课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	**化工原理 Principles of Chemical Engineering**
2.	**授课院系 Originating Department**	化学系 Department of Chemistry
3.	**课程编号 Course Code**	CH403
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业核心课 Major Core Courses
6.	**授课学期 Semester**	春季 Spring / 秋季 Fall
7.	**授课语言 Teaching Language**	中英双语 English & Chinese
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师）Instructor(s), Affiliation& Contact（For team teaching, please list all instructors）**	陈忠仁，讲座教授，化学系 科研教学中心 1002 室 chenzr@sustech.edu.cn 0755-8801-8334 Zhong-Ren Chen, Chair Professor, Chemistry Department. Rm.1002, Research and Teaching Center. chenzr@sustech.edu.cn 0755-8801-8334
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	无 NA
10.	**选课人数限额(可不填) Maximum Enrolment（Optional）**	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
学时数 Credit Hours	40	8			48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	高等数学（下）A（MA102B）、大学物理（下）B（PHY105B）
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	
14. 其它要求修读本课程的学系 Cross-listing Dept.	

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

化工原理是由化学系开设，面向化学专业的专业必修课。开设本门课程，旨在使学生全面系统地掌握流体流动过程、传热过程、传质过程（动量传递、热量传递、质量传递）的基本原理，掌握化学反应过程的基本概念、原理和方法，了解主要单元操作的典型设备构造、操作原理、过程计算等，能够分析化学反应过程，进行反应器的设计和选型，优化反应过程。本课程的学习能够培养学生从工程、经济观点出发，综合处理化学工程问题的能力。

Principles of Chemical Engineering is a compulsory course for students majored in Chemistry, offered by the Department of Chemistry. The course aims to make students grasp the basic principles of the fluid flow, heat transfer, mass transfer process (momentum transfer, heat transfer, mass transfer), comprehensively and systematically, master the basic concepts, principles, methods of chemical reaction processes, and understand the typical equipment structures of main unit operations, operating principles, process calculation, equipment selection and so on, finally the students could analyze chemical reaction processes, design and select the reactors, optimize the reaction processes. It develops the students' ability to analyze and solve the chemical engineering problems in terms of engineering and economy.

16. 预达学习成果 Learning Outcomes

1.学生掌握流体流动、传热、吸收、蒸馏等单元操作的基本原理，了解主要单元操作的典型设备构造、操作原理、过程计算等；

2.学生能够应用动量传递、热量传递、质量传递的基本原理，进行化学反应过程的解析、反应器的分析与设计，从而实现反应过程的最优化；

3.学生掌握基本计算公式的物理意义、应用方法和适用范围，具有查阅和使用常用工程计算图表、手册、资料的能力，具有设备选型的基本知识；

4.学生具有分析和解决化工单元操作、化学反应器工程等一般问题的初步能力。

1. The students can master the basic principles of the fluid flow, heat transfer, absorption, distillation and so on, and have a basic understanding of the typical equipments, operating principles, process calculation equipment selection, etc.

2. The students can analyse chemical reaction processes, design the reactors, finally optimize the reaction processes, in terms of the basic principles of momentum transfer, heat transfer and mass transfer.

3. The students can grasp the physical meaning of the basic calculation formulas, application methods and scope, be capable of looking up and using practical engineering information from nomographs and manuals, and selecting equipment types.

4. The students have the basic ability to analyse and solve the general problems of chemical unit operations.

17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

第一章 绪论（Week 1 周二，2 学时）

简要介绍化学工业的发展与现状，化学工程与相关学科联系，单元操作与化工生产过程，物料衡算与能量衡算，了解本课程目的与任务。

第二章 流体流动过程与输送机械（Week 2 周一，周二；Week 3 周二；Week 4 周一，周二。10 学时）

介绍流体的密度、比容、压力的意义及计算，流体流动类型与雷诺数，分子传递的基本定律（动量、质量、热量），总物料衡算和连续性方程，总能量衡算和柏努利方程，管路计算，流体压力与流量的计算，流体流动阻力，流体输送设备。

