Tamkang University Academic Year 114, 1st Semester Course Syllabus

Course Title	PHYSICAL CHEMISTRY	Instructor	CHIANG, CHAO-LUNG
Course Class	TEDXB2A DEPARTMENT OF CHEMICAL AND MATERIALS ENGINEERING, 2A	Details	◆ General Course ◆ Required ◆ 1st Semester ◆ 3 Credits
Relevance to SDGs	SDG4 Quality education SDG9 Industry, Innovation, and Infrastructure SDG11 Sustainable cities and communities		

Departmental Aim of Education

Education Objectives: Cultivation of chemical/materials engineering experts possessing professional knowledge, skills, and literacy.

Subject Departmental core competences

A. Qualified basic and core knowledge of chemical/materials engineering.(ratio:50.00)

B. Qualified capabilities to conduct chemical/materials engineering experiments and analyze experiment results.(ratio:5.00)

C. Qualified capabilities to use the techniques and tools for solving chemical/materials engineering problems.(ratio:20.00)

D. Qualified capability to analyze and design the components, processes, and systems of chemical/materials engineering.(ratio:5.00)

E. Qualified capability to manage and integrate cross-field projects and to communicate and cooperate with team members.(ratio:5.00)

F. Qualified capability to explore, analyze, and handle engineering problems while considering sustainable development.(ratio:5.00)

G. Comprehend contemporary issues and understand the interplay between chemical/materials engineering technologies, environmental sustainability, and societal cultural well-being, and develop the capability and habits of lifelong learning.(ratio:5.00)

H. Understand professional information ethics and social responsibility for chemical/materials engineers.(ratio:5.00)

Subject Schoolwide essential virtues

1. A global perspective. (ratio:5.00)

2. Information literacy. (ratio:20.00)

3. A vision for the future. (ratio:15.00)

4. Moral integrity. (ratio:15.00)

5. Independent thinking. (ratio:30.00)

6. A cheerful attitude and healthy lifestyle. (ratio:5.00)

7. A spirit of teamwork and dedication. (ratio:5.00)

8. A sense of aesthetic appreciation. (ratio:5.00)

Course Introduction	Physical Chemistry introduces fundamental principles governing physical and chemical behaviors of matter through integration of physics, chemistry, and mathematics. The course focuses on thermodynamic principles, covering properties of gases, laws of thermodynamics, entropy, and phase equilibria. Through theoretical discussions and problem-solving practices, students will develop both conceptual understanding and quantitative skills essential for chemical engineering applications.

The correspondences between the course's instructional objectives and the cognitive, affective, and psychomotor objectives.

Differentiate the various objective methods among the cognitive, affective and psychomotor domains of the course's instructional objectives.

I. Cognitive : Emphasis upon the study of various kinds of knowledge in the cognition of the course's veracity, conception, procedures, outcomes, etc.

II.Affective : Emphasis upon the study of various kinds of knowledge in the course's appeal, morals, attitude, conviction, values, etc.

III.Psychomotor: Emphasis upon the study of the course's physical activity and technical manipulation.

No.	Teaching Objectives	objective methods
1	Master the Fundamentals of Gas Behavior and Thermodynamic Laws: Understanding ideal and real gas behaviors, including state equations and the corresponding states principle. Students will comprehend the First Law of Thermodynamics, focusing on energy conservation, work, heat, internal energy, and enthalpy concepts. This foundation enables students to analyze various thermodynamic processes and calculate system properties under different conditions.	Cognitive

2	Apply Thermodynamic Principles to Analyze Spontaneous Processes: Mastering the Second Law of Thermodynamics and its applications in determining process spontaneity. Students will understand entropy concepts, Carnot cycle, and the relationship between entropy and irreversibility. This knowledge extends to the understanding of Gibbs and Helmholtz free energies, enabling quantitative analysis of chemical process feasibility and equilibrium conditions.	Cognitive
3	Analyze phase equilibria using thermodynamic principles, including phase rule, phase diagrams, vapor pressure calculations, phase transitions, and the Clausius-Clapeyron equation, with applications in chemical process design and optimization.	Cognitive

The correspondences of teaching objectives : core competences, essential virtues, teaching methods, and assessment

