



Specific course
Course Title: Analytical Chemistry Laboratory
Course Code: SCCH 268

Degree Bachelor Master Doctoral
Faculty of Science
Department of Chemistry

TQF 3 Course Specification

Section 1 General Information

1. **Course Code and Course Title** วทคม ๒๖๘ ปฏิบัติการเคมีวิเคราะห์
SCCH 268 Analytical Chemistry Laboratory
2. **Number of Credits** 1 (0 - 3 - 1) (Theory 0 hours Practice 3 hours Self-study 1 hours/week)
3. **Curriculum and Course Type**
 - 3.1 **Name of curriculum** Undergraduate level (International Program)
 - 3.2 **Type of Course** Specific course
4. **Course Coordinator and Instructor**
 - 4.1 **Course coordinator** Dr.Tinnakorn Tiensing
Department of Chemistry Faculty of Science
Phone: 02-2015110 email: tinnakorn.tie@mahidol.ac.th
 - 4.2 **Instructor** Dr.Tinnakorn Tiensing
email: tinnakorn.tie@mahidol.ac.th, tinnakorn.tie@mahidol.edu
5. **Semester / Class Level**
 - 5.1 **Semester** 1st Semester / 2nd year
 - 5.2 **Number of Students** Approximately 60 students
6. **Pre-requisite** SCCH 152 / SCCH 161 / General Chemistry Course
7. **Co-requisite** none
8. **Study Site Location** Salaya Campus Faculty of Science
9. **Date of Preparation/Latest Revision of the Course Specification** 4 July 2023



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Section 2 Goals and Objectives

1. Course Goals

After completion of this course, student should be able to describe and understand principle knowledge and theories in analytical chemistry laboratory and also perform experiment with safety culture, the experimental topics involving glassware usage in analytical chemistry, quantitative analysis, titration methods, data analysis based on accuracy and precision results. Student should be able to apply practices in quantitative methods to their upper-level course.

2. Objectives of Courses

2.1 Course Objectives

After completion of this course, student will be able to:

- 1) Understand principles and theories behind each experiment related to the analytical chemistry in the following topics; quantitative analysis, basic statistic of quantitation, titration methods, calibration methods, potentiometry, absorption spectrophotometry, buffer and buffer capacity measurement
- 2) Appropriate choose reagents, chemicals, glassware and equipment in the experiment
- 3) Plan and carry out the experiment based on chemical safety concept
- 4) Analyses quantitative results, calculate and solve problems in the topics related to analytical chemistry

2.2 Course-Level Learning Outcomes: CLOs

After completion of this course, student should be able to:

- 1) CLO1 Describe principle knowledge and theories correctly in analytical chemistry, quantitative analysis, titration methods, data analysis based on accuracy and precision results, calibration methods, potentiometry, absorption spectrophotometry, buffer and buffer capacity
- 2) CLO2 Write experimental planning of given analytical chemistry laboratory appropriately
- 3) CLO3 Select reagents, chemicals, glassware and equipment with an appropriately given experimentation
- 4) CLO4 Perform experiment with suitable analytical method based on safety concept for quantitative analysis of given samples
- 5) CLO5 Analyze experimental results with appropriated statistical test for quantitative data analysis
- 6) CLO6 Calculate and solve analytical chemistry problems related to the given experimentation



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Section 3 Course Description and Implementation

1. Course Description

ทักษะพื้นฐานทางเคมีวิเคราะห์ การใช้เครื่องแก้ว การเตรียมสารละลาย สถิติพื้นฐานในการวิเคราะห์เชิงปริมาณ วิธีการไทเทรต เครื่องมือพื้นฐานที่เกี่ยวกับหัวข้อการเทียบมาตรฐาน การวิเคราะห์เชิงสีและเทคนิคทางสเปกโตรโฟโตเมทรี วิธีการทางโพเทนทิโอเมทรีโดยการวัดพีเอช การเตรียมสารละลายบัฟเฟอร์และการหาค่าความจุบัฟเฟอร์

Basic skills in analytical chemistry; glassware's usage; solution preparations; basic statistics in the quantitative analysis; titration methods; the basic instrumental analysis based on calibration concepts; colorimetric analysis and spectrophotometry technique; the potentiometric method by pH measurements; preparations of buffer solution and the determination of the buffer capacity

2. Number of Hours per Semester

Lecture (hour)	Practical Laboratory (hour)	Self-study (hour)
0	45	15 (1 hour/week)

3. Number of Hours per Week for Individual Advice

1 hour/week depends on studying topic which can be arranged by instructor via e-mail or other communication system.



