COURSE SYLLABUS

ILSE 625 Chemistry Education

Semester A (2021), 3 (3-0-6) credit hours

Course coordinator

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Office: Institute for Innovative Learning, Mahidol University

Instructors:

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Course Description

Nature of learning chemistry; misconceptions in learning chemistry; pedagogical content knowledge (PCK) for teaching chemical bonding, chemical reactions and stoichiometry, chemical thermodynamics, chemical kinetics, chemical equilibrium, electrochemistry, nanochemistry, green chemistry, biocatalyst, solar cell, spectroscopy techniques

Class Period

Thursday, 13.00-16.00, Room: Chemistry Laboratory (Online learning is also available for oversea students and in any circumstances face-to-face meeting are not possible)

Online: https://mahidol.webex.com/mahidol/j.php?MTID=m45773c782672cc87b6b5f924c55413f2

Meeting number: 2643 457 3757

Password: ILSE625

Host key: 144006

Course Learning Outcomes

At the end of this course, students will be able to:

Course Learning Outcomes (CLOs)	PLOs	Sub-PLOs
1) Display appropriate ethical behavior in using existing learning and teaching material	1	1.1
2) Understand nature of learning in chemistry	2	2.2
3) Analyze chemistry contents under TPCK framework	3, 5	3.1, 5.2
4) Design an instruction to improve students' understanding in selected topics in chemistry	3	3.2
5) Propose ways to solve students' difficulties in learning chemistry	4, 5	4.1, 5.1, 5.2 5.3
6) Evaluate in-depth conceptual understanding of oneself in chemistry	6	6.1, 6.2, 6.3
7) To display ability to collaborate with others	8	8.2

Readings

Readings will consist of articles drawn from the primary literature of chemical education and some chapters from the books, e.g., Theoretical Frameworks for Research in Chemistry/Science Education by George M. Bodner & Marykay Orgill; Chemical Education: Towards Research-based Practice by John K. Gilbert; Misconception in chemistry by Hans-Dieter Barke, Al Hazari, Sileshi Yitbarek and General Chemistry. Copies of some articles will be provided by the instructors.

Course Outline

Week	Date	Content	CLOs	Teaching approaches	Instructor
1	11 Aug 22	Nature of learning chemistry	2, 7	Lecture, Discussion, Case study	SY, PC, PL
2	18 Aug 22	The role of TPCK for chemistry teaching	3, 7	Lecture, Discussion, Case study	SY, PC, PL
3	25 Aug 22	* Chemical bonding, misconception about chemical bonding	1, 2, 3, 4, 5, 6, 7	Laboratory experiment /Demonstration, Discussion	SY, PC, PL
4	1 Sep 22	* Acids and bases, misconception about acids and bases	1, 2, 3, 4, 5, 6, 7	Laboratory experiment /Demonstration, Discussion	SY, PC, PL
5	8 Sep 22	* Chemical reactions and stoichiometry, misconception about chemical reaction and stoichiometry	1, 2, 3, 4, 5, 6, 7	Laboratory experiment /Demonstration, Discussion	SY, PC, PL
6	15 Sep 22	* Chemical thermodynamics, misconception about chemical thermodynamics	1, 2, 3, 4, 5, 6, 7	Laboratory experiment /Demonstration, Discussion	SY, PC, PL
7	22 Sep 22	*Chemical kinetics, misconception about chemical kinetics	1, 2, 3, 4, 5, 6, 7	Laboratory experiment /Demonstration, Discussion	SY, PC, PL
8	29 Sep 22	*Chemical equilibrium, misconception about chemical equilibrium	1, 2, 3, 4, 5, 6, 7	Laboratory experiment /Demonstration, Discussion	SY, PC, PL
9	6 Oct 22	* Electrochemistry, misconception about electrochemistry	1, 2, 3, 4, 5, 6, 7	Laboratory experiment /Demonstration, Discussion	SY, PC, PL

10	20 Oct 22	Solar cell	2, 3, 6, 7	Lecture, Laboratory experiment /Demonstration, Discussion	SY, PC, PL
11	27 Oct 22	Green chemistry	2, 3, 6, 7	Lecture, Laboratory experiment /Demonstration, Discussion	SY, PC, PL
12	3 Nov 22	Biocatalyst	2, 3, 6, 7	Lecture, Laboratory experiment /Demonstration, Discussion	PC, SY, PL
13	10 Nov 22	Nanochemistry, misconception about nanochemistry	2, 3, 6, 7	Lecture, Laboratory experiment /Demonstration, Discussion	SY, PC, PL
14	17 Nov 22	Spectroscopy techniques	2, 3, 6, 7	Lecture, Laboratory experiment /Demonstration, Discussion	SY, PC, PL
15	24 Nov 22	Digital Learning Technologies in Chemistry Education	2, 3, 6, 7	Lecture, Discussion, Case study	SY, PC, PL
16	1 Dec 22	Examination	2, 3	-	SY, PC, PL

* Assignment

Course Requirements

- **Class participation (10%): To evaluate CLO 7**

  Each student is expected to discuss and analyze the concepts presented during the learning activities and oral presentations.

