topics are discussed in the frame of the course: weather phenomena what are hazardous for aviation; aviation meteorological telegrams, maps and weather forecasts; methods used in aviation meteorology; demands of aviation from meteorology and daily routine of weather services of aviation controlled by the International Civil Aviation Organization (ICAO).

**Literature**

Compulsory literature:

International Standards and Recommended Practices, Meteorological Service for Interrnational AirNavigation, Annex 3 ICAO

Additional literature:

Meteorological Office: Handbook of Aviation Meteorology Stationery Office Books (1994) ISBN-10: 0114003653

**Schedule:**

*1st week* – Vertical division of the atmosphere, hypoxia. Effects of air temperatures on aviation. The thermic.  Characteristics of the state curve.

*2nd week* – Aeronautical issues of air pressure and density. Barometric altimetry. Definitions of QFE and QNH. International Standard Atmosphere. Altimetry. Effects of air pressure and temperature on landing and takeoff.

*3rd week* – Impacts of wind on aviation, high altitude winds. Effects of winds on landing and takeoff. Air movements over obstacles. Wave development, lee waves. Types of jet streams and their occurrence.

*4th week* – Impacts of air humidity on aviation. Visibility, runway visual range (RVR), skew and vertical visibility. Visibility reducing factors.

*5th week* – Fog. Conditions of the development of radiative, advective and frontal fogs. Cloud cover, cloud development.

*6th week* – Thermal convection, frontal lift, convergence, chimney effect. Types and classification of clouds. Effects of clouds on aviation. Determination of the amount of clouds and the height of cloud base. The highest level of the clouds the cloud top.

*7th week* – Forms of precipitation. Non falling precipitation forms. Falling precipitation forms. Effects of precipitation on aviation. Visibility reducing impacts of precipitation. Aviation climatology. Aviation climate of Hungary. Aviation climatological information.

*8th week* – Development of dust and sand storms and their effects on aviation. Hazards of volcanic ash. Warnings. Application of satellite, radar and lightning localization images in pilots' briefings.

*9th week* – Definition, development conditions and types of icing. Factors what effect on icing of airplanes. Impacts of icing on airplanes and helicopters. Forecasting of icing.

*10th week* – Measurements of turbulence. Effects of turbulence on aviation. Mechanical, thermal and dynamic turbulences. Thunderstorm turbulences. CAT. Inversion turbulences.

*11th week* – Low level wind shear and thunderstorms. Low level turbulence and aviation accident investigations. Downbursts. Measurement of wind shear. Types and structure of thunderstorms. Characteristics of single cell, multiple cell and supercell thunderstorms, rotating storms and tornadoes. Hazards of thunderstorms; effects of hail and atmospheric electricity on aviation.

*12th week* – METAR, TAF, SPECI, LANDING FORECAST coding rules

*13th week* – SIGMET, AIRMET, GAMET, SNOWTAM, VOLMET, ATIS telegrams.

*14th week* – Interpretation of meteorological information before flight. Review of the mid latitude significant maps. Review of the maps for different flight heights. High altitude temperature and wind forecast maps.

**Requirements:**

*- for a signature*
Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Ferenc Wantuch, assistant professor, PhD

**Lecturer:** Dr. Ferenc Wantuch, assistant professor, PhD

| **Title of course**: Basics of computer programming<br>**Code**: TTGBG5519_EN | **ECTS Credit points:** 2 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: -<br>- practice: 2 hours/week<br>- laboratory: - | |
| **Evaluation:** mid-semester grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: -<br>- practice: 28 hours<br>- laboratory: -<br>- home assignment: 32 hours<br>- preparation for the exam: -<br>Total: 60 hours | |
| **Year, semester**: 3rd year, 2nd semester | |
| **Its prerequisite(s)**:TTGBE5501_EN | |
| **Further courses built on it**: | |

**Topics of course**

The aim of the course is to introduce students into the basics of computer programming. Students get a programming task. They create a programming algorithm and write programs individually in C programming language in the frame the practice. By the end of the course students must be able to read in meteorological datafrom ASCII file format, to process them, to write results into file and screen; document and present them.

**Literature**

*Compulsory:*
- Kernighan, Brian W. ; Ritchie Dennis, M.: C programozási nyelv Tankönyv ISBN **:** 9631605523-

*Recommended:*
- Pohl László: A programozás alapjai. 2010 BME internetes anyag.
Benkő Tiborné, Benkő László,Tóth Bertalan: Programozzunk C nyelven.ComputerBooks Kft

**Schedule:**

*1st week* – History of C language. Language tag C, identifiers, constants, string literals, operators. Phases of translation of C programs. The first sample program.

*2nd week* – Structure of program C. Modules in C language. Types (character, integer, listed, floating point etc.), variables, constants. Sample program. Create and test own program.

*3rd week* – Operators and terms. Comparative and Logical Operators. Type conversion.
Presentation of sample tasks and making own programs.

*4th week* – Values, Addresses, Indicators. Dynamic memory usage.
Presentation of sample tasks and making own programs referring to this theme.

*5th week* – C language instructions "If" and cycle expressions.
Presentation of sample tasks and making own programs by the help of these.

