CIMET Radiometry, Sources and Detectors

Course name: Radiometry, sources and detectors **Course** CIMET RSD
Course level: Master **ECTS Credits:** 5.00

Course instructors: Antonio Pozo & Ana Carrasco Sanz (University of Granada-CSIC), and Mathieu Hebert (University Jean Monnet)

Education period (Dates): 2nd semester **Language of instruction:** English

Prerequisite(s): Module "Photonics and Optics Fundamentals" (1st semester)

Expected prior-knowledge: Basic geometrical optics.

Aim and learning outcomes:
This course develops an understanding of the measurement of electromagnetic radiation in spectral regions from ultraviolet to infrared. The course covers principles of radiometric, photometric and spectrophotometric instrumentation, including the study of light sources and physical detectors.

On completion of this course the student will be able to:

- Understand (i.e. to describe, analyse and reason about) how to use the methodology in quantifying electromagnetic radiation, from ultraviolet to infrared.
- Correctly use radiometric and photometric quantities and units.
- Understand (i.e. to describe, analyse and reason about) how to characterize light sources with different emission spectra.
- Understand (i.e. to describe, analyse and reason about) how to characterize photodetectors with different properties and responsivities.
- Demonstrate the use of mathematical tools to solve problems in radiometry and photometry.

Topics to be taught (may be modified):

- Fundamentals of radiometry: Radiometric quantities and important laws.
- Photometric quantities: Photometry versus radiometry, radiometric and photometric quantities.
- Sources: Thermal sources (blackbody and incandescent lamps), gas discharge, luminescent, laser, solid state (light emitting diodes).
- Secondary light sources. Transmission, reflection, absorption.
- Photodetectors: Important features and types (thermal, photoemissive, photoconductive and photovoltaic detectors).
- Electronics reviews: detector electronics, detector interfacing.
- Noise in detection. Performance limits.
- Matrix detectors.
- Design and calibration of a radiometric system. Measurement uncertainty.
- Radiometric, spectroradiometric and photometric instruments.
- Radiometric measurements of satellite observation and remote sensing.
- Radiometry of laser and coherent sources.

Practical Laboratory Sessions:

- Verification of photometry laws.
- Design and built a radiance meter.
- Photodetector calibration.
- Source calibration.

Teaching methods: Lectures, lab classes, and homework exercises.

Form(s) of Assessment: 60% for the exam(s) versus 40% for practical (seminar, exercices, project...)

External/internal examiner: --

Examination support: None

Literature and study materials: Handouts of the material covered in the lectures will be distributed.

Reference book:
Wolf, W. L., "Introduction to Radiometry", Ed. By SPIE-The International Society for Optical Engineering (Bellingham, 1998).

Additional books:
Grum F. and Becherer J., "Radiometry", vol. 1 of "Optical Radiation Measurements", Ed. By Academic Press, 1979.
Boyd R. W., "Radiometry and the detection of optical radiation", Ed. By John Wiley & Sons, 1983.
Parr A. C., Datla R. U. and Gardner J. L., editors, "Optical Radiometry", Elsevier Academic Press, 2005.

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