香港城市大學
City University of Hong Kong

SYL

Course Syllabus

offered by Department of Chemistry
with effect from Semester B 2017/18

This form is for the completion by the *Course Leader*. The information provided on this form is the official record of the course. It will be used for the City University's database, various City University publications (including websites) and documentation for students and others as required.

Please refer to the Explanatory Notes on the various items of information required.

Prepared / Last Updated by:

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Part I Course Overview

Course Title:	Physical Chemistry
Course Code:	BCH3016 (and BCH3016A)
Course Duration:	1 semester
Credit Units:	4 (3) credits
Level:	B3
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	BCH2008 Principles of Physical Chemistry
Equivalent Courses: *(Course Code and Title)*	BCH2251 Physical Chemistry (from the "old" curriculum)
Exclusive Courses: *(Course Code and Title)*	Nil

Note: BCH3016A does not contain any practical component, and has a credit unit value of three (3).

Part II Course Details

1. Abstract

(A 150-word description about the course)

This course aims to:

- examine the nonelectrolytic solutions in terms of partial molar quantities;
- examine the electrolytic solutions in terms of conductances and ionic activities;
- describe the basic principles of electrochemistry and the application to chemical systems;
- describe the principles of kinetics, surface chemistry and macromolecules;
- extend the treatment of thermodynamics to chemical equilibria and phase equilibria;
- perform a deeper treatment of environmental chemistry in the areas of atmospheric chemistry and the interactions between liquids, solids and gases in aquatic chemistry.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Explain the thermodynamics of mixing, the real solution, and the principles of distillation and azeotropes.	11%		✓	
2.	Compare and contrast the systems between nonelectrolyte and electrolyte, the origin of conductance in solution and the different behaviours of colligative properties of these two solution systems.	22.5%			✓
3.	Critically evaluate simple and complex cases in chemical equilibrium and chemical kinetics, including effects of pressure, temperature, catalysts and enzymes.	22.5%		✓	✓
4.	Design an electrolytic cell of a selected category and evaluate its application based on their operation principles.	11%		✓	✓
5.	Critically evaluate surface phenomena in terms of Gibbs energy, principles of catalysis, and characteristics of micelles and colloids.	11%		✓	✓
6.	Explain the properties of macromolecules and solid polymers.	11%	✓	✓	
7.	Explain thermodynamics and phase equilibria with Gibbs free energy, and Clapeyron and Clausius-Clapeyron equations.	11%		✓	
		100%			

** If weighting is assigned to CILOs, they should add up to 100%.*

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.							Hours/week (if applicable)
		1	2	3	4	5	6	7	
Group activities	Teaching and learning will be primarily based around group activities examining the thermodynamics in different types of mixing, observation of the real solution and the processes involved in distillation.	✓							
Group activities and practical sessions	Teaching and learning will be based on group activities laying the basis for observing the difference between the nonelectrolyte and electrolyte systems, along with complementary practical sessions where students will be able to differentiate these systems themselves under guidance.		✓						
Group activities and practical sessions	Teaching and learning will be based on group activities laying the basis for evaluating the cases in chemical equilibrium and chemical kinetics, along with complementary practical sessions where students will be able to present the examples and techniques under guidance.			✓					
Laboratory class	Laboratory class will be divided into small groups for designing of electrolytic cells of different categories. Electrolytic cells currently available in the market will be provided for reference and comparison on their applicability and efficiency.				✓				
Group activities, written assignments, and complementary video presentations	Teaching and learning will be primarily by group activities, written assignments, and complementary video presentations related to surface phenomena and characteristics of micelles and colloids.					✓			
Group activities	Teaching and learning will be primarily by group activities, and students will be involved in group-based assessments of the properties of macromolecules and solid polymers which they will present to other members of the class.						✓		
Group activities	Teaching and learning will be primarily by group activities, and students will be involved in group-based understanding of thermodynamics and phase equilibria which they will present to other members of the class.							✓	

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.							Weighting*	Remarks
	1	2	3	4	5	6	7		
Continuous Assessment: 30%									
Tutorial Assignments & Quizzes	✓	✓	✓	✓	✓	✓	✓	15%	
Practicals		✓	✓	✓				8%	
Group Presentations	✓				✓	✓	✓	7%	
Examination: 70% (duration: 3 hours)									
** The weightings should add up to 100%.*								100%	

Starting from Semester A, 2015-16, students must satisfy the following minimum passing requirement for BCH courses:

"A minimum of 40% in both coursework and examination components."

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Tutorial Assignments & Quizzes	Ability to express, explain and apply the core concepts and equations in the covered subjects of physical chemistry.	high	significant	Moderate	basic	minimal
2. Practicals	Ability to integrate the principles and the practicals and accomplish the objectives of the designed experiments.	high	significant	Moderate	basic	minimal
3. Group Presentations	Clear presentation indicative of critical and logical thinking.	high	significant	Moderate	basic	minimal
4. Examination	Ability to tackle the designer problems on physical chemistry utilizing the firm grip on the acquired core concepts and topical contents.	high	significant	Moderate	basic	minimal

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

Nonelectrolyte Solutions

Concentration units. Partial molar quantities. Thermodynamics of mixing. Binary mixtures of volatile liquids. Real solutions. Distillation: pressure-temperature and composition diagrams. Azeotropes. Colligative properties.

