南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

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	**物理化学 I Physical Chemistry I**
2.	授课院系 Originating Department	化学系 Department of Chemistry
3.	课程编号 Course Code	CH301
4.	课程学分 Credit Value	4
5.	课程类别 Course Type	专业基础课 Major Foundational Courses
6.	授课学期 Semester	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）	黄立民教授，化学系 办公室：第一科研楼 406 室 Email: huang.lm@sustech.edu.cn Dr. Limin Huang, Professor, Department of Chemistry Office: No 1 Faculty Research Bldg.Room-406. Email: huanglm@sustech.edu.cn
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced
10.	选课人数限额(可不填) Maximum Enrolment （Optional）	100

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	64				64

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 B（下）（PHY105B）、化学原理 A（CH101A）
13.	后续课程、其它学习规划 **Courses for which this course is a pre-requisite**	本课程为化学, 化工，材料系和环境系的专业基础课，生物和生物医学工程系的学生也建议选修。 This fundamental course should be taken by students with contemplating in Chemistry, Chemical Engineering, Materials Science and Engineering, Environmental Engineering and etc. It is also highly recommended to students in Biology and Biomedical Engineering.
14.	其它要求修读本课程的学系 **Cross-listing Dept.**	无 None

教学大纲及教学日历 SYLLABUS

15. **教学目标 Course Objectives**

物理化学 I 以热力学为主线，讨论化学热力学，简单的混合物和溶液，相图，化学和电化学平衡，界面与胶体化学。通过统计力学将微观和宏观性质联系起来，初步掌握统计热力学。通过本课程的学习，要求学生系统地掌握物理化学的基本原理和方法，加深对其它化学课程内容的理解，并具备应用物理化学的基本原理分析关于平衡态化学，电化学体系和界面。

Based on thermodynamics, Physical Chemistry I deals with chemical thermodynamics, simple mixtures and solutions, phase equilibrium, chemical equilibrium, equilibrium electrochemistry, interfaces and colloidal chemistry, and statistical thermodynamics. This course is intended to provide students with an understanding of basic principles, laws and theories of physical chemistry that are necessary for other chemistry courses, and with the ability to solve problems that are associated with solutions, phase diagrams, chemical equilibrium, electrochemical systems and interfaces.

16. **预达学习成果 Learning Outcomes**

通过该课程的学习，学生可以系统地掌握物理化学（平衡态）的基本原理和方法，并能利用这些知识解决与溶液，相图，化学平衡，电化学平衡和界面相关的问题。具备利用统计热力学将简单体系的微观性质和宏观性质联系起来的能力。

The course will help students develop the ability to handle basic problems involving solutions, phase diagrams, chemical and electrochemical systems equilibrium, and interfaces, and understand the macroscopic property of a system based on its microscopic property via statistic mechanics.

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.)

1 The properties of gases (3 hours)

The perfect gas

1.1 The states of gases

1.2 The gas laws

Real gases

1.3 Molecular interactions

1.4 The van der Waals equation

1.5 The principle of corresponding states

2 The First Law (10 hours)

The basic concepts

2.1 Work, heat, and energy

2.2 The internal energy

2.3 Expansion work

2.4 Heat transactions

2.5 Enthalpy

2.6 Adiabatic changes

Thermochemistry

2.7 Standard enthalpy changes

2.8 Standard enthalpies of formation

2.9 The temperature-dependence of reaction enthalpies

State functions and exact differentials

2.10 Exact and inexact differentials

2.11 Changes in internal energy

2.12 The Joule–Thomson effect

3 **The Second Law (10 hours)**

The direction of spontaneous change

3.1 The dispersal of energy

3.2 Entropy

3.3 Entropy changes accompanying specific processes

3.4 The Third Law of thermodynamics

Concentrating on the system

3.5 The Helmholtz and Gibbs energies

3.6 Standard reaction Gibbs energies

Combining the First and Second Laws

3.7 The fundamental equation

3.8 Properties of the internal energy

3.9 Properties of the Gibbs energy

4 Simple mixtures (8 hours)

The thermodynamic description of mixtures

4.1 Partial molar quantities

4.2 The thermodynamics of mixing

4.3 The chemical potentials of liquids

The properties of solutions

4.4 Liquid mixtures

4.5 Colligative properties

Activities

4.6 The solvent activity

4.7 The solute activity

4.8 The activities of regular solutions

4.9 The activities of ions in solution

5 Phase diagrams (8 hours)

Phases, components, and degrees of freedom

5.1 Definitions

5.2 The phase rule: Gibbs phase rule

Physical transformations of pure substances

5.3 Three typical phase diagrams

Supercritical fluids

5.4 The thermodynamic criterion of equilibrium

5.5 The dependence of stability on the conditions

5.6 The location of phase boundaries

5.7 The Ehrenfest classification of phase transitions

Two-component systems

5.8 Vapour pressure diagrams

5.9 Temperature–composition diagrams

5.10 Liquid–liquid phase diagrams

5.11 Liquid–solid phase diagrams

Impact on materials science: Ultrapurity

Complex phase diagram

6 Chemical equilibrium (4 hours)

Spontaneous chemical reactions

6.1 The Gibbs energy minimum

6.2 The description of equilibrium

The response of equilibria to the conditions

6.3 How equilibria respond to pressure

6.4 The response of equilibria to temperature

7 Electrochemistry (10 hours)

Electrolyte

7.1 The conductivities of electrolyte solutions

7.2 The mobilities of ions

7.3 Conductivities and ion–ion interactions

Equilibrium electrochemistry

7.4 Half-reactions and electrodes

7.5 Varieties of cells

7.6 The electromotive force

7.7 Standard potentials

7.8 Applications of standard potentials

Electrolysis

7.9 Electrode Polarization: Overpotential

7.10 Electrode Reactions in electrolysis

8 Interface Chemistry and Colloid Chemistry (4 hours)

Interface Chemistry

8.1 Definition: Surface energy and Surface tension

8.2 Additional pressure under curved surface :Young-Laplace equation

8.3 Applications of Young-Laplace Equation

8.4 Solid-liquid interface: Wetting

8.5 Solution Surface: The Gibbs adsorption equation

8.6 Solid surface: Langmuir equation and BET equation

Colloid Chemistry

8.7 Characteristics of Colloid

8.8 Structure of colloid: double layer and zeta potential

9 Introduction to Statistical Thermodynamics (7 hours)

9.1. Classification of Statistic Systems

9.2 Motion forms and energy level formula of molecules

9.3 Distribution of energy and the number of microstates: The Boltzmann Distribution

9.4 The molecular partition function

9.5 Expression of thermodynamic state functions in terms of the partition function

Effect of choice of zero point energy

9.6 The application of statistical thermodynamics to perfect gases

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

Required:

P.W. Atkins, “Physical Chemistry”, Seventh Edition (or latest), Oxford University Press, 2003.

Recommended:

1. 傅献彩、沈文霞、姚天扬等. 物理化学（上、下册）(第五版). 北京高等教育出版社, 2006;

2. 范康年等， 物理化学（第二版）ISBN：7-04-016767-0，高等教育出版社

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				
课堂表现 Class Performance				
小测验 Quiz		10		
课程项目 Projects				
平时作业 Assignments		15		
期中考试 Mid-Term Test		30		
期末考试 Final Exam		45		
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