No.	Core Competences	Essential Virtues	Teaching Methods	Assessment
1	ABCDEFGH	12358	Lecture, Discussion, Publication, Practicum, Experience	Testing, Study Assignments, Discussion(including classroom and online), Practicum
2	ABCDEFG	12345	Lecture, Discussion, Publication, Practicum, Experience	Testing, Study Assignments, Discussion(including classroom and online), Practicum
3	ABCDEFH	123567	Lecture, Discussion, Publication, Practicum, Experience	Testing, Study Assignments, Discussion(including classroom and online), Practicum

Course Schedule

Week	Date	Course Contents	Note
1	114/09/15 ~ 114/09/21	Introduction of Physical Chemistry & Gases and the Zeroth Law of Thermodynamics (I)	
2	114/09/22 ~ 114/09/28	Gases and the Zeroth Law of Thermodynamics (II)	
3	114/09/29 ~ 114/10/05	The First Law of Thermodynamics (I)	
4	114/10/06 ~ 114/10/12	The First Law of Thermodynamics (II)	
5	114/10/13 ~ 114/10/19	The Second and Third Laws of Thermodynamics (I)	
6	114/10/20 ~ 114/10/26	The Second and Third Laws of Thermodynamics (II)	
7	114/10/27 ~ 114/11/02	Gibbs Energy and Chemical Potential (I)	

8	114/11/03 ~ 114/11/09	Gibbs Energy and Chemical Potential (II)	
9	114/11/10 ~ 114/11/16	Midterm Exam/Evaluation Week for Teachers	
10	114/11/17 ~ 114/11/23	Introduction to Chemical Equilibrium (I)	
11	114/11/24 ~ 114/11/30	Introduction to Chemical Equilibrium (II)	
12	114/12/01 ~ 114/12/07	Equilibrium in Single-Component Systems (I)	
13	114/12/08 ~ 114/12/14	Equilibrium in Single-Component Systems (II)	
14	114/12/15 ~ 114/12/21	Equilibrium in Multiple-Component Systems (I)	
15	114/12/22 ~ 114/12/28	Equilibrium in Multiple-Component Systems (II)	
16	114/12/29 ~ 115/01/04	Final Week of Diverse Assessments	
17	115/01/05 ~ 115/01/11	Final Week of Diverse Assessments/Flexible Teaching Week for Teachers	
18	115/01/12 ~ 115/01/18	Flexible Teaching Week for Teachers	

Key capabilities	self-directed learning International mobility Information Technology Problem solving Interdisciplinary
Interdisciplinary	STEAM course (S:Science, T:Technology, E:Engineering, M:Math, A field:Integration of Art and Humanist)
Distinctive teaching	Special/Problem-Based(PBL) Courses
Course Content	Logical Thinking Green Energy Sustainability issue

Requirement	This course encourages students to use AI for collaboration and mutual learning to enhance course outcomes based on the principles of transparency and responsibility. This course adopts the following policy: Conditionally open, please specify how generative AI is used in assignments or reports. Students should briefly explain how they use generative AI in the course assignments or reports in the "footnote on the title page" or "after the references," such as for brainstorming, text polishing, or structural references. For "personal reflection reports" and "group interview assignments," the use of generative AI tools for writing is prohibited. If it is found that generative AI was used but not indicated in the assignment or report, the instructor, the university, or related units have the right to reevaluate the assignment of report or with hold scores. Students enrolled in this course agree to the above ethics statement.
Textbooks and Teaching Materials	Self-made teaching materials:Presentations, Handouts Using teaching materials from other writers:Textbooks, Presentations, Videos Name of teaching materials: David W. Ball, Essentials of Physical Chemistry, Cengage Learning (2014)
References	Peter Atkins et al., Atkin's Physical Chemistry 12e, Oxford University Press (2023) LibreTexts Chemistry: Physical & Theoretical Chemistry: https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps
Grading Policy	◆ Attendance： 10.0 % ◆ Mark of Usual：10.0 % ◆ Midterm Exam： 30.0 % ◆ Final Exam： 30.0 % ◆ Other〈Quizzes & Videos〉：20.0 %
Note	This syllabus may be uploaded at the website of Course Syllabus Management System at https://web2.ais.tku.edu.tw/csp or through the link of Course Syllabus Upload posted on the home page of TKU Office of Academic Affairs at http://www.acad.tku.edu.tw/CS/main.php. ※"Adhere to the concept of intellectual property rights" and "Do not illegally photocopy, download, or distribute." Using original textbooks is advised. It is a crime to improperly photocopy others' publications.