**SYLLABUS**

**1. Information regarding the programme**

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| 1.1 Higher education institution | **Babeş-Bolyai University of Cluj-Napoca** |
| 1.2 Faculty | **Environmental Science and Engineering** |
| 1.3 Department | **Environmental Analysis and Assessment** |
| 1.4 Field of study | **Environmental Engineering** |
| 1.5 Study cycle | **Master** |
| 1.6 Study programme / Qualification | **Sustainable Developement and Environmental Management** |

**2. Information regarding the discipline**

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|---|---|---|---|---|---|---|---|
| 2.1 Name of the discipline | LIDAR Systems | | | | | | |
| 2.2 Course coordinator | **Nicolae Ajtai, Lecturer Ph.D.** | | | | | | |
| 2.3 Seminar coordinator | **Nicolae Ajtai, Lecturer Ph.D.** | | | | | | |
| 2.4. Year of study | **II** | 2.5 Semester | **3** | 2.6. Type of evaluation | **C** | 2.7 Type of discipline | Optional |

**3. Total estimated time** (hours/semester of didactic activities)

| | | | | | |
|---|---|---|---|---|---|
| 3.1 Hours per week | 3 | Of which: 3.2 course | 1 | 3.3 seminar/laboratory | 2 |
| 3.4 Total hours in the curriculum | 42 | Of which: 3.5 course | 14 | 3.6 seminar/laboratory | 28 |

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|---|---|
| Time allotment: | hours |
| Learning using manual, course support, bibliography, course notes | 10 |
| Additional documentation (in libraries, on electronic platforms, field documentation) | 10 |
| Preparation for seminars/labs, homework, papers, portfolios and essays | 10 |
| Tutorship | 2 |
| Evaluations | 4 |
| Other activities: .................. | |

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| 3.7 Total individual study hours | 30 |
| 3.8 Total hours per semester | 78 |
| 3.9 Number of ECTS credits | 4 |

**4. Prerequisites** (if necessary)

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| 4.1. curriculum | Basic knowledge of atmospheric environment |
| 4.2. competencies | Basic computer and technical skills |

**5. Conditions** (if necessary)

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|---|---|
| 5.1. for the course | Video projector |
| 5.2. for the seminar /lab activities | Laboratory with computers; |

**6. Specific competencies acquired**

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|---|---|
| **Professional competencies** | • Understanding the concepts, methods and models used in environmental data acquisition and remote sensing<br>• Understanding the composition of the atmosphere and its dynamics<br>• Understanding radiative transfer through the atmosphere<br>• Understanding basic meteorological aspects<br>• Understanding the principles of active and passive remote sensing<br>• Learn to derive microphysical properties of particles from optical ones<br>• Learn to use trajectory models for particle dynamics<br>• Learn the basic operation of LIDAR systems |
| **Transversal competencies** | • Apply descriptive methodologies according to the type of study design for answering a particular research question<br>• Learn data processing with specific software<br>• Learn to work in research teams<br>• Learn to integrate environmental data with other socio-economical parameters in order to get a broader perspective on sustainable development |

**7. Objectives of the discipline** (outcome of the acquired competencies)

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|---|---|
| 7.1 General objective of the discipline | Acquire expertise regarding concepts, methodologies and techniques used in environmental data acquisition and LIDAR remote sensing |
| 7.2 Specific objective of the discipline | • Acquire a theoretical background regarding data acquisition and remote sensing<br>• To provide hands-on expertise in the use of LIDAR systems and remote sensing instrumentation<br>• Learn to integrate different types of environmental data in order to better characterize environmental factors |

