Principles of Chemical Engineering

Lecture 1 - Introduction

Prof. Jie Xiao (肖 杰)

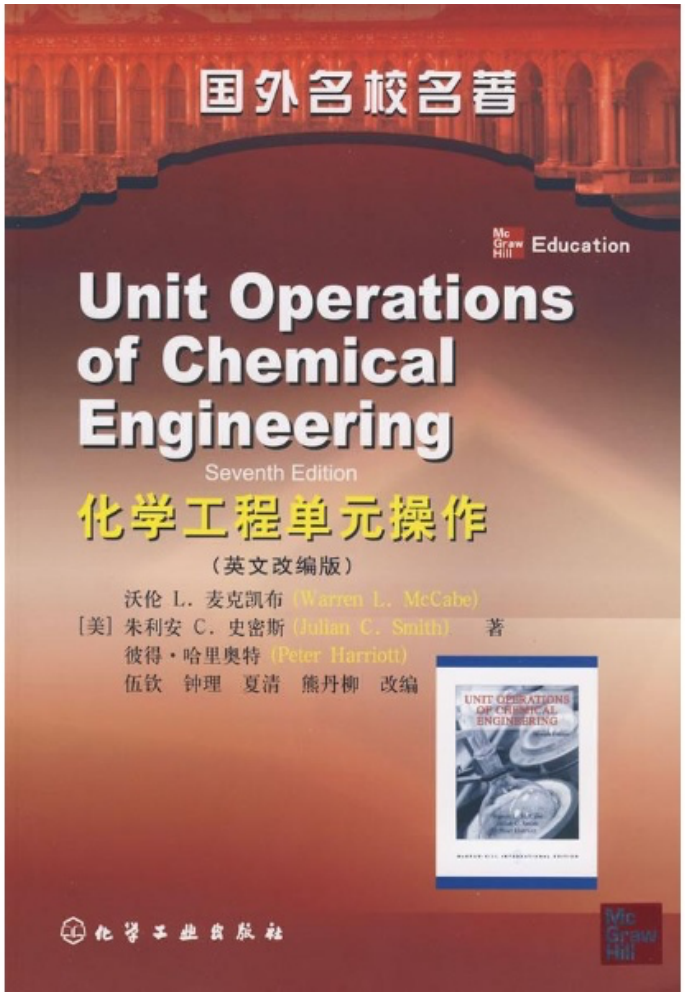
E-mail: jie.xiao@suda.edu.cn
Office phone: (0512) 65882756
Office location: 911-505
Office hour: by appointment

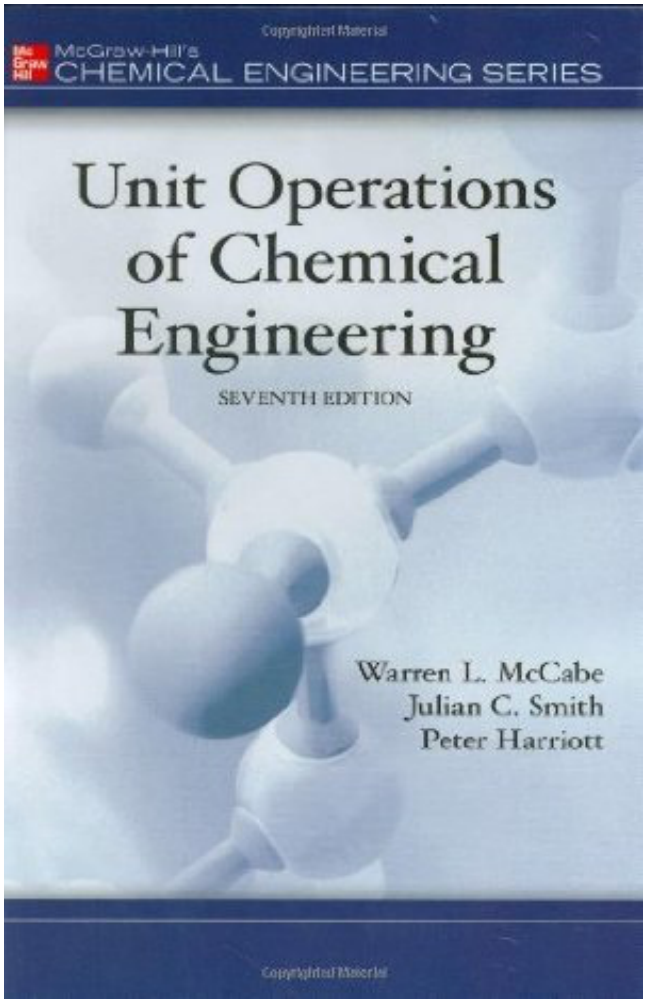
School of Chemical and Environmental Engineering
College of Chemistry, Chemical Engineering and Materials Science
Soochow University

