COURSE OUTLINE

1. Study programme information

1.1 Higher education institution	West University of Timisoara
1.2 Faculty / Department	Chemistry, Biology, Geography / Geography
1.3 Sub-department	
1.4 Field of study	Geography
1.5 Level of study	Master's degree
1.6 Study programme / Qualification	Geographic Information Systems

2. Course information

2.1 Course title				Methods and models for analysing remote sensing data			
2.2 Course convenor/ Lecturer				Lect. Dr. Florina ARDELEAN			
2.3 Teaching assistant				Lect. Dr. Florina ARDELEAN			
2.4 Year of study	I	2.5 Semester	II	2.6 Type of assessment	E	2.7 Course type	DS/ DO

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

3.1 Number of hours per week	3	of which: 3.2 lecture	1	3.3 seminar/laboratory	2
3.4 Total hours in the curriculum	42	of which: 3.5 lecture	14	3.6 seminar/laboratory	28
Time distribution:					**hours**
Studying textbooks, course materials, bibliography and notes					25
Further research in libraries, on electronic platforms and in the field					20
Preparing seminars/ laboratories, homework, research papers, portfolios and essays					20
Tutoring					10
Examinations					8
Other activities ……					

3.7 Total hours of individual study	**83**
3.8 Total hours per semester	**125**
3.9 Number of credits	**5**

4. Prerequisites (if applicable)

4.1 based on curriculum	
4.2 based on competencies	• basic knowledge in GIS

5. Conditions (if applicable)

5.1 for the course	• computer / laptop for the teacher and students • internet access; access to the e-learning UVT platform; • video projector
5.2 for the seminar/laboratory	• computer / laptop for the teacher and students; • internet access; access to the e-learning UVT platform; • video projector

6. Objectives of the discipline - expected learning outcomes to the formation of which contribute to the completion and promotion of the discipline

Knowledge	• knowledge of the basics of electromagnetic spectrum and spectral signatures • knowledge on sensors, platforms and image acquisition methods • knowledge on the main types of satellite images and their acquisition and processing steps • develop multi-step remote sensing workflows to solve problems in the field of geosciences • analyze digital remote sensing data independently using different image processing software • extract relevant information from remotely sensed data using different manual and automated techniques; • integrating remote sensing data with other spatial data in geographical information systems • formulate a title and design a research project based on the use of remote sensing data in the field of geosciences (problem, hypothesis, objectives, methodology) and carry out independent projects with the use of remote sensing and GIS
Skills	• process remotely sensed data to make it useful for different applications in GIS environment • search, acquire and import relevant remote sensing images for the proposed project • extract and process quantitative geo- and biophysical measurements from remotely sensed data • process satellite images using specific methods, such as feature extraction, thematic classifications and change detection analysis on different types of satellite images • generate relevant geographical information by processing digital remotely sensed data and critically evaluate its use for environmental applications • communicate project findings from the analysis of remotely sensed data through presentations
Responsibility and autonomy	• understanding of ethics in academic conduct (correct citations, avoiding plagiarism) • development of a critical and analytical spirit among students • developing team working abilities • developing communication skills to present relevant results in the field of geosciences

7. Content

7.1 Lecture	**Teaching methods**	**Observations**
Course introduction - structure, syllabus. Remote sensing principles. Electromagnetic radiation – physical properties and interactions • Jensen, J.R., 2007, Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Ed., Prentice Hall. • Campbell, J B., Wynne, R., 2011, Introduction to Remote Sensing, 5th edition. The Guilford Press. 667 p. • Strahler, A.H., Woodcock, C.E., Smith, J.A., 1986. On the nature of models in remote sensing. Remote Sensing of Environment, 20(2), 121-139. • Online resources on WUT e-learning platform	Lecture / heuristic conversation /	2 hours
Remote sensing platforms and sensors. Passive and active remote sensing. Remote sensing products • Prost, G. L., 2013, Remote Sensing for Geoscientists: Image Analysis and Integration, Third Edition, CRC Press Taylor and Francis Group, 702 p. • https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/resource/tutor/fundam/pdf/fundamentals_ e.pdf • Online resources on WUT e-learning platform		2 hours
Characteristics of satellite images and aerial photography (scale, spectral signatures, resolutions, brightness, contrast, geometric properties, processing levels, ancillary data etc.). Multispectral remote sensing systems. Landsat, Sentinel, MODIS archives • Lillesand, T., Kiefer, R., Chipman, J., 2015. Remote Sensing and Image Interpretation, 7th ed., Wiley, 720 p. • Prost, G. L., 2013, Remote Sensing for Geoscientists: Image Analysis and		4 hours