*6$^{th}$ week* – Return, Break and Continue Instructions.
Presentation of sample tasks and making own programs.
Use of interruption resume and return instructions.

*7$^{th}$ week* – Arrays, strings and their functions in C language.
Presentation of sample tasks and making own programs.

*8$^{th}$ week* – Pointers and their use in C language.
Presentation of sample tasks and making own programs.

*9$^{th}$ week* – Declaring, calling, and return type of C functions. Functions Parameters.
Presentation of sample tasks and making own programs.

*10$^{th}$ week* – C Librarian Functions and Their Use.
Presentation of sample tasks and making own programs.

*11$^{th}$ week* – The basics of standard file management in C.
Presentation of sample tasks and making own programs.

*12$^{th}$ week* – Mathematical functions in C. Error Test.
Examples and making own programs.

*13$^{th}$ week* – Programming task based on data of meteorological information.
File reading calculation and result file writing.

*14$^{th}$ week* – Consultation opportunity and submission of the required programming task.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*

The course ends in a **practice grade**.

The minimum requirement is 50%. the grade for the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Ferenc Wantuch, assistant professor, PhD

**Lecturer:** Dr. Ferenc Wantuch, assistant professor, PhD

| **Title of course**: Global climate change<br>**Code**: TTGBE5511_EN | **ECTS Credit points:** 2 |
|---|---|

**Type of teaching, contact hours**
- lecture: 1 hours/week
- practice: 1 hours/week
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 14 hours
- practice: 14 hours
- laboratory: -
- home assignment: 14 hours
- preparation for the exam: 18 hours

Total: 60 hours

**Year, semester**: 3rd year, 2nd semester

**Its prerequisite(s)**: TTGBE5501_EN

**Further courses built on it**:

**Topics of course**

The aim of the course is to provide up-to-date knowledge on the scientific background of climate change. The following topics are discussed in the frame of the course: research methods of climate change; estimations for the expected changes; reports of the Intergovernmental Panel on Climate Change (IPCC); possible regional impacts of climate change; remote signals of climate anomalies.

**Literature**

Compulsory literature:

IPCC Fifth Assessment Report (AR5) – Climate Change 2013: The Physical Science Basis http://www.ipcc.ch/2008.html

Burroughs, W. J. (2001): Climate Change - A Multidisciplinary Approach. Cambridge University Press 298 p.

Additional literature:

Houghton, J. (1997): Global Warming. Cambridge University Press 250 p.

**Schedule:**

*1st week* – The demand for examinations on the background of global changes. Aims, tasks and functioning of the Intergovernmental panel on Climate Change (IPCC).

*2nd week* – Contents of IPCC reports. Review on the chapters of the volume on the physical science basis. Main processes of the climate system. Terminology: climate, natural variability of climate, climate change.

*3rd week* – Observed climate change and variability 1: Observed changes in the surface temperatures during the last 200 years. Changes in higher atmospheric layers. Changes in parameters related to temperatures. Changes in the temperatures before the observations. Observed trends in the changes of the temperatures in Hungary.

*4th week* – Observed climate change and variability 2: Observed changes in the precipitation during the last 200 years. Changes in higher atmospheric layers. Changes in parameters related to precipitation and air humidity. Changes in the precipitation before the observations. Observed trends in the changes of the amount of precipitation in Hungary.

*5th week* – Changes in atmospheric circulation. Changes of the extreme values. Carbon cycle and atmospheric carbon-dioxide: natural carbon cycle and anthropogenic impacts. Continental and marine carbon cycles.

*6th week* – Atmospheric chemistry and greenhouse gases: methane, nitrous oxide, the CFCs and tropospheric ozone. Global emission scenarios (SRES scenarios) and their basic outcomes.

*7th week* – Atmospheric aerosols and their direct and indirect effects: feedback mechanisms. Radiation forcing on the climate change: radiation forcing of the greenhouse gases, decrease of stratospheric ozone, the stratospheric aerosol, changes in the surface albedo and changes in the intensity of solar radiation. Spatial pattern of radiation forcing on the earth's surface. Radiation forcing in the past and present

*8th week* – Physical processes in the earth's system and their feedbacks: atmospheric, marine, continental and cryospheric processes, their feedbacks and consequences.

*9th week* – Modell estimations: development and types of climate models. Problems and limits of climate models. Forecasting future climates: comprehension of the outcomes of different models for air temperatures and precipitation.

*10th week* – Regional climate information: evaluation and forecasting. Methods for downscaling global models. Results of examinations for Hungary.

*11th week* – Changes of the sea level: factors what determine the sea level. Changes of the sea level in the past. Explanation of the changes of the sea level during the 20th century. Possible changes of the sea level in the future; long term changes. Methods for decreasing uncertainties.

*12th week* – Detecting climate change. Features of the reasons of the changes. Development of climate change scenarios. Uncertainties.

*13th week* – Possible impacts of climate change. Strategies for adaptation and mitigation measures. Hungarian examinations in the field of climate change.

*14th week* – End test.

**Requirements:**
Attendance at **lectures** is recommended, but not compulsory.

Attendance at **practice** is compulsory.

