

**Doctor of Philosophy Program in Chemistry  
(International Program)  
Revised Program 2018**

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Name of Institution                          Mahidol University  
Campus/Faculty/Department              Department of Chemistry Faculty of Science

**Section 1 General Information**

**1. Curriculum Name**

Thai       : หลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาเคมี (หลักสูตรนานาชาติ)  
English   : Doctor of Philosophy Program in Chemistry (International Program)

**2. Name of Degree and Section**

Full Name    Thai       : ปรัชญาดุษฎีบัณฑิต (เคมี)  
                  English     : Doctor of Philosophy (Chemistry)

Abbreviation Thai       : ปร.ด. (เคมี)  
                  English     : Ph.D. (Chemistry)

**3. Major Subjects    : None**

**4. Required Credits**

4.1 For students holding M.Sc. degree: at least 48 credits

4.2 For students holding B.Sc. degree: at least 78 credits

**5. Curriculum Characteristics**

**5.1 Curriculum Category** : Doctoral degree

**5.2 Language**                      : English

**5.3 Enrollment**                     : Both Thai and international students

**5.4 Cooperation with Other Universities** : This program is a Mahidol University program.

**5.5 Degrees Offered to the Graduates** : One degree of one major

## 6. Status and Approval of the Curriculum

6.1 Program was revised in 2018

6.2 To be offered in the 1<sup>st</sup> semester of academic year 2018

6.3 Scrutiny by the curriculum screening committee in its 4/2018 meeting on February 14, 2018

6.4 The Mahidol University Council approved the program in its meeting 531 on April 18, 2018

## 7. Ability to Implement and Promote the Curriculum

The curriculum from the program is readily implemented or promoted its quality and standard according to criteria set by Thai Qualification Framework for Higher Education in academic year 2020 (2 years after implementation).

## 8. Opportunities for the Graduates

Graduates of the program can work in the following capacity:

8.1 University professors;

8.2 Advanced research and development in commercial sector and in academia;

8.3 Business entrepreneurs;

8.4 Research scientists and advanced specialists in the government sector;

8.5 Scientific communicators.

## 9. Name-Surname / Identification Card Number / Positions / Academic qualifications of instructors responsible for the curriculum

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
1	x-xxxx-xxxx-xx-x Associate Professor Dr. Preeyanuch Sangtrirutnugul	Ph.D. (Chemistry) University of California, Berkeley, USA: 2007 B.S. (Chemistry) Massachusetts Institute of Technology, USA: 2000	Department of Chemistry Faculty of Science

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
2	x-xxxx-xxxxx-xx-x Associate Professor Dr. Siwaporn Meejoo Smith	Ph.D. (Chemistry) University Birmingham, UK: 2003 B.Sc. (Chemistry) Mahidol University: 1997	Department of Chemistry Faculty of Science
3	x-xxxx-xxxxx-xx-x Associate Professor Dr. Tienthong Thongpanchang	Ph.D. (Chemistry) Columbia University, USA: 1999 B.Sc. (Chemistry) Prince of Songkla University: 1994	Department of Chemistry Faculty of Science
4	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Chutima Jiarpinitnun	Ph.D. (Chemistry) University of Wisconsin-Madison, USA: 2008 B.S. (Chemistry) The University of Chicago, USA: 2001	Department of Chemistry Faculty of Science
5	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Panida Surawatanawong	Ph.D. (Chemistry) Texas A&M University, USA: 2009 B.Sc. (Chemistry) Mahidol University: 2004	Department of Chemistry Faculty of Science
6	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Pasit Pakawatpanurut	Ph.D. (Chemistry) Harvard University, USA: 2005 M.A. (Chemistry) Harvard University, USA: 2004 B.S. (Chemistry) The University of Chicago, USA: 1999	Department of Chemistry Faculty of Science

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
7	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Rattikan Chantiwas	Ph.D. (Chemistry) Chiang Mai University: 2003 M.Sc. (Chemistry) Mahidol University: 1999 B.Sc. (Chemistry) Mahidol University: 1996	Department of Chemistry Faculty of Science

## 9. Location

Department of Chemistry, Faculty of Science, Mahidol University, Phayathai Campus and Salaya Campus.

## 10. External Factors Contributing to the Curriculum Planning

### 10.1 Economic Situation/Development

The enactment of Thailand 4.0, a long-term national economic model, calls for an overhaul in almost every sector of Thailand's social and economic components. In order to achieve the goals of Thailand 4.0, providing young generations with high-quality education and skills is strongly required. In addition, the current global economy has already shifted from commodity-based market to innovation-driven competition. Together with an increasing influence of climate change, which constantly changes the landscape of natural resources and social challenges, contemporary chemistry education clearly needs an update in a timely manner.

The Ph.D. Program in Chemistry just completed its fifth year after its first use in 2013. With all the factors mentioned above, it is now a high time for a careful revision of the program. As reflected in this document, such a revision is designed to not only cultivate students with in-depth knowledge in chemistry and related disciplines, but it also prepares them with skills and perspectives that bode well for their future career in a changing world.

## **10.2 Social and Cultural Situation/Development**

The joint endeavor in the region set up by the Association of Southeast Asian Nations (ASEAN) and increasing flow of the workforce across the globe introduce both opportunities and challenges to future graduates. To make the most of a powerful trend of globalization, new graduates need to have sufficient intellectual foundation of knowledge, with competent communication skills that will allow them to perform to full potential in various international settings.

Aside from the ASEAN network and other international collaborations, the Eastern Economic Corridor (EEC), a pilot project of the economic development of Thailand's Eastern Seaboard, recently announced by the Thai government will also reshape the demands for high-quality human resource.

In addition, the ever-increasing development of the open-border policy shared by many countries around the world also means that the future graduates will likely have to work within a community of diverse culture and ethnicity. To prepare the students for this social change, it is imperative that the student community within the program should learn to live and work under multicultural environment. Therefore, the program aims to actively recruit applicants from other countries, such as those of the ASEAN members. In addition, many courses and activities provided by the program are administered with full conscience of social and cultural diversity.

## **11. The Effects of Factors Mentioned in 11.1 and 11.2 on the Curriculum Development and Their Relevance to the Missions of the University**

### **11.1 Curriculum Development**

With an advent of interconnected society and increasing emphasis on innovation and new technologies, it is necessary for the program to provide in-depth knowledge that instills expertise of relevant fields for the students. At the same time, the training in the program should also cover a broader aspect of personal development, such as communication and interpersonal skills. A good understanding of cultural differences would prepare the students well for working in a diverse society.

### **11.2 Their Relevance to the Missions of the University**

Mahidol University is known for its academic rigor especially in basic sciences, research, and development. Nevertheless, with a changing environment in many social

and economic aspects both within and outside the country, the formal training at Mahidol University needs to integrate soft skill teaching in order to best prepare new graduates for modern-day workforce. All curriculums at the university are an integration of the seven core values: Mastery, Altruism, Harmony, Integrity, Determination, Originality, and Leadership. The resulting education is expected to provide new graduates with comprehensive knowledge and sensible understanding that will guide them well in their future endeavors.

## 12. Cooperation with Other Curriculums of the University

None

### Section 2 Information of the Curriculum

#### 1. Philosophy and Objectives of the Curriculum

##### 1.1 Philosophy

The doctoral program in Chemistry is designed to endow our students with ability to tackle fundamental scientific questions from chemical perspective. The core principle of our program is to provide students with an education of high quality, equivalent to international standards. To equip our graduates with a strong foundation in chemistry, advanced courses, scientific discussions, and, most importantly, research programs guided by a faculty mentor in the fields of organic chemistry, analytical chemistry, inorganic chemistry, physical chemistry and chemical physics, and chemistry for natural resources and waste materials are offered. The program is conducted to reinforce students to acquire excellent proficiency in a focused area of expertise as well as a broad base of problem-solving skills and exposure to interdisciplinary science. The education of high quality along with general skills establish our graduates with professional capability and personal quality that are demanded in the employment market and the society at large. Research ethics, academic principles, and moral standards are emphasized in the teaching to ensure that our graduates can fulfill Mahidol University's philosophical view of higher education, namely, " True success is not in the learning, but in its application to the benefit of mankind."

## 1.2 Objectives

The program aims to produce quality graduates in the following context.

- 1.2.1 Graduates have good moral understanding and conform to scientific ethics.
- 1.2.2 Graduates possess comprehensive knowledge and experience in chemistry for their future careers in private and government sectors.
- 1.2.3 Graduates have capability of making well-informed decisions, conducting a task effectively, and creating original work.
- 1.2.4 Graduates show good responsibility and are able to work as a team.
- 1.2.5 Graduates attain analytical, communication, and information technology skills that enable them to compete at the international level.

## 1.3 Program Learning Outcomes (PLOs)

- 1.3.1 Graduates adhere to scientific ethics and respect rules and regulations of the program and the institution.
- 1.3.2 Graduates are able to use English speaking, listening, reading, and writing skills to communicate with others on advanced research topics.
- 1.3.3 Graduates are able to correctly explain advanced principles, theories, and chemical research in selected discipline.
- 1.3.4 Graduates are able to describe principles of operation and select appropriate scientific equipment for specific tasks.
- 1.3.5 Graduates are able to conduct experiments and evaluate the resulting data.
- 1.3.6 Graduates possess good working discipline and teamwork skills.
- 1.3.7 Graduates are able to choose appropriate information technology platforms that suit their research inquiries, analyze numerical data, and use basic statistics in a research project.
- 1.3.8 Graduates are able to propose hypotheses and design suitable experiments to verify them.
- 1.3.9 Graduates are able to evaluate the relationship among chemical research, innovation, and society.

## 2. Plan for Development and Improvement

Plan	Strategy	Index
1. To maintain high quality of the curriculum	<ol style="list-style-type: none"> <li>1. Encourage collaboration across disciplines within the program.</li> <li>2. Provide a platform for the critique of the curriculum by external experts.</li> <li>3. Revise the curriculum once every five years.</li> <li>4. Build partnership with other domestic and international institutions.</li> </ol>	<ol style="list-style-type: none"> <li>1. Number of co-publications across disciplines</li> <li>2. Record of the meeting for the critique of the curriculum</li> <li>3. The curriculum report</li> <li>4. Documents declaring partnership with other institutions</li> </ol>
2. To revise curriculum according to stakeholders and social and economic changes	<ol style="list-style-type: none"> <li>1. Survey employers' opinion about the graduates.</li> <li>2. Revise the curriculum once every five years.</li> <li>3. Develop research collaboration with public and private sectors.</li> </ol>	<ol style="list-style-type: none"> <li>1. Report of employers' opinion especially on curriculum content</li> <li>2. Document of the curriculum revision</li> <li>3. Document of research network</li> </ol>
3. To foster high-quality research skills in chemistry	<ol style="list-style-type: none"> <li>1. Encourage students to conduct short-term research visits at respectable institutions</li> <li>2. Support students to present their works at academic conferences.</li> <li>3. Require students to publish their findings in quality journals.</li> </ol>	<ol style="list-style-type: none"> <li>1. Number of students conducting short-term research visits</li> <li>2. Number of students participating academic conferences, both domestic and international</li> <li>3. Number of publications in quality journals</li> </ol>



## Section 3 Educational Management System, Curriculum Implementation, and Structure

### 1. Educational Management System

1.1 System Semester system

1.2 Summer Session Summer session is not offered

1.3 Credits Equivalent to Trimester System No equivalency

### 2. Curriculum Implementation

2.1 Teaching Schedule Classes take place during regular working hours.

#### 2.2 Qualifications of Prospective Students

2.2.1 Obtained B.Sc. in chemistry or related fields with a minimum GPA of 3.50 (only eligible for Plan 2.2), or

2.2.2 Obtained M.Sc. in chemistry or related fields with a minimum GPA of 3.50 (for Plan 2.1) and, for Plan 1.1, also produced research publication and passed a placement test organized by the program;

2.2.3 Obtained an English Proficiency Examination score as required by the Faculty of Graduate Studies;

2.2.4 A student of qualifications other than those listed above may be eligible to enroll in the program, pending approval of the program director and the dean of the Faculty of Graduate Studies.

#### 2.3 Problems That New Students Encounter When They Start the Program

2.3.1 English and communication skills

2.3.2 Chemistry background

2.3.3 Adaptation to graduate study and the atmosphere

#### 2.4 Strategies to Solve Problems in 2.3

Problem	Strategy
English and communication skills	Provide a compulsory course on English and communication skills, as well as regular English workshops to provide continuous development.

Problem	Strategy
Chemistry background	Recommend a student to review basic chemical knowledge when necessary under the supervision of an advisor.
Adaptation to graduate study and the atmosphere	Arrange student-organized events, such as off-campus orientation camp, and promote peer-to-peer mentoring system among students.