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Section 4 Development of Students' Learning Outcomes

1. A brief summary of the knowledge or skills expected to develop in students; the course-level expected learning outcomes (CLOs).

By the end of the course, students who successfully complete the course will be able to:

- 1) CLO1 Describe principle knowledge and theories correctly in analytical chemistry, quantitative analysis, titration methods, data analysis based on accuracy and precision results, calibration methods, potentiometry, absorption spectrophotometry, buffer and buffer capacity
- 2) CLO2 Write experimental planning of given analytical chemistry laboratory appropriately
- 3) CLO3 Select reagents, chemicals, glassware and equipment with an appropriately given experimentation
- 4) CLO4 Perform experiment with suitable analytical method based on safety concept for quantitative analysis of given samples
- 5) CLO5 Analyze experimental results with appropriated statistical test for quantitative data analysis
- 6) CLO6 Calculate and solve analytical chemistry problems related to the given experimentation

2. How to organize learning experiences to develop the knowledge or skills stated in number 1 and how to measure the learning outcomes

Course Code	Teaching and learning experience management					Learning outcomes measurements					
	Lecture / Lab demonstration	Practice / perform experiment	Lab report (group)	Assignment / Home work (individual)	Problem based learning / practice	Quiz	Exam on using glassware / equipment	Practical examination	Evaluate from lab report	Home work / assignment (individual)	Evaluate from lab planning (individual)
CLO1 Describe principle knowledge and theories correctly in analytical chemistry, quantitative analysis, titration methods, data analysis based on accuracy and precision results, calibration methods, potentiometry, absorption spectrophotometry, buffer and buffer capacity	✓	✓	✓			✗		✗	✗		



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Course Code	Teaching and learning experience management					Learning outcomes measurements					
	Lecture / Lab demonstration	Practice / perform experiment	Lab report (group)	Assignment / Home work (individual)	Problem based learning / practice	Quiz	Exam on using glassware / equipment	Practical examination	Evaluate from lab report	Home work / assignment (individual)	Evaluate from lab planning (individual)
CLO2 Write experimental planning of given analytical chemistry laboratory appropriately	✓	✓	✓	✓	✓	✗		✗	✗	✗	✗
CLO3 Select reagents, chemicals, glassware and equipment with an appropriately given experimentation	✓	✓	✓		✓	✗	✗	✗	✗		✗
CLO4 Perform experiment with suitable analytical method based on safety concept for quantitative analysis of given samples	✓	✓	✓		✓	✗		✗	✗		✗
CLO5 Analyze experimental results with appropriated statistical test for quantitative data analysis	✓			✓	✓			✗	✗	✗	
CLO6 Calculate and solve analytical chemistry problems related to the given experimentation	✓			✓	✓			✗	✗	✗	



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Section 5 Lesson Plan and Evaluation

1. Lesson Plan

Week	Topics/Details	Number of hours		Teaching activities/ media	Instructors
		Theory	Practice		
1	1. Course introduction and Lab Safety Glassware check	0	3	<u>Teaching activities</u> (1) Lecture (2) Assignment <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) PowerPoint slides	Dr. Tinnakorn Tiensing
2	2. Accuracy and Precision of Volumetric Glassware in Quantitative analysis: Significant number, error and uncertainty of the volume, basic statistic in analytical chemistry	0	3	<u>Teaching activities</u> (1) Lecture (2) Exercise (3) Discussion <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) PowerPoint slides	Dr. Tinnakorn Tiensing
3	3. Acid-Base Titration 1: Preparation of acid-base solutions and standard solutions, standardization technique, direct titration technique	0	3	<u>Teaching activities</u> (1) Lab Practice (2) Report (3) Quiz <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) VDO demonstration (3) Lab apparatus	Dr. Tinnakorn Tiensing
4	4. Acid-Base Titration 2: Preparation of acid-base solutions and standard solutions, standardization technique, back titration technique, sample of weak acid analysis	0	3	<u>Teaching activities</u> (1) Lab Practice (2) Report (3) Quiz <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) Lab apparatus	Dr. Tinnakorn Tiensing
5	5. Complexometric titration using EDTA titration:	0	3	<u>Teaching activities</u> (1) Lab Practice	Dr. Tinnakorn Tiensing