*- for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. István Lázár, assistant professor, PhD

**Lecturer:** Dr. István Lázár, assistant professor, PhD

| **Title of course**: Meteorological field measurements<br>**Code**: TTGBE5518_EN | **ECTS Credit points:** 2 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 1 hours/week<br>- practice: 1 hours/week<br>- laboratory: - | |
| **Evaluation:** mid-semester grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 14 hours<br>- practice: 14 hours<br>- laboratory: -<br>- home assignment: 32 hours<br>- preparation for the exam: -<br>Total: 60 hours | |
| **Year, semester**: 1st year, 2nd semester | |
| **Its prerequisite(s)**: | |
| **Further courses built on it**: TTGBE5502_EN | |

**Topics of course**

The aim of the course is to introduce students into the methodology of meteorological field measurements. In the frame of the course students are introduced into the theoretic background, the methods and techniques of the preparation works and execution of meteorological field measurements. Field survey, measurement techniques, database building, data processing, evaluation and presentation methods are discussed as well. Students carry out their own meteorological field measurements in different topics (forest microclimate, urban climate, etc.) They take field trips to meteorological and climatological observatories.

**Literature**

Compulsory literature:

T. R. Oke: Boundary Layer Climates. Routledge (1997) ISBN-10: 0415043190

Additional literature:

R. G. Barry, P. D. Blanken: Microclimate and Local Climate Cambridge University Press; (2016) ISBN-10:1107145627

**Schedule:**

*1st week* – Introduction: terminology used in local climatology.

*2nd week* – Characteristics of local climates.

*3rd week* – Development of the local climate conception.

*4th week* – Development of the methods used in local climatology.

*5th week* – Preparation activities before local climate measurements.

*6th week* – Methods and instruments of local climate measurements 1.

*7th week* – Methods and instruments of local climate measurements 2.

*8th week* – Additional examinations for description of local climate 1: micro precipitations.

*9th week* – Additional examinations for description of local climate 2: plant phenological observations.

*10th week* – Additional examinations for description of local climate 3: Frost mapping.

*11th week* – Additional examinations for description of local climate: cloud observations.

*12th week* – Interpretation of the results of local climate measurements 1.

*13th week* – Interpretation of the results of local climate measurements 2.

*14th week* – End test.

**Requirements:**
Attendance at **lectures** is recommended, but not compulsory.

Attendance at **practice** is compulsory.

*- for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Sándor Szegedi, associate professor, PhD

**Lecturer:** Dr. Sándor Szegedi, associate professor, PhD

| **Title of course**: Meteorological instruments<br>**Code**: TTGBL5508_EN | **ECTS Credit points:** 2 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: -<br>- practice: 2 hours/week<br>- laboratory: - | |
| **Evaluation:** mid-semester grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: -<br>- practice: 28 hours<br>- laboratory: -<br>- home assignment: 32 hours<br>- preparation for the exam: -<br>Total: 60 hours | |
| **Year, semester**: 2nd year, 1st semester | |
| **Its prerequisite(s)**: TTGBE5501_EN | |
| **Further courses built on it**: | |

**Topics of course**

The aim of the course is to introduce the students of the course into the methods of climatological data collection, data base building and management; data processing, analyses and presentation. The course enables students to prepare and analyze climate diagrams, to recognize climate types and characterize the climate zones of the Earth.

The following topics are discussed in the frame of the course: collection of climatological data; data base building and management; data processing, data screening methods, conversions between measures, presentation of datasets in diagrams; preparation and analyses climate diagrams; identification of climate types using Walter-Lieth diagrams; description of the climate zones of the Earth.

**Literature**

Compulsory literature:

H. Negretti: A Treatise on Meteorological Instruments: Explanatory of Their Scientific Principles, Method of Construction, and Practical Utility. Leopold Classic Library (2016)

Additional literature:

WMO GUIDE TO METEOROLOGICAL INSTRUMENTS AND METHODS OF OBSERVATION. WMO-No. 8 (Seventhedition) 6 August 2008 http://www.wmo.int/pages/prog/www/IMOP/publications/CIMO-Guide/CIMO_Guide-7th_Edition-2008.html

**Schedule:**

*1st week* – History of meteorological measurements.

*2nd week* – The World Meteorological Organization (WMO).

*3rd week* – The WMO classification of meteorological observatories.

*4th week* – Weather station classification system of the Hungarian Weather Service (OMSZ).

Terminals of meteorological measurements. Types of meteorological instruments.

*5th week* – Instruments and methods of the measurement of temperature.

*6th week* – Instruments and methods of actionometry.

*7th week* – Instruments and methods of air pressure measurements.

*8th week* – Instruments and methods of the measurement of air humidity.

*9th week* – Instruments and methods for the measurement of evaporation. Calculation methods of evaporation.

*10th week* – Instruments and methods of the measurement of precipitation. Observation methods of cloud cover.

*11th week* – Instruments and methods of the measurement of wind directions and wind speeds. Visibility measurements.

*12th week* – Automatic weather stations. Remote sensing techniques in meteorology: meteorological radars, lightning detecting systems.

*13th week* – Meteorological satellites.