第三章 传热过程 （Week 5 周二； Week 6 周一，周二；Week7 周二。8 学时）

工业生产中常见的换热方法，热传导及傅里叶定律，间壁式换热，对流传热机理及对流传热系数的影响因素，间壁式换热的计算，换热器。

第四章 气体吸收 （Week 8 周一，周二；Week 9 周二；Week10 周一。8 学时）

传质过程类型及共性，吸收的气、液相平衡，气体在溶液中的溶解度，亨利定律，吸收速率，填料吸收塔的计算，填料塔简介，其他气体分离技术简介。

第五章 蒸馏（Week10 周二；Week 11 周二；Week12 周一，周二。8 学时）

蒸馏简介，双组份溶液的气、液相平衡，简单蒸馏和平衡蒸馏，精馏原理，双组份连续精馏计算，间歇精馏，特殊精馏，板式塔。

第六章 工业化学反应器设计基础（Week13 周二；2 学时）

化学反应和工业反应器，工业反应器的操作方式（间歇、连续、半连续），反应工程学中的重要概念，反应设计的基础方程。

第七章 均相反应过程与理想反应器（Week14 周一，周二。4 学时）

釜式反应器，间歇搅拌釜式反应器，理想连续釜式反应器，活塞流管式反应器，理想均相反应器的优化。

第八章 停留时间分布与非理想反应器的计算（Week15 周二。2 学时）

停留时间分布函数，非理想流动模型（离析流模型、多釜串联模型、轴向扩散模型），非理想反应器的计算。

第九章 多相催化反应（Week16 周一。2 学时）

工业催化简介，气、固相催化反应动力学（内扩散与外扩散），非等温过程，气、固相反应器。

第十章 化工过程开发（Week16 周二。2 学时）

化工过程开发步骤及内容，化工过程开发的放大方法，化学反应器的放大，化学工业的发展趋势，新兴化学工业及其发展前景。

Chapter 1 Introduction (Week 1 Tue. 2 Credit Hours)

Introduction to the development and current situation of chemical industry; Chemical engineering and related disciplines; Unit operations and chemical production process; Mass Balance and energy balance; Purpose and task of the course.

Chapter 2 Fluid Flowing and fluid transport equipment(Week 2 Mon, Tue; Week 3 Tue; Week 4 Mon, Tue. 10 Credit Hours)

Introduction to the viscosity of fluids, specific volume of fluids, pressure of fluids; Types of fluid flow and Reynolds number; General molecular transport equation for Momentum, Heat, and Mass Transfer; Overall mass Balance and Continuity Equation; Overall energy balance and Bernoulli Equation ; Pipeline calculation; Calculation of fluid pressure and flow rate; Flowing drag force; Fluid transport equipment.

Chapter 3 Heat Transfer and Heat Exchanger(Week 5 Tue; Week 6 Mon, Tue; Week7 Tue. 8 Credit Hours)

Common methods of heat transfer in industrial production; Heat conduction and Fourier's Law; Wall-type heat exchange; Principles of heat flow in Fluids and the influence factors of convection heat transfer coefficient; Calculation of wall-type heat exchange; Heat exchanger.

Chapter 4 Gas absorption (Week 8 Mon, Tue; Week 9 Tue；Week10 Mon. 8 Credit Hours)

Types of mass transfer processes; Absorption of gas and liquid phase equilibrium; Gas solubility in the solution; Henry's law, rate of absorption; Calculation of packed absorbing tower; Introduction of packed tower; Introduction to the other gas separation technology.

Chapter 5 Distillation (Week10 Tue; Week11 Tue; Week12 Mon Tue. 8 Credit Hours)

Introduction of distillation, Two-component system of gas-liquid phase balance; Simple distillation and equilibrium distillation Principles of rectification and Calculation of two-component continuous distillation; Batch rectification; Special rectification; Plate tower.

Chapter 6 Industrial chemical reactor design basis. (Week13 Tue. 2 Credit Hours)

Chemical reactions and industrial reactor; Operating mode of industrial reactor (batch operation, continuous operation, semi-continuous Operation); Important concepts of reaction engineering; Basic equations in reaction design.

Chapter 7 Homogeneous reaction process and ideal reactor (Week14 Mon, Tue. 4 Credit Hours)

Tank Reactor; Batch stirred reactor; Ideal continuous stirred tank reactor; Piston flow tube reactor; Optimizing the ideal homogeneous reactor.

Chapter 8 Residence time distribution and calculation of non-ideal reactor (Week15 Tue. 2 Credit Hours)

Residence time distribution function; Non-ideal flow model (discrete model, tanks-in-series model, axial diffusion model); Calculation of non-ideal reactor.

Chapter 9 Heterogeneous catalytic reaction (Week16 Mon. 2 Credit Hours)

Introduction of industrial catalysis; Kinetics of gas-solid catalytic reaction; Non-isothermal process; Gas-solid catalytic reactor.

Chapter 10 Chemical engineering process development (Week16 Tue. 2 Credit Hours)

Steps and content of chemical engineering process development; Scale-up method of chemical engineering process development; Scale-up of chemical reactor; Development trend of chemical industry; Emerging chemical industry and its development prospect.

18. 教材及其它参考资料 Textbook and Supplementary Readings

教材：

彭盘英、娄向东编著.《化工基础》. 第一版.科学出版社.2011.

参考教材：

Christie J. Geankoplis, 'Transport Processes and Unit Operations', third edition.

陈敏恒、丛德滋、方图南、齐鸣斋编著.《化工原理》. 第三版.化学工业出版.2006.

陈涛、张国亮编著.《化工传递过程基础》.第三版.2009.

陈甘棠编著《化学反应工程》.第三版.2007.

课程评估 ASSESSMENT

19.

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		5		
课堂表现 Class Performance		5		
小测验 Quiz				
课程项目 Projects		10		
平时作业 Assignments		20		
期中考试 Mid-Term Test		20		
期末考试 Final Exam		40		
期末报告 Final Presentation				
其它（可根据需要改写以上评估方式） Others (The above may be modified as necessary)				

20. 记分方式 GRADING SYSTEM

☑ A. 十三级等级制 Letter Grading
☐ B. 二级记分制（通过/不通过） Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority

化学系教学指导委员会

Teaching committee of the chemistry department