

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of General Engineering
Master of Science and Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: CIIM 6018

Course Title: NANOSTRUCTURED MATERIALS

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Study of the dependence of materials properties on crystal size at the nanoscale. Nanotechnology is discussed from the perspectives of characterization techniques, processing, and applications of nanostructures composed of functional materials. After completing the course, the students will be able to analyze, debate, and suggest synthesis, characterization, and application alternatives for nanostructures of different materials.

Spanish: Estudio de las propiedades de materiales y su dependencia del tamaño de cristales a escala nanométrica. Se discute la nanotecnología desde la perspectiva de técnicas de caracterización, procesamiento y aplicaciones de nano-estructuras compuestas por materiales funcionales. Al completar el curso, los estudiantes serán capaces de analizar, debatir y sugerir alternativas de síntesis, caracterización y aplicación para nano-estructuras de diferentes materiales.

3. /Co-requisites and other requirements:

Graduate student with permission of the Program Coordinator.

4. Course Objectives:

By the end of the course students will:

- Describe nano-world and nanotechnology perspectives.
- Identify mechanisms involved in particle formation.
- Analyze conditions conducive to the particle stability and formation of solid solutions.
- Identify the options to produce and control monodisperse systems and other particle characteristics, such as: morphology, structure, composition, structure, layered structures, and surface modification.
- Analyze the conditions for the formation and stabilization of clusters and nanoparticles.
- Identify particle synthesis routes, i.e. chemical alternative (colloids, micelles, polymers, glasses, zeolites hosts), mechanical alternative (mechanical attrition) and other physical routes.
- Recognize the conditions to produce nanowires, nanocomposites, films and carbon nanostructures.
- Distinguish processing alternatives for various nanostructured materials: metals, ceramics, composites and others.
- Evaluate different characterization techniques to determine structures and crystal lattice, specific surface area, composition, morphology, chemical, mechanical and other functional properties.
- Apply the studied concepts to semiconducting, magnetic, catalysts, and other functional nanostructures.
- Evaluate current and potential applications of nanomaterials to biological and medical uses.
- Apply nanotechnology concepts to environmental issues.

5. Instructional Strategies:

- conference discussion computation laboratory
seminar with formal presentation seminar without formal presentation workshop
art workshop practice trip thesis special problems tutoring
research other, please specify:

6.]Minimum or Required Resources Available:

No specific resources are required

7. Course time frame and thematic outline

Outline	Contact Hours
- Introduction to nanotechnology and nanomaterials processing.	2
- Fundamentals of particles formation I: Nucleation and particle growth	3
- Fundamentals of particles formation II: Recrystallization. Solid-solution formation.	5
- Nanoparticles and nanostructures	5
- Nanostructured materials processing (nanoparticles, nanowires, thin films and bulk nanostructured materials)	9
- Carbon nanostructures	4
- Characterization techniques for nanostructured materials	6
- Fundamental and industrial applications.	6
- Nanotechnology-related social and environmental considerations.	4
- Exam	1
Total hours: (equivalent to contact period)	45

8. Grading System

- Quantifiable (letters) Not Quantifiable
 Standard Curve:
 100-90 A; 89-80 B; 79-70 C; 69-60 D; 59-0 F

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	1	20
<input checked="" type="checkbox"/> Final Exam	1	20
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	2	30
<input checked="" type="checkbox"/> Monographies	2	30
<input type="checkbox"/> Portfolio		
<input type="checkbox"/> Projects		
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

Shimizu, T. (2008). *Self-assembled nanomaterials* (2 Vol.). Berlin: Springer. [Available at the Circulation Collection (QD281 .P6 F6 2008), UPRM General Library]

Other resources:

Brinker, C. J., & Scherer, G. W. (1990). *Sol-gel science: The physics and chemistry of sol-gel processing*. Boston: Academic Press. There is no newer version. [Available at the Circulation Collection (TP810.5 .B75 1990), UPRM General Library]

Cao, G. (2004). *Nanostructures & nanomaterials: Synthesis, properties & applications*. London: Imperial College Press. There is no newer version. [Available at the Circulation Collection (QC176.8.N35 C36 2005) and online via EBSCO EBooks Collection, UPRM General Library]

Poole, C. P., & Owens, F. J. (2003). *Introduction to nanotechnology*. Hoboken, NJ: J. Wiley. There is no newer version. [Available at the Circulation Collection (T174.7 .P66 2003), UPRM General Library]

Zhang, J. Z., Wang, Z., Liu, J., Chen, S., & Liu, G. (2003). *Self-assembled nanostructures*. New York: Kluwer Academic/Plenum Publishers. There is no newer version. [Available at the Circulation Collection (QC176.8 .N35 S45 2003), UPRM General Library]

Selected articles from specialized journals available in: *ACS* (<http://pubs.acs.org>), *Science Direct* (<http://www.sciencedirect.com>) and *IEEE* (<http://ieeexplore.ieee.org/xplore/dynhome.jsp>) [Available online via ACS Journals, ScienceDirect and IEEE, UPRM General Library]

Binns, C. (2011). *Introduction to nanoscience and nanotechnology*. Hoboken, N.J.: Wiley.

Ramsden, J. (2011). *Nanotechnology: An introduction*. Norwich, N.Y.; Oxford: William Andrew ; Elsevier Science.

11. According to Law 51: Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students Office at (787) 265-3864 or (787) 832-4040 extensions 2040 or 3372.

Prepared by:



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Approved by:



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