Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	
TEACHER NAME(S)	Nazzareno Pierdicca
Teacher e-mail (s)	nazzareno.pierdicca@uniroma1.it
Teacher phone	+39 06 44585411
Teacher meeting	Appointments (remotely or in person) or through Google Classroom
Teacher office address	Via Eudossiana 18, 00184 Rome (IT)
DISCIPLINE (SSD)	ING/INF-02
Semester (1-4)	2
Credits (CFU/ECTS)	6
Lecture hours (h)	60
Prerequisite and learning activity	N/A
Teaching language and method	English, using slides and software for satellite image processing
Assessment method	Oral questions, exercises during the course
SUBJECT WEBSITE	

OBJECTIVES

The module aims to provide a general background on the remote sensing systems for Earth Observation from airborne, and especially space-borne platforms. It describes, using a system approach, the characteristics of the system to be specified to fulfil the final user requirements in different application domains. It reviews the physical bases of remote sensing and simple wave interaction models useful for data interpretation. It describes or simply recalls the technical principles of the main sensors operating in different ranges of the electromagnetic spectrum. It provides an overview of the most important applications and bio-geophysical parameters (of the atmosphere, the ocean and the land) which can be retrieved in different regions of the electromagnetic spectrum. It reviews the most important techniques for data processing and product generation, also by proposing practical exercises using the computer. Finally, it provides an overview of the main Earth Observation satellite missions and the products they provide to the final user.

OUTCOMES (Dublin descriptors: knowledge, understanding, explain, skill, ability)

The student shall become able to:

Specify the main characteristics of an Earth Observation mission and its subsystems, and in particular selecting the sensors and their spectral and radiometric properties in relation to the final application.

Interact with the final users of an Earth Observation mission, during the different phases of system design and implementation, such as specification of system requirements, definition of products and algorithms, mission operation and data commercialization.

Carry out simple data processing tasks, and in particular geometric corrections, image classification to produce thematic maps, generation of earth surface temperature and atmospheric parameters maps.

Understand the technical and scientific literature about remote sensing, and develop novel processing algorithms and value added products for the final applications.

PROGRAM CONTENT

INTRODUCTION. Definition of remote sensing. The electromagnetic spectrum and its use for remotely sensing the Earth; visible, infrared and microwave bands.

PHYSICAL BASES. Physical bases of remote sensing. Radiative quantities (power density, radiance, emissivity); thermal emission; Planck, Wien, Stefan-Boltzmann laws; absorption and scattering phenomena. Atmospheric effects in spaceborne and airborne remote sensing.

SENSORS. Classification of remote sensing sensors. Parameters to characterize sensor performances and product quality; geometric, radiometric and spectral resolutions; geometric accuracy and sensor coverage.

Principles of imaging sensors in the visible and infrared spectral bands: camera, scanning radiometers, push-broom radiometers. Multispectral technique. Principle of microwave sensors, both passive (radiometers) and active (radar, synthetic aperture radar).

PRODUCTS AND APPLICATIONS. Spectral properties of the sea, soil and vegetation surfaces in the visible and near infrared spectral ranges. Main applications of visible and near infrared radiometers. Retrieval of sea surface temperature. Properties of radiometric and radar responses of sea, soil, vegetation surfaces and the atmosphere in the microwave band. Main applications in the microwave spectrum.

SATELLITES. Earth observation satellites. Space and ground segments of an Earth observation system. Radiometric, spectral, spatial and temporal requirements of an Earth observation mission. Main orbits for remotely sensing the Earth. Overview of Landsat, Meteosat, SPOT, Tiros, Sentinel-1 and Sentinel-2. “Very High Resolution” satellites.

DATA PROCESSING. Data processing and image interpretation. Image enhancement. Standard methods to perform image geometric corrections and image classification. Texture and principal components.

REFERENCES AND MATERIAL

- Copy of the slides used during the class lessons.
- N. Pierdicca, "Appunti dalle lezioni a cura del docente" in Italian
- Textbooks available in the Library of Department of Information Engineering, Electronics, Telecommunications.
  - Charles Elachi, 1987, "Introduction to the Physics and Techniques of Remote Sensing", John Wiley & Sons.
  - John A. Richards, 1986, “Remote Sensing Digital Image Analysis. An Introduction”, Springer Verlag.