Course guide
330340 - TEL - Remote Sensing

Last modified: 04/07/2023

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: MASTER'S DEGREE IN MINING ENGINEERING (Syllabus 2013). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Oliveras Mejías, Jordi

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
4. (ENG) Explorar i investigar jaciments de recursos geològics.
5. (ENG) Realitzar estudis de gestió del territori.
6. (ENG) Avaluar ambientalment projectes.

Transversal:
1. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

2. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

3. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

TEACHING METHODOLOGY

Lectures with multimedia support.
Individual work supervised by the professor in the classroom and computer laboratory.
Collaborative work combining individual and group work.
Individual or group face-to-face tutorials.
Other: Reading recommended texts, solving exercises and using software.

LEARNING OBJECTIVES OF THE SUBJECT

Concept of space remote sensing.
Sensors and platforms.
Geometric and radiometric correction of satellite imagery.
Numerical transformations.
Digital classification of images.
Interpretation of results and production of thematic maps.
Examples of applications.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	45,0	36.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

INTRODUCTION

Description:
Remote Sensing aims to introduce students to multispectral image analysis methods and techniques and their application in mining. During the course, the methodological foundations of Earth and space remote sensing techniques corresponding to aspects of multispectral image acquisition, digital processing and the interpretation and production of thematic maps are presented first. Then several case studies related to the study of geological and environmental resources (mining exploration, water resources, desertification, land use, etc.) are explained.

Specific objectives:
1. SUSTAINABILITY AND SOCIAL COMMITMENT: An awareness and understanding of the complexity of the economic and social phenomena associated with a welfare society; the ability to relate well-being to globalisation and sustainability; and the ability to use know-how and technology in a way that is balanced and compatible with economic considerations and the goal of sustainability.
2. TEAMWORK: The ability to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
3. EFFECTIVE USE OF INFORMATION RESOURCES:
The ability to acquire, structure, analyse and present data and information in the area of specialisation and critically assess the results obtained.
4. The ability to explore and research geological deposits.
5. The ability to carry out land management studies.
6. The ability to assess projects in environmental terms.

Full-or-part-time: 125h
Practical classes: 45h
Self study : 80h

Topic 1: General aspects of remote sensing

Description:
Concept of remote sensing. Elements of a remote sensing system. Historical evolution. Advantages and disadvantages of remote sensing. Stages in the development of a remote sensing application.

Related activities:
Information search.

Full-or-part-time: 8h
Practical classes: 3h
Self study : 5h

Topic 2: Physical basis of remote sensing

Description:
Electromagnetic radiation (EMR): nature and characteristics. Electromagnetic spectrum.
Interaction between EMR and matter. Atmospheric effects. Concept of spectral signature. Spectral signatures of land cover objects: rocks/soil, vegetation and water.

Related activities:
Numerical exercises: radiation laws, spectral signature.

Full-or-part-time: 16h
Practical classes: 6h
Self study : 10h

Topic 3: Data acquisition: sensors and platforms

Description:
Concept of passive and active remote sensing. Electro-optical sensors for mechanical and electronic scanning. Earth observation programmes. General aspects of remote sensing.

Related activities:
Numerical exercises. Search for image acquisition sources.

Full-or-part-time: 8h
Practical classes: 3h
Self study : 5h

Topic 4: Digital image processing

Description:
Concept and characteristics of an image. Image restoration: radiometric and geometric correction. Image enhancement: radiometric and geometric filtering. Colour composition. Image transformations: arithmetic operations and principal component analysis. Image classification: supervised and unsupervised.

Related activities:
Introduction to free remote sensing software. Application of theoretical methodology to a case.

Full-or-part-time: 32h
Practical classes: 12h
Self study : 20h

Topic 5: Applications of remote sensing in mining

Description:
Methodological aspects of an application of remote sensing in mining. Application examples in geological mapping, mining exploration, water resources, erosion-desertification, coastal areas, vegetation mapping, etc.

Related activities:
Search for specific applications.

