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 6007
Course Title: KINETICS AND PHASE TRANSFORMATION
Number of credits: 3
Contact Period: 3 hours of lecture per week

## 2. Course Description:

**English:** Study of thermodynamic and diffusion concepts applied to the kinetics of phase transformations, which will permit the development of skills necessary for the analysis of such transformations in diverse systems. Nucleation and growth phenomena applied to the processes of recovery, recrystallization, precipitation, and solidification will be studied, as well as spinoidal, order-disorder, and athermal transformations.

**Spanish:** Estudio de los conceptos termodinámicos y de difusión aplicados a la cinética de transformaciones de fase que permitirá el desarrollo de destrezas necesarias para el análisis de estas transformaciones en diversos sistemas. Se estudiarán los fenómenos de nucleación y crecimiento de fases aplicados a los procesos de recuperación, recristalización, precipitación y solidificación así como las transformaciones espinoidales, de orden-desorden y atermales.

## 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 thermodynamic concepts to solid-solid phase reactions.
- Describe the use of diffusion principles in solid-solid state reactions.
- Discuss solidification microstructure based on liquid and solid diffusion mechanisms.
- Identify different processes involving solid-solid reactions.
- Describe thermally induced processes from surface effects such as texture.
- Analyze orientation relationships between new phases and parent phases.
- Evaluate microstructural changes based upon local instabilities.
- Propose appropriate models to describe these processes.
- Define processes in terms of thermal / athermal relationships.
- Differentiate among related driving forces.
- 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 |
|---|---|
| - Characteristics of point, line and surface imperfections | 4 |
| - Atomistic basis for diffusion. Analysis of diffusion kinetics in single and multiphase systems. Interfacial equilibrium and interface controlled kinetics. Energetics and kinetics of phase nucleation | 8 |
| - Solidification reactions, analysis of kinetics, segregation profiles and microstructure development | 5 |
| - Annealing effects, relaxation, recrystallization and kinetics. Thermodynamics of alloy phase changes | 8 |
| - Precipitation reactions-kinetics, crystallography, microstructural morphology and stability | 9 |
| - Martensitic transformations-crystallography and microstructures | 4 |
| - Advanced materials developments. | 5 |
| - Exams | 2 |
| **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 |
|---|---|---|
| ☒ **Exams** | **2** | **50** |
| ☒ **Final Exam** | **1** | **25** |
| ☒ **Short Quizzes** | **5** | **15** |
| ☐ **Oral Reports** | | |
| ☐ **Monographies** | | |
| ☐ **Portfolio** | | |
| ☒ **Projects** | **2** | **10** |
| ☐ **Journals** | | |
| ☐ **Other, specify:** | | |
| **TOTAL:** | | **100%** |

## 10. Bibliography:


Textbook:

Sinha, A. K. (2003). *Physical metallurgy handbook*. New York, NY: McGraw-Hill. There is no newer version. [Available at the Circulation Collection (TN690.4 .S57 2003), UPRM General Library]

Other resources:

Kostorz, G. (2001). *Phase transformations in materials*. Weinheim; New York; Chichester: Wiley-VCH. There is no newer version. [Available at the Circulation Collection (TA403 .P42 2001), UPRM General Library]

Tisza, M. (2002). *Physical metallurgy for engineers* (2 nd printing). Materials Park, Ohio: ASM. There is no newer version. [Available at the Circulation Collection (TN665 .T57 2002), UPRM General Library]

Selected articles from specialized journals available in: *Science Direct* (http://www.sciencedirect.com) and *IEEE* (http://ieeexplore.ieee.org/xplore/dynhome.jsp) [Available online via ScienceDirect and 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.

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Revised: June 2016