Integration, Third Edition, CRC Press Taylor and Francis Group, 702 p. • https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/resource/tutor/fundam/pdf/fundamentals_e.pdf • Online resources on WUT e-learning platform		
Satellite images acquisition, storage, preprocessing and analysis workflows. • Mihai, B.A., 2007, Teledetecție. Introducere în procesarea digitală a imaginilor., Ed. Universitații din București • Prost, G. L., 2013, Remote Sensing for Geoscientists: Image Analysis and Integration, Third Edition, CRC Press Taylor and Francis Group, 702 p. • Jensen, John R., 2005, Introductory Digital Image Processing, 3rd Ed., Upper Prentice Hall. • https://spatialanalysisonline.com/HTML/index.html • Online resources on WUT e-learning platform		2 hours
Classification of remotely sensed data. Change detection analysis. Accuracy assessment. • Prost, G. L., 2013, Remote Sensing for Geoscientists: Image Analysis and Integration, Third Edition, CRC Press Taylor and Francis Group, 702 p. • Hussain, M., Chen, D., Cheng, A., Wei, H., Stanley, D., 2013. Change detection from remotely sensed images: From pixel-based to object-based approaches. ISPRS Journal of Photogrammetry and Remote Sensing, 80, 91-106. • http://www.spatialanalysisonline.com/HTML/index.html • Online resources on WUT e-learning platform		4 hours

References

- Campbell, J B., Wynne, R., 2011, *Introduction to Remote Sensing, 5th edition*. The Guilford Press. 667 p.
- Chuvieco, E., 2016, *Fundamentals of satellite remote sensing: An environmental approach* (2nd Edition) CRC Press, Boca Raton, Florida. 468 p.
- Gorelick, N., Hancher, M., Dixon, M., Ilyushchenko, S., Thau, D., Moore, R., 2017, Google Earth Engine: Planetary-scale geospatial analysis for everyone, *Remote Sensing of Environment*, 202, 18-27, doi.org/10.1016/j.rse.2017.06.031
- Green, K., Congalton, R., Tukman, M. 2017, *Imagery and GIS: Best practices for extracting information from imagery*. ESRI Press, Redlands, California. 437 p.
- Hussain, M., Chen, D., Cheng, A., Wei, H., Stanley, D., 2013. Change detection from remotely sensed images: From pixel-based to object-based approaches. *ISPRS Journal of Photogrammetry and Remote Sensing*, 80, 91-106.
- Jensen, J.R., 2007, Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Ed., Prentice Hall.
- Lillesand, T., Kiefer, R., Chipman, J., 2015. *Remote Sensing and Image Interpretation*, 7th ed., Wiley, 720 p.
- Mather, Paul M., Koch, Magali, 2011, Computer processing of remotely-sensed images-An introduction (4th Edition), Wiley-Blackwell, 462 p.
- Mihai, B.A., 2007, Teledetecție. Introducere în procesarea digitală a imaginilor., Ed. Universitații din București
- Prost, G. L., 2013, Remote Sensing for Geoscientists: Image Analysis and Integration, Third Edition, CRC Press Taylor and Francis Group, 702 p.
- Richards, J.A., 2013, *Remote sensing digital image analysis*, Springer, 494 p.
- Strahler, A.H., Woodcock, C.E., Smith, J.A., 1986. On the nature of models in remote sensing. *Remote Sensing of Environment*, 20(2), 121-139.
- https://natural-resources.canada.ca/sites/nrcan/files/earthsciences/pdf/resource/tutor/fundam/pdf/fundamentals_e.pdf
- https://spatialanalysisonline.com/HTML/index.html
- Course related materials, presentations and references posted on e-learning WUT platform (https://elearning.e-uvt.ro/)