## 2.5 Five-Year Plan for Enrollment and Graduation of Students

### 2.5.1 For Students Holding M.Sc. Degree (Plan 1.1)

Academic Year	2018	2019	2020	2021	2022
Number of students enrolled	3	3	3	3	3
Cumulative number	-	6	9	9	9
Number of students graduated	-	-	3	3	3

### 2.5.2 For Students Holding M.Sc. Degree (Plan 2.1)

Academic Year	2018	2019	2020	2021	2022
Number of students enrolled	4	4	4	4	4
Cumulative number	-	8	12	12	12
Number of students graduated	-	-	4	4	4

### 2.5.3 For Students Holding B.Sc. Degree (Plan 2.2)

Academic Year	2018	2019	2020	2021	2022
Number of students enrolled	4	4	4	4	4
Cumulative number	-	8	12	16	16
Number of students graduated	-	-	-	4	4

## 2.6 Budget

### 2.6.1 For Students Holding M.Sc. Degree (Plan 1.1)

#### Estimates of Expenses in the Program

##### *Income from enrollment*

Registration	Credit	Baht per credit	Total
Dissertation	48	1,500	72,000
Research fee			300,000
<b>Income incurred per student</b>			<b>372,000</b>

##### *Expense*

##### *Expenses per student*

Contribution paid to the faculty and the university	21,600
Committees for qualification exam, advising, and thesis defense	18,200
<b>Expense incurred per student</b>	<b>39,800</b>

##### *Expenses for program management*

Salary for program's officer (10,000 baht/month)	360,000
Public utility (3,100 baht/month)	111,600
Supplies (39,000 baht/semester)	234,000
Equipment (150,000 baht/semester)	900,000
Others (e.g., equipment maintenance, renovation of classrooms and labs, and workshops)	138,000
<b>Expense incurred for program management</b>	<b>1,743,600</b>

Number of students for a balanced sheet: 6 students

Expenses until graduation per student (assuming 6 students): 330,400 baht

### 2.6.2 For Students Holding M.Sc. Degree (Plan 2.1)

#### Estimates of Expenses in the Program

##### *Income from enrollment*

Registration	Credit	Baht per credit	Total
Courses	12	9,000	108,000
Dissertation	36	1,500	54,000
Research fee			300,000
<b>Income incurred per student</b>			<b>462,000</b>

*Expense**Expenses per student*

Contribution paid to the faculty and the university	21,600
Committees for qualification exam, advising, and thesis defense	18,200
<b>Expense incurred per student</b>	<b>39,800</b>

*Expenses for program management*

Salary for program's officer (10,000 baht/month)	360,000
Remuneration for invited lecturers (3 credits/semester, 1,500 baht/hr)	432,000
Public utility (4,100 baht/month)	147,600
Supplies (52,000 baht/semester)	312,000
Equipment (31,000 baht/semester)	186,000
Others (e.g., equipment maintenance, renovation of classrooms and labs, workshops, and travel expenses for invited lecturers)	462,000
<b>Expense incurred for program management</b>	<b>1,899,600</b>

Number of students for a balanced sheet: 6 students

Expenses until graduation per student (assuming 6 students): 356,400 baht

**2.6.3 For Students Holding B.Sc. Degree (Plan 2.2)****Estimates of Expenses in the Program***Income from enrollment*

Registration	Credit	Baht per credit	Total
Courses	30	9,000	270,000
Dissertation	48	1,500	72,000
Research fee			300,000
<b>Income incurred per student</b>			<b>642,000</b>

*Expense**Expenses per student*

Contribution paid to the faculty and the university	54,000
Committees for qualification exam, advising, and thesis defense	18,200
<b>Expense incurred per student</b>	<b>72,200</b>

*Expenses for program management*

Salary for program's officer (10,000 baht/month)	480,000
Remuneration for invited lecturers (3 credits/semester, 1,500 baht/hr)	576,000

Public utility (4,100 baht/month)	196,800
Supplies (52,000 baht/semester)	416,000
Equipment (31,000 baht/semester)	248,000
Others (e.g., equipment maintenance, renovation of classrooms and labs, workshops, and travel expenses for invited lecturers)	620,000
<b>Expense incurred for program management</b>	<b>2,536,800</b>
<b>Number of students for a balanced sheet:</b>	<b>5 students</b>
<b>Expenses until graduation per student (assuming 7 students):</b>	<b>579,360 baht</b>

## 2.7 Educational System

Classroom style

## 2.8 Transfer of Credits, Courses, and Cross University Registration

In accordance with Mahidol University's regulations on graduate studies, which can be viewed at [www.grad.mahidol.ac.th](http://www.grad.mahidol.ac.th).

## 3. Curriculum and Lecturers

### 3.1 Curriculum

#### 3.1.1 Number of Credits

- (1) For students holding M.Sc. degree: at least 48 credits
- (2) For students holding B.Sc. degree: at least 78 credits

#### 3.1.2 Curriculum Structure

##### (1) Plan 1.1

The curriculum structure complies with the Thai Qualifications Framework for Higher Education (TQF) 2015 as detailed below.

##### For Students Holding M.Sc. Degree in Chemistry or Related Fields

Dissertation	48	credits
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##### (2) Plan 2

The curriculum structure complies with the Thai Qualifications Framework for Higher Education (TQF) 2015 as detailed below.

##### (Plan 2.1) For Students Holding M.Sc. Degree in Chemistry

Compulsory courses	6	credits
Elective courses* not less than	6	credits
Dissertation	36	credits
<b>Total not less than</b>	<b>48</b>	<b>credits</b>

\* For students already holding M.Sc. degree in Chemistry or other fields from the Department of Chemistry, Faculty of Science, Mahidol University, no more than 3 credits can be transferred from the M.Sc. program. In addition, any course registered in this program must have never been taken before in the M.Sc. program.

**(Plan 2.1) For Students Holding M.Sc. Degree in Related Fields**

Compulsory courses**	9 credits
Elective courses** not less than	3 credits
Dissertation	36 credits
<b>Total not less than</b>	<b>48 credits</b>

\*\* Any course registered in this program must have never been taken before in the previous M.Sc. program, and no course credits can be transferred from the M.Sc. program. Students may also need to take extra courses in addition to the required credits per recommendation of the advisors and/or the program committee.

**(Plan 2.2) For Students Holding B.Sc. Degree in Chemistry or Related Fields**

Compulsory courses	21 credits
Elective courses not less than	9 credits
Dissertation	48 credits
<b>Total not less than</b>	<b>78 credits</b>

### 3.1.3 Course List

#### (1) Compulsory Courses

(1.1) For Students Holding B.Sc. Degree (Plan 2.2): 21 credits

Credit (lecture-practice-self study)

SCCH 701	Frontiers in Chemistry	3 (3-0-6)
SCCH 702	Chemical Safety and Risk Management	1 (1-0-2)
SCCH 703	Scientific Communications	1 (1-0-2)
SCCH 704	Seminar in Chemistry	1 (1-0-2)
SCCH 705	Progress in Chemistry*	3 (3-0-6)
SCCH 706	Research Skill Development I*	3 (3-0-6)
SCCH 708	Special Problems in Chemistry	3 (3-0-6)

**Note:** \* denotes a course with S/U grading scheme

† *In addition, with a consent of an academic advisor and a course coordinator, students must take two (6 credits) of the following courses.*

		Credit (lecture-practice-self study)
†	SCCH 711 Organic Structure Determination	3 (3-0-6)
†	SCCH 712 Molecular Structures and Functions	3 (3-0-6)
†	SCCH 731 Advanced Techniques in Analytical Chemistry	3 (3-0-6)
†	SCCH 732 Instrumental Analysis Laboratory	3 (1-6-4)
†	SCCH 763 Inorganic Structure and Bonding	3 (3-0-6) #
†	SCCH 764 Characterization Techniques in Inorganic Chemistry	3 (3-0-6) #
†	SCCH 778 Physico-Chemical Techniques	3 (2-3-5)
†	SCCH 785 Advanced Physical Chemistry	3 (3-0-6) #
†	SCCH 801 Environmental Materials	3 (3-0-6) #
†	SCCH 802 Lignocellulosic Chemistry	3 (3-0-6)

**(1.2) For Students Holding M.Sc. Degree in Chemistry (Plan 2.1): 6 credits**

SCCH	707 Research Skill Development II*	3 (3-0-6)
SCCH	708 Special Problems in Chemistry	3 (3-0-6)

**Note:** \* denotes a course with S/U grading scheme

**(1.3) For Students Holding M.Sc. Degree in Related Fields (Plan 2.1):9 credits**

SCCH	701 Frontiers in Chemistry	3 (3-0-6)
SCCH	706 Research Skill Development I*	3 (3-0-6)
SCCH	708 Special Problems in Chemistry	3 (3-0-6)

**Note:** \* denotes a course with S/U grading scheme

**(2) Elective Courses**

SCCH	713 Advanced Organic Synthesis	3 (3-0-6)
SCCH	714 Advanced Organic Reaction Mechanism	3 (3-0-6)
SCCH	715 Frontiers in Medicinal Chemistry	3 (3-0-6)
SCCH	716 Chemical Biology	3 (3-0-6)
SCCH	717 Advanced Natural Product Chemistry	3 (3-0-6)
SCCH	718 Asymmetric Synthesis	3 (3-0-6)
SCCH	719 Advanced Heterocyclic Chemistry	3 (3-0-6)
SCCH	720 Current Topics in Organic Chemistry	3 (3-0-6)
SCCH	733 Separation Techniques	3 (3-0-6)

## Credit (lecture-practice-self study)

SCCH 734	Fluidic Technology for Analytical Science	3 (3-0-6)
SCCH 735	Chemometrics	3 (2-3-5)
SCCH 736	Solution Chemistry	3 (3-0-6)
SCCH 737	Environmental Chemistry	3 (3-0-6)
SCCH 738	Special Topics in Analytical Chemistry	3 (3-0-6)
SCCH 739	Current Topics in Analytical Chemistry I	3 (3-0-6)
SCCH 740	Current Topics in Analytical Chemistry II	3 (3-0-6)
SCCH 754	Organotransition Metal Chemistry	3 (3-0-6)
SCCH 757	Solid State Chemistry	3 (3-0-6)
SCCH 765	Main Group Chemistry	3 (3-0-6) #
SCCH 766	Inorganic Reaction Mechanisms	3 (3-0-6) #
SCCH 767	NMR Spectroscopy in Inorganic Chemistry	3 (3-0-6) #
SCCH 768	Special Topics in Inorganic Chemistry	3 (3-0-6) #
SCCH 769	Bioinorganic Chemistry: from Metals in Biology to Modern Applications	3 (3-0-6) #
SCCH 771	Quantum Chemistry	3 (3-0-6)
SCCH 772	Thermodynamics and Statistical Mechanics	3 (3-0-6)
SCCH 774	Chemical Kinetics and Molecular Dynamics	3 (3-0-6)
SCCH 775	Modern Chemical Physics	3 (3-0-6)
SCCH 776	Mathematical Methods	3 (3-0-6)
SCCH 779	Surface Chemistry and Advanced Electrochemistry	3 (3-0-6)
SCCH 780	Special Topics in Physical Chemistry	3 (3-0-6)
SCCH 781	Special Topics in Chemical Physics	3 (3-0-6)
SCCH 782	Seminar in Physical Chemistry and Chemical Physics I	1 (1-0-2)
SCCH 783	Seminar in Physical Chemistry and Chemical Physics II	1 (1-0-2)
SCCH 784	Seminar in Physical Chemistry and Chemical Physics III	1 (1-0-2)
SCCH 803	Chemistry of Waste and Pollution	3 (3-0-6) #
SCCH 804	Concepts in Sustainability	3 (3-0-6) #
SCCH 805	Natural Fibers	3 (3-0-6) #
SCCH 806	Industrial Chemistry	3 (3-0-6) #

In addition to the elective courses shown above, students may choose to enroll in any other courses offered within or outside Mahidol University, pending approval of the advisor and the program director. Students can enroll in any compulsory courses in the program to fulfill the elective credit requirement.

# new course



**(3) Dissertation****(3.1) For Students Holding M.Sc. Degree (Plan 1.1)****Credit (lecture-practice-self study)**

SCCH 898      Dissertation      48 (0-144-0) #

**(3.2) For Students Holding M.Sc. Degree (Plan 2.1)**

SCCH 699      Dissertation      36 (0-108-0)

**(3.3) For Students Holding B.Sc. Degree (Plan 2.2)**

SCCH 799      Dissertation      48 (0-144-0)

# new course

**3.1.4 Research Project (Dissertation)**

The research projects undertaken by the students may encompass wide-ranging disciplines in chemistry and related interdisciplinary areas, including the following focuses:

- (1) Organic chemistry, natural products, organic synthesis and synthetic methodology, and organic materials and chemical biology;
- (2) Analytical chemistry, development of instrumentation, methods of analysis, and applications;
- (3) Inorganic chemistry, catalysts, and inorganic material properties;
- (4) Physical chemistry and chemical physics and molecular understanding of modern technologies;
- (5) Chemistry for natural resources and waste materials, sustainable development of new materials, and community-level applications.

