Atılım University
Department of Metallurgical and Materials Engineering

MATE 313 **Phase Transformations and Kinetic Processes in Materials** Course Information					
Code	**Course Name**	**Term**	**Theory + Recit. + Lab.**	**Credits**	**ECTS**
MATE 313	Phase Transformations and Kinetic Processes in Materials	5	3 + 0 + 0	3	5.5

Pre-requisite Course(s)	MATE 202		
Course Type	Compulsory	**Language of the Course**	English

Course Catalogue Description
Overview of equilibrium thermodynamics, steady state and non-steady state diffusion in solids; surface and interfacial energies, types of crystal interfaces and their motion, chemical reaction rate theory, diffusional and diffusionless phase transformations and microstructural evolution; nucleation & growth of phases, precipitation & coarsening, spinodal and order-disorder transformations, martensitic transformations, similarities and differences among material groups in terms of their phase transformation mechanisms.

Course Objectives	▪ To furnish students with the knowledge of phase transformations in materials. ▪ To teach students the diffusion mechanisms in solids. ▪ To introduce students the concept of surface energy, the types of interfaces and their roles in phase transformations. ▪ To get students familiar with the diffusional and diffusionless phase transformations.

Course Book	***Phase Transformations in Metals and Alloys***, 3rd Edition, David A. Porter, Kenneth E. Easterling and Mohamed Sherif, CRC (2009)
Other Sources	▪ *Fundamentals of Physical Metallurgy*, J.D. Verhoeven, Wiley (1975) ▪ *Physical Metallurgy Principles*, R. Abbaschian and R.E. Reed-Hill, CL-Engineering (2008) ▪ *Kinetics, Transport, and Structure in Hard and Soft Materials,* P.F. Green, CRC Press; 1st Edition (2005) ▪ *Kinetic Processes*, K.A. Jackson, Wiley-VCH (2004)

Covered Topics

- Thermodynamics and Phase Diagrams (6 h.)
- Interstitial & Substitutional Diffusion (6 h.)
- Interface Energy, Crystal Interfaces and Microstructure (8 h.)
- ***Midterm I***
- Solidification in Pure Metals and Alloys (1 h.)
- Diffusional Phase Transformations (12 h.)
- ***Midterm II***
- Diffusionless Phase Transformations (6 h.)
- Rate Theory (1 h.)
- Intr. to Kinetic Processes in Polymers (1 h.)
- Intr. to Kinetic Processes in Ceramics (1 h.)

Grading Policy
Two Midterms (22.5% each), Final Exam (35%), Assignments & Quizzes (10%), Attendance & Class Participation (10%)

Contribution to Professional Component	
Mathematics and Basic Sciences	
Basic Occupational Courses (Engineering)	
Expertise/Field Courses (Engineering Design)	**X**
Courses on Communication and Management Skills (Social Sciences)	

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Course Learning Outcomes vs. Program Outcomes Correlation Table

Scale: "5"=very strong; "4"= strong; "3"= medium; "2"=some; "1"= poor; "-"= NA

	MATE 313 Course Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CLO1	Review of the thermodynamic knowledge necessary to understand phase transformations	5	5	3	2	2	2	2	3	3	2	1	1
CLO2	Understanding of the mechanisms of the inerstitial and substitutional diffusion in solids.	5	5	3	2	2	2	2	3	3	2	1	1
CLO3	Understanding of the surface energy concept, the types of interfaces in solids and their roles in phase transformations?	5	5	3	2	2	2	2	3	3	2	1	1
CLO4	Understanding of the diffusional and diffusionless phase transformations.	5	5	3	2	2	2	2	3	3	2	1	1

Metallurgical and Materials Engineering Program Outcomes

PO1	Knowledge in mathematics, science, and Metallurgical and Materials Engineering, and an ability to apply the theoretical and applied knowledge gained in these areas to model and solve complex engineering problems and material systems.
PO2	Understanding of the science and engineering principles regarding the structure, properties, processing, and performance of material systems.
PO3	Ability to detect, identify, formulate, and solve complex engineering problems; ability to select and use appropriate analysis and modeling methods for this purpose.
PO4	Ability to design and select material for a system, component, product or a process under realistic conditions and constraints to meet desired needs; ability to apply modern design and material selection methods for this purpose.
PO5	Ability to select, use and improve the techniques, skills, and modern engineering tools necessary for Metallurgical and Materials Engineering practice; ability to effectively use information technology.
PO6	Ability to design and conduct experiments, collect data, and use statistical and computer methods to analyze and interpret results for the investigation of complex engineering problems or Metallurgical and Materials Engineering specific research subjects.
PO7	Ability to function effectively in self-disciplinary and multidisciplinary teams; ability to work alone.
PO8	Ability to use Turkish to communicate effectively in oral and written means; knowledge of at least one foreign language, ability for effective report writing and understanding written reports, ability to prepare design and production reports, make effective presentations, give and take clear and understandable orders/directions.
PO9	Recognition of the need for, and an ability to engage in, life-long learning; ability to access information, follow developments in science and technology
PO10	Awarness of acting according to ethical principles, awarness of professional and ethical responsibilities; knowledge of standards used in engineering applications.
PO11	Knowledge on business life practices such as project management, risk management, change management; awareness of entrepreneurship, innovation, and sustainable development.
PO12	Recognition of the impact of metallurgical and materials engineering solutions on health, environment and security in global and societal context, recognition of the legal consequences of engineering solutions.

Prepared by: Assist.Prof.Dr. Erkan KONCA	**Date:** 29.06.2017	**Total Pages:** 2	**Revision:** 06