INSTITUTO DE FÍSICA
FACULTAD DE FÍSICA

COURSE : **INTRODUCTION TO ATOMIC FORCE MICROSCOPY**
TRANSLATION : INTRODUCCIÓN A LA MICROSCOPÍA DE FUERZA ATÓMICA
NUMBER : FIM4666
CREDITS : 15 UC / 9 STC
MODULES : 4
REQUISITES : (FIS1532 OR FIS153D OR FIS1533) AND (FIS1542 OR FIZ0311 OR FIZ1450)
RESTRICTIONS : 030401, 030501
CHARACTER : OPTATIVE
FORMAT : THEORETICAL LECTURES Y LABORATORY
QUALIFICATION : STANDARD
FORMATIVE LEVEL : DOCTORATE
DISCIPLINE : PHYSICS

I. COURSE DESCRIPTION

This course is composed of two lecture modules and two laboratory modules that will allow students to know the operation and applications of atomic force microscopy and, later, be in a position to use the AFM microscope manufactured at the Institute of Physics, the commercial SPM brand JPK and the software for the analysis of images and data for your research work.

II. LEARNING OUTCOMES

The objective of the course is to address basic concepts of Probe Microscopy (SPM) and, in particular, of Atomic Force Microscopy (AFM) methods, including advanced applications of analysis of force or elasticity curves of films.

III. CONTENT

a. Microscopy: magnification, resolution limit, conventional microscopy methods (optical and electronic).
b. Probe microscopy: probe-sample interaction, interaction potentials, image interpretation, piezoelectric-based motors, mechanical isolation systems.
c. Introduction to SPM control electronics: feedback circuit, four quadrant detectors, PID controllers, DAC converters, Lock-in amplifier, filters and amplifiers.
d. AFM microscopy: tip mounting and calibration, piezoelectric scanner calibration, contact and non-contact methods, PFM method.
and. Introduction to control software: measuring ranges, simultaneous measurement of topography channels, phase, differential, other possible interaction channels.
f. Introduction to analysis software: artifacts in images, filters, image interpretation, storage, image transfer. Use of different data and image analysis programs / software (own of the instruments, JPK, SPIP and Gwyddion).

IV. METHODOLOGICAL STRATEGIES

Theoretical classes
Team work,
Seminars prepared and presented by students
Experimental modules

V. EVALUATIVE STRATEGIES

a. Practical work (50%).
b. Tests, homework or presentations and group work and seminars prepared and presented by students (50%).

VI. BIBLIOGRAPHY

Required

- R. Hermans, "Diseño, desarrollo y construcción de un microscopio de fuerza atómica versátil", Tésis Pontificia Universidad Católica de Chile, 2001. [Biblioteca Gauss UC: TUC 2001 H552d]
- Recomendaciones por el profesor según tema y tarea especifica de estudio e investigación.

Optional:

- E. Meyer, H. Hug, R. Bennewitz, ''Scanning Probe Microscopy: the lab on a tip''. Berlin, Springer, 2004.
- R. Wiesendanger, H.-J. Güntherodt, "Scanning Tunneling Microscopy III: theory of STM and related scanning probe methods.'' Berlin, Springer, 1993.
- Morita, Wiesendanger, Meyer, "Noncontact Atomic Force Microscopy", Berlin, Springer, 2002.
- D. Sarid, "Scanning Force Microscopy: with applications to electric, magnetic and atomic forces", New York, Oxford University Press, 1994.
- Atomic Force Microscopy, Scanning Nearfield, Optical Microscopy and Nanoscratching. G. Kaupp, Springer 2006.
- Samuel H. Cohen and Marcia L. Lightbody, "Atomic force microscopy/scanning tunneling microscopy 2", Berlin, Springer 1997.
- NanoWizard AFM Handbook. JPK Instruments AG. Version 2.2., 2012.
- Scientific publications provided by the professor.