**3.1.5 Course Code**

The definition of four letters for the program course code is based on the rules and regulation set up by the Mahidol University as follow;

The first and second letters as Faculty

SC (๑๗) means The Faculty of Science

The last two alphabets describe the program responsible for teaching.

CH (๑๘) means Chemistry

The three number orders following the two letters, i.e., 6xx, 7xx and 8xx indicate the courses in the Graduate level.

## 3.1.6 Study Plan

## (1) For Students Holding M.Sc. Degree in Chemistry or Related Fields (Plan 1.1)

Year	First Semester	Second Semester
1	SCCH 898 Dissertation 8 (0-24-0) <i>Note: Qualifying examination period</i> Total 8 credits	SCCH 898 Dissertation 8 (0-24-0) Total 8 credits
2	SCCH 898 Dissertation 8 (0-24-0) Total 8 credits	SCCH 898 Dissertation 8 (0-24-0) Total 8 credits
3	SCCH 898 Dissertation 8 (0-24-0) Total 8 credits	SCCH 898 Dissertation 8 (0-24-0) Total 8 credits

## (2) For Students Holding M.Sc. Degree in Chemistry (Plan 2.1)

Year	First Semester	Second Semester
1	SCCH 707 Research Skill Development II 3 (3-0-6) SCCH 708 Special Problems in Chemistry 3 (3-0-6) Elective Courses 6 credits <i>Note: Qualifying examination period</i> Total 12 credits	SCCH 699 Dissertation 8 (0-24-0) <i>Note: Qualifying examination period</i> Total 8 credits
2	SCCH 699 Dissertation 7 (0-21-0) Total 7 credits	SCCH 699 Dissertation 7 (0-21-0) Total 7 credits
3	SCCH 699 Dissertation 7 (0-21-0) Total 7 credits	SCCH 699 Dissertation 7 (0-21-0) Total 7 credits

## (3) For Students Holding M.Sc. Degree in Related Fields (Plan 2.1)

Year	First Semester	Second Semester
1	SCCH 701 Frontiers in Chemistry 3 (3-0-6) SCCH 706 Research Skill Development I 3 (3-0-6) SCCH 708 Special Problems in Chemistry 3 (3-0-6) Elective Courses 3 credits <i>Note: Qualifying examination period</i> Total 12 credits	SCCH 699 Dissertation 8 (0-24-0) <i>Note: Qualifying examination period</i> Total 8 credits
2	SCCH 699 Dissertation 7 (0-21-0) Total 7 credits	SCCH 699 Dissertation 7 (0-21-0) Total 7 credits
3	SCCH 699 Dissertation 7 (0-21-0) Total 7 credits	SCCH 699 Dissertation 7 (0-21-0) Total 7 credits

## (4) For Students Holding B.Sc. Degree in Chemistry or Related Fields (Plan 2.2)

Year	First Semester	Second Semester
1	SCCH 701 Frontiers in Chemistry 3 (3-0-6) SCCH 702 Chemical Safety and Risk Management 1 (1-0-2) SCCH 703 Scientific Communications 1 (1-0-2) SCCH 706 Research Skill Development I 3 (3-0-6) Compulsory Courses 6 credits <i>Note: Qualifying examination period</i> <b>Total 14 credits</b>	SCCH 704 Seminar in Chemistry 1 (1-0-2) SCCH 705 Progress in Chemistry 3 (3-0-6) SCCH 799 Dissertation 6 (0-18-0) Elective Courses 6 credits <i>Note: Qualifying examination period</i> <b>Total 16 credits</b>
2	SCCH 708 Special Problems in Chemistry 3 (3-0-6) Elective Courses 3 credits SCCH 799 Dissertation 7 (0-21-0) <b>Total 13 credits</b>	SCCH 799 Dissertation 7 (0-21-0) <b>Total 7 credits</b>
3	SCCH 799 Dissertation 7 (0-21-0) <b>Total 7 credits</b>	SCCH 799 Dissertation 7 (0-21-0) <b>Total 7 credits</b>
4	SCCH 799 Dissertation 7 (0-21-0) <b>Total 7 credits</b>	SCCH 799 Dissertation 7 (0-21-0) <b>Total 7 credits</b>

## 3.1.7 Course Descriptions

Please refer to the attached Appendix A.

## 3.2 Name, I.D. Number, Academic Title, and Academic Degree of Members

## 3.2.1 Full time instructors of the curriculum Please refer to the attached Appendix B

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
1	x-xxxx-xxxxx-xx-x Associate Professor Dr. Preeyanuch Sangtrirutnugul	Ph.D. (Chemistry) University of California, Berkeley, USA: 2007 B.S. (Chemistry) Massachusetts Institute of Technology, USA: 2000	Department of Chemistry Faculty of Science

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
2	x-xxxx-xxxx-xx-x Associate Professor Dr. Siwaporn Meejoo Smith	Ph.D. (Chemistry) University Birmingham, UK: 2003 B.Sc. (Chemistry) Mahidol University: 1997	Department of Chemistry Faculty of Science
3	x-xxxx-xxxx-xx-x Associate Professor Dr. Tienthong Thongpanchang	Ph.D. (Chemistry) Columbia University, USA: 1999 B.Sc. (Chemistry) Prince of Songkla University: 1994	Department of Chemistry Faculty of Science
4	x-xxxx-xxxx-xx-x Assistant Professor Dr. Chutima Jiarpinitnun	Ph.D. (Chemistry) University of Wisconsin-Madison, USA: 2008 B.S. (Chemistry) The University of Chicago, USA: 2001	Department of Chemistry Faculty of Science
5	x-xxxx-xxxx-xx-x Assistant Professor Dr. Panida Surawatanawong	Ph.D. (Chemistry) Texas A&M University, USA: 2009 B.Sc. (Chemistry) Mahidol University: 2004	Department of Chemistry Faculty of Science
6	x-xxxx-xxxx-xx-x Assistant Professor Dr. Pasit Pakawatpanurut	Ph.D. (Chemistry) Harvard University, USA: 2005 M.A. (Chemistry) Harvard University, USA: 2004 B.S. (Chemistry) The University of Chicago, USA: 1999	Department of Chemistry Faculty of Science
7	x-xxxx-xxxx-xx-x Assistant Professor Dr. Rattikan Chantiwas	Ph.D. (Chemistry) Chiang Mai University: 2003 M.Sc. (Chemistry) Mahidol University: 1999 B.Sc. (Chemistry) Mahidol University: 1996	Department of Chemistry Faculty of Science

## 3.2.2 Full time instructors

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
1	x-xxxx-xxxxx-xx-x Professor Dr. Pramuan Tangboriboonrat	Ph.D. (Polymer Chemistry) Université de Haute, France: 1991 M.Sc. (Physical Chemistry) Mahidol University: 1986 B.Sc. (Chemistry) Khon Kaen University: 1983	Department of Chemistry, Faculty of Science
2	x-xxxx-xxxxx-xx-x Professor Dr. Vichai Reutrakul	Ph.D. (Chemistry) University of Wisconsin-Madison, USA: 1971 B.Sc. (Chemistry) University of Sydney, Australia: 1966	Department of Chemistry, Faculty of Science
3	x-xxxx-xxxxx-xx-x Associate Professor Dr. Atitaya Siripinyanond	Ph.D. (Chemistry) University of Massachusetts, Amherst, USA: 2002 M.Sc. (Applied Analytical and Inorganic Chemistry) Mahidol University: 1997 B.Sc. (Chemistry) Mahidol University: 1994	Department of Chemistry, Faculty of Science
4	x-xxxx-xxxxx-xx-x Associate Professor Dr. Chutima Kuhakarn	Ph.D. (Chemistry) University of Wisconsin-Madison, USA: 2001 M.Sc. (Organic Chemistry) Mahidol University: 1995 B.Sc. (Chemistry) Mahidol University: 1992	Department of Chemistry, Faculty of Science
5	x-xxxx-xxxxx-xx-x Associate Professor	Ph.D. (Analytical Chemistry) Liverpool John Moores University,	Department of Chemistry,

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
	Dr. Duangjai Nacapricha	UK: 1993 M.Sc. (Analytical Chemistry) Chiang Mai University: 1989 B.Sc. (Chemistry) Prince of Songkla University: 1987	Faculty of Science
6	x-xxxx-xxxxx-xx-x Associate Professor Dr. Ekasith Somsook	Ph.D. (Chemistry) University of Wisconsin-Madison, USA: 2001 B.Sc. (Chemistry) Mahidol University: 1994	Department of Chemistry, Faculty of Science
7	x-xxxx-xxxxx-xx-x Associate Professor Dr. On-Uma Kheowan	Ph.D. (Chemical Physics) Mahidol University and Otto-von- Guericke Universitaet, Germany: 2001 B.Sc. (Physics) Kasetsart University: 1995	Department of Chemistry, Faculty of Science
8	x-xxxx-xxxxx-xx-x Associate Professor Dr. Palangpon Kongsaree	Ph.D. (Chemistry) Cornell University, USA: 1998 M.Sc. (Chemistry) Cornell University, USA: 1995 B.Sc. (Chemistry) Mahidol University: 1992	Department of Chemistry, Faculty of Science
9	x-xxxx-xxxxx-xx-x Associate Professor Dr. Shuleewan Rajviroongit	Ph.D. (Organic Chemistry) Queen's University of Belfast, U.K: 1990 M.Sc. (Organic Chemistry) Mahidol University: 1985 B.Sc. (Chemistry) Mahidol University: 1982	Department of Chemistry, Faculty of Science

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
10	x-xxxx-xxxxx-xx-x Associate Professor Dr. Taweechai Amornsakchai	Ph.D. (Polymer Physics) Leeds University, UK: 1994 B.Sc. (Industrial Chemistry) King Mongkut's Institute of Technology Ladkrabang: 1989	Department of Chemistry, Faculty of Science
11	x-xxxx-xxxxx-xx-x Associate Professor Dr. Vuthichai Ervithayasuporn	Ph.D. (Material Science) Japan Advanced Institute of Science and Technology, Japan: 2010 M.Sc. (Chemistry) Worcester Polytechnic Institute, USA: 2006 B.Sc. (Chemistry) Chulalongkorn University: 2004	Department of Chemistry, Faculty of Science
12	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Arada Chaiyanurakkul	Ph.D. (Chemistry) University of Bristol, UK: 2007 M.Sc. (Organic Chemistry) Mahidol University: 2002 B.Sc. (Chemistry) Mahidol University: 1997	Department of Chemistry, Faculty of Science
13	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Darunee Soorukram	Dr.rer.nat (Organic Chemistry) Ludwig-Maximilians Universität München, Germany: 2006 M.Sc. (Organic Chemistry) Mahidol University: 2003 B.Sc. (Chemistry) Khon Kaen University: 1999	Department of Chemistry, Faculty of Science
14	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Jonggol Tantirungrotechai	Ph.D. (Chemistry) University of California, Berkeley, USA: 2004 A.B. (Chemistry) Princeton University, USA: 1998	Department of Chemistry, Faculty of Science

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
15	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Kanchana Uraisin	Ph.D. (Molecular and Material Science) Okayama University: 2006 M.Sc. (Applied Analytical and Inorganic Chemistry) Mahidol University: 2003 B.Sc. (Chemistry) Mahidol University: 2000	Department of Chemistry, Faculty of Science
16	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Sirilata Yotphan	Ph.D. (Chemistry) University of California, Berkeley, USA: 2010 B.Sc. (Chemistry) McGill University, Canada: 2006	Department of Chemistry, Faculty of Science
17	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Soraya Pornsuwan	Ph.D. (Chemistry) University of Pittsburgh, USA: 2007 M.Sc. (Chemistry) University of Wisconsin-Madison, USA: 2001 B.Sc. (Chemistry) Mahidol University: 1997	Department of Chemistry, Faculty of Science
18	x-xxxx-xxxxx-xx-x Assistant Professor Dr. Supavadee Kiatisevi	Dr.rer.nat. (Chemie) Universität Stuttgart: 2004 Diplom-Chemikerin Universität Stuttgart: 2000 B.Sc. (Chemistry) Mahidol University: 1995	Department of Chemistry, Faculty of Science
19	x-xxxx-xxxxx-xx-x Lecturer Dr. Nopporn Ruangsupapichat	Ph.D. (Organic Chemistry) University of Groningen, the Netherlands: 2011 M.Sc. (Organic Chemistry) Mahidol University: 2006 B.Sc. (Chemistry) Mahidol University: 2002	Department of Chemistry, Faculty of Science



