UNIVERSITÀ DEGLI STUDI DELLA BASILICATA

Allegato 2

PROPOSAL FOR A UNIVERSITY MASTER
A.A. 2025-2026

TEACHING REGULATIONS OF THE FIRST-LEVEL MASTER'S PROGRAM IN

Earth Observations from Space: Advanced Technologies and Applications (EO-SAT)

1. CURRICULA

[Art. 5.9- lett. a) – If different curricula are foreseen, specify their denominations]

N/A

2. EDUCATIONAL OBJECTIVES AND PURPOSES OF THE COURSE AND OF THE INDIVIDUAL CURRICULA, IF PROVIDED, ALSO IN RELATION TO THE DEMAND IN THE PROFESSIONAL SECTOR TO WHICH THEY REFER [Art. 5.9 - lett. b)]

The gap between the demand and supply of specific skills in the field of Earth Observation from Space has been recognized by the European Commission as one of the main limiting factors for the development of the aerospace sector and, in particular, the insufficient growth of the European market for products and services based on EO techniques.

The lack (at the European level) of a university curriculum dedicated to training researchers and professionals with skills capable of covering the entire supply chain—from the design of platforms and sensors to the development of systems, applications, and services based on the processing of Earth Observation data from space—has been acknowledged as an important gap that the Commission encourages overcoming also through the joint effort of European Universities belonging to the Copernicus Academy Network. Several times, companies operating in the sector have expressed difficulty in finding personnel with such professional skills who are not only able to meet but also anticipate the future demand of a continuously evolving market such as that of Earth Observation applications from space. Following the EU's guidelines and exploiting the synergies enabled by UNIBAS's membership in the Copernicus Academy Network, this proposal aims to train professionals with all the basic and specialized skills necessary to understand (and provide original contributions to the development of) the entire supply chain—from the design and operation of remote sensing platforms and instruments to the analysis and interpretation of remotely sensed data for the development of advanced applications and services.

All these skills are already separately offered, albeit in an uncoordinated manner and with varying intensity and educational objectives, in courses present in the University programs of

Aeronautical Engineering, Environmental Engineering, Mechanical Engineering, Electronic and Telecommunications Engineering, Physics, Computer Science, etc., but, to this day, no similar university curriculum exists at the European level that offers all these basic skills together to enable the imagination of new Earth Observation services and applications from space, starting from the design of dedicated platforms and instruments rather than merely the use of available EO data.

This is a training gap widely recognized by the European Commission (there is nothing in the European Skills, Competences, Qualifications and Occupations catalog—ESCO—that alludes to this kind of professional) which, also for this purpose, has identified the collaboration of European Universities (through the Copernicus Academies Network) as one of the pillars of its Copernicus User Uptake strategy.

The University Master's program in Earth Observations from Space: Advanced Technologies and Applications (EO-SAT), organized by the University of Basilicata, therefore aims to fill this gap by training new professional figures who will be employable in companies operating in the aerospace sector and ICT as well as in public administrations. The Master's program will leverage specific skills in the sector present at the University of Basilicata, as well as contributions from highly qualified professors from other universities, research centers, and private companies in the sector.

A particular added value of the Master, besides the well-established relationships with the local and national aerospace industry system grouped in the TeRN Technological District and the Lucanian Aerospace Cluster (CLAS), is its strong interconnection with the National Doctorate in Earth Observation (to which UNIBAS has been affiliated since its inception) and with the European Network of Copernicus Academies, which UNIBAS was the first to promote. This will broaden the pool of teaching staff as well as the internship opportunities available to Master's participants.

The course aims to attract young people interested in orienting their professional activity towards a highly innovative and competitive sector and to develop skills easily transferable to other productive sectors. The content of the Master will integrate knowledge derived from university scientific research with the methods and practices characterizing professional activity within companies in the sector.

The course is primarily intended for young graduates in scientific disciplines motivated to engage in professional activities in the aerospace sector. In this sense, a mindset that is both scientific and professional as well as an international vision of one's placement is required. The Master may also be of interest to professionals, both public and private employees, who wish to broaden and deepen their skills in this specific sector.

