INSTITUTO DE FÍSICA
FACULTAD DE FÍSICA

COURSE	:	**LASER SURFACE MODIFICATION**
TRANSLATION	:	LÁSERES APLICADOS A LA MODIFICACIÓN DE SUPERFICIES
NUMBER	:	FIM3045
CREDITS	:	15 UC / 9 SCT
MODULES	:	2 PER WEEK
FORMAT	:	THEORETICAL LECTURES
REQUISITES	:	FIS1533, FIZ0224
CONECTOR	:	OR
RESTRICTIONS	:	030401, 030501
CHARACTER	:	OPTATIVE
QUALIFICATION	:	STANDARD
FORMATIVE LEVEL	:	MAGISTER
DISCIPLINE	:	PHYSICS

I. COURSE DESCRIPTION

Many of the current multifunctional materials require the modification of their surfaces by means of laser radiation in order to optimize properties such as friction, resistance to corrosion and wear, wettability, among others. This course seeks to provide the basic knowledge of continuous and pulsed lasers that are used in surface modification processes. In turn, the main techniques applied to modify the properties of functional surfaces will be discussed. Finally, materials science techniques will be presented that allow characterizing relevant properties of surfaces, such as topography, crystallinity and oxidation state.

II. LEARNING OUTCOMES

- Recognize the main fundamentals and techniques currently used to produce surface modification using continuous and pulsed lasers.
- Acquire basic knowledge to interpret results obtained through standard materials characterization techniques.

III. CONTENT

Unit I: continuous and pulsed lasers

1) Gaussian rays
2) Cavities
3) Operation of the gain medium at the microscopic and macroscopic level
4) Properties of laser light
5) Types of lasers
6) Pulse generation

Unit II: surface modification

1) Physical and geometric optics
2) Interaction of laser light with matter: Drude and Lorentz models
3) Interaction of laser light with biological organisms
4) Temperature distributions in thin films and solid materials
5) Technological laser processes: cutting, drilling and welding
6) Laser interference metallurgy (LIM) and ultra short pulse processes

Unit III: characterization of surfaces

1) Scanning electron microscopy (SEM): fundamentals and scope
2) Atomic force microscopy (AFM): fundamentals and scope
3) X-ray diffraction (XRD): determination of crystallographic phases and thin film properties
4) Raman spectroscopy: fundamentals and interpretation of spectra
5) Chemical characterization of surfaces: Auger electron spectroscopy (AES) and photoelectron (XPS)
6) Advanced techniques: backscattered electron diffraction (EBSD) and atomic probing tomography (APT)

IV. METHODOLOGICAL STRATEGIES

- Theoretical lectures

V. EVALUATIVE STRATEGIES

- Attendance,
- Summative tests
- Oral presentations.

VI. BIBLIOGRAPHY

REQUIRED

Siegman AE. Lasers. University Science Books; 1986;1283.

Silfvast WT. Laser Fundamentals. Cambridge University Press; 2004;:642.

Svelto O, Hanna DC. Principles of Lasers. Springer; 2010;:642.

Diels JC, Arissian L. Lasers: The Power and Precision of Light. Wiley; 2011;:277.

Introduction to Solid State Physics 7th edition- Kittel, Charles. 2013. pp. 1-692.

Steen WM, Mazumder J. Laser Material Processing. Springer; 2010;:576.

Hecht E. Optics. Addison-Wesley Longman, Incorporated; 2002.

Maldovan M, Thomas EL. Periodic Materials and Interference Lithography: For Photonics, Phononics and Mechanics. Wiley; 2009;:331.

Birkholz M. Thin Film Analysis by X-Ray Scattering. John Wiley & Sons; 2006.

Goodhew PJ, Humphreys J, Beanland R. Electron Microscopy and Analysis, Third Edition. Taylor & Francis; 2000.

McCreery RL. Raman Spectroscopy for Chemical Analysis. John Wiley & Sons; 2005.

Hofmann S. Auger- and X-Ray Photoelectron Spectroscopy in Materials Science: A User-Oriented Guide. Springer; 2012;:528.

OPTIONAL

N/A