COURSE OUTLINE

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	DEPT. OF PHYSICS		
LEVEL OF STUDIES	Masters		
COURSE CODE	**M144**	**SEMESTER**	**2**
COURSE TITLE	**Nanoscale Physics**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	7
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*special background, specialised general knowledge, skills development*
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek or English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The "Nanosclale Physics" course provides Post Graduate level training on the physics of nanomaterials, in conjunction with quantum-size phenomena and matter-photon interactions, as well as their applications.

After successful completion of the course students will acquire the following skills:

- Deepen understanding of physical principles and methods necessary to master nanomaterials' science & technology.
- To be able to combine quantum physics, solid state physics and atomic-molecular physics to analyze, simulate the properties of nanomaterials .
- To be familiarized with the basic theoretical models pertaining with the interpretation of electronic, photophysical, interfacial physicochemical properties of nanomaterials within the broader context of applicability of nanomaterials & nanotechnology .
- To be trained on modern methods of nanomaterials controlled synthesis, characterization in direct relation to their targeted applications.
- To be acquainted with the environmental & biophysical aspects of

nanomaterials in conjunction with the utilization of physics for safe-by-design nanomaterials.

- To be trained on autonomous study and self-motivated research on cutting-edge nanomaterials science and technology, with a tangible skill on writing a research paper or literature review./

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Decision-making
Respect for the natural environment
Production of free, creative and inductive thinking
Criticism and self-criticism

(3) SYLLABUS

Introductory review of the principles and mathematical tools of quantum physics from the atom to nanoparticle. Electrons, phonons in 3D, 2D nanostructures. Finite lattices, lift of degeneracy. Phase transitions, Landau theory. Diellectric, piezoelectric, properties of nanomaterials. Magnetic, superparamagnetic nanostructures. Elements of quantum optics.
Graphene. Quatum Dots. Plasmoninc metal nanomaterials. Nanosemiconductors. Nanoheterostructures. Work function, Band Bending. Thermodynamics of nanomaterials. Kelvin effect, Ostwald ripening. Interfacial phenomena in nanostructures .Surface Plasmon Resonance. Hot electrons. Photon-electron at the nano-interface. Liquid-Nanomaterial interfacial electrostatic double layer, hydrophobicity. Modern methods of nanomaterials synthesis. Case studies on nanomaterials research & technology. Nanomaterials Life Cycle Analysis.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face teaching
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Video projector assisted teaching. Moodle tele-teaching for teaching notes, exam subjects, practical courses and communication with the students.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-*	

Activity	*Work load per semester*
Lectures,	39
laboratory practice	12
educational visits	4
Literature Review	31
essay writing	40
non-directed study	46
Examination	3

directed study according to the principles of the ECTS		
	TOTAL	***175***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written or oral examination at the end of teaching semester, problem solving. Laboratory work. Written work, essay/report	

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*
  - «Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience » E. L. Wolf, Willey-VCH 2015
  - "Optical Properties of Nanoparticle systems", M. Quinten, 2011, Willey-VCH
  - "Physical Fundamentals of Nanomaterials" B. Zhang, Elsevier, 2018.
  - "Thermoplasmonics" G. Baffou, Cambridge Univ. Press 2018.
  - "Νανουλικά & Περιβάλλον", Ι. Δεληγιαννάκης Εκδόσεις Τζιόλα, 2010 Κωδικός Βιβλίου στον Εύδοξο: 18548870.
- *Related academic journals:*
  - Nature Photonics
  - Nanoscale
  - Physical Review B
  - ACS Nano
  - Applied Materials & Interfaces