Core Courses

- Introduction to Chemical Engineering (ICE, 1st year)
- Advanced Mathematics (1st year)
- Principles of Chemical Engineering (2nd year, Spring Semester, 4 credits)
- Thermodynamics (3rd year)
- Chemical Reaction Engineering (3rd year)

Textbook


国外名校名著
Education
Unit Operations of Chemical Engineering
Seventh Edition
化学工程单元操作
（英文改编版）
沃伦 L. 麦克凯布 (Warren L. McCabe)
[美] 朱利安 C. 史密斯 (Julian C. Smith) 著
彼得·哈里奥特 (Peter Harriott)
伍钦 钟理 夏清 熊丹柳 改编
化学工业出版社


McGraw-Hill's
CHEMICAL ENGINEERING SERIES
Unit Operations of Chemical Engineering
SEVENTH EDITION
Warren L. McCabe
Julian C. Smith
Peter Harriott

Topics to be Covered in This Course

Transport Phenomena

+

Unit Operations

Fundamentals + Applications

Topics to be Covered in This Course

- Momentum transfer and its applications (Chapters 1 to 3)
- Heat transfer and its applications (Chapters 4 to 5)
- Mass transfer and its applications (Chapters 6 to 10)

Transport Theories + Applications

Team of Instructors

Prof. Jie Xiao

Jiangsu Professor

Jiangsu Innovation and Entrepreneurship Talent

Deputy Head, School of Chem. & Environ. Eng.