3. PROFILES AND POSSIBLE WORK OUTCOMES

[Art. 5.9- lett. b)]

The University Master's program in *Earth Observations from Space: Advanced Technologies and Applications (EO-SAT)* aims to train professionals capable of conceiving and designing new systems, sensors, services, and applications for Earth Observation from space, who will be able to find employment in companies operating in the aerospace and ICT sectors, as well as in public administrations.

4. REQUIRED DEGREES FOR ADMISSION

[Art. 5.9 - lett. c)]

Applications for admission to the Master’s program may be submitted by **Italian or foreign citizens** holding a **Bachelor’s Degree or an equivalent qualification** in one of the following degree classes (either Bachelor’s or single-cycle degrees):

Bachelor’s Degree Classes:

- L-2 Biotechnology
- L-7 Civil and Environmental Engineering
- L-8 Information Engineering
- L-9 Industrial Engineering
- L-13 Biological Sciences
- L-17 Architectural Science
- L-21 Territorial, Urban, Landscape and Environmental Planning
- L-25 Agricultural and Forestry Sciences and Technologies
- L-26 Agro-Food Sciences and Technologies
- L-27 Chemical Sciences and Technologies
- L-29 Pharmaceutical Sciences and Technologies
- L-30 Physical Sciences and Technologies
- L-31 Computer Science and Technologies
- L-32 Environmental and Nature Sciences and Technologies
- L-33 Economics
- L-34 Geological Sciences
- L-35 Mathematics
- L-41 Statistics

Single-cycle Master’s Degree:

- LM-4 C.U. Architecture and Building Engineering-Architecture

Other Degrees:
Other degree holders may be admitted following evaluation of the candidate’s curriculum by the Master’s Scientific Committee.

5. EVENTUAL OTHER REQUIREMENTS FOR ADMISSION
[Art. 5.9 - lett. c)]

6. ADMISSION CRITERIA
[Art. 5, comma 10 - lett. c)]

The selection for admission to the EO-SAT Master’s program will be based on academic qualifications. The evaluation will consider the final grade of the Bachelor’s degree as well as any additional qualifications (including a Master’s degree or single-cycle degree, other Master’s programs or specialization courses, and scientific publications). In case of a tie in the final score, preference will be given to the younger candidate.

7. PLACE AND DATES OF MASTER’S ACTIVITIES
[Art. 5.9 - lett. d)]

The **lectures**, which will be held **in English**, will take place at the University of Basilicata (Macchia Romana Campus – Potenza). Classes will begin in January 2026 and will end in June 2026. At the end of the coursework, a company internship period of approximately 3 months will follow.

8. LIST OF TEACHING MODULES AND UNITS AND OTHER ACTIVITIES, INCLUDING INTERNSHIPS

[Art. 5.9 - lett. e)]

Denominazione	SSD	CFU	Struttura CFU			Totale ore
			Ore didattica frontale	**Ore altre attività formative**	**Ore studio individuale**	
Module 1: Modern sensor physics	IINF-02/A PHYS-03/A	**6**	**48**		**102**	**150**
Ud1.1 Optical Physics	PHYS-03/A ING-INF/02	2	16		34	50
Ud1.2 Physics of sensors	PHYS-03/A	2	16		34	50
Ud1.3 E.m. Radiation sensors	PHYS-03/A	2	16		34	50
Module 2: Atmospheric Physics and Meteorology	PHYS-05/B	**8**	**64**		**136**	**200**
Module 3: Digital mapping and GIS	CEAR-04/A	**6**	**48**		**102**	**150**
Module 4: Fundamentals of Optical Band Remote Sensing	PHYS-05/B	**6**	**48**		**102**	**150**
Module 5: Fundamentals of Microwave Remote Sensing	IINF-02/A IINF-03/A	**6**	**48**		**102**	**150**
Module 6: Inverse problem theory applied to EO Remote Sensing	PHYS-05/B	**6**	**48**		**102**	**150**
Module 7: Engineering of spacecraft systems for Earth Observations	IIND-01/E CEAR-01/B	**9**	**72**		**153**	**225**
Ud7.1 Spacecraft dynamics	IIND-01/E	2	16		34	50
Ud7.2 Engineering of space systems and vehicles	IIND-01/E	4	32		68	100
Ud7.3 Earth Observation techniques from Aircraft Systems to Remote Piloting (SAPR)	CEAR-04/A	3	24		51	75
TOTAL CFUs - TEACHING AND STUDY HOURS		**47**	**376**		**799**	**1175**
Internships		**10**		**250**		**250**
Final exam		**3**			**75**	**75**
TOTAL		**60**	**376**	**250**	**874**	**1500**