Full-or-part-time: 21h
Practical classes: 6h
Self study : 15h

ACTIVITIES

INTRODUCTION

Description:
The main aim of the practicals is for students to develop an applied remote sensing application. Various types of satellite imagery (Landsat TM, ETM+, SPOT-5, etc.) are available for students to process digitally and interpret the results in order to produce a thematic map in the context of the study carried out (geological mapping, land use, water and mineral resources and other environmental aspects).
The practical will consist of four parts of methodological content explained in the lectures: a) Geometric and radiometric image correction, b) Spectral and spatial image enhancement, c) Numerical transformation of images, d) Digital classification.

Full-or-part-time: 8h
Practical classes: 3h
Self study: 5h

Activity 1: INTRODUCTION TO FREE SOFTWARE FOR DISPLAYING AND WORKING WITH IMAGES

Description:
Knowledge of the tools.

Specific objectives:
Use of ICT tools.

Material:
Free software. Satellite image.

Delivery:
Using the tool to be employed in the final practical assignment.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

Activity 2: GEOMETRIC AND RADIOMETRIC CORRECTION OF A MULTISPECTRAL IMAGE

Description:
Pre-processing.

Specific objectives:
Use of ICT tools.

Material:
Free software. Satellite image.

Delivery:
Using the tool to be employed in the final practical assignment.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

Activity 3: IMAGE DISPLAY AND INTERPRETATION

Description:
Photointerpretation.

Specific objectives:
Use of ICT tools.

Material:
Free software. Satellite image.

Delivery:
Using the tool to be employed in the final practical assignment.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

Activity 4: NUMERICAL TRANSFORMATIONS OF IMAGES: BAND INDICES OR RATIOS, PCA, IHS, TASSELED CAP, ETC.

Description:
Processing resources.

Specific objectives:
Use of ICT tools.

Material:
Free software. Satellite image.

Delivery:
Using the tool to be employed in the final practical assignment.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

Activity 5: THEMATIC LAND COVER MAPPING USING SUPERVISED AND UNSUPERVISED DIGITAL CLASSIFICATION

Description:
Generation of products.

Specific objectives:
Use of ICT tools.

Material:
Free software. Satellite image.

Delivery:
Using the tool to be employed in the final practical assignment.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

GRADING SYSTEM

Exam on theory (40% of the final mark)
Practical application assignment (60% of the final mark)

EXAMINATION RULES.

Planned activities must be done in class with a personal computer and do not require the submission of documents.

Numerical exercises, information search and photointerpretation activities, etc. are set in class for group comment at the beginning of the next class. Proof of the work carried out (individually or in groups) must be submitted to the professor in the virtual campus.

BIBLIOGRAPHY

Basic:
- Chuvieco Salinero, Emilio. Teledetección y medio ambiente: la observación de la tierra desde el espacio. Madrid: UNED, 2006. ISBN 8436252330.
- Düzgün, H. Sebnem; Demirel, Nuray. Remote sensing of the mine environment. Boca Raton: CRC Press, 2011. ISBN 9780415878791.
- Gupta, R. P. Remote sensing geology [on line]. 2nd ed. Berlin: Springer, 2003 [Consultation: 28/10/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=6312665. ISBN 3540431853.
- Sabins, Floyd F. Remote sensing: principles and interpretation. 3rd ed. New York: Freeman, 1997. ISBN 9781577665076.
- Vincent, Robert K. Fundamentals of geological and environmental remote sensing. Upper Saddle River: Prentice Hall, 1997. ISBN 0133487806.

Complementary:
- Jensen, J. R. Introductory digital image processing: a remote sensing perspective [on line]. Upper Saddle River: Prentice Hall, 2005 [Consultation: 28/10/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5831484. ISBN 0131453610.
- Latifovic, Rasim. Mining and the environment: satellite remote sensing in assessing the environmental impact of large-scale surface mining operations. Saarbrücken: VDM Verlag Dr. Müller, 2009. ISBN 9783639135121.
- Borengasser, Marcus; Hungate, W.S.; Watkins, Russell. Hyperspectral remote sensing: principles and applications. London: CRC Press, 2008. ISBN 9781566706544.

RESOURCES

Other resources:
Websites for the software used and websites on image acquisition.