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Week	Topics/Details	Number of hours		Teaching activities/ media	Instructors
		Theory	Practice		
	Preparation solutions and standardization technique, EDTA titration technique, apply EDTA titration for Ca determination in milk sample			(2) Report (3) Quiz <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) Lab apparatus	
6	6. Iodimetry and Iodometry titration: Preparation solutions and standardization technique, apply iodine titration for determination of formaldehyde in a given sample	0	3	<u>Teaching activities</u> (1) Lab Practice (2) Report (3) Quiz <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) Lab apparatus	Dr. Tinnakorn Tiensing
7	7. Precipitation titration	0	3	<u>Teaching activities</u> (1) Lab Practice (2) Report (3) Quiz <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) Lab apparatus	Dr. Tinnakorn Tiensing
8	8. Practical Exam in Titration Technique	0	3	<u>Teaching activities</u> (1) Practice Exam <u>Teaching media</u> (1) Lab apparatus	Dr. Tinnakorn Tiensing
9	Midterm Exam Week				
10	9. Absorption spectrophotometry technique: color analyses by absorption spectrophotometry, preparation of standard solutions for construct calibration curve, and determine content of analyte in the given sample	0	3	<u>Teaching activities</u> (1) Lab Practice (2) Report (3) Quiz <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) Lab apparatus (3) VDO demonstration	Dr. Tinnakorn Tiensing



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Week	Topics/Details	Number of hours		Teaching activities/ media	Instructors
		Theory	Practice		
11	10. Determination of Fe(II) complex using absorption spectrophotometry technique: Fe(II) and o-phenanthroline complex formation studies, absorption spectrum scanning, construct calibration curve and applied for determining iron content in a given sample	0	3	<u>Teaching activities</u> (1) Lab Practice (2) Report (3) Quiz <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) Lab apparatus (3) Power point slides	Dr. Tinnakorn Tiensing
12	11. Practical Exam in Colorimetric analysis	0	3	<u>Teaching activities</u> (1) Practice Exam <u>Teaching media</u> (1) Lab apparatus	Dr. Tinnakorn Tiensing
13	12. Potentiometry 1: Study of pH measurement using pH glass electrode, using pH meter, calibrate pH meter	0	3	<u>Teaching activities</u> (1) Lab Practice (2) Report (3) Quiz <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) Lab apparatus (3) Power point slides	Dr. Tinnakorn Tiensing
14	13. Potentiometry 2: Buffer preparation and buffer capacity	0	3	<u>Teaching activities</u> (1) Lab Practice (2) Report (3) Quiz <u>Teaching media</u> (1) Manual in Analytical Chemistry Laboratory (2) Lab apparatus (3) Power point slides	Dr. Tinnakorn Tiensing
15	15. Practical examination in pH measurement and buffer capacity	0	3	<u>Teaching activities</u> (1) Practice Exam <u>Teaching media</u> (1) Lab apparatus	Dr. Tinnakorn Tiensing



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Week	Topics/Details	Number of hours		Teaching activities/ media	Instructors
		Theory	Practice		
16	16. Practical exam	0	3		
	Total	0	45		

2. Evaluation of the CLOs

2.1 Measurement and Evaluation of learning achievement

a. Formative Assessment

The formative assessment methods for improving learning skill in which evaluation results are not included in the final score after completion the course are:

- Ask questions in the classroom
- Demonstrate examples for problem solving in the related topics of studying

b. Summative Assessment

(1) Tool and weight for measurement and evaluation

Course Code	Learning outcomes measurements						Weight (percent)
	Quiz before experiment	Exam on using glassware / equipment	Practical examination	Evaluate from lab report	home work / assignment (individual)	Evaluate from lab planning (individual)	
CLO1 Describe principle knowledge and theories correctly in analytical chemistry, quantitative analysis, titration methods, data analysis based on accuracy and precision results, calibration methods, potentiometry, absorption spectrophotometry, buffer and buffer capacity	3		5	5			13
CLO2 Write experimental planning of given analytical chemistry laboratory appropriately	3		5	5		4	17
CLO3 Select reagents, chemicals, glassware and equipment with an appropriately given experimentation	2	10	5	5		3	24



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Course Code	Learning outcomes measurements						Weight (percent)
	Quiz before experiment	Exam on using glassware / equipment	Practical examination	Evaluate from lab report	home work / assignment (individual)	Evaluate from lab planning (individual)	
CLO4 Perform experiment with suitable analytical method based on safety concept for quantitative analysis of given samples	2		5	5		3	15
CLO5 Analyze experimental results with appropriated statistical test for quantitative data analysis			5	5	5		15
CLO6 Calculate and solve analytical chemistry problems related to the given experimentation			5	5	5		15
Total	10	10	30	30	10	10	100

(2) Grading policy

Criteria and conditions for measurement and evaluation are to be enforced in accordance with Mahidol University Regulation on Diploma and Undergraduate Study and recently Announcement, the Faculty of Science on Undergraduate Study, by using symbols showing results with assigned scores as shown in the table:

Score (percentage)	Symbols
80 – 100	A
70 – 79	B+
65 – 69	B
60 – 64	C+
55 – 59	C
50 – 54	D+
45 – 49	D
0 – 44	F

Symbol with D means pass in this course.

