SYLLABUS

1. Information regarding the programme

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	**Bachelor**
1.6 Study programme / Qualification	**Environmental Engineering**

2. Information regarding the discipline

2.1 Name of the discipline	**Atmospheric remote sensing**						
2.2 Course coordinator			Assoc. Prof. dr. eng. Nicolae Ajtai				
2.3 Seminar coordinator			Assoc. Prof. dr. eng. Nicolae Ajtai				
2.4. Year of study	**IV**	2.5 Semester	**7**	2.6. Type of evaluation	**C**	2.7 Type of discipline	compulsory

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

3.1 Hours per week	4	Of which: 3.2 course	2	3.3 seminar/laboratory	2
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory	28
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					20
Additional documentation (in libraries, on electronic platforms, field documentation)					6
Preparation for seminars/labs, homework, papers, portfolios and essays					14
Tutorship					0
Evaluations					2
Other activities:					-

3.7 Total individual study hours	42
3.8 Total hours per semester	98
3.9 Number of ECTS credits	4

4. Prerequisites (if necessary)

4.1. curriculum	Basic knowledge of atmospheric environment
4.2. competencies	-

5. Conditions (if necessary)

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

6. Specific competencies acquired

Professional competencies	• Understanding the concepts, methods and models used in environmental data acquisition and remote sensing; • Understanding the composition of the atmosphere and its dynamics; • Understanding radiative transfer through the atmosphere; • Understanding basic meteorological aspects; • Understanding the principles of active and passive remote sensing; • Learn to use trajectory models for particle dynamics; • Learn the basic operation of remote sensing instruments for clouds and aerosol studies;
Transversal competencies	• Apply descriptive methodologies according to the type of study design for answering particular research question; • Learn data processing with specific software; • Learn to work in research teams;

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

7.1 General objective of the discipline	- Presentation and assimilation of the main concepts and methods of active and passive remote sensing of clouds and atmospheric aerosol.
7.2 Specific objective of the discipline	- Acquiring theoretical knowledge regarding the study of the atmosphere through remote sensing. - Acquisition of theoretical knowledge regarding the methods of radiative transfer in the atmosphere. - Acquiring practical knowledge regarding the sounding of the atmosphere with active and passive remote sensing instruments.

8. Content

8.1 Course	Teaching methods	Remarks
1. Remote sensing. Introductory notions.	Interactive exposure Explanation Oral presentation	
2. Radiative transfer in the atmosphere.	Interactive exposure Explanation Oral presentation	
3. The atmosphere. Structure, dynamics, gases and material particles.	Interactive exposure Explanation Oral presentation	
4. Study of atmospheric aerosol and clouds using active and passive remote sensing techniques.	Interactive exposure Explanation Oral presentation	
5. Passive remote sensing - aerosol. Radiometers and solar photometers.	Interactive exposure Explanation	

	Oral presentation	
6. Active remote sensing - aerosol. Elastic backscatter LIDAR systems.	Interactive exposure Explanation Oral presentation	
7. Active remote sensing. RAMAN multichannel LIDAR systems. Applications in the detection and characterization of aerosols.	Interactive exposure Explanation Oral presentation	
8. Study of clouds by remote sensing. Cloud radar. Ceilometer	Interactive exposure Explanation Oral presentation	
9. Study of clouds by remote sensing. Microwave radiometer. Wind doppler lidar.	Interactive exposure Explanation Oral presentation	
10. Satellite imaging techniques;	Interactive exposure Explanation Oral presentation	
11. Detection and classification of particulate matter at ground level using optical particle counters.	Interactive exposure Explanation Oral presentation	
12. Modeling the dispersion of pollutants in the atmosphere on a small, medium and macro scale. Integration of remote sensing data.	Interactive exposure Explanation Oral presentation	
13. International environmental monitoring networks based on remote sensing.	Interactive exposure Explanation Oral presentation	
14. The RADO concept. Romanian Atmospheric 3D Research Observatory. Development of an advanced platform for the study of the atmosphere.	Interactive exposure Explanation Oral presentation	

