REMOTE SENSING

Hydrogeology MSc course

2018/19 1. Semester

COURSE COMMUNICATION FOLDER

University of Miskolc
Faculty of Earth Science and Engineering
Institute of Mineralogy and Geology

Course datasheet

Course Title: Remote sensing (Optional subject group (2)) **Instructor:** Dr. Norbert Németh, associate professor	**Code:** MFFTT730032 **Responsible department/institute:** Department of Geology and Mineral Deposits
	Type of course: Optional
Position in curriculum (which semester): 3	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 1+2	**Type of Assessment (examination/ practical mark / other):** practical mark
Credits: 3	**Course:** full time

Course Description:
Introduction of the basics, physical basis, applications and uses of the remote sensing. Students gain insight to the interpretation of certain data recordings.
Competencies to evolve:
Knowledge:
Ability:
Attitude:
Autonomy and responsibility:

The short curriculum of the subject:
General concepts of the remote sensing. Electromagnetic waves and realms of perception, data collecting systems. Instruments of aerial and space remote sensing (photography, CCD, satellites, radar). Remote sensing methods by photography, spectrometry, radiometry and acoustics. Remote sensing observation of global changes of the Earth in the atmosphere, biosphere, hydrosphere and on the continents. Geological and other interpretation of aerial geophysical recordings, aerial photos, radar and acoustic images, use of multispectral and hyperspectral images. Spectral characteristics of the rocks, valley net analysis and recognizable characteristics of classical geological features (volcanic cones, intrusive bodies, bedded strata and tectonic forms). Spectral characteristics of soil types and vegetation. Recognition of soil and plant damages. Spectral characteristics of hydrological systems (rivers, lakes, seas). Application of the remote sensing in environment protection, recognition and monitoring of pollutions. Prediction of geological hazards and catastrophes (volcanic eruption, earthquake).

Assessment and grading:
Signature requirements: attendance on the seminars and pass grade on the midterm exam.
Practical mark: presentation on a choosen topic from the application of remote sensing.
Students will be assessed according to the results of the presentation.
Grading scale:

% value	Grade
90 –100%	5 (excellent)
80 – 89%	4 (good)
70 – 79%	3 (satisfactory)
60 – 69%	2 (pass)
0 – 59%	1 (failed)

Compulsory or recommended literature resources:

- Fundamentals of Remote Sensing. Canada Centre for Remote Sensing tutorial
  URL: www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/educational-resources/9309
- Adams, John: Remote sensing of landscapes with spectral images: a physical modeling approach. Cambridge University Press, Cambridge, 2006.
- Thomas M. Lillesand – Ralph W. Kiefer 1987: Remote sensing and image interpretation. John Wiley & Sons, New York, 722p.
- John R. Schott 1997: Remote Sensing: The Image Chain Approach. Oxford University Press, 394p.
- Philipson, W.R. (ed.) 1997: Manual of photographic interpretation (2nd ed). American Society for Photogrammetry and Remote Sensing, Bethesda, Maryland, 700p.

Syllabus of the semester

Monday, 12:00-15:00

<table>
<tr><td>2018.09.10.</td><td>Terms, aims and physical background of the remote sensing</td></tr>
<tr><td>2018.09.17.</td><td>Remote sensing methods: aerial photography, multispectral scanners, hyperspectral scanners</td></tr>
<tr><td>2018.09.24.</td><td>Data processing in remote sensing: stereoscopy, photogrammetry, image processing</td></tr>
<tr><td>2018.10.01.</td><td>Application of remote sensing: meteorology, oceanography, vegetation mapping, hydrology, geography, geodesy, geology, mineral exploration</td></tr>
<tr><td>2018.10.08.</td><td>Open-book exam for the</td></tr>
<tr><td>2018.10.15.
2018.10.22.
2018.10.29.
2019.11.05.
2018.11.12.
2018.11.19.
2018.11.26.
2018.12.03.</td><td>Presentations
The students have to make a 20 min. presentation based on material collected, including at least 5 papers published in referred journals. The source of every data, picture or other presented item has to be indicated in the presentation.
Issues to introduce:
• Data sources, sensors and platforms
• Processing of the data, tools for interpretation
• Advantages and possible pitfalls of the methods
The students may choose from the following list of topics:
Remote sensing and…
1. Surface temperature and moisture
2. Precipitation
3. Agriculture
4. Surface runoff and water catchment
5. Water quality (sea and lakes)
6. Bathymetry (ocean floor mapping)
7. Groundwater prospecting/exploration
8. Aquifer vulnerability mapping
9. Environmental studies of solid waste landfills
10. Environmental studies of open pit mines
11. Environmental studies of wetlands and coastal areas
12. Monitoring of flooding
13. Monitoring of earthquakes and mass movements
14. Monitoring of ice and snow coverage
15. Geological mapping (overview)
16. Vegetation cover (overview)
17. Extraterrestrial surfaces (overview)
After presentation a discussion will follow, when everybody can put questions to the presenter on the topic.
Grading is based on the achievement (preparation and presentation).</td></tr>
<tr><td>2018.12.10.</td><td>Supplements (failed or missed midterm exam and presentations)</td></tr>
</table>