No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
20	x-xxxx-xxxxx-xx-x Lecturer Dr. Pawaret Leowanawat	Ph.D. (Chemistry) University of Pennsylvania, USA: 2013 B.Sc. (Chemistry) Mahidol University: 2004	Department of Chemistry, Faculty of Science
21	x-xxxx-xxxxx-xx-x Lecturer Dr. Phoonthawee Saetear	Ph.D. (Analytical Chemistry) Mahidol University: 2014 M.Sc. (Applied Analytical and Inorganic Chemistry) Mahidol University: 2010 B.Sc. (Chemistry) Mahidol University: 2007	Department of Chemistry, Faculty of Science
22	x-xxxx-xxxxx-xx-x Lecturer Dr. Teera Chantarojsiri	Ph.D. (Chemistry) University of California, Berkeley, USA: 2015 B.Sc. (Chemistry) Stanford University, USA: 2010	Department of Chemistry, Faculty of Science
23	x-xxxx-xxxxx-xx-x Lecturer Dr. Tinnakorn Tiensing	Ph.D. (Environmental Science) University of Aberdeen, Scotland, UK: 2002 M.Sc. (Applied Analytical and Inorganic Chemistry) Mahidol University: 1997 B.Sc. (Chemistry) Mahidol University: 1995	Department of Chemistry, Faculty of Science
24	x-xxxx-xxxxx-xx-x Lecturer Dr. Torsak Luanphaisarnnont	Ph.D. (Chemistry) Harvard University, USA: 2012 M.A. (Chemistry) Harvard University, USA: 2008 B.S. (Chemistry) Massachusetts Institute of Technology, USA: 2005	Department of Chemistry, Faculty of Science

### 3.2.3 Part-Time Instructors

No.	ID Card Number Academic Position Full Name	Degree (Major) Institution: Graduation Year	Department
1	x-xxxx-xxxxx-xx-x Professor Dr. Juwadee Shiowatana	Ph.D. (Analytical Chemistry) University of New South Wales, Australia: 1986 B.Eng., M.Sc. Tokyo Institute of Technology: 1975	Retired faculty member of the Department of Chemistry, Faculty of Science, Mahidol University
2	x-xxxx-xxxxx-xx-x Associate Professor Dr. Prapin Wilairat	Ph.D. (Physical Chemistry) University of Kent at Canterbury, UK: 1975 M.S. (Physical Chemistry) University of California, USA: 1970 B.Sc. (Chemistry) Australian National University, Australia: 1967	Retired faculty member of the Department of Chemistry, Faculty of Science, Mahidol University
3	x-xxxx-xxxxx-xx-x Dr. Waret Veerasai	Dr.rer.nat. (Physical Inorganic Chemistry) University of Innsbruck, Austria: 1981 M.Sc. (Physical Chemistry) Mahidol University: 1975 B.Sc. (Chemistry) Chiang Mai University: 1973	Retired faculty member of the Department of Chemistry, Faculty of Science, Mahidol University

#### 4 Details of Practicum

-None-

#### 5 Dissertation Requirement

##### 5.1 Short Description

Basic or applied research that presents original, in-depth knowledge and new contribution to the chosen field, as well as demonstrating good scientific ethics.

## 5.2 Standard Learning Outcomes (or Program Learning Outcomes or PLOs)

Upon completion of the dissertation, students

- 5.2.1 adhere to scientific ethics and respect rules and regulations of the program and the institution;
- 5.2.2 attain English speaking, listening, reading, and writing skills to communicate with others on advanced research topics;
- 5.2.3 are able to correctly explain advanced principles, theories, and chemical research in selected discipline;
- 5.2.4 are able to describe principles of operation and select appropriate scientific equipment for specific tasks;
- 5.2.5 are able to conduct experiments and evaluate the resulting data;
- 5.2.6 possess good working discipline and teamwork skills;
- 5.2.7 are able to choose appropriate information technology platforms that suit their research inquiries, analyze numerical data, and use basic statistics in a research project;
- 5.2.8 are able to propose hypotheses and design suitable experiments to verify them; and
- 5.2.9 are able to evaluate the relationship among chemical research, innovation, and society.

## 5.3 Timeframe

Students may start performing dissertation work in the first semester (Plan 1.1) or the second semester (Plans 2.1 and 2.2) of the first academic year.

## 5.4 Number of Credits

- 5.4.1 For students holding M.Sc. degree (Plan 1.1): 48 credits
- 5.4.2 For students holding M.Sc. degree (Plan 2.1): 36 credits
- 5.4.3 For students holding B.Sc. degree (Plan 2.2): 48 credits

## 5.5 Preparation

- 5.5.1 The faculty members in the program inform the students about available research areas and/or topics.
- 5.5.2 The students choose their research advisors and together develop research topics.

5.5.3 The students plan out their research projects under the supervision of their research advisors.

5.5.4 The students prepare their research proposals, undertake proposal examinations, and acquire dissertation advisory committees.

## 5.6 Evaluation Process

A qualifying examination is held in order to evaluate a student's academic competency, which can take place in the first semester (Plan 1.1) or the second semester (Plans 2.1 and 2.2) of the first academic year. The dissertation proposal examination must be held within 2 semesters of first registering for the dissertation. After passing the proposal examination, the progress of the dissertation is evaluated by an advisor twice a year and by presenting the work to the faculty at the end of each academic year. Once the dissertation is completed, a dissertation examination committee that consists of at least 5 members, one of which is an external expert, evaluates the work. One (for Plans 2.1 and 2.2) or two (for Plan 1.1) of research articles derived from the dissertation must be published in domestic or international journals.

## Section 4 Learning Outcome, Teaching Strategies, and Evaluation

### 1. Development of Students' Specific Qualifications

Special Characteristics	Teaching Strategies or Student Activities
<p>1. Graduates have good moral understanding and conform to scientific ethics.</p>	<ol style="list-style-type: none"> <li>1. Integrate the teaching on ethics and morality into courses and the thesis period.</li> <li>2. Provide advices, directly or indirectly, to students on social etiquettes in classes and during the thesis period.</li> <li>3. Encourage students to work as teaching assistants, at least once during their study in the program.</li> </ol>
<p>2. Graduates possess comprehensive knowledge and experience in chemistry for their future careers in private and government sectors.</p>	<ol style="list-style-type: none"> <li>1. Provide courses of fundamental and advanced principles, as well as courses that offer broad perspective and experience.</li> <li>2. Offer opportunities for short-term research visit at international institutions.</li> <li>3. Provide support during the thesis period via advisory thesis committee.</li> <li>4. Provide several platforms for oral presentations, at least once every year.</li> </ol>
<p>3. Graduates have capability of making well-informed decisions, conducting a task effectively, and creating original work.</p>	<ol style="list-style-type: none"> <li>1. Encourage students to work as teaching assistants, at least once during their study in the program.</li> <li>2. Offer opportunities for short-term research visit at international institutions at least once during their study in the program, depending on funding availability.</li> <li>3. Provide support during the thesis period via advisory thesis committee.</li> <li>4. Provide several platforms for oral presentations, at least once every year.</li> </ol>

Special Characteristics	Teaching Strategies or Student Activities
4. Graduates show good responsibility and are able to work as a team.	1. Encourage students to work as teaching assistants, at least once during their study in the program. 2. Provide courses that offer group tasks. 3. Provide support during the thesis period via advisory thesis committee.
5. Graduates attain analytical, communication, and information technology skills that enable them to compete at the international level.	1. Encourage students to work closely with research advisors. 2. Provide support during the thesis period via advisory thesis committee. 3. Organize seminars or workshops in English and information technology and database, at least once every semester. 4. Offer opportunities for short-term research visit at international institutions at least once during their study in the program, depending on funding availability. 5. Provide support for students to present their work at academic conferences at least once during their study in the program.

## 2. Learning Outcome in Each Area

The program strictly conforms to the quality assurance guided by the Thai Qualifications Framework for Higher Education (TQF) 2015. Thus, to successfully produce graduates according to the program objectives (in Section 2) or the Specific Qualifications of Students stated above, the TQF learning outcomes for the program are formulated as shown below.

Learning Outcome	Teaching Strategy	Evaluation Strategy
<b>1. Morality and Ethics</b> 1.1 Have professional integrity and compassion. 1.2 Have self-discipline and self-	1.1 Give advice, directly or indirectly, during the teaching of the courses and the dissertation	1.1 Observe and make record of punctuality for class attendance and

Learning Outcome	Teaching Strategy	Evaluation Strategy
responsibility. 1.3 Respect rules and regulations of the program and institution. 1.4 Possess professional ethics.	period. 1.2 Give a clear timeline emphasis on assignments and class attendance. 1.3 Organize an orientation to new students to inform them of rules and regulations in the program and the university. 1.4 Arrange group activities and encourage group assignments in relevant courses.	assignments. 1.2 Monitor students' behavior. 1.3 Allow students to self-evaluate. 1.4 Evaluate the performance of group activities or assignments.
<b>2. Knowledge</b> 2.1 Possess basic knowledge, theories and concepts, and in-depth understanding of relevant chemical research. 2.2 Remain updated on new research advances. 2.3 Can disseminate knowledge and research findings to the public at an international level.	2.1 Courses 2.2 Seminars and class discussion 2.3 Practices on academic writing 2.4 Dissertation period that includes proposal, progress report, and defense 2.5 Participation in national or international academic conference 2.6 Manuscript preparation	2.1 Course evaluation, as well as dissertation proposal examinations and defense 2.2 Evaluation of students' works or seminar presentations 2.3 Record of conference participations 2.4 Qualifying examinations 2.5 Publication of manuscript in an international journal
<b>3. Intellectual Development</b> 3.1 Systematically plan the experiments and perform analysis. 3.2 Solve problems analytically and logically. 3.3 Understand a contribution of a research finding toward a	3.1 Courses 3.2 Seminars and group discussion 3.3 Scientific report 3.4 Dissertation period that includes proposal, progress report, and defense	3.1 Course evaluation, as well as dissertation proposal examination and defense 3.2 Evaluation of students' works or seminar presentations

Learning Outcome	Teaching Strategy	Evaluation Strategy
broader chemical knowledge. 3.4 Apply academic knowledge to real-life situations or events.	3.5 Manuscript preparation	3.3 Qualifying examinations 3.4 Publication of manuscript in an international journal
<b>4. Interpersonal Skills and Responsibility</b> 4.1 Be open-minded toward different opinions and possess good human relations. 4.2 Be responsible for assigned task and duty. 4.3 Be a constructive team member in various roles.	4.1 Seminars and group discussion 4.2 Group assignments 4.3 Dissertation period that includes proposal, progress report, and defense	4.1 Monitor students' behavior. 4.2 Evaluation of group performance 4.3 Evaluation by peers 4.4 Dissertation proposal examination and defense
<b>5. Skills in Numerical Analysis, Communication, and Information Technology</b> 5.1 Record and analyze data using appropriate technology. 5.2 Choose appropriate information technology platforms that suit research inquiry. 5.3 Use English speaking, listening, reading, and writing skills to communicate with others. 5.4 Analyze numerical data and use basic statistics correctly. 5.5 Communicate chemical information to other people effectively by using appropriate media.	5.1 Group research and assignment using information technology 5.2 Dissertation period that includes proposal, progress report, and defense 5.3 Participation in the national or international conferences 5.4 Workshops on English skills	5.1 Group reports 5.2 Dissertation progress reports, proposal examination, and defense 5.3 Record of conference participations 5.4 Examinations and self-evaluation

The curriculum detailed in this document was developed with a concept of outcome-based education provided by the ASEAN University Network–Quality Assurance



(AUN-QA) guidelines. Consistent with the AUN-QA, the program conducted a survey for different opinions from students, faculty, and employers in order to formulate a set of program learning outcomes (PLOs). Key information gained from the survey and the implementation of obtained PLOs are shown in Appendix C. The PLOs serve as a critical measure that can guide the operation of the program to achieve its objectives. The PLOs are closely aligned with the TQF learning outcomes stated above, the alignment of which can be found in Appendix D. The PLOs of this program are shown below.

### 2.1 Program Learning Outcomes

- 2.1.1 Graduates adhere to scientific ethics and respect rules and regulations of the program and the institution.
- 2.1.2 Graduates are able to use English speaking, listening, reading, and writing skills to communicate with others on advanced research topics.
- 2.1.3 Graduates are able to correctly explain advanced principles, theories, and chemical research in selected discipline.
- 2.1.4 Graduates are able to describe principles of operation and select appropriate scientific equipment for specific tasks.
- 2.1.5 Graduates are able to conduct experiments and evaluate the resulting data.
- 2.1.6 Graduates possess good working discipline and teamwork skills.
- 2.1.7 Graduates are able to choose appropriate information technology platforms that suit their research inquiries, analyze numerical data, and use basic statistics in a research project.
- 2.1.8 Graduates are able to propose hypotheses and design suitable experiments to verify them.
- 2.1.9 Graduates are able to evaluate the relationship among chemical research, innovation, and society.

### 3. Curriculum Mapping

The curriculum mapping according to the TQF is shown in Appendix E.