*14th week* – Use of remote sensed data and satellite images in weather forecasting. Evaluation of advantages disadvantages and hazards during the construction and working different technology, size and capacity hydropower plants.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*

The course ends in a **practice grade**.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. István Lázár, assistant professor, PhD

**Lecturer:** Dr. István Lázár, assistant professor, PhD

| **Title of course**: Agrometeorology<br>**Code**: TTGBE5517 | **ECTS Credit points: 3** |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 1 hours/week<br>- practice: 2 hours/week<br>- laboratory: - | |
| **Evaluation:** mid-semester grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 14 hours<br>- practice: 28 hours<br>- laboratory: -<br>- home assignment: 48 hours<br>- preparation for the exam: -<br>Total: 90 hours | |
| **Year, semester**: 2nd year, 2nd semester | |
| **Its prerequisite(s)**: TTGBE5501, TTGBE5502 | |
| **Further courses built on it**: - | |

**Topics of course**

The series of lectures are based on the topics of technical drawing and mechanics. It reviews the fundamental relations of the sizing procedure of machineries (stress analysis for static combined loads; dimensioning on strength at harmonically varying loads, fatigue and life of members) and the concept of manufacturing tolerance and fitting. After that it deals with connections between components (connection with force transmission by friction, positive connections, bolted joints, weldings), gaskets, elastic connections (metal springs, rubber springs) beds for machine eg. rolling bearings, plain journal bearings. In the laboratory, being connected with the lectures machine elements are studied and tests of them are carried out. In seminars there are two design tasks to elaborate: a welded machinery base, and a hydraulic cylinder.

**Literature**

*Compulsory:*

- R. G. Barry, P. D. Blanken: Microclimate and Local Climate Cambridge University Press; (2016) ISBN-10: 1107145627

*Recommended:*

- T. R. Oke: Boundary Layer Climates. Routledge (1997) ISBN-10: 0415043190

**Schedule:**

*1st week* – History of C programming language. Set of symbols, identifiers, constants, string literals operators of C language. Phases of the translations of C programs. The first sample program.

*2nd week* – Structure of the C program. Modules in the C language. Types (character, integrate, listed, floating point), variables, constants. Sample program. The students write their own rogram and test it.

*3rd week* – Operators and expressions. Comparative and logical operators. Type conversions.
Presentation sample tasks and individual program writing.

*4th week* – Values, addresses, indexes, dynamic memory use.
Presentation sample tasks and individual program writing.

*5th week* – Statements of C language. The “if” statement and cycle statements.
Presentation sample tasks and individual program writing.

*6th week* – The “break”, “continue” and “return” statements.
Presentation sample tasks and individual program writing.

*7th week* – Blocks and strings and their functions.
Presentation sample tasks and individual program writing.

*8th week* – Indexes and their useage
Presentation sample tasks and individual program writing.

*9th week* – Declaration, calling and return types of functions. Parameters of the functions.
Presentation sample tasks and individual program writing.

*10th week* – Library functions and their usage.
Presentation sample tasks and individual program writing.

*11th week* – Basics of standard file management.
Presentation sample tasks and individual program writing.

*12th week* – Mathematical functions, error handling.
Presentation sample tasks and individual program writing.

*13th week* – Achievement of the programming task on the base of meteorological measurements with opportunity for consultation.

*14th week* – Opportunity for consultation, and presentation of the programs written by the students.

**Requirements:**
Attendance at **lectures** is recommended, but not compulsory.

Attendance at **practice** is compulsory.

- *for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Sándor Szegedi, associate professor, PhD

**Lecturer:** Dr. Sándor Szegedi, associate professor, PhD

| **Title of course**: Climate of the Earth<br>**Code**: TTGBE5512_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 2 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 28 hours<br>- practice: -<br>- laboratory: -<br>- home assignment: -<br>- preparation for the exam: 62 hours<br>Total: 90 hours | |
| **Year, semester**: 2nd year, 1st semester | |
| **Its prerequisite(s)**: TTGBE5501_EN | |
| **Further courses built on it**: | |

**Topics of course**

The aim of the course is to provide knowledge on the forming factors and features of the climate of the continents and their climate related environmental problems. The course deals with the following topics: overview of the factors that form the climate of the Earth: the role of solar radiation, surface material and energy transport processes in forming climate; the climate of Europe, Asia, Africa, North and South America, Australia and the Antarctica: the effects of climate forming factors, temporal and spatial patterns of climate elements in the continents; special features and environmental issues of the climate of the continents: impacts of relief, desertification in Africa, Asia and Australia; the monsoon; tropical cyclones in North America and over the Pacific; tropical deforestation; melting polar ice caps.

**Literature**

Compulsory literature:

J. E. Oliver: Encyclopedia of World Climatology (Encyclopedia of Earth Sciences Series). Springer (2008) ISBN-10: 1402032641

Additional literature:

M. Arraby, R. Garratt: Encyclopedia of Weather and Climate. Facts on File Inc. (2007) ISBN-10:0816063508

**Schedule:**

*1st week* – Introduction: definition of regional climatology. Its position within the system of sciences, its subject and methods.

*2nd week* – Review of the climate forming factors of the Earth: role of solar radiation, the surface and surface energy transport processes in the formation of climates.

*3rd week* – The climate of Europe 1: passive and active factors that form the climate of the continent.

