COURSE DATA

Data Subject

Code	34280
Name	Remote sensing
Cycle	Grade
ECTS Credits	4.5
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Faculty of Physics	4	Second term

Subject-matter

Degree	Subject-matter	Character
1105 - Degree in Physics	16 - Complements of Physics	Optional

Coordination

Name	Department
SOBRINO RODRIGUEZ, JOSE ANTONIO	345 - Earth Physics and Thermodynamics

SUMMARY

The subject is taught, optionally, in the second quarter of the fourth course in the degree in physics.

Remote Sensing develops a basic block of issues that are of great help in planning, understanding and resolving problems that may explain a wide range of natural phenomena that shape and affect the environment. Among the subjects taught in the degree is related to various subjects specific subjects such as Physics and Meteorology and Climatology, among others.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

This course is essential to have basic knowledge given by subjects as physics, it is also desirable to know any programming language such as IDL, and a spreadsheet program like Excel or statistical analysis.

OUTCOMES

1105 - Degree in Physics

- Knowledge and understanding of the fundamentals of physics in theoretical and experimental aspects, and the mathematical background needed for its formulation.
- To know how to apply the knowledge acquired to professional activity, to know how to solve problems and develop and defend arguments, relying on this knowledge.
- Ability to collect and interpret relevant data in order to make judgements.
- Problem solving: be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems .
- Modelling & Problem solving skills: be able to identify the essentials of a process / situation and to set up a working model of the same; be able to perform the required approximations so as to reduce a problem to an approachable one. Critical thinking to construct physical models.
- Physics general culture: Be familiar with the most important areas of physics and with those approaches which span many areas in physics, or connections of physics with other sciences.
- Basic & applied Research: acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results.
- Foreign Language skills: Have improved command of English (or other foreign languages of interest) through: use of the basic literature, written and oral communication (scientific and technical English), participation in courses, study abroad via exchange programmes, and recognition of credits at foreign universities or research centres.
- Literature Search: be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development.
- Learning ability: be able to enter new fields through independent study, in physics and science and technology in general.
- Communication Skills (written and oral): Being able to communicate information, ideas, problems and solutions through argumentation and reasoning which are characteristic of the scientific activity, using basic concepts and tools of physics.
- Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

LEARNING OUTCOMES

With this course students will acquire the following skills:
1. Management of instrumentation for measuring in situ
2. Management of digital image processing
3. Simple hypotheses to predict the evolution of the system under realistic conditions that alter the values of the parameters chosen.
4. Other skills transferable to other subjects of the degree are: the management of systems of physical units, the skills approach, the ability to interpret graphical information, using basic modeling techniques and, in general, critical analysis of all such situations.

The following skills and abilities have an overall theme:
-Develop the ability to identify problems and devise strategies for their resolution.
-Develop basic skills in the search and selection of scientific information (for the theoretical items and the resolution of assigned problems).
-Develop the ability to plan and organize own learning, based on individual work, from the literature and other sources.
-Planning and resolution of physical models that enable us concrete practical situations (from the issues raised in class and assigned
individually).
-Ability to develop a text from recommended reading and writing it in an understandable and organized.
-Build capacity for teamwork when dealing with problematic situations collectively.
-Assess the relative importance of different causes involved in a phenomenon.
-Identify the essential elements of a complex situation, make the approximations needed to construct simplified models that describe it
and to understand their behavior in other situations.
-Versatility and ability to manage their own learning: professional practice increasingly requires continuous recycling.

DESCRIPTION OF CONTENTS

1. Introduction.

Definition of Remote Sensing and objectives. Historical evolution. Major applications. Sensors. Satellites.

2. Basic radiometric magnitudes and fundamental laws.

The electromagnetic spectrum. Basic quantities. Fundamental laws. Reflection by a surface. Combined reflection and emission.

3. Equation of Radiative Transfer.

Radiation balance in a volume element, source function, plane-parallel atmosphere, the ETR in integral form

4. Reflection of short-wave radiation.

Reflectivity concepts and nomenclature. The measure of reflectivity in a natural environment. Reflectivity of natural surfaces. Index of vegetation

5. Emission.

Concept of emissivity and nomenclature. Measuring the emissivity in a natural environment. The method of the box. Emissivity of natural surfaces. Factors that influence. Effective parameters. Geometric model

6. Microwaves.

General concepts. Microwave emission of natural surfaces. Geometric aspects of the backscattered radar. The synthetic aperture radar

7. Atmospheric correction in the solar spectrum.

Interaction of radiation with atmospheric components. Radiative transfer equation. Correction algorithm. Transfer codes