## Section 5 Criteria for Student Evaluation

### 1. Grading System

Students receive grades according to the criteria stated in Mahidol University's regulations on graduate studies.

### 2. Evaluation Process for the Learning Outcomes of Students

#### 2.1 Evaluation Process during Students' Undertaking of the Program

- 2.1.1 The evaluation process for the learning outcomes is formally stated as part of the quality assurance system of Mahidol University.
- 2.1.2 The evaluation process for each active course is conducted by a committee that consists of full-time instructors and/or selected experts.
- 2.1.3 The evaluation process for the entire program is conducted by full-time faculty members and the program committee.

#### 2.2 Evaluation Process after Students' Graduation

Students' career after graduation is emphasized. The specific aspects of the students' career used in the evaluation are:

- 2.2.1 the employment status;
- 2.2.2 work performance;
- 2.2.3 level of satisfaction of the employers; and
- 2.2.4 award or certificate of compliment received in, for example, ethics, knowledge, performance, human relations, responsibility, communications, decision making, and technological capability.

### 3. Requirements for Graduation

Requirement	Plan 1	Plan 2	
		M.Sc. Student	B.Sc. Student
Time of study	The duration of study shall not exceed the study plan	The duration of study shall not exceed the study plan	The duration of study shall not exceed the study plan
Credit requirement	48 credits of dissertation	At least 12 credits of courses and 36 credits of dissertation	At least 30 credits of courses and 48 credits of dissertation

Requirement	Plan 1	Plan 2	
		M.Sc. Student	B.Sc. Student
GPA requirement	-	At least 3.00 upon completion of all courses	At least 3.00 upon completion of all courses
English proficiency	As required by the Faculty of Graduate Studies	As required by the Faculty of Graduate Studies	As required by the Faculty of Graduate Studies
Soft skills	Fulfill soft skill training in each of the following areas: language and communication, leadership, research, and information technology	Fulfill soft skill training in each of the following areas: language and communication, leadership, research, and information technology	Fulfill soft skill training in each of the following areas: language and communication, leadership, research, and information technology
Qualifying Examination	Pass	Pass	Pass
Dissertation	Pass proposal and defense examinations	Pass proposal and defense examinations	Pass proposal and defense examinations
Publication from dissertation	At least 2 publications in international journals	At least 1 publication in an international journal	At least 1 publication in an international journal

## Section 6 Faculty Development

### 1. Orientation for New Faculty

A more senior faculty member helps mentor a new member on teaching, research, and grant applications.

### 2. Development of Skills and Knowledge for the Faculty

#### 2.1 Skill Development in Teaching and Evaluation

- 2.1.1 Encourage the faculty to develop skills on teaching and learning methods.
- 2.1.2 Encourage the faculty, and provide support when necessary, to participate in workshops on teaching and curriculum development that are organized by Mahidol University and other institutions.

#### 2.2 Other Academic and Professional Skills

- 2.2.1 Encourage the faculty to participate in national or international conferences and workshops on a regular basis.
- 2.2.2 Encourage the faculty to engage in academic services, such as invited speakers or lecturers, research grant reviewers, committee members of professional societies, and academic article contributors.

## Section 7 Quality Assurance

### 1. Quality Assurance of the Curriculum

The management of the program is carried out by the program committee, which consists of a director and full-time faculty members oversighted by the dean of the Faculty of Graduate Studies and also works closely with the dean of the Faculty of Science. Administration of the teaching is done in collaboration with the administrators of the Faculty of Science. The curriculum is continuously monitored by the program committee, the information collected from which will be used in the revision process of the curriculum scheduled once every 5 years.

Objective	Action	Evaluation
1. To become a progressive program, where students and faculty have strong proficiency in chemistry.	1.1 Develop the curriculum in accordance with the Thai Qualifications Framework for Higher Education 2015. 1.2 Require all instructors to hold a doctoral degree. 1.3 Encourage all instructors to master academically.	1.1 The curriculum is reviewed by the committee on curriculum restructuring, the Faculty of Graduate Studies, and the university council. 1.2 Keep database of the faculty in the program. 1.3 Review academic performance of the instructors.
2. To make sure that the curriculum is high quality.	2.1 Continuously monitor and conduct the revision of the curriculum once every 5 years.	2.1 The quality of students is regularly assessed by all advisors and, after graduation, the information from both students and employers will be collected on a regular basis.
3. To motivate students to have a desire for learning.	3.1 Require students to perform teaching assistant	3.1 Feedback from undergraduate students

Objective	Action	Evaluation
4. To evaluate the program on a regular basis.	(TA) duty for at least 1 semester prior to graduation. 4.1 Appoint a committee that includes external experts to assess the curriculum. 4.2 Maintain a database of students, faculty, research, budget, and international collaboration for quality assessment whenever needed. 4.3 Survey for opinions from graduates and employers.	taking the class is used to assess a TA's attitude toward teaching others. 4.1 Keep record of the meeting for the curriculum assessment. 4.2 Regularly check the completeness of the database. 4.3 Check for the evidence and information of the survey.

## 2. Graduates

### 2.1 Quality of Graduates in Accordance with the Thai Qualifications Framework for Higher Education 2015

The program plans to conduct regular surveys on the needs of employers and their satisfaction with graduates. The results from all of these surveys will be used in the next revision of the curriculum.

### 2.2 Employment and Research Output of the Graduates

Upon completion of the curriculum, graduates will acquire academic competency and professional skills that will empower them for future workforce in various capacity, such as an academic or research personnel at government or private sector, a researcher or faculty at university or research institution, and even an entrepreneur of their own choices. The program plans to conduct regular surveys on the status of our graduates after completing the degree. The number of scientific conference proceedings, national and international journals resulting from the thesis or parts of the thesis will be collected regularly.

### 3. Students

#### 3.1 Admission of Students

Qualification of prospective students is described in Topic 2.2 of Section 3. Under supervision of an advisor, a student may be recommended to take college chemistry courses whenever necessary. Seminar or workshops in information technology and database are organized. Student-organized events, such as off-campus orientation camp are arranged to help students adapt to graduate study and the new atmosphere. Peer-to-peer mentoring system is promoted among students to provide needed support.

#### 3.2 Student Support and Development

The program provides courses of fundamental and advanced principles, as well as courses that offer broad perspective and experience. Compulsory courses on English and communication skills, as well as regular English workshops are provided for continuous language skill development of the students. The teaching on ethics and morality is integrated into courses and the thesis period. Several platforms for oral presentations for students are provided to develop good communication skills and human relations. Students will be encouraged to work as teaching assistants. The program also supports students to present their works at academic conferences and to conduct short-term research visits at respectable institutions. Students will be encouraged to publish their findings in quality journals.

#### 3.3 Student Performance

The number of students enrolled and graduated will be collected each year. The surveys on student satisfaction will be conducted. If students question grading in any of the courses, they have a right to review their exam papers and grades. In addition, students also have a right to file complaints directly to dean of the Faculty of Graduate Studies.

### 4. Faculty Members

#### 4.1 Management and Development of the Faculty Members

General requirements for the recruitment of new faculty members are set according to the regulations of Mahidol University. Any new faculty member needs to have a doctoral degree in chemistry or related field, extensive research experience, good teaching skill, and adequate English proficiency. After an initial

contact with the department, a candidate for a faculty position is invited to give a seminar and hold a trial teaching session. After an interview with the candidate, the department summons a meeting to make final decision on the candidate. A more senior faculty member helps mentor a new member on teaching, research, and grant applications.

The faculty members are encouraged to develop skills on teaching and learning methods. The program encourages and provides support, when necessary, for the faculty to participate in workshops on teaching and curriculum development that are organized by Mahidol University and other institutions. The faculty is encouraged to participate in national or international conferences and workshops on a regular basis. The faculty is also encouraged to engage in academic services, such as invited speakers or lecturers, research grant reviewers, committee members of professional societies, and academic article contributors.

#### **4.2 Quality of the Faculty Members**

All faculty members and instructors of the curriculum hold a doctoral degree (Topic 3.2 of Section 3). The number of scientific conference proceedings and national and international journals published by the faculty of the curriculum will be recorded regularly.

#### **4.3 Faculty Performance**

The number of the faculty members and instructors of the curriculum will be recorded each year. The surveys on faculty satisfaction will be conducted.

### **5. Curriculum, Teaching Methods, and Student Evaluation**

#### **5.1 Details of the Curriculum**

The program provides in-depth knowledge that instills expertise of relevant fields for the students. At the same time, the training in the program should also cover a broader aspect of personal development, such as communication and interpersonal skills. A good understanding of cultural differences would prepare the students well for working in a diverse society. The full-time instructors of the program and contributing faculty have joint meetings in order to plan and improve teaching and learning methods by using the results of students' evaluations of instructors in order to review and assess the curriculum.



Regarding to the thesis requirement, the faculty members in the program inform the students about available research areas and/ or topics. The students choose their research advisors and together develop research topics. The students plan out their research projects under the supervision of their research advisors. The students need to pass a qualifying examination, prepare their research proposal, undertake proposal examination, and acquire dissertation advisory committee. After passing the proposal examination, the progress of the dissertation work is evaluated twice a year. Once the dissertation is completed, a dissertation examination committee that consists of at least 5 faculty members—one of which needs to be an external expert and also chairs the examination—evaluates the work. The dissertation work or part of it must be published in international journals.

### **5.2 Instructor Specifications and Teaching Methods**

All faculty members have a doctoral degree in chemistry or related field, extensive research experience, good teaching skill, and adequate English proficiency. Course coordinators may invite guest lecturers when necessary, pending approval of the program director. Guest lecturers must either have doctoral degrees or extensive experience in fields relevant to the teaching.

General advisors are appointed according to the program director's suggestion to provide counseling to the first-year students on study plan and course registration. Once the dissertation proposals are approved, research advisors are appointed to provide guidance on dissertation works. The evaluation process for the entire program is conducted by full-time faculty members and the program committee.

### **5.3 Student Evaluation**

Students receive grades according to the criteria stated in Mahidol University's regulations on graduate studies. The evaluation process for the learning outcomes is formally stated as part of the quality assurance system of Mahidol University. The evaluation process for each active course is conducted by a committee that consists of full-time instructors and/or selected experts.

Total time of study should not exceed 6 or 8 academic years for students holding M.Sc. or B.Sc., respectively. Students must fulfill the course credit requirement. Students must have a minimum of 3.00 GPA upon the completion of all courses. The English requirement set by the Faculty of Graduate Studies is

fulfilled. Students must pass dissertation examination. The dissertation work (or part of it) must be published (or accepted for publication) in international scientific journals.

## **6. Teaching Materials and Resources**

### **6.1 Budget**

The Faculty of Science and the Faculty of Graduate Studies provide both annual and quarter budgets for purchasing an adequate number of books, teaching and learning media, visual aids, and teaching aids. The Department of Chemistry also helps provide books, teaching and learning media, as well as sufficient internet access for a suitable environment for learning.

### **6.2 Utilization of Available Resources**

The Central Library and the Faculty of Science Library together provide abundant books, both electronic and hardcopy, as well as subscription to various journals and databases. The faculty and the department also provide learning resources, such as computers, visual projectors, high-speed internet via local area network, and sufficient wireless internet access. In addition, the faculty and the department regularly maintain lecture rooms and laboratory spaces of various capacity to accommodate teaching activities.

### **6.3 Search for More Resources**

The program regularly collaborates with the Faculty of Science Library on the expansion of book and journal collections. The Faculty of Science can also allocate budget for learning space construction when demanded; just recently, the Faculty of Science Library started offering new learning spaces equipped with high-speed internet access and multimedia resources, to which all students and staff members in the program have access.

### **6.4 Evaluation on the Adequacy of the Resources**

The Faculty of Science Library annually conducts survey for the need of additional resources, such as books and journal subscriptions. The faculty's staff members are always on standby to assist the instructors and the students on audio and visual equipment. An online course evaluation system is available to collect feedback from students twice a year.

## 7. Key Performance Indicators

The key performance indicators (KPIs) numbered 1 to 5 in the following table are the required KPIs of the program that need to be fulfilled for at least two consecutive years. The program also expects that at least 80% of all KPIs in the following table will be fulfilled in each year.