*4th week* – The climate of Europe 2: spatial and temporal patterns of the climate parameters in Europe.

*5th week* – The climate of Europe 3: Climatic regions of Europe.

*6th week* – The climate of Asia 1: passive and active factors that form the climate of the continent.

*7th week* – The climate of Asia 2: spatial and temporal patterns of the climate parameters in Asia. Special climate phenomena: monsoon, tropical cyclones (typhoons).

*8th week* – The climate of Africa 1: passive and active factors that form the climate of the continent.

*9th week* – The climate of Africa 2: spatial and temporal patterns of the climate parameters in Asia. Special climate phenomenon: desertification of the Sahel belt.

*10th week* – The climate of North America 1: passive and active factors that form the climate of the continent.

*11th week* – The climate of North America 2: spatial and temporal patterns of the climate parameters in North America. Special climate phenomena: tornadoes, tropical cyclones (hurricanes).

*12th week* – The climate of Central and South America: passive and active factors that form the climate of the continent, spatial and temporal patterns of the climate parameters in the continents. Special climate phenomenon: the ENSO.

*13th week* – The climate of Australia: passive and active factors that form the climate of the continent, spatial and temporal patterns of the climate parameters in the continent. Special climate phenomenon: droughts caused by ENSO.

*14th week* – Climate of the polar regions: passive and active factors that form the climate of the continent, spatial and temporal patterns of the climate parameters in the polar regions.

**Requirements:**
Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Sándor Szegedi, associate professor, PhD

**Lecturer:** Dr. Sándor Szegedi, associate professor, PhD

| **Title of course**: Climate history<br>**Code**: TTGBE5514_EN | **ECTS Credit points:** 4 |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: 1 hours/week
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: 14 hours
- laboratory: -
- home assignment: 28 hours
- preparation for the exam: 50 hours

Total: 120 hours

**Year, semester**: 2nd year, 1st semester

**Its prerequisite(s)**: TTGBE5501_EN

**Further courses built on it**:

**Topics of course**

The aim of the course is to provide knowledge on short term climate changes of the historic ages and their effects historic events. The aim of the course is to examine the connections between climate and history from climatological aspect as well. The course deals with the following topics: geologic, archeologic historical and meteorological methods and sources, data processing techniques of historical climate reconstruction; reasons and evidences of short time scale fluctuations of climate¸ characteristics of the climate of the geological ages; human adaptation to ice age environment; characteristics of the climate of historic ages from the ancient civilizations to present with special respects to those areas and periods where and when changes of the climate had a direct impact on historic events.

**Literature**

Compulsory literature:

Lamb, H.H.: Climate, History and the Modern World. Routledge (1995) ISBN-10:0415127351

Additional literature:

Lamb, H.H.: Climate: Present, Past and Future - Volume 1: Fundamentals and Climate Now, Routledge (1972)

Rácz L: ClimateHistory of Hungary Since 16th Century: Past, Present and Future. Discussion Papers, Pécs (1999). 160p.

**Schedule:**

*1st week* – Subject, methods and position of climate history within the system of sciences.

*2nd week* – Scientific and archaeological methods used in climate historical research.

*3rd week* – Historical evidences of climate historical research.

*4th week* – Methods of the processing of historical sources of climate historical research.

*5^th week* – Possible causes and evidences of short term fluctuations of climate

*6^th week* – Brief review of the climate of the geological ages.

*7^th week* – Adaptation of mankind to the ice age environment.

*8^th week* – Fluctuations of climate during the times of the early civilizations.

*9^th week* – Fluctuations of climate during the ancient Greek and Roman times.

*10^th week* – Fluctuations of climate during the age of the great migrations in the early mediaeval period.

*11^th week* – The medieval optimum climate period.

*12^th week* – Characteristics of the climate of the 14^th-15^th centuries

*13^th week* – The little ice age.

*14^th week* – Fluctuations of climate during the 19^th-20^th centuries.

**Requirements:**
Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Sándor Szegedi, associate professor, PhD

**Lecturer:** Dr. Sándor Szegedi, associate professor, PhD

| **Title of course**: Environmental Climatology<br>**Code**: TTGBE5514_EN | **ECTS Credit points:** 3 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: 2 hours/week<br>- practice: -<br>- laboratory: - | |
| **Evaluation:** exam | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: 28 hours<br>- practice: -<br>- laboratory: -<br>- home assignment:<br>- preparation for the exam: 62 hours<br>Total: 90 hours | |
| **Year, semester**: 2nd year, 1st semester | |
| **Its prerequisite(s)**: TTGBE5501_EN | |
| **Further courses built on it**: | |

**Topics of course**

The aim of the course is to provide knowledge on local and micro scale climate phenomena; the special climate of simple and complex surfaces (deserts, water bodies and ice surfaces); climate phenomena that occur at the border between surfaces of different physical types (water banks, sloping surfaces, etc.); climate of plant stands (low plant stands and forests); urban climate: its forming factors, main features and impacts on human comfort, mitigation of adverse effects of urban climate. The course deals with the meteorological aspects of air pollution as well.