Postdoc, Washington State University, USA

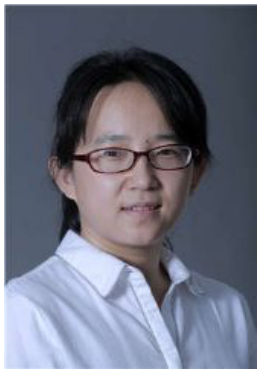
PhD, Wayne State University, USA

A/Prof. Yanwei Wang

PhD, Technical University of Denmark

A/Prof. Nan Fu

PhD, Monash University, Australia



A/Prof. Na Li

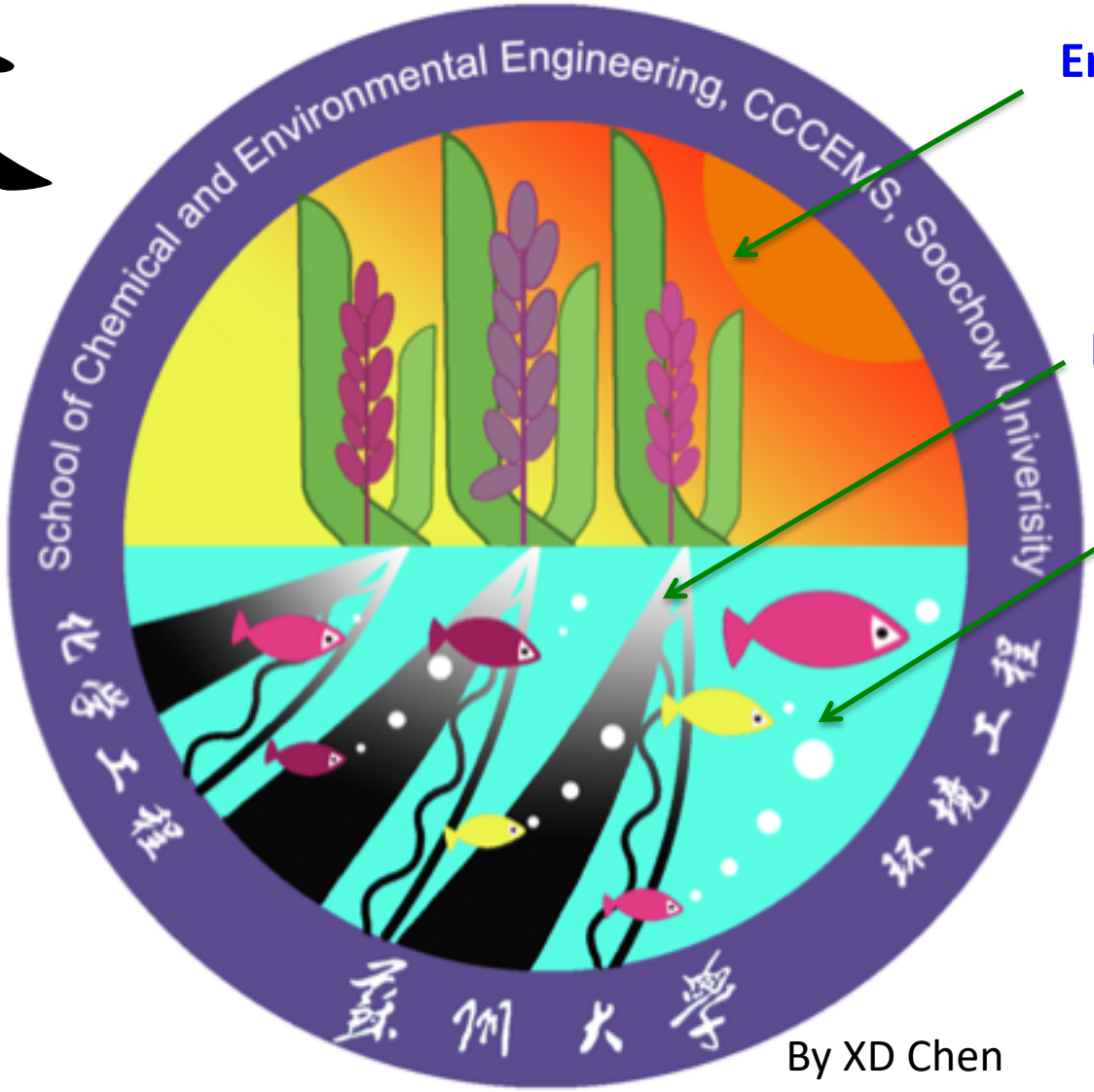
PhD, China University of Petroleum

Dr. Saartje Hernalsteens

PhD, State University of Campinas, Brazil

蘇

Soochow Chemical Engineering – Serving the society creatively



Energy Transfer

Mass Transfer

Momentum transfer

Reaction Eng. (bioreactor)

Biology-Environmental Eng.-Materials

By XD Chen

Momentum (Newton's law)

$$\tau_{yx} = -\mu \frac{dv_x}{dy}$$

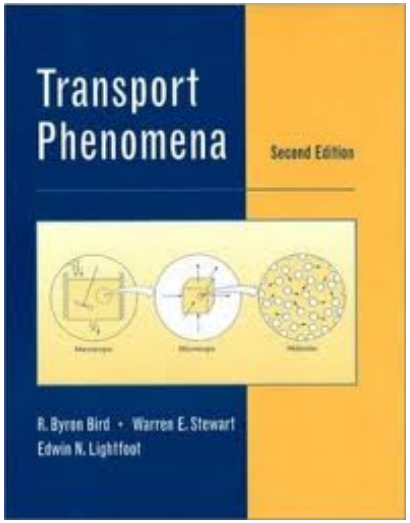
Heat (Fourier's law)

$$q_y = -k \frac{dT}{dy}$$

Mass (Fick's law)

$$j_{Ay} = -D_{AB} \frac{d\rho\omega_A}{dy}$$

1950's & 1960's: **Bird, Stewart, & Lightfoot** (BSL) of the University of Wisconsin-Madison reveal **the unifying concepts of mass, momentum, and energy transport.** Their textbook, "***Transport Phenomena***" *continues to be a* phenomenon in Chemical Engineering Education.