Key Performance Indicator	Academic Year				
	2018	2019	2020	2021	2022
1. At least 80% of instructors responsible of the curriculum participate in meetings that set up plans to evaluate and revise the curriculum.	✓	✓	✓	✓	✓
2. The program must have the details of the curriculum reported in TQF2, which is associated with the Thai Qualifications Framework for Higher Education.	✓	✓	✓	✓	✓
3. The program must have course specifications according to TQF3 before the beginning of each semester.	✓	✓	✓	✓	✓
4. Instructors must produce course reports according to TQF5 within 30 days after the end of each semester.	✓	✓	✓	✓	✓
5. Instructors must produce program reports according to TQF7 within 60 days after the end of the academic year	✓	✓	✓	✓	✓
6. Instructors must revise the grading of students according to learning standards indicated in TQF3 for at least 25 percent of the courses that are offered in each academic year.	✓	✓	✓	✓	✓
7. Instructors must use the evaluation results in TQF7 of the previous academic year to assess the teaching methods, the teaching techniques, or the grading system.	-	✓	✓	✓	✓

Key Performance Indicator	Academic Year				
	2018	2019	2020	2021	2022
8. All new instructors (if any) have to participate in the orientation and receive adequate advice on the teaching requirements.	✓	✓	✓	✓	✓
9. Full-time instructors of the program must participate in activities related to academic and/or professional improvement at least once a year.	✓	✓	✓	✓	✓
10. At least 50% of the supporting staff (if any) must participate in activities related to academic and/or professional improvement at least once a year.	✓	✓	✓	✓	✓
11. The level of satisfaction given by new graduates and senior-year students toward curriculum quality has an average score of at least 3.5 out of 5.	-	-	✓	✓	✓
12. The level of satisfaction given by employers of new graduates has an average score of at least 3.5 out of 5.	-	-	-	✓	✓

## Section 8 Evaluation and Improvement of the Curriculum Implementation

### 1. Evaluation on the Teaching Efficiency

#### 1.1 Evaluation of Teaching Strategies

- 1.1.1 Provide online system for students' evaluation toward courses and instructors.
- 1.1.2 Organize meetings for full-time faculty members of the program and instructors to discuss about the evaluation results and teaching strategies.

#### 1.2 Evaluation of Instructors' Skills in Using Teaching Strategies

- 1.2.1 Provide online system for students' evaluation toward courses and instructors.
- 1.2.2 Collect feedback from course coordinators, program director, and/or other instructors within or outside the program.

### 2. Evaluation of the Curriculum in General

To obtain the overall picture of the curriculum, the program provides an evaluation platform for the following stakeholders:

- 2.1 Current students and graduates
- 2.2 Instructors
- 2.3 External experts
- 2.4 Employers or relevant users of the graduates

### 3. Evaluation of the Curriculum Implementation Specified in the Curriculum

The evaluation is made annually by the program faculty members and the instructors according to the KPIs in Item 7 of Section 7.

### 4. Review of the Evaluation and Plans for Improvement

- 4.1 Collect the evaluation results and suggestions made by students, graduates, instructors, employers, and external experts.
- 4.2 The program committee analyzes the above evaluation results.
- 4.3 A set of recommendations are proposed and discussed among the program faculty and instructors.



Attachment  
Appendix A Course Descriptions

(1) Compulsory Courses

Credit (lecture-practice-self-study)

SCCH 701 Frontiers in Chemistry 3 (3-0-6)

วทคม ๗๐๑ เคมีแนวหน้า

Integrated learning from recent and most advanced selected achievements in a broad spectrum of chemistry; relevancy and significance of interdisciplinary knowledge for problem-solving in chemistry

การเรียนรู้ในเชิงบูรณาการจากหลากหลายสาขาของเคมีขั้นสูงในปัจจุบัน ความสัมพันธ์และ  
ความสำคัญของการใช้ความรู้ในลักษณะสหสาขาเพื่อนำมาแก้ปัญหาทางเคมี

SCCH 702 Chemical Safety and Risk Management 1 (1-0-2)

วทคม ๗๐๒ ความปลอดภัยทางเคมีและการจัดการความเสี่ยง

Chemical hygiene plan; hazard communication; safety data sheet; chemical labeling; personal protective equipment; preparation for emergencies; chemical storage and chemical usage; laboratory design; handling of hazardous materials; fire safety; waste management; risk management; related regulations

แผนสุขอนามัยเคมี การสื่อสารเกี่ยวกับสารอันตราย เอกสารความปลอดภัยของสารเคมี การเขียนฉลากสารเคมี อุปกรณ์ป้องกันภัยส่วนบุคคล การเตรียมตัวในสถานะฉุกเฉิน การเก็บและการใช้สารเคมี การออกแบบห้องปฏิบัติการ การปฏิบัติกับสารอันตราย ความปลอดภัยทางอัคคีภัย การจัดการของเสีย การจัดการความเสี่ยง กฎหมายที่เกี่ยวข้อง

SCCH 703 Scientific Communications 1 (1-0-2)

วทคม ๗๐๓ การสื่อสารทางวิทยาศาสตร์

Scientific communication skills; techniques in presenting research findings and writing scientific articles; research ethics and proper research conduct; access of bibliographic databases; small-group workshops; research grant writing

ทักษะการสื่อสารทางวิทยาศาสตร์ เทคนิคการนำเสนอผลงานวิจัยและการเขียนบทความวิจัยทางวิทยาศาสตร์ จริยธรรมการวิจัยและข้อประพฤติการทำงานวิจัยที่พึงาม วิธีการสืบค้นข้อมูล ปฏิบัติการกลุ่มย่อย การเขียนข้อเสนอโครงการวิจัย

## Credit (lecture-practice-self-study)

## SCCH 704 Seminar in Chemistry

1 (1-0-2)

## วทคม ๗๐๔ สัมมนาทางเคมี

Seminar on new findings and modern research topics in chemistry; subjects from published peer review publications or document; presentation and scientific explanation skills

สัมมนาในหัวข้อที่ค้นพบใหม่และหัวข้อวิจัยที่ทันสมัยทางเคมี เนื้อหาจากวารสารหรือเอกสารวิชาการ ทักษะการนำเสนอและตอบข้อซักถาม

## SCCH 705 Progress in Chemistry

3 (3-0-6)

## วทคม ๗๐๕ ความก้าวหน้าทางเคมี

Systematic learning process towards a better understanding of a topic of interest in chemistry in a broad and in-depth level; information seeking, critical identification and analysis for obtaining useful literatures; writing summary from the cited literatures directly related to thesis or research questions being developed

กระบวนการเรียนรู้อย่างเป็นระบบ เพื่อความเข้าใจยิ่งขึ้นเกี่ยวกับหัวข้อเคมีที่น่าสนใจทั้งในเชิงกว้างและเชิงลึก การค้นหาข้อมูล การบ่งชี้และการวิเคราะห์เชิงวิพากษ์ข้อมูลสืบค้นที่เป็นประโยชน์ การเขียนบทสรุปจากเอกสารอ้างอิงซึ่งสัมพันธ์โดยตรงกับคำถามเกี่ยวข้องกับวิทยานิพนธ์ หรืองานวิจัยที่จะทำในอนาคต

## SCCH 706 Research Skill Development I

3 (3-0-6)

## วทคม ๗๐๖ การพัฒนาทักษะการวิจัย ๑

Vital parts for promoting development of generic research skills in line with framework of 21st century learning; research project planning, time/project management, and writing/presentation skills

องค์ประกอบสำคัญซึ่งส่งเสริมการพัฒนาทักษะด้านงานวิจัยทั่วไปตามแนวทางรูปแบบการเรียนรู้แบบศตวรรษที่ ๒๑ การวางแผนโครงการวิจัย การบริหารจัดการด้านเวลา/การดำเนินโครงการวิจัย การเขียนและนำเสนอผลงาน

## SCCH 707 Research Skill Development II

3 (3-0-6)

## วทคม ๗๐๗ การพัฒนาทักษะการวิจัย ๒

Specialized research skills and competencies; systematic planning, critical thinking, effective communication, leadership and working with others

ทักษะวิจัยเฉพาะทาง และ สมรรถนะเฉพาะตามสายอาชีพ การวางแผนอย่างเป็นระบบ การคิดเชิงวิพากษ์ การสื่อสารอย่างมีประสิทธิภาพ ภาวะความเป็นผู้นำ และการทำงานร่วมกับผู้อื่น



## Credit (lecture-practice-self-study)

- SCCH 708 Special Problems in Chemistry** 3 (3-0-6)  
**วทคม ๗๐๘ ปัญหาพิเศษทางเคมี**  
 Comprehension of new findings and modern research topics in chemistry  
 หัวข้อที่ค้นพบใหม่และหัวข้อวิจัยที่ทันสมัยทางเคมี
- SCCH 711 Organic Structure Determination** 3 (3-0-6)  
**วทคม ๗๑๑ การหาโครงสร้างของสารอินทรีย์**  
 Fundamental and advanced aspects of characterization methods in organic spectroscopy; application in compound characterization and structure elucidation  
 พื้นฐานหลักการและวิธีการขั้นสูงในการศึกษาโมเลกุลด้วยเทคนิคทางสเปกโทรสโกปีสำหรับสารอินทรีย์ การประยุกต์ใช้ในการศึกษาลักษณะและการหาโครงสร้างของโมเลกุล
- SCCH 712 Molecular Structures and Functions** 3 (3-0-6)  
**วทคม ๗๑๒ โครงสร้างและหน้าที่ระดับโมเลกุล**  
 Factors that influence molecular structures and functions; conformational analysis; reaction mechanisms and reactive intermediates; stereoelectronic effects; molecular orbitals and reactions; pericyclic reactions by thermal or photo processes  
 ปัจจัยที่มีผลต่อโครงสร้างและหน้าที่ของโมเลกุล การวิเคราะห์เชิงคอนฟอร์เมชัน กลไกและสารมัธยันตร์ของปฏิกิริยา ผลทางสเตอริโออิเล็กทรอนิกส์ โมเลกุลาร์ออร์บิทัลและการเกิดปฏิกิริยา ปฏิกิริยาเพอร์ไซคลิกโดยกระบวนการผ่านความร้อนหรือแสง
- SCCH 731 Advanced Techniques in Analytical Chemistry** 3 (3-0-6)  
**วทคม ๗๓๑ เทคนิคทางเคมีวิเคราะห์ขั้นสูง**  
 Recent developments in atomic and molecular spectrometry; mass spectrometry; electrochemical techniques  
 พัฒนาการใหม่ๆ ทางสเปกโทรสโกปีของอะตอมและโมเลกุล แมสสเปกโตรเมตรี เทคนิคทางเคมีไฟฟ้า
- SCCH 732 Instrumental Analysis Laboratory** 3 (1-6-4)  
**วทคม ๗๓๒ ปฏิบัติการห้องทดลองการวิเคราะห์โดยอุปกรณ์**  
 Laboratory of modern analytical instruments; atomic absorption spectrophotometers; inductively coupled plasma mass spectrometer; inductively coupled plasma optical

emission spectrometer; electroanalytical instruments; high performance liquid chromatography; gas chromatograph; capillary electrophoresis, microfluidic analysis, construction of flow injection analysis systems

ปฏิบัติการห้องทดลองการใช้เครื่องมือวิเคราะห์สมัยใหม่ อะตอมมิคแอบซอร์พชันสเปกโทรโฟโตมิเตอร์ อินดักทีฟพลาสมาแมสสเปกโตรมิเตอร์ อินดักทีฟพลาสมาออปติคัลอิมิสชันสเปกโตรมิเตอร์ เครื่องมือวิเคราะห์ทางไฟฟ้า เครื่องโครมาโทกราฟีของเหลวสมรรถนะสูง เครื่องแก๊สโครมาโทกราฟี การติดตั้งระบบวิเคราะห์แบบอัตโนมัติ

Credit (lecture-practice-self-study)

SCCH 763 Inorganic Structure and Bonding 3 (3-0-6)

วทศ ๗๖๓ โครงสร้างอินทรีย์และพันธะเคมี

Atomic structure; electronic properties of atoms and molecules; diatomic molecules; polyatomic molecules; transition metal complexes; bonding in solids

โครงสร้างอะตอม คุณสมบัติทางอิเล็กทรอนิกส์ของอะตอมและโมเลกุล โมเลกุลอะตอมคู่ โมเลกุลพหุอะตอม สารเชิงซ้อนแทรนซิชัน พันธะในของแข็ง

SCCH 764 Characterization Techniques in Inorganic Chemistry 3(3-0-6)

วทศ ๗๖๔

เทคนิค

การพิสูจน์เอกลักษณ์ในเคมีอินทรีย์

Fundamental aspects of characterization methods in inorganic chemistry: spectroscopy, microscopy and crystallography

หลักการและการประยุกต์ใช้วิธีพิสูจน์เอกลักษณ์ในเคมีอินทรีย์ สเปกโทรสโกปี จุลทรรศน์ และ ผลึกศาสตร์

SCCH 778 Physico-chemical Techniques 3 (2-3-5)

วทศ ๗๗๘ เทคนิคทางเคมีเชิงฟิสิกส์

Instrumental principles for analysis; methods of physico-chemical measurement employed in contemporary research

หลักการของเครื่องมือที่ใช้ในการวิเคราะห์ แบบแผนของการวัดทางเคมีเชิงฟิสิกส์ที่ใช้ในการทำวิจัยในปัจจุบัน

SCCH 785 Advanced Physical Chemistry 3 (3-0-6)