**Literature**

Compulsory literature:

R. G. Barry, P. D. Blanken: Microclimate and Local Climate Cambridge University Press; (2016) ISBN-10:1107145627

Additional literature:

T. Brady: Microclimates. Krupskaya (2001) ISBN-10: 1928650090

T. R. Oke: Boundary Layer Climates. Routledge (1997) ISBN-10: 0415043190

**Schedule:**

*1st week* – Spatial and temporal characteristics of climatological scales.

*2nd week* – Radiation and energy exchange processes in micro and local climate spaces 1: radiation balances of micro and local climate spaces.

*3rd week* – Radiation and energy exchange processes in micro and local climate spaces 2: energy balances of micro and local climate spaces.

*4th week* – Climate of unvegetated surfaces 1: Characteristics of the climate of sand deserts and water bodies.

*5th week* – Climate of unvegetated surfaces 2: Characteristics of the climate of snow and ice surfaces.

*6th week* – Climate of plant stands: characteristics of the climates of vegetated surfaces (grasslands, low agricultural plant stands, orchards and forests).

*7th week* – Climate phenomena that occur at the border between surfaces of different physical types (water banks, sloping surfaces, etc.).

*8th week* – Urban climatology 1: definition of urban climate. Its spatial extent. Layers of the urban atmosphere.

*9th week* – Urban climatology 2:the role of the alterations of urban surfaces in the development of local climate.

*10th week* – Urban climatology 3: radiation budgets of buildup spaces.

*11th week* – Urban climatology 4: urban water budget and its effects on energy budgets of urban surfaces.

*12th week* – Urban climatology 5: Changes of the climate elements in urban spaces: the air humidity, precipitation and air movements.

*13th week* – Urban climatology 6: spatial and temporal dynamics of the urban heat island. Effect of urban climate on human health and comfort.

*14th week* – Diffusion climatology: meteorological issues of air pollution.
Fluctuations of climate during the 19th-20th centuries.

**Requirements:**
Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*
The course ends in an **examination**. The exam grade is the result of the examination.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

**Person responsible for course:** Dr. Sándor Szegedi, associate professor, PhD

**Lecturer:** Dr. Sándor Szegedi, associate professor, PhD

| **Title of course**: Statistical Climatology<br>**Code**: TTGBG5509_EN | **ECTS Credit points: 5** |
|---|---|

**Type of teaching, contact hours**
- lecture: 2 hours/week
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: 28 hours
- practice: 28 hours
- laboratory: -
- home assignment: 54 hours
- preparation for the exam: 40 hours

Total: 150 hours

**Year, semester**: 2nd year, 1st semester

**Its prerequisite(s)**: TTGBE5501_EN

**Further courses built on it**:

**Topics of course**

The aim of the course is to introduce students into the most important methods of statistical climatology. The following topics are discussed in the frame of the course: description of climatological time series using different distributions: distribution and density functions of the length of solar irradiance, global irradiance, temperature, the amount of precipitation, wind speed, relative humidity; discrete climate probability variables: number of rainy days, diurnal changes of wind directions, number of threshold days etc.; correlation and regression analyses: definition, form and tightness of stochastic relationships; simple linear correlation and regression (SLCR); nonlinear regressions reducible to SLCR, the measures of their tightness; significance of the tightness of correlations; multiple linear correlation and regression; significance of the multiple linear correlation coefficient; statistical probes.

**Literature**

Compulsory literature:

H von Storch, F. W. Zwiers: Statistical Analysis in Climate Research. Cambridge University Press (2002) ISBN-10: 0521012309

Additional literature:

D. E. Wilkes: Statistical Methods in the Atmospheric Sciences, Volume 100, Third Edition (International Geophysics) Academic press (2011) ISBN-10: 0123850223

**Schedule:**

*1st week* – Objects, tasks and methods of statistical climatology.

*2nd week* – The statistical sample. Main issues of statistical sampling.

*3rd week* – Statistical functions: mean, standard deviation, corrected standard deviation, raw and central moments, median, lower and upper quantiles, mode, range, skewness, kurtosis.

*4th week* – Characteristics of the statistical distribution and density functions.

*5th week* – Characteristics of discrete distributions. Most frequent distributions in meteorology and climatology: binominal, geometric, hypergeometric and Poisson distributions.

*6th week* – Characteristics of continuous distributions. Most frequent continuous distributions in meteorology and climatology 1: the normal, log-normal, chi-squared, exponential distributions.

*7th week* – Characteristics of continuous distributions. Most frequent continuous distributions in meteorology and climatology 2: the gamma, the Weibull, the Rayleigh and the Gumbel distributions.

*8th week* – Statistical hypothesis testing 1: definition of a statistical hypothesis, tests for examinations of the parameters of the probability variables (U test, T tests, Welch test, F test).

*9th week* – Statistical hypothesis testing 2: tests for examinations of the distribution of the probability variables ($\chi^2$ test, Kolmogorov-Smirnov test).

*10th week* – Homogeneity and independence examinations using the $\chi^2$ test.

*11th week* – Definition of stochastic relationship. Measures of the correlation of stochastic relationships, regression equations that determine the shape of the relationship. The concept of simple linear correlation relationship (SLCR).

*12th week* – Nonlinear regressions reducible to SLCR, measure of their correlation and their significance.

*13th week* – The concept of multiple linear correlation and regression (MLCR). Significance of the multiple linear correlations.