8. Atmospheric correction in the thermal spectrum.

Interaction of radiation with atmospheric components. The continuous water vapor absorption. The single-channel correction equation. The method of differential absorption

9. Biophysical parameters of vegetation cover.

Index of leaf area. Fraction of vegetation cover. Fraction of absorbed photosynthetically active radiation. Chlorophyll content. Biomass

10. Estimation of land surface temperature.

Estimation of emissivity from satellite. Estimating the water vapor content of the atmosphere. Algorithms operating on land and sea

11. Estimation of evapotranspiration.

General concepts. Energy balance equation. Models for calculating evapotranspiration. EVT mapping

12. Thermal inertia.

The concept of thermal inertia. Calculation methods. Thermal inertia maps

13. Future Missions.

Introduction. ESA. EUMETSAT. NASA. Hyperespectrales

14. International Programs.

Context. GMES. GEOSS. CEOS

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	15,00	100
Development of group work	10,00	0
Development of individual work	5,00	0
Study and independent work	49,00	0
Preparation of evaluation activities	3,50	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

The course consists of several parts, with a distinct methodology:

-Theory (blackboard classes)
-Seminars
-Tutoring
-Laboratory.

For each one of them is a different development methodology:
theory:
Two classes of slate a week. In class the teacher teaches content based on materials (slides, notes, figures and diagrams) to be provided to students in advance.

Tutorials:
In the compulsory tutorials (small subgroups of less than 16 students), the teacher monitors the work and progress of students, in addition to resolve the questions raised.

seminars
It also proposes two additional sessions of attendance at seminars where students will learn some current issues in remote sensing.

laboratory
Three laboratory sessions (one session each week). These are taught in small subgroups, with one teacher assigned to each subgroup. In the sessions the students will be grouped in pairs, and perform 3 practices: Introduction to digital imaging satellite, Digital processing of satellite images of high and low resolution, and field radiometry. For each practice, the couple must file a report for the collection and treatment data (errors, graphic settings), and the conclusions reached. With emphasis on the use of computer programs for data processing, which can be done during the practice sessions with the computers available in the laboratory.

EVALUATION

The evaluation of the course is done taking into account the following distinct parts to it:
a) Theory;
b) Seminars;
c) Laboratory.

The evaluation was done separately, with the criteria detailed below:

a) Assessment of theory: The assessment of this part of the course will be based on a written exam.
b) Seminars: The student will have to do a small job or a summary of some of the seminars that are taught in the course.
c) Evaluation of the laboratory: The laboratory work is evaluated based on reports made by students for each of the practices provided during the course.

The assessment shall be subject to the following criteria:

A) 70 points: a written exam. This examination will consist of issues and questions of theory
B) 30 points: work in the laboratory.

The final rating will be obtained from the sum of the scores of paragraphs A and B which under A to obtain a minimum of 40 points and 10 points in B. The total score required to pass the course will be 50 points.

REFERENCES

Basic

- Chuvieco, E. (1997). Fundamentos de teledetección espacial. Madrid, Rialp.
- Elachi, C. (1987). Introduction to the Physics and techniques of remote sensing. Ed. John Wiley & Sons.
- Gandía, S. Y Melía, J. Editores (1991). La teledetección en el seguimiento de los fenómenos naturales. Recursos renovables: Agricultura. Universitat de València.
- Pinilla, C. (1995). Elementos de Teledetección. Ra-Ma.
- Sobrino, J. A. et al., (2000). Teledetección. Ed. J. A. Sobrino. Servicio de Publicaciones. Universitat de València.
- Asrar, G. (1989). Theory and Applications of Optical Remote Sensing. New York, John Wiley & Sons.
- Colwell, R. N. (1983). Manual of remote sensing, vol I y II. American Society of Photogrammetry, Falls Church.
- Kondratyev, K. Y. (1969). Radiation in the atmosphere. New York, Academic Press.
- Ulaby, F. T., Moore, R. K. Y Fung, A. K. (1982). Microwave remote sensing: active and passive, vol. I y II. Addison-Wesley, London.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

TEACHING METHODOLOGY:

In case that health situation requires blended teaching, the teaching model approved by the Academic Degree Committee on July 23, 2020 will be adopted.

— Compulsory subjects: 50% student attendance in the classroom, while the rest of students attend the class in streaming broadcast. Two groups will be set with alternate days attendance to the classroom in order to guarantee 50% of teaching hours attendance for all students. Laboratory sessions will have a 100% attendance.

— Optional subjects: 100% attendance in all activities.

If a total reduction in attendance is necessary, classes will be broadcast by synchronous videoconference at their regular schedule, along the period determined by the Health Authority.