

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 6005
Course Title: FUNDAMENTALS OF ADVANCED MATERIALS
Number of credits: 4
Contact Period: 3 hours of lecture and one hour of seminar per week

2. Course Description:

English: Integrated study of the fundamental concepts of advanced materials necessary to understand the development of their structures and properties, as well as their engineering applications. Analysis of the structure and properties of ceramic, composite, electronic, metallic, and polymer materials; atomic- and nanometer-scale microstructures, including long-range and short-range order atomic arrangements, as well as the development of microstructures and their transformations. Case studies on the design of materials and their synthetic pathways.

Spanish: Estudio integrado de los conceptos fundamentales de materiales avanzados necesarios para entender el desarrollo de sus estructuras y propiedades así como sus aplicaciones en ingeniería. Análisis de las estructuras y propiedades de materiales cerámicos, compuestos, electrónicos, metálicos y polímeros; las microestructuras a escala atómica y nanométrica, incluyendo el ordenamiento atómico de corto y largo alcance así como el desarrollo de microestructuras y sus transformaciones. Estudio de casos sobre el diseño de materiales y sus rutas de síntesis.

3. Pre/Co-requisites and other requirements:

Graduate student with permission of the Program Coordinator.

4. Course Objectives:

By the end of the course students will:

- Apply the fundamental structure of materials in the quest for novel ones based on the design approach.
- Describe different categories of materials. Identify materials types and develop criteria for their applications.
- Estimate the expected properties of a material, based on its interaction with electrons at different levels
- Describe how these effects could enhance properties in different materials (e.g. Semiconductors).
- Identify different phenomena at different levels e.g., subatomic and atomic levels, microstructure induced and dependent effects.
- Describe thermal effects on magnetism.
- Describe tensile, fatigue, fracture and creep tests.
- Compare materials based on these tests. Relate behavior to structure, and processing techniques.
- Define electric and dielectric properties based on structure.
- Apply advanced processing techniques concepts for property enhancements in terms of thermal / athermal relationships.
- Describe atomistically this phase transformation and the conditions for its occurrence.
- Analyze high energy processes based upon kinetic / thermodynamic models.

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 of materials categories, the science & engineering of materials. Structural bases of ceramics, composites, electronic, metals and polymer materials. Engineering basis for reinforced materials (e.g. CMC, MMC, PMC)	8
- Ceramics, metals, and polymer materials, and their composite derivatives. Electronic materials.	4
-Transport phenomena based on electron interactions such as thermal effects, optical effects, and electric field effects, and magnetic fields effect.	6
-Magnetic phenomena and magnetic properties. Anisotropic behaviors, magnetic phase transformation. Permanent magnets, soft and hard magnets.	8
-Mechanical properties and relationship to structure. Effects of processing and use advanced techniques property enhancements.	8
-Electrical and dielectrical properties. Engineering materials based on these properties	6
-Advanced materials developments	5
-Seminars	14
-Exam	1
Total hours: (equivalent to contact period)	60

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	25
<input checked="" type="checkbox"/> Final Exam	1	25
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	4	25
<input checked="" type="checkbox"/> Monographies	2	25
<input type="checkbox"/> Portfolio		
<input type="checkbox"/> Projects		
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

Schaffer, J. P., Saxena, A., Antolovich, S., Sanders, T. H. Jr., & Warner, S. B. (2001). *The science and design of engineering materials* (2nd ed.). Boston: WCB/McGraw-Hill. There is no newer version. [Available at the Circulation Collection (TA403 .S418 2001), UPRM General Library]

Other resources:

Soboyejo, W. O., & Srivatsan, T. S. (2007). *Advanced structural materials: Properties, design optimization, and applications*. Boca Raton, FL: CRC Press.

<http://dx.doi.org/10.1201/9781420017465> [Available via CRCNetBASE, UPRM General Library]

Selected articles from: *Acta Materialia*. Elsevier. (<http://www.journals.elsevier.com/acta-materialia>) [Available online via ScienceDirect, UPRM General Library]

Selected articles from: *Materials Science & Engineering: A, B, C, R*. Elsevier.

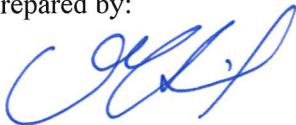
(<http://www.journals.elsevier.com/materials-science-and-engineering-a,b,c,r>) [Available online via ScienceDirect, UPRM General Library]

Selected articles from specialized journals available in: *IEEE*

(<http://ieeexplore.ieee.org/xplore/dynhome.jsp>) [Available online via IEEE, UPRM General Library]

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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