วทศ ๗๘๕ เคมีเชิงฟิสิกส์ขั้นสูง

Nonlinear analysis; energy materials; magnetic resonance in biological systems; computational chemistry; atmospheric chemistry

การวิเคราะห์ที่ไม่เชิงเส้น วัสดุพลังงาน เรโซแนนซ์แม่เหล็กในระบบทางชีววิทยา เคมีคำนวณ เคมีบรรยากาศโลก

## Credit (lecture-practice-self-study)

SCCH 801 Environmental Materials 3 (3-0-6)

วทศม ๘๐๑ วัสดุเชิงสิ่งแวดล้อม

Materials structure, chemical and physical properties, processing and design; material extraction and resource implications, environmental impacts of materials processing, end-of-life issues; environmental legislation and economic factors; real world examples and case studies of materials design for sustainability

โครงสร้างวัสดุ รวมทั้งสมบัติเชิงเคมี สมบัติเชิงฟิสิกส์ การออกแบบและกรรมวิธีการผลิตวัสดุ การคัดเลือกและการเลือกใช้ทรัพยากรเชิงวัสดุ ผลกระทบด้านสิ่งแวดล้อมซึ่งเนื่องมาจากกรรมวิธีการผลิตวัสดุ หรือวัสดุซึ่งหมดอายุการใช้งาน ปัจจัยด้านเศรษฐกิจและกฎหมายด้านสิ่งแวดล้อม ตัวอย่างและกรณีศึกษาการใช้งานจริงของวัสดุซึ่งได้รับการออกแบบเพื่อความยั่งยืน

SCCH 802 Lignocellulosic Chemistry 3 (3-0-6)

วทศม ๘๐๒ เคมีเชิงลิกโนเซลลูโลส

Lignocellulose as a resource of fuels and chemicals; cellulose, hemicellulose, lignin and extractives; pretreatments of lignocellulose; chemical conversion of lignocellulosic feedstocks; analytical methods

การใช้ลิกโนเซลลูโลสเพื่อผลิตเชื้อเพลิงและสารเคมี เซลลูโลส เฮมิเซลลูโลส ลิกนินและสารสกัดจากลิกนิน การปรับสภาพของลิกโนเซลลูโลสก่อนใช้งาน การเปลี่ยนวัตถุดิบของลิกโนเซลลูโลสเป็นผลิตภัณฑ์ตลอดจนกรรมวิธีวิเคราะห์

## (2) Elective Courses

SCCH 713 Advanced Organic Synthesis 3 (3-0-6)

วทศม ๗๑๓ เคมีอินทรีย์สังเคราะห์ขั้นสูง

Contemporary and modern organic reactions; reactivity; reaction selectivity; utility in the synthesis of organic compounds; structurally complex natural products; bioactive compounds; synthetic design

ปฏิกิริยาเคมีอินทรีย์ร่วมสมัยและทันสมัย ความไวปฏิกิริยา สมรรถนะการเลือกเกิดปฏิกิริยา การนำไปใช้ในการสังเคราะห์สารอินทรีย์ สารจากธรรมชาติที่มีโครงสร้างซับซ้อน สารออกฤทธิ์ทางชีวภาพ การออกแบบการสังเคราะห์

SCCH 714 Advanced Organic Reaction Mechanism 3 (3-0-6)

วทศม ๗๑๔ กลไกปฏิกิริยาเคมีอินทรีย์ขั้นสูง

Analysis of advanced organic reaction mechanisms via electron-pushing principles; class discussion of the proposed reaction mechanisms presenting in current chemistry literatures

การวิเคราะห์กลไกปฏิกิริยาเคมีอินทรีย์ขั้นสูง โดยใช้หลักการการเคลื่อนที่ของอิเล็กตรอน การอภิปรายกลไกปฏิกิริยาที่เสนอในวารสารทางเคมีในปัจจุบัน

Credit (lecture-practice-self-study)

SCCH 715 Frontiers in Medicinal Chemistry 3 (3-0-6)

วทคม ๗๑๕ เคมีทางยาแนวหน้า

Perspectives on the discovery of therapeutics and their developments; search of new lead molecules; kinetics of interactions between the lead molecules and their biological targets; rational design of new therapeutics; advances in combinatorial chemistry; examples of successful developments of drug discovery in pharmaceutical industries

ภาพรวมของการค้นพบและการพัฒนาเภสัชภัณฑ์ การค้นหาสารต้นแบบตัวใหม่ จลนพลศาสตร์ของอันตรกิริยาของสารต้นแบบกับชีวโมเลกุล หลักการออกแบบสารสังเคราะห์ที่มีฤทธิ์ทางชีวภาพ การสังเคราะห์ที่มีประสิทธิภาพขั้นสูง ตัวอย่างการค้นพบและพัฒนาที่ประสบความสำเร็จต่างๆ ในอุตสาหกรรมยา

SCCH 716 Chemical Biology 3 (3-0-6)

วทคม ๗๑๖ เคมีชีววิทยา

Frontier knowledge of chemistry and biology; relationship between small molecules and biomolecules and subsequent effects on biological functions; biosynthesis of bioactive natural products; metabolic engineering; chemical genetics; chemical proteomics; protein design and engineering; emerging topics in related areas

ศาสตร์ทางเคมีและชีววิทยาแนวหน้า ความสัมพันธ์ระหว่างโมเลกุลขนาดเล็กและชีวโมเลกุลผลต่อหน้าที่ทางชีวภาพ ชีวสังเคราะห์ของสารผลิตภัณฑ์ธรรมชาติที่มีฤทธิ์ทางชีวภาพ วิศวกรรมการเผาผลาญ เคมีพันธุกรรม เคมีคัลโปรตีโอมิกส์ วิศวกรรมการออกแบบโปรตีน หัวข้อใหม่ ๆ ที่เกี่ยวข้อง

SCCH 717 Advanced Natural Product Chemistry 3 (3-0-6)

วทคม ๗๑๗ เคมีของสารผลิตภัณฑ์ธรรมชาติขั้นสูง

Chemistry of bioactive natural products; the occurrences and biosynthetic pathways; structure elucidation; biological activities

เคมีของสารผลิตภัณฑ์ธรรมชาติที่มีฤทธิ์ทางชีวภาพ การเกิดและชีวสังเคราะห์ การพิสูจน์โครงสร้างฤทธิ์ทางชีวภาพ

SCCH 718 Asymmetric Synthesis 3 (3-0-6)

วทคม ๗๑๘ การสังเคราะห์แบบอสมมาตร

Asymmetric reactions; selectivity and transition state theory; chiral ligands and chiral catalysts; reaction mechanisms; examples of asymmetric reactions for modern synthesis

ปฏิกิริยาอสมมาตร สมรรถนะการเลือกและทฤษฎีสถานะแทรนซิชัน ไครัลลิแกนต์และตัวเร่งปฏิกิริยาชนิดไครัล กลไกปฏิกิริยา ตัวอย่างของการประยุกต์ปฏิกิริยาแบบอสมมาตรในการสังเคราะห์สมัยใหม่

Credit (lecture-practice-self-study)

SCCH 719 Advanced Heterocyclic Chemistry 3 (3-0-6)

วทคม ๗๑๙ เคมีของสารเฮเทอโรไซคลิกขั้นสูง

Chemical properties and chemical reactions of heterocyclic compounds; advanced study and applications in research

สมบัติทางเคมีและปฏิกิริยาเคมีของสารประกอบเฮเทอโรไซคลิก การศึกษาและการประยุกต์ขั้นสูงในงานวิจัย

SCCH 720 Current Topics in Organic Chemistry 3 (3-0-6)

วทคม ๗๒๐ หัวข้อที่เป็นปัจจุบันทางเคมีอินทรีย์

Current topics with modern and advanced contents related to the field of organic chemistry

หัวข้อที่เป็นปัจจุบันที่ครอบคลุมเนื้อหาทันสมัยที่มีเนื้อหาขั้นสูงเฉพาะทางศาสตร์เคมีอินทรีย์

SCCH 733 Separation Techniques 3 (3-0-6)

วทคม ๗๓๓ เทคนิคการแยก

Separation techniques; instrumentations and applications; high performance liquid chromatography techniques; ion chromatography, capillary electrophoresis; gas chromatography; qualitative and quantitative analysis in chromatographic techniques; sample preparation and extraction techniques

เทคนิคการแยก เครื่องมือและการประยุกต์ เทคนิคโครมาโทกราฟีของเหลวสมรรถนะสูง ไอออนโครมาโทกราฟี โครมาโทกราฟีแบบแยกขนาด คาปิลลารีอิเล็กโตรโฟรีซิส แก๊สโครมาโทกราฟี โครมาโทกราฟีแบบของไหลวิกฤตยิ่งยวด การวิเคราะห์เชิงคุณภาพและเชิงปริมาณด้วยเทคนิคทางโครมาโทกราฟี เทคนิคการเตรียมตัวอย่างและการสกัด

SCCH 734 Fluidic Technology for Analytical Science 3 (3-0-6)

วทคม ๗๓๔ เทคโนโลยีของไหลสำหรับศาสตร์วิเคราะห์

Definitions and theories in fluidics; related technologies; flow pattern in macroscale and microscale; fabrication techniques of microfluidic devices; microfluidics analysis and its applications

นิยามและทฤษฎีของไหล เทคโนโลยีที่เกี่ยวข้อง รูปแบบการไหลในระดับมหภาคและระดับจุลภาค การสร้างอุปกรณ์ต่าง ๆ การวิเคราะห์โดยของไหลจุลภาคและการประยุกต์

**Credit (lecture-practice-self-study)**

**SCCH 735 Chemometrics**

**3 (2-3-5)**

**วทคม ๗๓๕ เคมีเมตริกส์**

Chemometrics; utilization of statistics; data processing for complex chemical analysis; processing of time-based electronic signals; simplex optimization for analytical system; univariate and multivariate calibrations; principle component analysis; partial least squares regression analysis; pattern recognition and classification; modeling; applications of chemometrics

เคมีเมตริกส์ การใช้สถิติ การจัดการข้อมูลเพื่อประยุกต์ในงานเคมีวิเคราะห์ที่ซับซ้อน การจัดการข้อมูลชุดสัญญาณอิเล็กทรอนิกส์ที่ขึ้นกับเวลา การหาสภาวะที่เหมาะสมของระบบวิเคราะห์แบบซิมเพล็กซ์ การสอบเทียบแบบตัวแปรเดียวและแบบหลายตัวแปร การวิเคราะห์องค์ประกอบหลัก การวิเคราะห์ด้วยกำลังสองน้อยที่สุดบางส่วน การจดจำและการจำแนกรูปแบบ การสร้างแบบจำลอง การประยุกต์ใช้เคมีเมตริก

**SCCH 736 Solution Chemistry**

**3 (3-0-6)**

**วทคม ๗๓๖ เคมีของสารละลาย**

Interactions in solution; chemical equilibrium; thermodynamics; chemical kinetics; metal ions in various types of solvent; solvation number and structure of solvated ions; speciation of complex species in solution; selected applications for analytical sciences

อันตรกิริยาต่างๆ ในสารละลาย สมดุลเคมี อุณหพลศาสตร์ จลนพลศาสตร์เคมี ไอออนของโลหะในตัวทำละลายชนิดต่างๆ จำนวนโมเลกุลของตัวทำละลายรอบตัวถูกละลายและโครงสร้างของไอออนในสารละลาย การจำแนกชนิดของสารเชิงซ้อนในสารละลาย การประยุกต์ในศาสตร์การวิเคราะห์

**SCCH 737 Environmental Chemistry**

**3 (3-0-6)**

**วทคม ๗๓๗ เคมีสิ่งแวดล้อม**

Environmental phases; hydrosphere; atmosphere; lithosphere; biosphere; interaction between phases and its effects on environmental condition; chemical cycles in nature; analysis and monitoring of environmental pollution; ecosystem; chemical toxicology and risk assessment

วิทยาศาสตร์สิ่งแวดล้อม วิทยาศาสตร์ของน้ำ วิทยาศาสตร์ของอากาศ วิทยาศาสตร์ของดิน ชีวภาค อันตรกิริยาระหว่างวิทยาศาสตร์ต่างๆ และผลกระทบต่อสิ่งแวดล้อม วงจรของสารเคมีในธรรมชาติ การวิเคราะห์และเฝ้าระวังมลภาวะทางสิ่งแวดล้อม ระบบนิเวศ พิษวิทยาเคมีและการประเมินความเสี่ยง

Credit (lecture-practice-self-study)

SCCH 738 Special Topics in Analytical Chemistry 3 (3-0-6)

วทคม ๗๓๘ หัวข้อเรื่องพิเศษทางเคมีวิเคราะห์

Special topics with modern and advanced contents related to the field of analytical chemistry

หัวข้อเรื่องพิเศษครอบคลุมเนื้อหาทันสมัยและขั้นสูงเฉพาะทางเคมีวิเคราะห์

SCCH 739 Current Topics in Analytical Chemistry I 3 (3-0-6)