9. PRINCIPALI CONTENUTI DEI MODULI DIDATTICI E DELLE UNITÀ DIDATTICHE [Art. 5, comma 9- lett. e)]	
Denominazione	**Contenuti**
Modulo 1: Fisica moderna dei sensori	
Ud1.1 Ottica fisica	Special Relativity and Maxwell's Equations (introductory concepts); Electromagnetic Waves. Electromagnetic field equations and propagation: Helmholtz equations; principles of physical optics; fundamentals of geometrical optics. Einstein's Theory of Radiation: Photons, photoelectric effect, absorption, emission, stimulated emission: the laser.
Ud1.2 Fisica dei sensori	Geometrical Theory of Optical Imaging: Fundamentals of interference theory and interferometry; basics of diffraction theory and grating spectrometers; scattering from inhomogeneous media.
Ud1.3 Sensori della radiazione e.m.	Electrical Conduction in Solids: Semiconductors, pn-junctions, diodes and transistors; photoelectric and photovoltaic effects; detectors: MCT detectors, InSb bolometers, CCD.
Modulo 2: Fisica dell'Atmosfera e della Meteorologia	Thermodynamics Fundamentals: Thermodynamic transformations; atmospheric thermodynamics; atmospheric stability; blackbody radiation, solar radiation; radiative transfer in a gray atmosphere; atmospheric greenhouse gases; atomic and molecular absorption spectra. Basic Meteorology: Local circulation, precipitation; satellite technologies for Earth Observation; satellite missions – examples; basic analysis techniques for thermodynamic parameters; the Copernicus Programme.
Modulo 3: Cartografia digitale e GIS	Reference Systems (Geodesy): Overview of reference systems; classical topographic reference systems: geoid and ellipsoid; global and continental reference systems (WGS84; ITRFxx; ETRFxx); ellipsoid geometry. Cartography and GIS: Basics of cartography; datum transformations in GIS; projections and representations of the ellipsoid; conformal and equivalent map projections; digital cartography. GIS software and main functionalities (e.g., QGIS); database management in GIS; raster and vector data; data acquisition (photogrammetry, remote sensing, GNSS); digitization of traditional maps. Spatial Data Processing in GIS: Spatial interpolation and DTM creation; error sources and data quality in GIS; spatial data analysis and processing; GIS applications in hydrology.
Modulo 4: Fondamenti del Telerilevamento in Banda Ottica	Remote Sensing Fundamentals: Fundamental physical laws; radiation-matter interaction at the Earth's surface and in the atmosphere; optical passive platforms and sensors for surface and atmospheric remote sensing.Processing and interpretation of multispectral and multitemporal imagery; practical applications; spectral signature laboratory; spectroscopy; Google Earth Engine (GEE); ESA SNAP toolbox.
Modulo 5: Fondamenti di Telerilevamento nelle Microonde	RADAR as a Remote Sensing technology: micro-wave systems introduction, scattering characteristics, radar equation. Synthetic Aperture RADAR (SAR): the mathematical basis for SAR, RADAR resolution cell. Satellite systems: description of the Satellite based SAR systems and their differences. Geometric distortion. Radiometric Calibration, differential SAR interferometry. Image