Topics to be Covered in This Course

Transport Phenomena

+

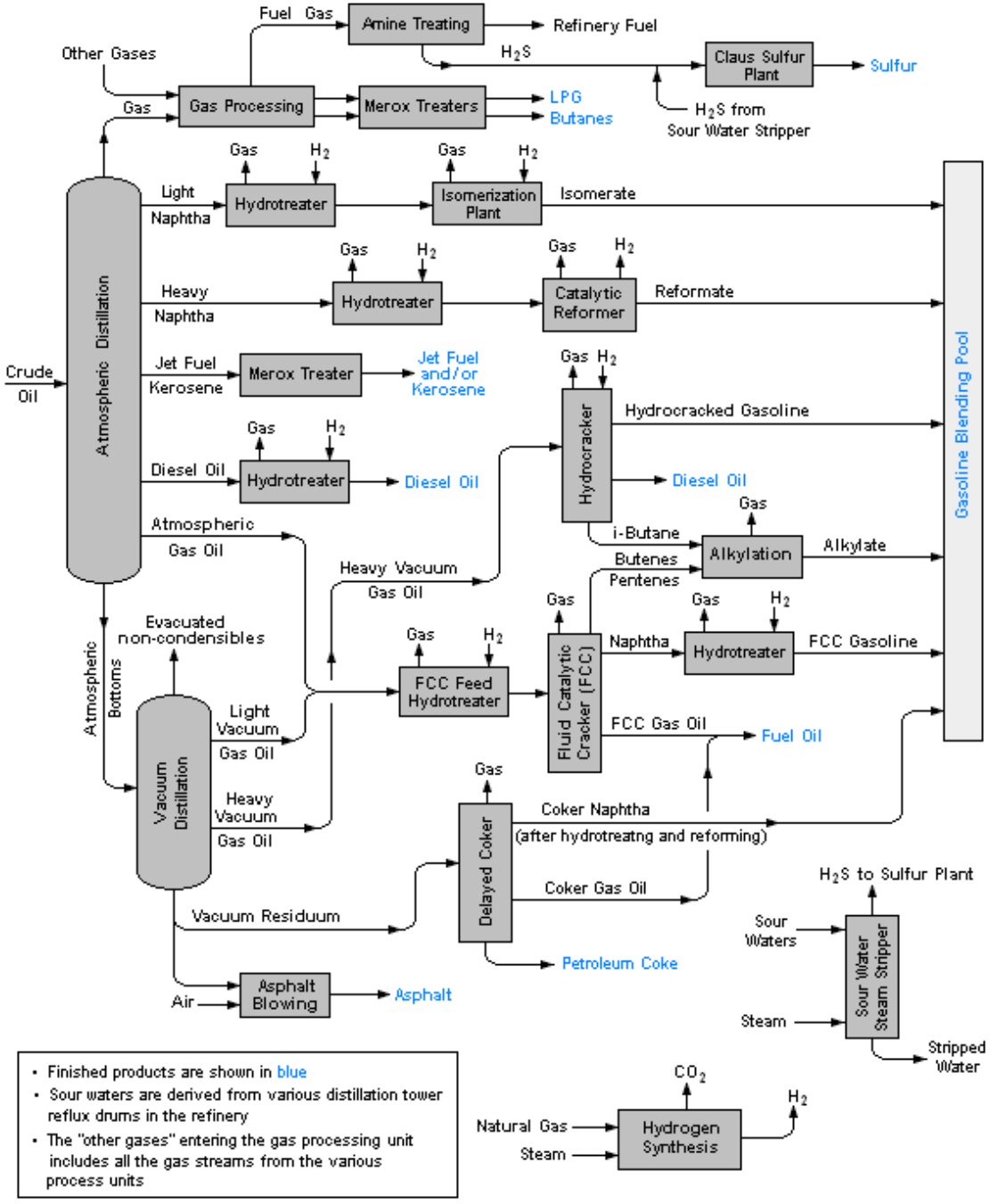
Unit Operations

Fundamentals + Applications

Brief History of ChemE

- 1880s: Chemists with an instinct for engineering and engineers with a taste for chemistry grew into chemical engineers.
- **ChemE emerged upon the development of unit operations.** In 1887 **George E. Davis** gave a series of 12 lectures on chemical engineering, which he presented at the Manchester Technical School (University of Manchester today). This chemical engineering course was organized around individual chemical operations, later to be called "unit operations."
- **1915: Arthur D. Little coined the term "unit operations".**
- 1928: Alfred Holmes White (AIChE president 1929-30) said: "**Almost all schools which teach chemical engineering now recognize these unit processes (i.e. unit operations) as providing the framework for the engineering side of chemical engineering.**"