*14th week* – Definition of stochastic processes and time series. Methods of time series analyses: trend analyses with sliding averages and analytic trend analyses. Methods of time series analyses: periodicity analyses using harmonic analyses.

**Requirements:**
*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*
The course ends in a **practice grade**.

The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-64 | pass (2) |
| 65-79 | satisfactory (3) |
| 80-89 | good (4) |
| 90-100 | excellent (5) |

| |
|---|
| **Person responsible for course:** Dr. István Lázár, senior lecturer PhD |
| **Lecturer:** Dr. István Lázár, senior lecturer PhD |

| **Title of course**: Geoecology<br>**Code**: TTGBE6011_EN | **ECTS Credit points:** 3 |
|---|---|

**Type of teaching, contact hours**

- lecture: 1 hours/week
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**

- lecture: 14 hours
- practice: 28 hours
- laboratory: -
- home assignment: 18 hours
- preparation for the exam: 30 hours

Total: 90 hours

**Year, semester**: 2nd year, 1st semester

**Its prerequisite(s)**: Soil geography TTGBE6001_EN

**Further courses built on it**: Landscape ecology TTGBE6008_EN

**Topics of course**

The aim of the course is to introduce students into the theory and practice of analyzing spatial patterns and mosaics of natural ecosystems shaped by abiotic factors (heat, light, water, relief, soil, base rock, etc.). The characteristics of local biogeochemical cycles especially of water and coal, and the geoecological characterization of typical of habitats in Central Europe. Geoecological studies and their space-time scale. The practical part of the course is to know the most important geo-ecological factors in field data collection, sampling and measurement methods. It is an indispensable prerequisite for indicating the living phenomena required for field sampling methods, for the interpretation, representation and analysis of field data. Introduction into the methods of field data collection, sampling and measurements. The possibilities of data processing, depicting, interpretation and analysis. Mapping of ecosystems.

**Literature**

*Compulsory:*

- Hugett, R. J. (1995): Geoecology – an evolutionary approach, Routledge, London, 320.
- Kruckeberg, A. R. (2002): Geology and plant life: The effects of landforms and rock types on plants. Seattle, Univ. of Washington Press. ISBN: 0–295–98203–9, 304.

*Recommended:*

**Schedule:**

**lectures**

*1st week*

Subject of geoecology. Approaches, research methods.

*2nd week*

Time-space scale of geoecological studies. Ecotops as units of geoecological studies.

*3rd week*

Role of topography and morphology of the surface in shapeing of ecotops.

*4th week*

Local water cycles of ecotops.
*5th week*
Local carbon cycles of ecotops.
*6th week*
Local cycles of main plant nutrients and microelements in ecotops.
*7th week*
Functioning of ecotops. Types of Central European ecotops.
*8th week*
Peatlands and bogs and their typical processes.
*9th week*
Fluvial and riverine ecotopes.
*10th week*
Grassland ecotops on plain landscapes. Differences according the parent material of soils.
*11th week*
Forests and forest steppe ecotops in plain landscapes. Interactions with groundwater table.
*12th week*
Slopeing forested ecotops and functioning. Effects of base rock quality.
*13th week*
Lacustrine ecotops.
*14th week*
Mapping of spatial pattern of ecotop-complexes.

**practice**
*1st week*
Sampling designe, orientation with sampling tools in the field.
*2nd week*
Evaluation of landforms, topography and morphology.
*3rd week*
Mapping of base rock and parent material diversity.
*4th week*
Soil sampling of surface samples, field evaluation. Soils field data collection.
*5th week*
Groundwater sampling. Tools, methods, field practice, database evaluation.
*6th week*
Sampling of vegetation I. Grasslands. Data collecting, evaluation.
*7th week*
Sampling of vegetation I. Forests. Data collecting, evaluation.
*8th week*
Sampling of animal communities. I. Insects.
*9th week*
Sampling of animal communities. II. Vertebrates.
*10th week*
Ecotop mapping. Delineation of habitats and ecotops.
*11th week*

Compilation of geoecological maps based on field data collection.

*12th week*

Application of databases from maps and remote sensed data in ecotope mapping.

*13th week*

Evaluation of geoecological surveys from conservational point of view and regarding the ecosystem services.

*14th week*

Mapping and evaluation of ecosystem interactions and networking.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*

During the semester students have to write an essay dealing with a selected subject of course focussing attention on their home country.

The course ends in a written **examination**. Based on the result of examination and the quality of essay, the final grade is calculated as an average of them:

- the quality of the essay (15%)
- the result of the examination (85%)

The grade for the course is given according to the following table:

| Score | Grade |
|---|---|
| 0-50 | fail (1) |
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-87 | good (4) |
| 88-100 | excellent (5) |

If the score of student result is below 50, students can take a new written examination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

*-an offered grade:*

**Person responsible for course:** Dr. Tibor Novák, associate professor, PhD

**Lecturer:** Dr. Tibor Novák, associate professor, PhD

| **Title of course**: GIS fieldwork and mapping<br>**Code**: TTGBL7023_EN | **ECTS Credit points:** 4 |
|---|---|

**Type of teaching, contact hours**
- lecture: -
- practice: 4 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**
- lecture: -
- practice: 56 hours
- laboratory: -
- home assignment: 64 hours
- preparation for the exam: -

Total: 120 hours

**Year, semester**: 3rd year, 1st semester

**Its prerequisite(s)**: -

**Further courses built on it**: -

**Topics of course**

The theory of the geoid and its important measurable parameters. Overview of national and international map projections. Horizontal measurements, the theory of triangulation, the structure of the horizontal baseline network. Types of altitude measurements. Structure of the elevation baseline network and persistence of the points. The main parts of geodetic field surveyor instruments for horizontal and altitude measurements, the principle of their operation, their practical use. Processing, mapping and analysis of field data in a software environment. Theory and practice of Global Positioning System.