**8. Content**

| 8.1 Course | Teaching methods | Remarks |
|---|---|---|
| 1. Introduction. Initial Evaluation | • Conversation<br>• Assessment | |
| 2. The atmosphere. Composition and dynamics | • Interactive exposure<br>• Explanation<br>• Oral presentation<br>• Conversation | |
| 3. Radiative transfer through the atmosphere | • Interactive exposure<br>• Explanation<br>• Oral presentation | |

| | | |
|---|---|---|
| | • Conversation | |
| 4. Active and passive remote sensing systems. | • Interactive exposure<br>• Explanation<br>• Oral presentation<br>• Conversation | |
| 5. LIDAR systems. Set-up and operation. | • Interactive exposure<br>• Explanation<br>• Oral presentation<br>• Conversation | |
| 6. LIDAR data acquisition and processing. | • Interactive exposure<br>• Explanation<br>• Oral presentation<br>• Conversation | |
| 7. Final evaluation. | • Explanation<br>• Conversation | |
| | • Assessment | |
| | | |


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Holloway, A., Wayne, R., (2010), *Atmospheric chemistry*, RSC Publishing, ISBN: 978-1-84755-807-7. 260 pp

Hobbs, P.V., (2000), *Introduction to Atmospheric Chemistry*, Camb. Univ. Press, p. 150

Ångström, A., (1929), *On the atmospheric transmission of sun radiation and on dust in the air*, Geogr. Ann., 11, 156–166


| 8.2 Seminar / laboratory | Teaching methods | Remarks |
|---|---|---|
| 1. Discussions over initial evaluation. Project assignments. | • Interactive discussions<br>• Brainstorming | |
| 2. Data acquisition procedures and protocols. Safety procedures in the laboratory | • Explanation<br>• Oral presentation | |
| 3. The radiative transfer equation. | • Explanation<br>• Demostration<br>• Hands-on learning | |
| 4. LIDAR technique. Instrumentation. | • Explanation<br>• Demostration<br>• Hands-on learning | |
| 5. LIDAR technique. Operation. | • Explanation<br>• Demostration<br>• Hands-on learning | |
| 6. LIDAR technique. Data acquisition. | • Interactive discussions<br>• Assessment | |
| 7. LIDAR data pre-processing in LabView | • Explanation<br>• Oral presentation | |

| | | |
|---|---|---|
| 8. LIDAR data processing in LabView. | • Explanation<br>• Demostration<br>• Hands-on learning | |
| 9. LIDAR data processing in LabView. | • Explanation<br>• Demostration<br>• Hands-on learning | |
| 10. HYSPLIT particle back-trajectory model | • Explanation<br>• Demostration<br>• Hands-on learning | |
| 11. Joint project work. | • Explanation<br>• Demostration<br>• Hands-on learning | |
| 12. Joint project work. | • Explanation<br>• Demostration<br>• Hands-on learning | |
| 13. Joint project work. | • Explanation<br>• Demostration | |
| 14. Final project presentation | • Interactive discussions<br>• Assessment | |

**Bibliography**


Draxler, R.R., Rolph, G.D., (2012), HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://ready.arl.noaa.gov/HYSPLIT.php), NOAA Air Resources Laboratory, Silver Spring, MD

Dubovik, O., et al., (2006), *Application of spheroid models to account for aerosol particle nonsphericity in remonte sensing of desert dust,* J. Geophys. Res., 111, doi:10.1029/2005JD006619.

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**9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program**

This course will give the opportunity for the students to work with state-of-the-art remote sensing LIDAR equipmets available within the Romanian Atmospheric 3D Research Observatory and get a complete and complex view of the atmospheric environment.

**10. Evaluation**

| Type of activity | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 Share in the grade (%) |
|---|---|---|---|
| 10.4 Course | Theoretical and practical skills should | Coloquium | 50% |

| | | | |
|---|---|---|---|
| | be demonstrated within a 2 hour colloquim | | |
| 10.5 Seminar/lab activities | Project presentation | Public presentation | 50% |
| 10.6 Minimum performance standards | | | |
| Successful passing of the course is conditioned by the final grade that has to be at least 5, and the two individual composig grades should also be at least 5. | | | |

Date | Signature of course coordinator | Signature of seminar coordinator

15.04.2018

Date of approval | Signature of the head of department