(191[illegible] ss, on
what[illegible] a
coord[illegible]
opera[illegible] stallizing,
filter[illegible] he
numb[illegible] e and
relati[illegible] ular
proce[illegible] results
from[illegible] pressure,
etc., [illegible] ried out
in dif[illegible] s to
mate[illegible] imposed
by th[illegible] cting
subst[illegible]

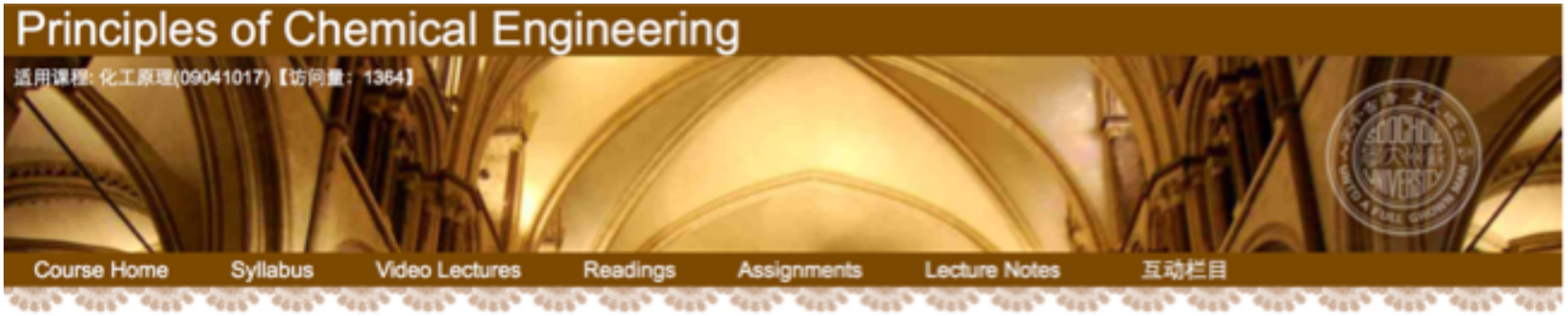


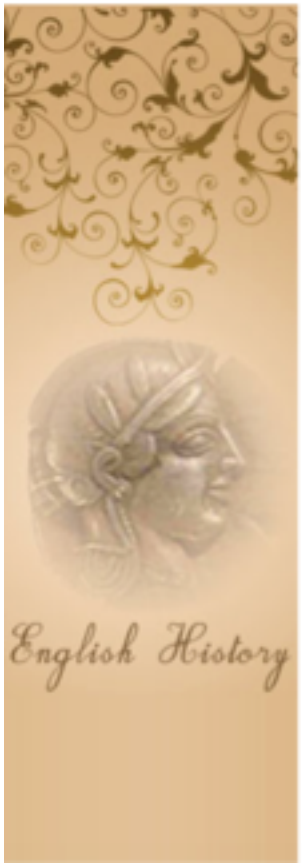
Unit Operations (II)

Chemical engineering unit operations consist of five classes:

- **Fluid flow processes**: fluids transportation, filtration, solids fluidization
- **Heat transfer processes**: evaporation, condensation
- **Mass transfer processes**: gas absorption, distillation, extraction, drying
- Thermodynamic processes: gas liquefaction, refrigeration
- Mechanical processes: solids transportation, crushing and pulverization

Course Website





Course Home

Principles of Chemical Engineering
(A Core Course for students in the Intensive-Training Chemistry and Engineering Classes in College of Chemistry, Chemical Engineering & Materials Science)

Principles of Chemical Engineering (化工原理) is one of the four core courses for Chemical Engineers. Two parts of key contents will be covered in this course: Transport Phenomena and Unit Operations.

