* Course Name	Chinese				
	English Kinetics of Materials				
* Credits	3	* Teaching Hours	48 1 =16		
* Semester	Spring	* Cross-semester?	No	Spanning over Semesters	
* Course Type	Program Core Course	* Course Type	For full-time students		
* Course Category	Specialized Course	Targeting Students	All graduates		
* Instruction Language	English	Teaching Method	In class teaching		
* Grade	Letter grading	Exam Method	Written Exam		
* School					
Subject					
Person in charge	Name	ID	School	E-mail	
				hongwang2@sjtu.edu.cn	

* ( ) Course Description	200 1) 2) 3) 4)
* English Course Description	This course provides a foundation for the advanced understanding of the phenomenological and atomistic kinetic process in materials. It emphasizes comprehension of fundamental concepts and stresses on development of students' ability of quantitative analysis. The course starts from a brief review of classical thermodynamics necessary for understanding of phase diagrams, followed by some key concepts such as flux and driving force. The principles of chemical reaction kinetics will be introduced, as well as several important applications such as in thin film growth process and chemical vapor deposition. The center stage of the course is given to the diffusion process in solid materials as well as the analytical and numerical methods to solve diffusion problems. Then

	the kinetic process driven by capillarity force will be discussed, followed by nucleation and growth of crystals and the phase transformation. Several important metallurgical processes such as solidification, spinodal decomposition, etc. will be discussed. Before the end of the course, the students will be exposed to basics of computer simulation methods and software for thermodynamics and kinetics. The overall goals of this course are to: 1) develop an understanding of why materials and microstructures undergo changes by reinforcing and significantly extending concepts introduced in thermodynamics courses; 2) provide an understanding of how diffusion enables changes in the chemical distribution and microstructure of materials by discussing mechanisms and rates of diffusion and the role of driving force on diffusional processes; 3) discuss a variety of phase transformations phenomena and the effects of temperature and driving force on the nature of the transformation and its impact on the resulting microstructure; 4) introduce the methods and software for thermodynamic and kinetic simulation, which became more and more important in today's materials design and development; In short, the course will give the students the tools required to understand how and why phase transformations occur, and how and why microstructures can be controlled and developed.
* ( ) Syllabus	24 45 I 1 1 II 1 1 III 2 1 1 1 1 IV 2 1 1 V 2 1 1 1 1 VI CALPHAD 1 2 1

* English Syllabus	The class will be delivered in 24 lectures, where each lecture contains two 45min classes. I INTRODUCTION AND BACKGROUND Introduction thermodynamics 1 lecture Phase diagrams, Driving force, flux 1 lecture II KINETICS OF CHEMICAL REACTIONS Chemical reaction kinetics, adsorption isotherms 1 lecture Thin film growth Rate controlling steps; CVD 1 lecture III DIFFUSION IN SOLIDS Fick's Laws and solutions to Fick's laws 2 lecture Interdiffusion 1 lecture Self, tracer, intrinsic and interdiffusion coefficients 1 lecture Atomistic models of diffusion, Diffusion in ionic crystals 1 lecture Multipath imperfections 1 lecture Midterm Exam IV KINETICS DRIVEN BY CAPILLARITY FORCES Capillarity forces on surfaces, grain growth 2 lectures Surface energy anisotropy 1 lecture Particle coarsening, sintering 1 lecture V KINETICS OF PHASE TRANSFORMATIONS Nucleation and growth 2 lectures Solidification 1 lecture Order-disorder Reactions 1 lecture Spinodal decomposition 1 lecture Martensitic transformation 1 lecture VI MODELLING OF KINETIC PROCESS Computational thermodynamics (CALPHAD) 1 lecture Diffusion simulation, Phase field simulation 2 lecture Computational lab 1 lecture Final Exam
* Requirements	50 1.10 2% 20% 2. 1 10 30% 3. 30% 4. 10% 5. : 5% 6. : 5%
* English Requirements	1. 10 Homework assignments, 2% each, 20% 2. Midterm Exam, covers first 10 lectures 30% each 3. Final Exam, covers later 9 lecture, 30% 4. Participation: attendance and class discussion, 10% 5. Quiz: simple questions due next morning 6:00am after each class, 5% 6. Project: computation lab work, 5% The final grade will be calculated based on the sum of the above.
* Resources	: KINETICS IN MATERIALS SCIENCE AND ENGINEERING Dennis W. Readey, CRC Press, 2017