

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 6020  
 Course Title: DIFFUSION PHENOMENA IN MATERIALS  
 Number of credits: 3  
 Contact Period: 3 hours of lecture per week

### 2. Course Description:

**English:** Study of the bases of atomic transport phenomena and diffusion mechanisms in solids, Fick's laws and the Kirkendall effect. Discussion of the characteristics of diffusion in ionic solids. Mathematical analysis of diffusion phenomena and the application of Green's function. The students will be able to analyze multi-component diffusion processes as well as other forms of diffusion in materials processing.

**Spanish:** Estudio de las bases de los fenómenos de transporte atómico y mecanismos de difusión en sólidos, las leyes de Fick y el efecto Kirkendall. Discusión de las características de difusión en sólidos iónicos. Análisis matemático de los fenómenos de difusión y aplicación de la función de Green. Los estudiantes serán capaces de analizar procesos de difusión multicomponente así como otras formas de difusión en el procesamiento de materiales.

### 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:

- Analyze diffusion and diffusivity of different diffusing species in different media.
- Use phase equilibria in the prediction of diffusion behavior
- Discuss the relationship between crystal defects and diffusion
- Calculate diffusivities based on experimental data
- Evaluate computational and mathematical models to predict diffusion behavior

Apply diffusion knowledge to the real-life multicomponent systems.

### 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
- Laws of diffusion. Diffusion in generalized media. Solutions to linear diffusion. Green's functions	5
- Diffusion couple. Diffusion in three dimensions. Generalized sources. Diffusion-reaction	9
- Spherical bodies. Steady-state diffusion. Inverse methods	5
- Random walks. Crystal Structure and diffusion. Defects and diffusion	9
- Diffusion in dilute alloys. Kirkendall effect. Anelasticity. Field-assisted diffusion	5
- Multicomponent diffusion	10
-Exams	2
<b>Total hours: (equivalent to contact period)</b>	<b>45</b>

### 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	2	50
<input checked="" type="checkbox"/> Final Exam	1	25
<input checked="" type="checkbox"/> Short Quizzes	5	15
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	10
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
<b>TOTAL:</b>		<b>100%</b>

### 10. Bibliography:

Textbook:

Glicksman, M. E. (2000). *Diffusion in solids: Field theory, solid-state principles, and applications*. New York: Wiley. There is no newer version. [Available at the Circulation Collection (QC481 .C87 2001), UPRM General Library]

Other resources:

Hübner, R. (2009). *Advanced Ta-based diffusion barriers for Cu interconnects* [e-book]. New York: Nova Science Publishers. [Available online via EBSCO EBooks Collection, UPRM General Library]

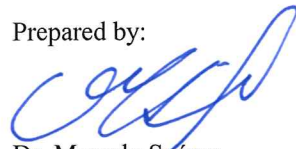
Wu, Z. (2001). *Nonlinear diffusion equations* [e-book]. River Edge, N.J.: World Scientific. There is no newer version. [Available online via EBSCO EBooks Collection, UPRM General Library]

Selected articles from: *Journal of Phase Equilibria and Diffusion*. Springer Verlag. [Available online via EBSCO Academic Search Complete, UPRM General Library]

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