Course Information	
Course title	Kinetics of Materials
Semester	114-2
Department	Materials Science and Engineering
Instructor	Te-Cheng Su
Administrative Curriculum Number	MSE5063
Teaching Curriculum Number	MSE5063
Class	
Credits	3
Full/Half Yr.	Half Yr.
Required/Elective	Elective / Core
Time	09:20 – 12:10, each Friday
Remarks	
Ceiba Web Server	
Table of Core Capabilities and Curriculum Planning	

Course Syllabus	
Course Description	Kinetics of Materials, one of the fundamental courses in NTU-MSE graduate school, teaches how to calculate the transport of different types of atoms and ions in materials through basic diffusion equations and reaction equations. We will focus on the analytical approaches for predicting the transient behavior of substances under various initial and boundary conditions. There is a wide range of applications of the Kinetics of Materials in the materials processing control, such as heat treatment, surface modification, doping of semiconductor components, production of conductive ceramics, and surface chemical reactions of various materials. However, the transient equations involved and the required calculation skills will become more complex. Therefore, the aim of the Kinetics of Materials course is: after reading the lecture notes, checking equations derived on the fancy electronic whiteboard, realizing how to solve example kinetics questions, and reviewing the recorded videos in NTU COOL, you will be able to utilize various kinetic equations and models while facing related kinetics problems, and accurately grasp the mass transfer and reaction issues in the

	materials processing system in the future.
Course Objective	The overall objectives of this course are to: • offer an overview of main kinetics theories such as Fick's laws, Peclet number, steady state, stochastic process, reaction rate law, Arrhenius equation, and ionic defect structure. • introduce how we can apply those physical laws to real systems through some mathematical tools such as tensor, Laplace transform, superposition principle, Fourier series, probability distribution functions, and linearized diagrams. • emphasize the outcomes of the competition between diffusion and reaction.
Course Requirement	Students should have taken the following MSE undergraduate courses (or other equivalent courses): • Physical Metallurgy (I and II), Curriculum Number MSE2004 and MSE2005 • Engineering Mathematics (I and II), Curriculum Number MSE2002 and MSE2003
Office Hours	use NTU COOL Conversations first
References	J. Crank, Mathematics of Diffusion , Oxford Science Publications, 2nd ed. 1992. W.D. Kingery, Introduction to Ceramics , John Wiley & Sons, Inc., 1976. D.A. Porter and K.E. Easterling, Phase Transformations in Metals and Alloys 2nd ed., Chapman & Hall, 1992. R.W. Balluffi, S.M. Allen, W.C. Carter, Kinetics of Materials , John Wiley & Sons, Inc., 2005. O. Levenspiel, Chemical Reaction Engineering , John Wiley, 3rd ed. 1999.
Designated reading	M.E. Glicksman, Diffusion in Solids: Field Theory, Solid-State Principles, and Applications , John Wiley & Sons, Inc., 2000. (01 - 12, Glicksman) K.J. Laidler, Chemical Kinetics, 3rd ed. , Harper & Row, New York, 1987. (13 & 14, Laidler)

	H. I. Yoo, Lectures on Kinetic Processes in Materials . Springer, https://doi.org/10.1007/978-3-030-25950-1 (part of 15, Yoo) M.G. Fontana, Corrosion engineering, 3rd ed. , McGraw-Hill, New York, 1986. (16, Fontana) Y.M. Chiang, D. Birnie III, W.D. Kingery, Physical Ceramics, Principles for Ceramic Science and Engineering , John Wiley & Sons, Inc., 1997. (17 & 18, Chiang)
Grading	see table below

No.	Item	%	Explanations for the conditions
1.	Midterm #1	50%	50% Close + 50% Open
2.	Final exam	50%	50% Close + 50% Open

Progress

Week	Date	Topic
Week 1	03/06	Introduction to Kinetics (00)
Week 2	03/13	Laws of Diffusion and Diffusion in Generalized Media (01 & 02, Glicksman)
Week 3	03/20	Solutions to the Linear Diffusion Equation I: superposition principle (03 - 06, Glicksman)
Week 4	03/27	Solutions to the Linear Diffusion Equation II: Fourier series (07 & 08, Glicksman)
Week 5	04/03	Solutions to the Linear Diffusion Equation III: steady-state method (10 & 12, Glicksman)
Week 6	04/10	Introduction to Chemical Kinetics I: basic concepts (13, Laidler)
Week 7	04/17	Introduction to Chemical Kinetics II: analysis of kinetic results (14, Laidler)
Week 8	04/24	Midterm examination (01 - 12 Glicksman and "13+" Laidler)
Week 9	05/01	Flexible arrangement of discussions on Chemical Kinetics and Physical Chemistry
Week 10	05/08	Adsorption and Evaporation (15, Yoo and others)

Week 11	05/15	High-Temperature Oxidation I: mechanisms and kinetics (16, Fontana)
Week 12	05/22	High-Temperature Oxidation II: high-temperature materials (16, Fontana)
Week 13	05/29	Vacancy-Assisted Diffusion I: defects in ceramics (17, Chiang)
Week 14	06/05	Vacancy-Assisted Diffusion II: defect equilibria (17, Chiang)
Week 15	06/12	Vacancy-Assisted Diffusion III: mass transport behavior (18, Chiang)
Week 16	06/15	Final examination (Mostly 13 - 18)