Sample for the midterm exam with answers

MFFTT730032 Remote sensing, test

1. What portions of the electromagnetic spectrum are represented by the listed wavelengths? Give the names of the portions! (e. g. 6.3 pm: gamma ray)

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250 nm: *UV*

12.8 μm: *IR*

0.55 μm: *visible light*

1.3 cm: *microwave*

29 m: *radio wave*

Points	**5**	

2. Indicate the devices used for sensing electromagnetic radiation!

Pages 48, 92-(radar chapter)

	yes	no
Across-track multispectral scanner	X	
Along-track multispectral scanner	X	
Stereoplotter		X
Proton precession magnetometer		X
Side-looking airborne radar	X	
Synthetic aperture radar	X	

Points	**3**	

3. What types of scattering are distinguished? Indicate also the factor determining the occurrence of each type! Give an atmospheric phenomenon as an example for each type!

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1. *Rayleigh scattering, wavelength > particle size*_____

Example: *skylight*_____

2. *Mie scattering, wavelength ~ particle size* _____

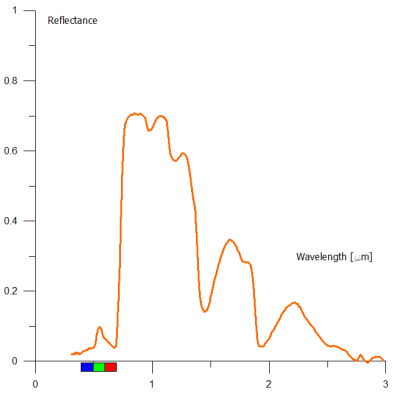
Example: *white clouds*_____

3. *Non-selective scattering, wavelength > particle size* _____

Example: *fog*_____

Points	**6**	

4. What is the property represented by this curve?
a. Explain it briefly!
b. What type of surface coverage can produce this pattern?



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Reflectance is the reflected proportion of the incident radiation as a function of wavelength.
The pattern is characteristic for vegetation.

Points	**2**	
Points	**1**	

5.
a. Introduce the characteristics of the orbits of the remote sensing satellites!
b. What are the advantages and drawbacks of these orbits?
c. What is the 'revisit period'? Explain the term!

Pages 36-38

a. Most remote sensing satellites have a sun-synchronous, quasipolar, retrograde orbit, which is nearly circular, in a typical altitude of 6-700 km.
b. Advantage: constant scale and illumination angle of the imagery
Drawback: polar areas are not covered; revisit period is limited
c. Revisit period is the time interval of repetition of the same scene (passing over the same area)

Points	**2**	
Points	**1**	
Points	**1**	

6. What are the two determinant factors of the azimuth or along-track resolution of the SLAR?

Page 101

1. *beamwidth / aperture (antenna length)*_____

2. *slant range distance*_____

Points	**2**	

7. There are three models to record true colour images digitally.
a. Name the factors recorded in each model!

Page 21+presentation

1. *red, green, blue channels (intensity values)*_____

2. *cyan, magenta, yellow*_____

3. *hue, saturation, intensity*_____

b. How many colour variations can be recoded by these to call it 'true colour' resolution?

$2^{24} = 256^3 \sim 16.7$ *Million*

Points	**3**	
Points	**1**	

8. Explain the process of filtering a digital image, and give an example of a convolution filter used for edge detection!

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A common filtering procedure involves moving a 'window' of a few pixels in dimension (e.g. 3x3, 5x5, etc.) over each pixel in the image, applying a mathematical calculation using the pixel values under that window, and replacing the central pixel with the new value. The window is moved along in both the row and column dimensions one pixel at a time and the calculation is repeated until the entire image has been filtered and a "new" image has been generated.

Example: Laplace filter

0	*1*	*0*
1	*-4*	*1*
0	*1*	*0*

Points	**5**	

9. Two SAR images were obtained from the same area during two different surveys. The reflection of a particular surface is more intensive on the second image than on the first one. Give four different possible reasons of this change!

1. *Temporal changes in the cover (vegetation, crop, snow, moisture etc.)*

_____

2. *Not the same orientation and incident angle of the illumination*

_____

3. *Different wavelength and, in consequence, different effective roughness and penetration*

_____

4. *Different polarisation (HH, VV, HV or VH)*

_____

Points	**4**	

10. Which method would you apply for the given task? Form pairs from the lists below!
(e. g. 1a, 2b etc.)

a.	C channel (λ=5.3 cm) SAR image	1.	Assessing damages of an earthquake
b.	K channel (λ=8.6 mm) SAR image	2.	Bathymetric mapping of a lagoon
c.	Landsat TM 123 (true colour) scene	3.	Biomass mapping
d.	Landsat TM 234 (false colour) scene	4.	Correcting an 1:10000 scale topographic map
e.	Panchromatic aerial photo series	5.	Monitoring rain (precipitation) intensity
f.	Quickbird panchromatic scene	6.	Monitoring wind speed conditions over oceans

1f, 2c, 3d, 4e, 5b, 6a

Points	**4**	

Summary:

Points	**40**	

Pass grade: 20 points

(**Location of information** is indicated in the source 'Fundamentals of Remote Sensing' if appropriate)