Level Eight

Special Topics in Applied Physics (2)

Course Code	Course Num.	Course Name	Credit Hours	Lec	Lab	Tut	Prerequisites
PHY	472	Special Topics in Applied Physics (2)	3	4	0	0	Consent of the department

An advanced course in Applied Physics of current interest proposed by a faculty member and whose topic may change from semester to semester.

Present Syllabous is
Physics-472

(Introduction to nanotechnology and thin films)

I- Generalities on nanotechnology

- **Introduction**; definitions, comparison between units.
- **History**; Richard Feynman, Norio Taniguchi.
- **Fundamental concepts**; bottom-up and top-down.
- **Importance of nanosystems**

  * Quantification.

  * Specific surface area.

II- Principal synthesis techniques of nanosystems

- **Introduction**; chemical and physics techniques.
- **Generalities on germination mechanism**; activation energy of nucleation, critical germ dimension, stability of the germ.
- **Chemical techniques**

  ***Free nanoparticles;** metallic salt reduction, electrochemical reduction, micellar systems, sol-gel, solvo-thermal.

  ***Enrobed nanoparticles;** in-situ synthesis, post synthesis addition.

- **Physical techniques**; thermal evaporation, milling, pulse laser deposition (PLD), electrical discharge, sputtering, molecular beam epitaxy (MBE), chemical vapour deposition (CVD), ionic implantation, lithography.

III-Quantification

- **Introduction;** free electrons and electrons in solid.
- **Gas of electrons;** description of free electrons in solid, concept of effective mass, quantification condition, Born Van Kerman (BVK) conditions, energy levels of free electron in solid, state densities in different structures 3D, 2D, 1D and 0D,
- **Applications:** systems 0D and 1D.

IV-Porosity and texture of materials

- **Introduction;** divided state, specific surface area.
- **Generalities on textural characterisations of porous solids;** Gurwitsch equation, porosity.
- **Electronic characterisation methods;** scanning electron microscopy (SEM), transmission electron microscopy.
- **Adsorption-desorption characterisation methods.**

V-Nanomaterials and devices

- **Application of carbon nanostructure;** carbon nanotube (CN), carbon nanosphere (C_{60}).
- **Optical, Electrical and magnetic properties of spintronic devices.**

VI-Deposition and etching of thin films; description of specific techniques for the elaboration of thin films.

VII- Characterization techniques; atomic force microscopy (AFM), Optical transmittance in UV-Vis-NIR range, four probe electric measurement, Hall effect measurement.

VII-Devices based on thin films

- **Diode,** - **Solar cell,** - **Superlattice.**

Textbooks and References

1. Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience,
Edward L. Wolf , Wiley-VCH; 2 edition, 2006.

2. The Essentials Understanding Nanoscience and NanoTechnology, By T. Pradeep, McGraw-Hill, USA , 2008.

3. Nano- and Micro-Electromechanical Systems: Fundamentals of Nano- and Microengineering,
Second Edition, Sergey Edward Lyshevski, 2000.