SUDA Course Number: 09041017
Credits: 4
Level: undergraduate
Open to: 3rd Year students in the Intensive Training Classes (both Chemistry and Engineering) (工程强化班和化学强化班学生)
Instructors:
Current Semester: Dr. Jie Xiao (肖杰), Dr. Na Li (李娜) for the academic year of 2015-2016
Dr. Jie Xiao (肖杰), Dr. Nan Fu (傅楠) for the academic year of years of 2013-2014 and 2014-2015
Dr. Jie Xiao (肖杰), Dr. Yanwei Wang (王衍伟) for the academic year of 2012-2013
Dr. Jie Xiao's homepage: http://www.scec-suda.com/index.aspx?lanmuid=75&sublanmuid=640&id=27
Dr. Nan Fu's homepage: http://www.scec-suda.com/index.aspx?lanmuid=75&sublanmuid=641&id=6
Dr. Na Li's homepage: http://www.scec-suda.com/index.aspx?lanmuid=75&sublanmuid=647&id=2
Dr. Yanwei Wang's homepage: http://chemistry.suda.edu.cn/index.aspx?lanmuid=69&sublanmuid=604&id=26

Lecture time: **Tuesday (10:00 AM-12:00 AM), Friday (1:00 PM-2:50 PM)**
Location: **605-5107 Dushu Lake Campus**
Textbook: McCabe, W. L.; Smith, J. C.; Harriott, P. Unit Operations of Chemical Engineering, 7th Edition McGraw-Hill, 2005.
Textbook website: http://highered.mheducation.com/sites/0072848235/information_center_view0/what_s_new.html

http://kczx.suda.edu.cn/G2S/Template/View.aspx?courseId=27872&topMenuId=283842&action=view&type=&name=&menuType=1

Chemical Engineering

FEATURED COURSES

Research in cutting-edge industries, including nanotechnology and biotechnology, and in traditional areas of inquiry depend on chemical engineers to decipher molecular information in order to develop new products and processes.

Our graduates work in a broad range of fields and create innovative solutions to important industrial and societal problems. They develop clean and sustainable energy systems, make advances in the life sciences, design and produce pharmaceuticals, and discover and create new materials.

The first chemical engineering curriculum at MIT was offered in 1888 and helped to establish chemical engineering as a discipline. Since then, members of the MIT Department of Chemical Engineering have developed the tools and guidelines to define and advance the field. The department has led the nation in awarding graduate degrees, and its nearly 6,000 living alumni have distinguished themselves as leaders in industry, government, and academia. We maintain strong ties with other departments within MIT and institutions and industries worldwide.

