上海交通大学研究生课程开设申请表

New Graduate Course Application Form, SJTU

Basic Information				
* Course Name	Chinese			
	English Principles of Solid State Transformations			
* Credits	3	* Teaching Hours	48 1 ≥16	
* Semester	Spring	* Cross-semester?	No	Spanning over Semesters
* Course Category	Specialized Course	* Course Type	For full-time students	
* Instruction Language	Chinese	Teaching Method	In class teaching	
* Grade	Letter grading	Exam Method	Written Exam	
* School	—			
Subject	—			

Person in charge	Name	ID	School	E-mail
			—	zhenghongguo@sjtu.edu.cn

Extended Information

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Course Description

	phase transformation, are introduced with both physical concepts and mathematical modeling. They are modulus softening, time-cone, analytical model, phase field, Landau thermodynamic and size effect of nanocrystalline, etc.; the third one introduces crystallographic features of both diffusionless and diffusional transformations by algebra expression, with particular focus on quantitative expression of orientation relationship and interfacial structure by singular criteria, such as invariant plane strain, invariant line strain and energy cusp associated with structural matching. In general, the lecture focuses on the interpretation of physical nature with mathematic tools of microstructural evolution to strengthen students' understanding about kinetics and crystallography of material. The purpose aims to conduct students to the material design/application and to understand more in-depth studies. The students who select this lecture are assumed to have learned following courses at least: Fundamentals of Materials Science (undergraduate level), Principles of Materials Processing/Principles of Heat Treatment (undergraduate level) and Thermodynamics of Materials (undergraduate/graduate level).
* ( ) Syllabus	,

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* English Syllabus	→			
	Chapter	Main Contents	Hour(s)	Manner
	Preface	Purpose of phase transformation research; Critical progress and related scientists; Course	1	Lecture in classroom

		contents; Course prerequisites; Main references; Examinations;		
	Chapter 1 An Overview	Instability of parent phase and transformation (Thermodynamic criterion of instability, Formation of transitional and equilibrium phase); Characteristics of Typical diffusional transformation(Precipitation, Eutectoid decomposition, Massive transformation, Spinodal decomposition, Austenitization); Characteristics of martensitic transformation (Crystallographic features of martensitic transformation, Energetics of martensitic transformation, Shape memory effect); Phase transformation in novel materials (Crystallization of amorphous alloys, Phase transformation in nanocrystalline materials, Thermal stability of quasi-crystalline materials);	5	ibid
	Chapter 2 Classification and Characteristics of Phase Transformation	Classification according to thermodynamics (Thermodynamical function of assembly, First- and higher-order transformations, Thermodynamic description of phase transformation); Classification of first-order transformation (Reconstructive (diffusional) and displacive (diffusionless) transformation, Classification and characteristics of reconstructive transformation, Classification and characteristics of displacive transformation); Classification according to kinetics (Stable and unstable free-energy curve, Gibbs's two type of transformation); Concise classification of first order transformation;	3	ibid
	Chapter 3 Interfacial Phenomenon	Interfacial structure (Misfit model of interface, Coherency Loss, Gli	2	

	Chapter 5 Spinodal Decomposition and Order-Disorder Transformation (including recitation)	system, Structure and energy of diffuse interfaces); Kinetics of homogeneous transformation (Diffusion potential for transformation, Cahn-Hilliard and Allen-Cahn equations, Numerical simulation an phase-field method); Wavelength and coherent-strain effect (Critical and kinetic wavelengths, Coherent-strain effect, Generalization of Cahn-Hilliard equation);	4	ibid
	Chapter 6 Nucleation	Homogeneous nucleation (Classical theory of nucleation, Incubation period, Effect of elastic strain energy, Nucleus shape of minimum energy, Effect of composition partitioning on the nucleation rate, Discussion); Heterogeneous nucleation (Nucleation on grain boundaries, edges and corners, Nucleation on dislocations, Nucleation on other crystalline defects); Martensitic nucleation (Nucleation by thermal fluctuation, Heterogeneous nucleation, Nucleation by modulus softening);	6	ibid
	Chapter 7 Growth	Growth process of precipitates (Growth without change of composition, Growth involving long-range diffusion, Growth of plate and acicular widmanstatten structure, Role of interface structure in growth process); Eutectoid transformation (Diffusion-controlled growth, Growth controlled by process at the interface); G		

* Requirements	: 1. 1 (3000) (20%) 2. 2 4 (30%) 3. 12 4 (30%) 4. ( ) 1 — (5000) (20%)
* English Requirements	— The course grading is based on different weight among four parts with each should be finished before deadline according to teacher's indications: a specific reading report (at least 3000 Chinese characters) within assigned topics (20%); Twice homework problems with each four (30%); Final examination with open book manner at night (30%); Literature review (at least 5000 Chinese characters) connecting course contents with research direction (20%).

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