Electrolyte Solutions

Electrical conduction in solutions: degree of dissociation, ionic velocities, applications of conductance measurements. Ions in aqueous solution. Ionic activities. Debye-Hückel theory of electrolytes. Colligative properties of electrolyte solutions: the Donnan effect.

Chemical Equilibrium

Chemical equilibrium in ideal and real gaseous systems. Reactions in solution. Heterogeneous equilibria. Influence of pressure, temperature and catalyst on the equilibrium constant. Fugacity, activity and activity coefficients.

Electrochemistry

Thermodynamics of electrochemical cells: Nernst equation. Types of electrodes. Single-electrode potential. Temperature-dependence of emf. Types of cells: concentration and fuel cells. Application of emf measurements. Potentiometric titrations. Biological oxidation. Membrane potential. Electrolysis, overpotentials, polarography. Corrosion. Industrial application of cells.

Chemical Kinetics

Composite, stepwise and complex reaction. Effect of temperature on reaction rate. Potential energy surfaces. Theories of reaction rates. Kinetic isotopes effect. Reactions in solution. Fast reactions in solution: flow and relaxation methods. Molecular beams. Homogeneous catalysis. Enzyme kinetics.

Surface Chemistry and Colloids

Adsorption of gases on solids. physical adsorption and chemisorption. Theories of adsorption: Langmuir, BET. Determination of surface areas and porosity of solids. Heterogeneous catalysis and kinetics. Factors affecting the choice of catalysts and examples. Surface energy. Gibbs adsorption equation. Surface films, interfacial potentials, double layer theories. Electrokinetic phenomena. Emulsions, micelles, colloids.

Macromolecules

Determination of the size, shape and molar mass of macromolecules. Bond distances and angles. Macromolecuar conformations. Physical properties of solid polymers.

Thermodynamics

Gibbs free energy and phase equilibria. Clapeyron and Clausius-Clapeyron equations.

Chemical Interactions Involving Solids, Liquids and Gases in the Environment

Surface sorption. Sediment formation. Colloidal particles. Coagulation and flocculation. Cation exchange. Sorption of organic compounds and gases.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	
2.	
3.	
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2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Atkins' Physical Chemistry, Atkins & de Paula, Oxford University Press, 9th Ed., 2010. Website: www.oup.com/
2.	Student's solution manual to accompany Atkins' Physical Chemistry, P. W. Atkins, Oxford University Press, 9th Ed., 2010.
3.	Physical Chemistry, Engel & Reid, Pearson, 2nd Ed., 2010 Website: www.chemplace.com
4.	Physical Chemistry, I. N. Levine, Mc Graw Hill, 5th Ed., 2002.
5.	Physical Chemistry, J. W. Moore, Prentice Hall, 5th Ed., 1972.
6.	Physical Chemistry with Applications to Biological System, R. Chang, Macmillan Publisher, 2nd Ed., 1977.
7.	Online Resources: Website: www.oup.com/ Website: www.aw-bc.com

Annex
(for GE courses only)

A. Please specify the Gateway Education Programme Intended Learning Outcomes (PILOs) that the course is aligned to and relate them to the CILOs stated in Part II, Section 2 of this form:

GE PILO	**Please indicate which CILO(s) is/are related to this PILO, if any** ***(can be more than one CILOs in each PILO)***
PILO 1: Demonstrate the capacity for self-directed learning	
PILO 2: Explain the basic methodologies and techniques of inquiry of the arts and humanities, social sciences, business, and science and technology	
PILO 3: Demonstrate critical thinking skills	
PILO 4: Interpret information and numerical data	
PILO 5: Produce structured, well-organised and fluent text	
PILO 6: Demonstrate effective oral communication skills	
PILO 7: Demonstrate an ability to work effectively in a team	
PILO 8: Recognise important characteristics of their own culture(s) and at least one other culture, and their impact on global issues	
PILO 9: Value ethical and socially responsible actions	
PILO 10: Demonstrate the attitude and/or ability to accomplish discovery and/or innovation	

GE course leaders should cover the mandatory PILOs for the GE area (Area 1: Arts and Humanities; Area 2: Study of Societies, Social and Business Organisations; Area 3: Science and Technology) for which they have classified their course; for quality assurance purposes, they are advised to carefully consider if it is beneficial to claim any coverage of additional PILOs. General advice would be to restrict PILOs to only the essential ones. (Please refer to the curricular mapping of GE programme: http://www.cityu.edu.hk/edge/ge/faculty/curricular_mapping.htm.)

B. Please select an assessment task for collecting evidence of student achievement for quality assurance purposes. Please retain at least one sample of student achievement across a period of three years.

Selected Assessment Task