Chemical and Biomolecular Engineering 142
Chemical Kinetics and Reaction Engineering
Fall Semester 2019
Course Website: CBE 142 FALL 2019 on bcourses.berkeley.edu

Instructor: Prof. Alexander Katz (233 Hildebrand Hall, 643-3248, askatz@berkeley.edu)
Office Hours: Mon 1:00 pm – 2:00 pm, Fri 1:00 pm – 2:00 pm; appointment.

GSIs: Mr. Paul Kim (373 Tan Hall, paul.kim@berkeley.edu)
Office Hours: Mon 3:00 pm – 4:00 pm, Latimer 433
Fri 11:00 am – 12:00 pm, 100D Hildebrand Library

Mr. Zach Konz (228 Hildebrand Hall, zachary_konz@berkeley.edu)
Office Hours: Mon 10:00 am - 11:00 am, 100F Hildebrand Library
Mon 5:00 pm – 6:00 pm, Latimer 403

Mr. Salwan Butrus (salwan@berkeley.edu)
All students will be automatically enrolled in the online forum Piazza. It can be accessed via the left-hand side navigation pane of bCourses. **Please see the Piazza Etiquette document on bCourses prior to using Piazza.**

Piazza cutoff for homework-related questions is 6:00 PM on day before homework is due.

Discussion 101 (PK): M, 11:00 am – 12:00 pm, LeConte 385
Discussion 102 (ZK): M, 4:00 pm – 5:00 pm, Latimer 105
Discussion 103 (PK): W, 3:00 pm – 4:00 pm, Hearst Field Annex B1
Discussion 104 (ZK): Th, 1:00 pm – 2:00 pm, Wheeler 24

Lecture Hours: TuTh, 3:30 pm – 5:00 pm, Valley Life Sciences 2040

Text: H. S. Fogler, Elements of Chemical Reaction Engineering, 5th Edition, Prentice Hall, 2016.

Course Grade: The course grade will be determined by the following:

Homework:	4%
Design Projects:	6%
Midterm Exam 1:	26%
Midterm Exam 2:	24%
Final Examination:	40%

Homework: Homework will be assigned on Tuesdays and will be due at the beginning of lecture on the following Tuesday, unless indicated otherwise. Approximately three to five problems will be assigned each week (typically a subset of these will be graded). Solutions will be posted on the class website.

Computer Use: The use of a numerical methods program for solving systems of ordinary differential equations and non-linear algebraic equations will be part of this course. GSIs will provide background for implementation of numerical methods in the beginning of the course. College of Chemistry facilities are equipped with MatLab, MathCad, and Polymath, which are sufficient for the types of problems being addressed in this course.

Grading Policies:

1. Homework must be turned in at the designated time – **before lecture at 3:30 pm**. Late problem sets will be corrected but assigned a score of zero.
2. Students should feel free to discuss the homework and design project assignment with others; however, **the final product must be entirely your own work**.
3. Although homework and design projects will not be regraded, requests for all homework/design project regrades can be made at the end of the course and will be taken into consideration when determining the final course grade.
4. Each student who submits a course evaluation by November 30, 2019 will have the **lowest five homework scores dropped** from their total score, when calculating the average homework course grade.
5. Exams will not be given early or late. If you miss an exam for a valid reason, your scores from other exams will be averaged to make up for the missed exam. Missing more than one exam will result in either an I or an F grade for the course. Missing an exam without a valid reason will result in a zero grade for that exam. Requests for exam regrades, if approved, will require the entire exam to be regraded (select portions will not be regraded).

References:

The following are intended to complement lecture notes and the primary textbook and are available for use in the Chemistry Library.

Chemical Kinetics

K. J. Laidler, Chemical Kinetics, 3rd edition, Harper & Row, 1987. (2 copies)
J. W. Moore and R G. Pearson, Kinetics and Mechanism, 3rd edition, Wiley, 1981.
W. C. Gardiner, Jr., Rates and Mechanisms of Chemical Reactions, W. C. Benjamin, Inc., 1969.
M. Boudart, Kinetics of Chemical Processes, Prentice-Hall, 1968.

Reaction Engineering

H. S. Fogler, Elements of Chemical Reaction Engineering, 4th Edition, Prentice Hall, 2006.
H.S. Fogler, Essentials of Chemical Reaction Engineering, 2011,
Prentice Hall, Upper Saddle River, New Jersey.
O. Levenspiel, Chemical Reaction Engineering, 3rd edition, Wiley, 1999.
C. G. Hill, Jr., An Introduction to Chemical Engineering Kinetics and Reactor Design, Wiley, 1977. (3 copies)
J. M. Smith, Chemical Engineering Kinetics, 3rd edition, McGraw Hill, 1981. (2 copies)

Heterogeneous Systems and Catalysis

C. N. Satterfield, Mass Transfer in Heterogeneous Catalysis, MIT Press, 1970. (2 copies)
J. J. Carberry, Chemical and Catalytic Reaction Engineering, McGraw Hill, 1976. (2 copies)

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Fall Semester 2019 Class Schedule

	Date	Lecture N^o	Topic	Chapter
Aug	29	1	Introduction; Definition of reaction rate	Preface; 1
Sept	3	2	General mole balances; Basic types of chemical reactors	1
	5	3	Reactor design equations	2
	10	4*	Reactor design for single reactions; Multiple-reactor systems	2
	12	5	Chemical reactions with volume and phase changes; Isothermal reactor design	4; 5
	17	6*	Concepts in chemical kinetics	3
	19	7	Reaction rate laws; Mechanisms of homogeneous reactions	3; 9
	24	8*	Mechanisms of homogeneous reactions	9
	26	9	Examples of reaction mechanisms	9
Oct	1	10*	Semibatch reactors	6
	3	11	Recycle and membrane reactors;	6
	8	12*	Reactor energy balances	11
	10	--	**Midterm 1**	
	15	13	Reactor energy balances	11
	17	14	Design of non-isothermal reactors	11; 12
	22	15*	Multiple steady-states; Reactor stability and thermal runaway	12
	24	16	Unsteady-state nonisothermal reactors	13
	29	17*	Design of reactors for multiple reactions; Series and parallel reactions	8; 13
	31	18	Concepts in heterogeneous catalysis	10

Date		Lecture N°	Topic	Chapter
Nov	5	19*	Mechanisms of surface-catalyzed reactions; Catalytic reactions	10
	7	20	External transport effects in catalyst particles	14
	12	21*	Intraparticle diffusion and reaction; Catalyst effectiveness factor	15
	14	--	**Midterm 2**	
	19	22*	Catalyst effectiveness factor	15
	21	23	Nonisothermal catalyst particles	15
	26	24*	Nonisothermal catalyst particles	15
	28	--	Thanksgiving Holiday	
Dec	3	25	Mass transfer and reaction in packed beds	15
	5	26*	Criteria for transport limitations/Summary	15
	20	--	**Final Examination (7 PM – 10 PM)**	

* Denotes dates on which homework problem assignments are due unless other arrangements are announced