CHEMICAL ENGINEERING COURSES

Course #	Course Title	Level
10.002J	Introduction to Numerical Analysis for Engineering (13.002J)	Undergraduate
10.010J	Introduction to Bioengineering (BE.010J)	Undergraduate
10.291J	Introduction to Sustainable Energy (Fall 2010)	Undergraduate
10.302	Transport Processes	Undergraduate
10.32	Separation Processes	Undergraduate
10.333J	Introduction to Modeling and Simulation	Undergraduate
10.37	Chemical and Biological Reaction Engineering	Undergraduate
10.390J	Fundamentals of Advanced Energy Conversion (Spring 2004)	Undergraduate
10.420	Molecular Aspects of Chemical Engineering (Fall 2004)	Undergraduate
10.426	Electrochemical Energy Systems (Spring 2011)	Undergraduate
10.492-2	Integrated Chemical Engineering Topics I: Introduction to Biocatalysis	Undergraduate
10.520	Molecular Aspects of Chemical Engineering (Fall 2004)	Undergraduate
10.542	Biochemical Engineering (Spring 2005)	Undergraduate
10.545	Separation Processes for Biochemical Products (Summer 2005)	Undergraduate
10.702	Experimental Biology & Communication	Undergraduate
10.702CI	Experimental Biology - Communications Intensive	Undergraduate
10.806	Management in Engineering	Undergraduate
10.34	Numerical Methods Applied to Chemical Engineering (Fall 2006)	Graduate
10.34	Numerical Methods Applied to Chemical Engineering (Fall 2005)	Graduate
10.391J	Introduction to Sustainable Energy (Fall 2010)	Graduate
10.392J	Fundamentals of Advanced Energy Conversion (Spring 2004)	Graduate
10.40	Chemical Engineering Thermodynamics	Graduate
10.44J	Statistical Thermodynamics of Complex Liquids	Graduate
10.52	Mechanics of Fluids	Graduate
10.536J	Thermal Hydraulics in Power Technology	Graduate
10.537	Molecular, Cellular and Tissue Biomechanics (BE.410J)	Graduate
10.538J	Biomolecular Kinetics and Cellular Dynamics (BE.420J)	Graduate
10.539J	Fields, Forces, and Flows in Biological Systems (BE.430J)	Graduate
10.543J	Protein Folding Problem	Graduate
10.547J	Principles and Practice of Drug Development	Graduate
10.548J	Tumor Pathophysiology and Transport Phenomena	Graduate
10.569	Synthesis of Polymers	Graduate
10.571J	Atmospheric Physics and Chemistry	Graduate
10.626	Electrochemical Energy Systems (Spring 2011)	Graduate
10.652J	Kinetics of Chemical Reactions	Graduate
10.675J	Computational Quantum Mechanics of Molecular and Extended Systems	Graduate
10.74J	Radiative Transfer	Graduate
10.792J	Proseminar in Manufacturing	Graduate
10.805J	Technology, Law, and the Working Environment	Graduate
10.816	Engineering Risk-Benefit Analysis	Graduate
10.817J	Atmospheric Chemistry	Graduate

http://ocw.mit.edu/courses/chemical-engineering/

Evaluation & Exam

- Evaluation
  - Homework 10%
  - Quiz 1 10%
  - Midterm 20%
  - Quiz 2 (team project) 20%
  - Final 40%

AIChE® American Institute of Chemical Engineers

Search

Topics | Events & Resources | People & Community

Log in | About | Join | Contact

About

Mission & Vision | Constitution | Governance | Financial | Code of Ethics | Privacy | Advertise with AIChE | Press | AIChE Move

About

AIChE is the world's leading organization for chemical engineering professionals, with over 45,000 members from over 90 countries. AIChE has the breadth of resources and expertise you need whether you are in core process industries or emerging areas, such as nanobiotechnology.

As a member, you can access information on recognized and promising chemical engineering processes and methods. Connect with a global network of intelligent, resourceful colleagues and their shared wisdom. Find learning opportunities from recognized authorities. Move forward professionally with AIChE and enrich the world we live in.

Select Language

AIChE

The American Institute of Chemical Engineers

Hereby certifies that as of January 2012

Soochow University

Officially achieved Student Chapter status in

The American Institute of Chemical Engineers

President, American Institute of Chemical Engineers

Chair, International Student Chapters Committee

American Institute Of Chemical Engineers

AIChE

Since 1908

Joining AIChE as an International Student Member

AIChE's International Student Membership is available to any chemical engineering student whose primary residence is outside of the United States and Canada. Membership provides a variety of benefits and costs just 7 USD per year (prorated during the first year). The membership period for AIChE International Student Membership is January 1st through December 31st each year.

As an AIChE international student member, you will receive:

- **Webinars** – lectures on the most interesting and important topics in engineering, from the *Nuclear Meltdown at Fukushima Daiichi* to the *Chemistry of Beer Brewing*. Students can view all of the archived webinars for free.
- **eLibrary** – unlimited access to selected Knovel resources including the full text of 200 critical engineering books, and also McGraw-Hill's AccessEngineering with Perry's and more titles, both offering interactive data, graphs and table to support your research and education.
- **Design Competition** – AIChE releases a problem each year that students are encouraged to spend an entire semester solving.
- **Career Resources Network** – get help on resumes, interviewing, and networking for full-time jobs and internships around the world. No matter where you are applying, check out CRN first!

To join AIChE and pay your membership fee with a check, you can use the PDF application form at http://www.aiche.org/uploadedFiles/Students/Join/6449_International_Student_App.writable%20Aug%202011.pdf and mail