**Literature**

Joel McNamara 2004. GPS for Dummies. Wiley Publishing, Inc. Indianapolis.
Wolfgang Torge 2001. Geodesy. Walter de Gruyter, Berlin – New York. ISBN: 3-11-017072-8 http://fgg-web.fgg.uni-lj.si/~/mkuhar/Zalozba/Torge-Geodesy(2001).pdf

**Schedule:**

*1st week* – Introduction

*2nd week* – Basics of field surveying

*3rd week* – Field survey methods – the classical methods

*4th week* – Field survey with classical surveying equipment – the levelling surveyor

*5th week* – Field survey with classical surveying equipment – the theodolite

*6th week* – Field survey methods –contemporary methods

*7th week* – Field survey with modern surveying equipment – the GPS

*8th week* – Mid-term test. Field survey with modern surveying equipment – the total station

*9th week* – Field survey with modern surveying equipment – the terrestrial laser scanner

*10th week* – Processing of collected data – I.

*11th week* – Processing of collected data – II.

*12th week* – Editing maps from collected data – I.

*13th week* – End-term test. Editing maps from collected data – II.

*14th week* – Questions

**Requirements:**

- *for a signature*

Attendance at classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks, drawing instruments and calculator of the course to each practice class.

- *for a grade*

Students have to submit a homework, which contains a self-surveyed and mapped area or object with description, in a document. The grade based on the quality of this paper.
During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 13th week. The final grade is calculated as an average of the grades of the tests.
The minimum requirement for the mid-term and end-term respectively is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-86 | good (4) |
| 87-100 | excellent (5) |

If the score of any test is below 50, students can take a retake test in the 14th week.
If the score of test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Gergely Szabó, assistant professor, PhD

**Lecturer:** Dr. Gergely Szabó, assistant professor, PhD

| **Title of course**: Principles of database management in earth sciences<br>**Code**: TTGBL7012_EN | **ECTS Credit points:** 2 |
|---|---|
| **Type of teaching, contact hours**<br>- lecture: -<br>- practice: 2 hours/week<br>- laboratory: - | |
| **Evaluation:** mid-semester grade | |
| **Workload (estimated), divided into contact hours:**<br>- lecture: -<br>- practice: 28 hours<br>- laboratory: -<br>- home assignment: 16 hours<br>- preparation for the exam: 16 hours<br>Total: 60 hours | |
| **Year, semester**: 2nd year, 1st semester | |
| **Its prerequisite(s)**: - | |
| **Further courses built on it**: - | |

**Topics of course**

Hydrological and hydro-meteorological data collection and basic terminology. Data collection from digital sources. Data collection from yearbooks. Grouping, debugging and corrections. Correction-making functions. Enhanced conditional-statements. Automatization of value search by function statements. Data analysis toolset. Validation menu. Drop-down lists. Error messages.

**Literature**

- https://www.tutorialspoint.com/advanced_excel/advanced_excel_tutorial.pdf
- http://web.mef.hr/web/images/pdf/ms_o_exc.pdf
- https://www.saylor.org/site/textbooks/How%20to%20Use%20Microsoft%20Excel.pdf

**Schedule:**

*1st week* – Introduction to the course

*2nd week* – Introduction to the methods of hydrological and hydro-meteorological data collection.

*3rd week* – Data collection from yearbooks

*4th week* – Joint data

*5th week* – Grouping, debugging and fixing. Use of debugging statements I.

*6th week* – Grouping, debugging and fixing. Use of debugging statements II.

*7th week* – Application of enhanced conditional statements

*8th week* – Data analysis tools, validation menu, drop-down lists, error messages.

*9th week* – Practical test I.

*10th week* – Cross-reference between data sheets

*11th week* – Data tabulation, sub-total compositions

*12th week* – Complex and special filtering. Diagram templates.

*13th week* – Summary of the semester knowledge. Practice for the Practical test II.

*14th week* – Practical test II.

**Requirements:**
Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.
During the semester there is two practical test. First is at 9th week then second is at 14th week.
The minimum score is 50%. Based on the score of the test, the grade for the test is given according to the following table:

| Score (%) | Grade |
|---|---|
| 0-49 | fail (1) |
| 50-59 | pass (2) |
| 60-74 | satisfactory (3) |
| 75-86 | good (4) |
| 87-100 | excellent (5) |

**Person responsible for course:** Dr. László Bertalan, assistant lecturer, PhD

**Lecturer:** Dr. László Bertalan, assistant lecturer, PhD