(3) Re-examination (if any)

Follow the Announcement, the Faculty of Science on Undergraduate Study on Re-examination which can be done in the following conditions;



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-
- Student received F or U
 - Student taken that course fail less than 15 students, and
 - That course would not open in the summer semester.

3. Student Academic Appeal

Students may submit formal complaint or academic appeal directly to

International Education and Administration Unit, Division of Salaya Campus

Room SC1-116, SC1-Building, Faculty of Science (Salaya Campus), Mahidol University

999 Phuttamonthon 4 Road, A. Phuttamonthon, Nakhon Pathom 73170, Thailand

E-mail: scsim@mahidol.ac.th; Phone: +66 2 4419820 ext. 1199

If it considered that a case exists, the matter will be investigated in accordance with the procedures, and the complainant informed of the outcome.



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Section 6 Teaching Resources

1. Required Texts and Main Documents

- 1) Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. Vogel's textbook of quantitative chemical analysis, Essex (UK): Pearson Education Limited, **2000** (or other years).
- 2) SKOOG, D.A.; WEST D.M and HOLLER F.J, Fundamentals of analytical chemistry, 9th ed., **2014**.
- 3) Skoog, D. A.; West, D. M. and Holler. J. Fundamental of Analytical Chemistry (7th ed.), Suanders College Publishing, **1997**.
- 4) Daniel C. Harris. Quantitative Chemical Analysis, 8th ed., **2010**.

2. Suggested Materials

- 1) All teaching documents
- 2) Books in Analytical Chemistry
- 3) Websites; <http://www.rsc.org/>

3. Other Resources (if any) none



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Section 7 Evaluation and Improvement of Course Implementation

1. Strategy for Course Effectiveness Evaluation by Students

On-line evaluation form (i.e., instructor/lecturer and overall of the course) can be done by student which is easily assessed by the internet. Contents of the evaluation consist of topics, management, grading evaluation, satisfaction of the course and method usage and teaching method of the course.

2. Strategy for Teaching Evaluation

Skill, knowledge, teaching strategy and learning media in that course can be evaluated by student and also co-course instructor.

3. Teaching Improvement

Teaching Improvement methods can be done by meeting/seminar all lecturers in the course for improving teaching and learning methods that will be applied in the next academic year from all sources of information such as;

- grading results
- evaluation of the subject; teaching method / student learning
- recording from lecturer on performance and behavior student class

4. Verification Standard of Learning Outcome for the Course

The verification processes will be conducted by instructors based on student score, grading system and course evaluation results in that course for revision and verification standard LOs for the course.

5. Revision Process and Improvement Plan for Course Effectiveness

At the end of academic year, course instructor will summaries and do the report for teaching and subject evaluation results and information in the form of TQF.5 to the program administrative committee for future vision and improvement plan.



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Appendix

Concordance between Specific Course and Program

Table 1 Relations between the course and the PLOs

Course name	PLOs					
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
Analytical Chemistry Laboratory						
Course code SCCH 268						

Remarks: Show the level of the course management with the symbols I, R, P, and M. This must correspond to the curriculum mapping written in the TQF2.

Table 2 Relations between CLOs and PLOs

Course code SCCH 268	PLOs					
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1 Describe principle knowledge and theories correctly in analytical chemistry, quantitative analysis, titration methods, data analysis based on accuracy and precision results, calibration methods, potentiometry, absorption spectrophotometry, buffer and buffer capacity						
CLO2 Write experimental planning of given analytical chemistry laboratory appropriately						
CLO3 Select reagents, chemicals, glassware and equipment with an appropriately given experimentation						
CLO4 Perform experiment with suitable analytical method based on safety concept for quantitative analysis of given samples						
CLO5 Analyse experimental results with appropriated statistical test for quantitative data analysis						
CLO6 Calculate and solve analytical chemistry problems related to the given experimentation						

Remarks:

- Each CLO should clearly correspond to the PLO at the SubPLO level to show a clear connection.



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b. Describe the PLOs and SubPlos only referred to in the course in “Table 3 PLOs that the course is responsible for”.

Table 3 Description of Program Learning Outcomes (PLO) and sub PLOs of your responsible course

PLOs	Sub PLOs
PLO1	1.1
	1.2
PLO2	2.1
	2.2
PLO3	3.1
	3.2