- **Class assignments (60%): To evaluate CLO1-CLO5**

  Students were assigned to search for up-to-date learning activity/laboratory experiment related to concepts learned in class, analyze strengths and weaknesses of the activity/laboratory experiment, and apply or adapted activity/laboratory experiment and demonstrate in the class.

- **Examination (30%): To evaluate CLO2 and CLO3**

  At the end of this class, each student will be assessed the chemical contents by written exam.

Final grades will be determined as follows:

85 - 100% = A,
75 - < 84% = B^+,
65 - < 74% = B,
55 - < 64% = C^+,
< 55% = I

Important remarks:

The final score for each student will be rounded to the nearest whole number prior applying to the assessment criteria. In addition, a student's final grade may be higher than the suggested guideline if the student's score is close enough (< 1% gap) to the next higher score. That is, close scores will likely earn the same final grade.

For audit students to get a passing grade, they are required to attend at least 80% of class time (13 out of 16 sessions) with active participation as required for credit students. Also, it's mandatory for audit students to complete assignments given by the instructors

Rubric and marking scheme for class participation are provided below.

	Present (1)	**Attentive (2)**	**Engaging (3)**	**Satisfactory (4)**	**Exemplary (5)**
Active contribution	Show up but never contribute to class discussion	Seldom contribute to class discussion, unless asked	Occasionally contribute to class discussion	Regularly contribute to class discussion	Proactively and regularly contribute to class discussion
Active listening	Lack of attention to the discussed topic	Listen when others discuss and occasionally respond to the discussed topic	Listen when others discuss and sometimes respond to the discussed topic	Appropriately listen when others discuss and consistently respond to the discussed topic	Appropriately listen when others discuss and usefully respond to the discussed topic

Criteria for evaluation class assignments (10 points)

Students were assigned to search for up-to-date learning activity/laboratory experiment related to concepts learned in class, analysis strength and weakness of the activity/laboratory experiment, and apply or adapt activity/laboratory experiment and demonstrate in the class. Each assignment will be evaluated according to the following criteria.

Instruction: Please evaluate students according to these aspects.

Aspects	Students			
1) Clearly explain concept related to the selected learning activity/laboratory **(3 points)**				
2) Correctly analyze strengths and weaknesses of the selected learning activity/laboratory **(2 points)**				
3) Ability to apply or adapt activity/laboratory and demonstrate in the class **(5 points)**				
Total **(10 points)**				

Appendix

Table 1 Summary the expected learning outcomes, teaching and learning approach, and summative assessment method used in the course

Assessment methods	Sub-PLOs												%
	1.1	**2.2**	**3.1**	**3.2**	**4.1**	**5.1**	**5.2**	**5.3**	**6.1**	**6.2**	**6.3**	**8.2**	
Active participation												10	10
Class assignments	5.45	5.45	5.41	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45		60
Final examination		10	10	10									30
Total	**5.45**	**15.45**	**15.45**	**15.45**	**5.45**	**5.45**	**5.45**	**5.45**	**5.45**	**5.45**	**5.45**	**10**	**100**

Table 2 The PLOs and key performance indicators of the Master of Science Program in Science and Technology Education (International Program) in Academic Year 2020.

PLOs	Key Performance Indicators
PLO 1: Display moral and ethical behavior for science and technology educators	1.1 Display moral and ethical behavior that aligns with the code of conduct for science and technology educators
PLO 2: Apply principle in science and technology education to design and implement learning activities in science and/or technology classes appropriately	2.2 Design learning activities for science and/or technology classes
PLO 3: Synthesize solutions to learning problems in the field of study	3.1 Analyze learning problems in the field of study 3.2 Apply PLO 2 to synthesize new ways and/or means to solve the learning problems
PLO 4: Conduct science and technology education research by integrating knowledge in the field of study	4.1 Propose a research project in science and technology education predicated on educational research methodology
PLO 5: Improve innovations in science and technology education consistent to knowledge in the field of study and social contexts	5.1 Display ability to search for existing innovations in science and technology education consistent to knowledge in the field of study 5.2 Analyze strengths and weaknesses of the existing innovation 5.3 Propose ways and/or means to improve the existing innovation
PLO 6: Evaluate knowledge of oneself	6.1 Classify criteria for self-evaluation 6.2 Reflect oneself against the criteria 6.3 Evaluate oneself validly and reliably
PLO 8: Display leadership quality and ability to effectively collaborate with others	8.2 Display ability to effectively collaborate with others