	Interpretation: acquisition mode, speckle, image processing. Information extraction Applications: Pol-InSAR, Altimeter, interferometry, radargrammetry, tomography. informazioni InSAR applications, coherence inversion. POL-InSAR applications. Tomography
Modulo 6: Teoria dei problemi inversi applicata all'EO Remote Sensing	Information Theory and Data Assimilation: Error analysis and characterization; optimal linear and nonlinear inverse methods; Kalman filter; data assimilation; forward model and its derivatives; use of a priori constraints; measurement errors and error modeling. Basic concepts of programming languages.
Modulo 7: Ingegneria dei sistemi dei veicoli spaziali per le Osservazioni della Terra	
Ud7.1 Dinamica dei veicoli spaziali	Spacecraft Dynamics and Celestial Mechanics
Ud7.2 Ingegneria dei sistemi dei veicoli spaziali	Spacecraft Environment and System Design: Environmental effects on design; mission analysis; propulsion systems; launch vehicles; spacecraft structure; attitude control; electrical systems; thermal control; telecommunications; telemetry, command, data handling and processing; ground segment; spacecraft mechanisms; electromagnetic compatibility engineering; assembly, integration, and verification; small satellite and drone engineering for specific applications; product assurance.
Ud7.3 Tecniche di osservazione della terra da Sistemi Aeromobili a Pilotaggio Remoto (SAPR)	Introduction to RPAS (Remotely Piloted Aircraft Systems - SAPR): Classification of RPAS, ENAC regulations and operational scenarios; hardware components and technical specifications; principles of aerodynamics and flight mechanics; airspace rules and meteorology; flight planning and simulation. Drone-Based Photogrammetry and GIS Applications: Basic principles of drone photogrammetry, post-processing of data, mapping/GIS, georeferencing raster imagery in GIS. DSM/DTM generation (multispectral, thermal, high-resolution visible imagery); practical flight sessions and photogrammetric outputs; examples of professional and scientific applications; preparation for SAPR pilot licensing.

10. TEACHING MODES

[Art. 5, comma 9 - lett. f)]

The Master’s program has a total duration of 9 months, comprising 6 months of in-class instruction (including teaching units, hands-on exercises, seminars, and assessments), followed by 3 months of company internship. All lectures will be delivered **in English**, both in-person at the University of Basilicata (Macchia Romana Campus – Potenza) and online.

The program will start in January 2026, and upon completion of the coursework, students will undertake a company-based internship. During the academic phase, learning assessments will take place at the end of every two-month module. To obtain the degree, students will be required to defend a final project work, developed either during the course or as part of the internship. The instructional period is full-time, with classes scheduled primarily from Monday to Saturday mornings. In addition to lectures (on-site or online), students will also participate in lab-based sessions and seminars.

The **first six months** correspond to **47 ECTS credits** for lectures and laboratory activities. The **internship period** accounts for **10 ECTS credits** (**250 hours**) over approximately 3 months of full-time engagement. The **final examination** consists of: **3 ECTS credits** (**75 hours**), and is carried out after the internship.

The **total student workload** for the entire Master program amounts to approximately **1,500 hours**, corresponding to **60 ECTS credits**. Upon successful completion of the program, participants will be awarded the **First-Level University Master's Degree in**: **"Earth Observations from Space: Advanced Technologies and Applications (EO-SAT)"**.

11. ATTENDANCE REQUIREMENTS AND CONTROL MEASURES
[Art. 5.9 - lett. g)]

The Master's program has a duration of one academic year. Attendance is mandatory for at least 80% of the total program and no less than 75% for each individual teaching unit, excluding the internship period, during which a minimum of 80% attendance is required.

12. PERIODIC LEARNING ASSESSMENTS
[Art. 5.9 - lett. h)]

Each teaching module, composed of several teaching units, will include a single assessment of student performance, carried out through written exams with open or multiple-choice questions. At the end of each module, an examination board will evaluate the student's achievement of the expected learning outcomes, and a grade out of 30 will be awarded.

13. FINAL EXAMINATION
[Art. 5.9 - lett. h)]

The final examination will consist of a presentation of the activities carried out and the project work developed during the internship period.

14. RECOGNITION OF PREVIOUSLY ACQUIRED CREDITS
[Art. 5.9 - lett. i)]

The program allows for the recognition of academic credits previously earned through other educational paths or professional experience, within the limits established by current regulations.

15. ENROLLMENT IN INDIVIDUAL MODULES OR TEACHING UNITS
[Art. 5.9 - lett. j]

It is possible to enroll in individual teaching modules or units. Applications for single-module enrollment will be evaluated on a case-by-case basis by the Scientific Committee, which will also determine the applicable tuition fee. Participants in individual modules will receive a certificate of attendance. Students who pass the associated assessments will also receive: A certificate of earned ECTS credits (if applicable), and a supplementary certificate detailing the educational content of the activities attended.s