



INSTITUTO DE FÍSICA
FACULTAD DE FÍSICA

COURSE	: EXPERIMENTAL METHODS AND TECHNIQUES IN PHYSICS
TRANSLATION	: MÉTODOS Y TÉCNICAS EXPERIMENTALES DE LA FÍSICA
NUMBER	: FIM4012
CREDITS	: 15 UC / 9 SCT
REQUISITES	: FIM8340
CONECTOR	: AND
RESTRICTIONS	: 030501
CHARACTER	: OPTATIVE
FORMAT	: LABORATORY
QUALIFICATION	: STANDARD
FORMATIVE LEVEL	: DOCTORATE
DISCIPLINE	: PHYSICS

I. COURSE DESCRIPTION

This course emphasizes the fundamentals and basic experimental techniques of physics, including apparatus and experimental setups for handling laboratory equipment with vacuum technology tools, low-temperature physics, magnetic fields, optical setups for analysis, radiation generation. electromagnetic, diffraction techniques and photon detectors.

II. LEARNING OUTCOMES

1. Present to the student the experimental techniques of physics, including apparatus and basic experimental setups.
2. Train the student in the management of laboratory equipment so that they feel confident in making analyzes of their respective materials of interest with their research work leading to the generation of a doctoral thesis.

III. CONTENT

1. Vacuum technology: how to make vacuum, high vacuum, ultra high vacuum (UHV), how to measure vacuum (pressure measurement) materials suitable for vacuum.
2. Low temperature physics: how to generate low temperatures, how to measure temperatures, mechanical construction of cryostats (thermal insulation: conductivity, radiation, convection), materials suitable for low temperatures.
3. Magnetic fields: how to generate magnetic fields, how to measure magnetic fields (Hall effect), how to protect components from magnetic fields.
4. Preparation of samples: manufacture of surfaces with different materials and methods (physics and chemistry), manufacture of single crystals.
5. Optical assemblies for sample analysis: how to measure magnetization in thin films, crystals or polycrystals (Kerr effect vs. Magnetometers), how to measure film thickness with photons, how to measure refractive indices (Drude method).
6. Basic electronic instrumentation: Lock-In amplifier digital multimeter, Feedback feedback circuits; signal capture and measurement, data acquisition interfaces.
7. Generation of electromagnetic radiation: visible and UV light, X-rays, electron beams and ions.
8. Diffraction techniques: photons, electrons, neutrons.
9. Photon detectors: visible, UV, X-ray, gamma ray.
10. Particle detectors: electrons, ions and neutrons.

IV. METHODOLOGICAL STRATEGIES

- The course is concentrated in three parts: Vacuum techniques, Electron Microscopy (SEM) and Auger Electron Spectroscopy (SAM).
- Each part has 6 weekly laboratory sessions of 2 modules each



INSTITUTO DE FÍSICA
FACULTAD DE FÍSICA

V. EVALUATIVE STRATEGIES

- Evaluation of equipment handling during laboratory work 30%
- A written work reporting analysis of different materials with evaluation of the analysis 30%
- Oral presentation 30%
- Mandatory attendance

VI. BIBLIOGRAPHY

REQUIRED

Czanderna, A. "Methods of Surface Analysis", ed. Elsevier Scientific Publishing Company, ISBN 0-444-41344-8.

Ertl, G. and Kuppers, J. "Low Energy Electrons and Surface Chemistry", Verlag Chemi, ISBN 3-527-25562-1.

Goldstein, D.; Newbury, D.; Joy, D.; Lyman, C.; Echlin, P.; Lifshin, E.; Sawyer, L. and Michael, J. "Scanning Electron Microscopy and X-ray Microanalysis", Springer, 2003.

Pobell, F. "Matter and Methods at Low Temperatures", 2nd Ed. Springer, Gerlin, 1996.

Bergmann and Schäfer's Experimental Physics book series.

OPTIONAL

N/A