7.2 Laboratory – practical activity	**Teaching methods**	**Observations**
Solutions and tools for satellite images acquisition and processing. Online data sources for remote sensing. Training data for remote sensing.	Hands-on exercises /lecture/ heuristic conversation	4 hours
Image resolution, information content, data formats. Image preprocessing, image enhancement, filters. Normalized indices (i.e. from Landsat / Sentinel)		4 hours
Feature extraction, thematic classification, accuracy assessment		4 hours

Landcover/landuse classification. Change detection analysis (i.e. urban growth)		4 hours
Natural hazards applications based on satellite images – i.e. forest fires, drought analysis, snow avalanches, floods		4 hours
Deep learning for remote sensing applications		4 hours
Final project assessment		4 hours

References

- Green, K., Congalton, R., Tukman, M. 2017, *Imagery and GIS: Best practices for extracting information from imagery*. ESRI Press, Redlands, California. 437 p.
- Jensen, J.R., 2007, Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Ed., Prentice Hall.
- Mather, Paul M., Koch, Magali, 2011, Computer processing of remotely-sensed images-An introduction (4th Edition), Wiley-Blackwell, 462 p
- https://www.esri.com/training/
- https://appliedsciences.nasa.gov/join-mission/training
- https://spatialanalysisonline.com/HTML/index.html
- https://gisgeography.com/remote-sensing-applications/
- https://learn.arcgis.com/en/gallery/#?c=imagery
- https://earthexplorer.usgs.gov/
- https://scihub.copernicus.eu/dhus/#/home
- https://search.earthdata.nasa.gov/search
- https://www.youtube.com/watch?v=eJFHMestpCo
- https://resources.maxar.com/product-samples
- https://www.planet.com/products/
- https://glad.earthengine.app/view/global-forest-change#dl=1;old=off;bl=off;lon=166.36956895580315;lat=61.532855836607766;zoom=3;
- https://www.esa-landcover-cci.org/
- https://modis.gsfc.nasa.gov/data/dataprod/mod12.php
- https://terra.ipums.org/
- Practical activity materials, presentations and references posted on e-learning WUT platform (https://elearning.e-uvt.ro/)

8. Corroborating course content with the expectations held by the representatives of the epistemic community, professional associations and typical employers in the field of the study programme

The content of the course was developed in accordance with the curriculum and meets the didactic and scientific requirements corresponding to similar specializations in other university centers. Course content will offer the students the necessary skills to acquire, integrate, process and analyze different types of remote sensing data in order to start-up GIS projects in the field of geosciences. It stimulates the personal involvement of students in identifying problems that are suitable to be solved using remotely sensed data in a GIS environment. The software solutions used in this course (commercial and open-source) are among the most modern and frequently used in specialized institutions in the field of remote sensing applications.

9. Assessment

Type of activity	9.1 Assessment criteria	9.2 Assessment methods	9.3 Weight in the final mark
9.4 Course	Understanding and assimilation of knowledge – concepts and methods in remote sensing and corresponding applications	Written exam	30 %
9.5 Laboratory-practical activity	Practical assignment 1	Written report on e-learning	15 %
	Practical assignment 2	Written report on e-learning	15 %
	Final project (content and results)	Presentation of results (written report on e-learning and oral evaluation)	40 %

9.6 Minimum performance standard
• Minimum mark 5 at course evaluation. • Minimum mark 5 at practical activities.

Date	Course convenor's signature
27.02.2022	Lect. Dr. Florina Ardelean
Date of approval in the department	Head of department's signature Lect. Dr. Ioan Sebastian Jucu