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COURSE: Methods and techniques for the Earth Observation

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ACADEMIC YEAR: 2017/18

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TYPE OF EDUCATIONAL ACTIVITY: Affine

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TEACHER: Carmine Serio

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website:

phone: +390971205222

mobile:

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Language: Italian and English

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ECTS: 9 (8 lessons and 1  
tutorials/practice)

n. of hours: (64 lessons and  
12 tutorials/practice)

Campus: Potenza  
School of Engineering  
Program: Laurea Magistrale in  
Ingegneria Informatica e delle  
Tecnologie dell'Informazione

Semester: I

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#### EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

This course examines the basic of the interaction between radiation and matter in the Earth atmosphere. The main objective of the course is to provide theoretical fundamentals for face problems of Remote Sensing

The main knowledges provided are

- Basic of Thermodynamics
- Basic of Optics
- Basics of Atmospheric Physics
- Fundamentals of Radiative Transfer.

The main skills obtained will be:

- To use advanced tools for Scientific Calculus.
  - Skill in distinguishing and characterizing atmospheric processes
  - To Evaluate and estimate geophysical parameters from remote sensing data.
  - To analyze and process Satellite data
  - Students will demonstrate they understand and manage basics concepts of Atmosphere Physics and in particular to understand basic concepts related to the remote sensing form different platforms, ground-based, airplane, satellite.
  - Students will show show they manage remote sensing methods and techniques.
  - Students will reach a level of good independency in dealing with the diverse remote sensing techniques and how they apply to the Earth Observations.
  - Students will reach adequate skill in exemplifying and showing Earth Observations methods and techniques to non-expert people.
  - Students will acquire skills for self-learning about Earth Observations from the science literature and how to relate with more advanced courses.
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#### PRE-REQUIREMENTS

The course pre-requirements are:

- Knowledge of Mechanics fundamentals Conoscenza dei concetti fondamentali di meccanica
  - Knowledge of Electromagnetism fundamentals;
  - Knowledge of Differential and Integral calculus fundamentals
  - Knowledge of numerical analysis basics
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#### SYLLABUS

1. Temperature fundamentals: Temperature and heat. Kinetic theory of gases, Ideal gas law, Thermodynamic process, First law of thermodynamics, Second law of thermodynamics

2. Review of Electromagnetism: Maxwell Equations and Electromagnetic waves . Wave propagation.

Optics fundamentals: Reflection, Refraction and Dispersion of the light. Interference and Diffraction. Michelson Interferometer.

4. Fundamentals of Radiation: Planck law for the black body. Wien low. Stefan–Boltzmann law. Absorption, Emission and Scattering. Kirkhoff low. The Sun. Solar radiation. Solar structure. Solar constant. Solar spectrum.

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5. Basics of Atmospheric Physics: Thermal and Chemical Structure of the Atmosphere. Water vapour. Adiabatic lapse rate. Cloud formation. The carbon cycle.
  6. Fundamentals of Radiative transfer in gray atmosphere. Schwartzchild Equation for radiative transfer. Radiative Equilibrium. Greenhouse Effect.
  7. Fundamentals of Line by Line Radiative transfer: Atomic absorption spectrum. Molecular absorption spectrum. Line shape. Absorption coefficient and transmittance. Scattering. Line-by-line radiative transfer models. Radiative transfer in presence of clouds.
  8. Inverse problems: Retrieval of geophysical parameters. EOF (Empirical Orthogonal Function) Methodology.
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#### TEACHING METHODS

The Course is organized as follows:

- Theoretical lessons (64 hh)
  - Classroom tutorials (12 hh)
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#### EVALUATION METHODS

Discussion of a project work and Oral examination.

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#### TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

- Lessonsminutes.
  - Textbooks:
    - D. Halliday, R., Resnick, J. Walker. Fondamenti di Fisica, Casa Editrice Ambrosiana, 2015 (Chapters. 14, 18, 19, 32, 33, 34, 35 and 36)
    - K. N. Liou, "An Introduction to Atmospheric Radiation", Academic Pres. (Chapters 1, 2, 3, 4, 5 and 6)
    - J. Houghton. "The Physics of Atmosphere", Cambridge University Press. (Chapters 1 and 2)
    - W. P. Menzel., "Remote Sensing Applications with Meteorological Satellites". WMO Technical Document (Chapter 3)
    - C. Serio et al. in PAUL N. FINDLEY. Environmental Modelling: New Research. p. 51-88, Nova Science Publishers.
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#### INTERACTION WITH STUDENTS

Students are welcome during the professor's office hours (Mondays from 16:30 to 18:00). Moreover the professor will be always available for the students after contact by e-mail.

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#### EXAMINATION SESSIONS (FORECAST)<sup>1</sup>

05/02/2018, 26/02/2018, 21/05/2018, 02/07/2018, 23/07/2018, 10/09/2018, 24/09/2018, 10/12/2018

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SEMINARS BY EXTERNAL EXPERTS    YES X    NO

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#### FURTHER INFORMATION

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<sup>1</sup> Subject to possible changes: check the web site of the Teacher or the Department/School for updates.