COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
DEPARTMENT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	ISCED level 6 – Bachelor's or equivalent level		
COURSE CODE	YN404	**SEMESTER**	4th Semester
COURSE TITLE	Nanochemistry and Nanomaterials		

TEACHING ACTIVITIES *If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
THEORY	3	3
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.		

COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	Specialization, Optional Mandatory
PREREQUISITES:	NO
TEACHING & EXAMINATION LANGUAGE:	Greek
COURSE OFFERED TO ERASMUS STUDENTS:	NO
COURSE URL:	https://eclass2.emt.duth.gr/courses/CHEM_H124/

(2) LEARNING OUTCOMES

Learning Outcomes

Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

The aim of the course is to familiarize students with the general principles of nanotechnology. To introduce advanced materials and their fields of application. To nanostructured materials based on carbon: carbon nanotubes, fullerenes, graphene oxide, graphene. To teach the methods of preparation and characterization, the properties and applications of nanoparticles in environmental protection, catalysis, nanomedicine, etc.

Upon completion of the course, the student will have acquired the knowledge and skills for Nanochemistry and Nanomaterials. Thus, they will:

- understand the basic principles of Nanotechnology and nanostructured materials.
- acquire the basic knowledge of modern nanomaterials and their fields of application.
- can understand the methods of synthesis of nanoparticles and the methods of their optical
- recording with modern electron microscopy.

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,
ICT Use
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Project design and management
Equity and Inclusion
Respect for the natural environment
Sustainability
Demonstration of social, professional and moral responsibility and sensitivity to gender issues

Working in an international environment *Working in an interdisciplinary environment* *Production of new research ideas*	*Critical thinking* *Promoting free, creative and inductive reasoning*

Is able to:

- Refer to sources, cross-reference and glean
- More specifically, the course content promotes the following skills:
  - Search, analyze and synthesize data and information, using the necessary technologies
  - Promote free, creative and inductive thinking
  - Work in an international environment
  - Work in an interdisciplinary environment
  - Autonomous work
  - Teamwork
  - Project planning and management
  - Respect for diversity and multiculturalism
  - Demonstrate social, professional and ethical responsibility and sensitivity to gender issues
  - Decision-making
  - Adaptation to new situations
  - Respect for the natural environment

(3) COURSE CONTENT

1. Nanochemistry and Nanoscale: Supramolecular Organization – The Principle: Movement of an Atom from a Surface
2. Tunneling Phenomena – Intramolecular Forces – Surfaces, Intrasurfaces – Self-Organization and Surface Reassembly
3. Nanomaterial Categories: Dendrimers – 3-D Nanomaterials, Nanohybrid Materials – Nanocomposites – Natural Nanomaterials. Nanoparticles – Nanowires – Thin Films
4. Processes – Nanomaterial synthesis techniques: Top down and bottom-up approaches, Sol-Gel technique
5. Micromachining techniques: Lithography, Substrate etching and removal, Substrate bonding
6. Chemical vapor deposition (CVD) techniques: Plasma technology, Plasma dry chemical etching, Molecular beam epitaxy, Hydrothermal and solvothermal processing techniques, Microwave synthesis, Pattern-assisted techniques (patterns or template assisted methods)
7. Electrophoresis – Electrochemical depositions – Pattern filling methods from colloidal dispersion solution, centrifugation, Synthesis by electrospinning
8. Nanomaterial characterization methods
9. Properties of nanomaterials: Size dependence of properties – Mechanical/Tribological – Electrical, Magnetic, Thermal properties, Optical.
10. Future trends and extensions of nanochemistry
11. Applications of nanochemistry in the environment

(4) LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD *Face to face, Distance learning, etc.*	Face to face
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) *Use of ICT in Teaching, in Laboratory Education, in Communication with students*	• Organization of the material in ppt slides. • Support of the learning process through the electronic platform • Communication via email.
TEACHING ORGANIZATION *The ways and methods of teaching are described in detail.* *Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.*	

Activity	Workload/semester
Lectures	52
Independent study	39
Total	75

The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.	
STUDENT EVALUATION *Description of the evaluation process* *Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others* *Please indicate all relevant information about the course assessment and how students are informed*	**Student evaluation languages** Greek **Method (Formative or Concluding)** Summative **Student evaluation methods** Written Exam with Multiple Choice Test. Presentation in audience **Rate** **100**

(5) SUGGESTED BIBLIOGRAPHY

- Κ.Α. Χαριτίδης, 'ΝΑΝΟΔΟΜΕΣ & ΝΑΝΟΫΛΙΚΑ - Σύνθεση, Ιδιότητες & Εφαρμογές', Πανεπιστημιακές Εκδόσεις ΕΜΠ, 2016.
- Dieter Vollath, Nanomaterials: An Introduction to Synthesis, Properties and Applications, 2nd Edition, Wiley (2013)
- G. Cao, Nanostructures and Nanomaterials – Synthesis, Properties and Applications, Imperial College Press (2004)
- Springer Handbook of Nanotechnology, Bharat Bhushan (Ed.), Springer- Verlag Berlin Heidelberg (2004)