Bibliography:

1. Jaqueline Lenoble, 1985, Atmospheric Radiative Transfer
2. Wallace, J.M., Hobbs, P.V., 2006, *Atmospheric science: an introductory survey* - 2nd edition., ISBN 13: 978-0-12-732951-2
3. Ann M Holloway and Richard P Wayne, 2010, *Atmospheric Chemistry*, RSC Publishing, ISBN: 9781847558077
4. Fizica mediului – atmosfera, D. Ristoiu, Ed. Napoca Star, 2005, 560 pg
5. Sabina Stefan, Doina Nicolae, Mihaela Caian, 2008, *Secretele aerosolului atmosferic in lumina laserului*, Ars Docendi, Bucuresti
6. Oleg Dubovik, Brent Holben, Thomas F. Eck, Alexander Smirnov, Yoram J. Kaufman, Michael D. King, Didier Tanre, and Ilya Slutsker, *Variability of Absorption and Optical Properties of Key Aerosol Types Observed in Worldwide Locations*, Journal of the Atmospheric Sciences, 2001, Vol. 59. p. 520
7. Vallis Geoffrey K., 2019, *Essentials of Atmospheric and Oceanic Dynamics*, ISBN: 9781107692794, Cambridge, 366pp.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Optoelectronic techniques for environmental monitoring.	conversaţia	
2. Passive remote sensing. Measurements with the CIMEL CE 318 sun photometer.	conversaţia, experimantarea	
3. AERONET platform - presentation	experimentul,conversaţia, învăţareaprin descoperire	
4. AERONET platform – analysis and interpretation of directly measured parameters	experimentul, conversa-ţia, învăţarea prin descoperire	

5. AERONET platform – analysis and interpretation of indirectly measured parameters.	experimentul, conversaţia, învăţarea prin descoperire	
6. Active remote sensing. Measurements with the CLOP LIDAR system	experimentul, învăţarea prin descoperire	
7. Measurements with the CLOP LIDAR system	experimentul, învăţarea prin descoperire	
8. Lidar data processing. The SCC model.	experimentul, învăţarea prin descoperire	
9. Aerosol and gas dispersion models;	experimentul, învăţarea prin descoperire	
10. Modeling the dispersion of pollutants at the macroscale. HYSPLIT.	experimentul, învăţarea prin descoperire	
11. Global networks of remote sensing instruments.	învăţarea prin descoperire; conversaţie	
12. Joint project work.	Team work, experiment;	
13. Joint project work.	Team work, experiment;	
14. Final project presentation.	Individual study presentation;	

Bibliography:

1. 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, [accesat în aprilie 2011]
2. Dubovik, O., Holben, B.N., Eck, T.F., Smirnov, A., Kaufman, Y.J., King, M.D., Tanre, D., Slutsker, I., (2002), *Variability of absorption and optical properties of key aerosol types observed in worldwide locations*, Journal of Atmospheric Science., 59, 590-608
3. Dubovik, O., Smirnov, A., Holben, B., (2000), *Accuracy assessments of aerosol optical properties retrieved from Aerosol Robotic Network (AERONET) sun and sky radiance measurements*. JGR, 105 (D8), 9791-9806
4. Mortier, A., Goloub, P., Podvin, T., Deroo, C., Chaikovsky, A., Blarel, L., Tanre, D. Ajtai, N., (2012), Detection and Characterization of Volcanic Ash Plumes over Lille during Eyjafjöll Volcano Eruption, submitted for publication in Atmospheric Physics and Chemistry/Atmospheric Measurement Techniques Special Issue, Observations and modeling of aerosol and cloud properties for climate studies (ACP/AMT Inter-Journal SI), ISSN: 1867-1381

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

- Analysis of atmospheric processes in order to reduce the impact on the environment;
- Identifying and specifying information related to the best technologies available in the field;
- Use of information on the best technologies for implementation in environmental projects;

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 be demonstrated within a 2 hour colloquim	Coloquium	50%

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

07.12.2024

Date of approval | Signature of the head of department