วทคม ๗๓๙ หัวข้อที่เป็นปัจจุบันทางเคมีวิเคราะห์ ๑

Discussion among students and instructors on the topics of current interest in the field of analytical chemistry

อภิปรายร่วมกันระหว่างนักศึกษาและอาจารย์ในหัวข้อที่อยู่ในความสนใจปัจจุบันทางเคมีวิเคราะห์

SCCH 740 Current Topics in Analytical Chemistry II 3 (3-0-6)

วทคม ๗๔๐ หัวข้อที่เป็นปัจจุบันทางเคมีวิเคราะห์ ๒

Discussion among students and instructors on the topics of current interest in the field of analytical chemistry; original research proposal

อภิปรายร่วมกันระหว่างนักศึกษาและอาจารย์ในหัวข้อที่อยู่ในความสนใจทางเคมีวิเคราะห์ การเสนอโครงการวิจัย

SCCH 754 Organotransition Metal Chemistry 3(3-0-6)

วทคม ๗๕๔ เคมีของโลหะทรานซิชันอินทรีย์

General scopes; types of ligand and bonding; reaction mechanisms and chemical reactivity; industrial applications of organotransition metal complexes

เคมีในภาพรวม ชนิดของลิแกนด์และพันธะ กลไกปฏิกิริยา และปฏิกิริยาทางเคมีที่เกี่ยวข้อง ตัวอย่างของการนำสาร ประกอบเชิงซ้อนโลหะทรานซิชันมาประยุกต์ใช้ในอุตสาหกรรม

SCCH 757 Solid State Chemistry 3(3-0-6)

**วทคม ๗๕๗****เคมีของสถานะของแข็ง**

Structure; chemical bonding; chemical properties of aggregates of molecules; crystals; metals; glasses; semiconductors; polymers and biomaterials

โครงสร้าง พันธะเคมี สมบัติทางเคมีของการเกาะรวมกลุ่มกันของโมเลกุล ผลึก โลหะ แก้ว สารกึ่งตัวนำ พอลิเมอร์และวัสดุชีวภาพ

Credit (lecture-practice-self-study)

SCCH 765 Main Group Chemistry

3(3-0-6)

**วทคม ๗๖๕ เคมีของธาตุหมู่หลัก**

General properties of inorganic and organometallic compounds of main group elements; hydrogen; carbon; silicon, germanium, tin, and lead; nitrogen, phosphorus, arsenic, antimony, and bismuth; the chalcogen; halogens and noble gases; boron, aluminum, gallium, indium, and thallium; the alkali and alkaline earth metals

คุณสมบัติทั่วไปของสารประกอบอนินทรีย์และสารเชิงซ้อนของธาตุหมู่หลัก ไฮโดรเจน คาร์บอน ซิลิกอน เจอร์มาเนียม ดีบุก และตะกั่ว ไนโตรเจน ฟอสฟอรัส อาร์เซนิก แอนติโมนี และบิสมัท ซาโคเจน ฮาโลเจน และแก๊สมีตระกูล โบรอน อะลูมิเนียม แกลเลียม อินเดียม และทาลเลียม โลหะอัลคาไลน์ และ อัลคาไลน์เอิร์ธ

SCCH 766 Inorganic Reaction Mechanisms

3(3-0-6)

**วทคม ๗๖๖ กลไกปฏิกิริยาอนินทรีย์**

Principles of chemical kinetics; techniques in the monitoring of reactions; applications of chemical kinetics in the elucidation of reaction mechanisms; DFT calculations to support the proposed mechanisms

หลักการของจลนศาสตร์เคมี เทคนิคการเฝ้าปฏิกิริยา การนำจลนศาสตร์เคมีไปใช้ในการค้นพบกลไกปฏิกิริยา การคำนวณดีเอฟทีเพื่อยืนยันกลไกปฏิกิริยาที่เสนอ

SCCH 767 NMR Spectroscopy in Inorganic Chemistry

3(3-0-6)

**วทคม ๗๖๗**

**เอ็นเอ็มเอ็ม**

**อาร์สเปกโตรสโกปีสำหรับเคมีอนินทรีย์**

Principles of NMR spectroscopy; some NMR spectroscopic techniques used in inorganic chemistry; Solid-state NMR; applications of NMR spectroscopy in inorganic chemistry

หลักการของเอ็นเอ็มเอ็มอาร์สเปกโตรสโกปี เทคนิคทางเอ็นเอ็มเอ็มอาร์ที่ใช้ในเคมีอนินทรีย์ เอ็นเอ็มเอ็มอาร์สถานะของแข็ง การนำเอ็นเอ็มเอ็มอาร์สเปกโตรสโกปีไปใช้ในเคมีอนินทรีย์

SCCH 768 Special Topics in Inorganic Chemistry

3(3-0-6)



**วทคม ๗๖๘ หัวข้อพิเศษทางเคมีอนินทรีย์**

Special topics with modern and advanced contents related to the field of inorganic chemistry

หัวข้อพิเศษที่มีเนื้อหาทันสมัยและขั้นสูงในสาขาเคมีอนินทรีย์

Credit (lecture-practice-self-study)

**SCCH 769 Bioinorganic Chemistry: from Metals in Biology to Modern Applications** 3(3-0-6)

**วทคม ๗๖๙ เคมีชีวอนินทรีย์: จากโลหะในชีวิตวิทยาสู่การประยุกต์ใช้ในปัจจุบัน**

Roles of metal in biology; different types of metalloenzymes; applications in biomedical sciences; applications in material sciences and alternative energy

ความสำคัญของไอออนโลหะในชีวิตวิทยา เมทัลโลเอนไซม์ประเภทต่างๆ การประยุกต์ใช้ทางการแพทย์ การประยุกต์ใช้ในวัสดุศาสตร์และพลังงานทางเลือก

**SCCH 771 Quantum Chemistry** 3 (3-0-6)

**วทคม ๗๗๑ เคมีควอนตัม**

Quantum postulates; particle in a box; harmonic oscillation; angular momentum; wave function of hydrogen atom; electron spin; variation method; approximation methods: Hartree-Fock theory, perturbation theory, configuration interaction and density functional theory

สัจพจน์ทางควอนตัม อนุภาคในกล่อง การสั่นแบบฮาร์มอนิก โมเมนตัมเชิงมุม ฟังก์ชันคลื่นของอะตอมไฮโดรเจน สปินของอิเล็กตรอน ระเบียบวิธีการแปรค่า วิธีการประมาณต่างๆ ทฤษฎีฮาร์ทรี-ฟอกค์ ทฤษฎีการรบกวน อันตรกิริยาของโครงสร้างและทฤษฎีฟังก์ชันความหนาแน่น

**SCCH 772 Thermodynamics and Statistical Mechanics** 3 (3-0-6)

**วทคม ๗๗๒ อุณหพลศาสตร์และกลศาสตร์เชิงสถิติ**

Thermodynamics of pure substance and solutions; single- and multi-phase; physical transformation and chemical reaction; statistical mechanics of ideal and real gases and liquid

อุณหพลศาสตร์ของสารบริสุทธิ์และสารละลาย วิชาภาคเดียวและหลายวิชาภาค การเปลี่ยนแปลงกายภาพและปฏิกิริยาเคมี กลศาสตร์เชิงสถิติของแก๊สอุดมคติ แก๊สจริงและของเหลว

**SCCH 774 Chemical Kinetics and Molecular Dynamics** 3 (3-0-6)

**วทคม ๗๗๔ จลนพลศาสตร์เคมีและพลศาสตร์โมเลกุล**

Kinetic theory of gases; rates of chemical reactions; theories of chemical reaction rates; reactions in liquid solutions; molecular dynamics of chemical reactions

ทฤษฎีจลนพลศาสตร์ของแก๊ส อัตราการเกิดปฏิกิริยาเคมี ทฤษฎีอัตราการเกิดปฏิกิริยาเคมี ปฏิกิริยาในสารละลายของเหลว พลศาสตร์โมเลกุลของปฏิกิริยาเคมี

**SCCH 775 Modern Chemical Physics 3 (3-0-6)**

**วทคม ๗๗๕ ฟิสิกส์เชิงเคมีแผนใหม่**

Interesting properties and phenomena in physics and chemistry; mathematics and its applications in the nonlinear world; self-organization and pattern formation

สมบัติและปรากฏการณ์ทางฟิสิกส์และเคมีที่น่าสนใจ การใช้คณิตศาสตร์ในการทำความเข้าใจโลกไม่เชิงเส้น การจัดระเบียบตนเองและการเกิดลวดลาย

**Credit (lecture-practice-self-study)**

**SCCH 776 Mathematical Methods 3 (3-0-6)**

**วทคม ๗๗๖ วิธีทางคณิตศาสตร์**

Partial differential equations in physics and chemistry; equation solving: separation of variables, application of special functions; numerical method: finite differences; use of computer programming to solve problems in physics and chemistry

สมการเชิงอนุพันธ์ย่อยในฟิสิกส์และเคมี การแก้สมการโดยการแยกตัวแปรและการประยุกต์ฟังก์ชันพิเศษ การคำนวณเชิงตัวเลขสำหรับแก้สมการอนุพันธ์โดยวิธีไฟไนต์ดิฟเฟอเรนซ์ ใช้งานโปรแกรมคอมพิวเตอร์ในการแก้ปัญหาทางฟิสิกส์และเคมี

**SCCH 779 Surface Chemistry and Advanced Electrochemistry 3 (3-0-6)**

**วทคม ๗๗๙ เคมีพื้นผิวและเคมีไฟฟ้าขั้นสูง**

Theories based on surface chemistry and electrochemistry; sorption on colloids; properties of electrolyte solutions and fused salts; electrode processes and electrokinetic phenomena

ทฤษฎีเกี่ยวข้องกับเคมีพื้นผิวและเคมีไฟฟ้า การดูดซับสารบนคอลลอยด์ สมบัติของสารละลายอิเล็กโทรไลต์และเกลือที่หลอมเหลว การเปลี่ยนแปลงที่ขั้วไฟฟ้า และปรากฏการณ์จลนพลศาสตร์ไฟฟ้า

**SCCH 780 Special Topics in Physical Chemistry 3 (3-0-6)**

**วทคม ๗๘๐ หัวข้อเรื่องพิเศษทางเคมีเชิงฟิสิกส์**

Special topics with modern and advanced contents related to the field of physical chemistry

หัวข้อเรื่องพิเศษครอบคลุมเนื้อหาทันสมัยที่มีเนื้อหาขั้นสูงเฉพาะทางศาสตร์เคมีเชิงฟิสิกส์

**SCCH 781 Special Topics in Chemical Physics 3 (3-0-6)**

**วทคม ๗๘๑ หัวข้อเรื่องพิเศษทางฟิสิกส์เชิงเคมี**

Special topics with modern and advanced contents related to the field of chemical physics

หัวข้อเรื่องพิเศษครอบคลุมเนื้อหาทันสมัยที่มีเนื้อหาขั้นสูงเฉพาะทางศาสตร์ฟิสิกส์เชิงเคมี

**SCCH 782 Seminar in Physical Chemistry and Chemical Physics I 1 (1-0-2)**

**วทคม ๗๘๒ สัมมนาทางเคมีเชิงฟิสิกส์และฟิสิกส์เชิงเคมี ๑**

Seminars given by invited speakers and students on new findings and modern research topics in physical chemistry and chemical physics; published peer review publications; presentation and scientific explanation skills

การให้สัมมนาในหัวข้อที่ค้นพบใหม่และหัวข้อวิจัยที่ทันสมัยทางเคมีเชิงฟิสิกส์และฟิสิกส์เชิงเคมีโดยวิทยากรพิเศษและนักศึกษา เนื้อหาจากวารสารหรือเอกสารวิชาการ ทักษะการนำเสนอและตอบข้อซักถาม

**Credit (lecture-practice-self-study)**

**SCCH 783 Seminar in Physical Chemistry and Chemical Physics II 1 (1-0-2)**

**วทคม ๗๘๓ สัมมนาในวิชาเคมีเชิงฟิสิกส์และฟิสิกส์เชิงเคมี ๒**

Seminars given by invited speakers and students on new findings and modern research topics in physical chemistry and chemical physics; published peer review publications; presentation and scientific explanation skills

การให้สัมมนาในหัวข้อที่ค้นพบใหม่และหัวข้อวิจัยที่ทันสมัยทางเคมีเชิงฟิสิกส์และฟิสิกส์เชิงเคมี โดยวิทยากรพิเศษและนักศึกษา เนื้อหาจากวารสารหรือเอกสารวิชาการ ทักษะการนำเสนอและตอบข้อซักถาม

**SCCH 784 Seminar in Physical Chemistry and Chemical Physics III 1 (1-0-2)**

**วทคม ๗๘๔ สัมมนาในวิชาเคมีเชิงฟิสิกส์และฟิสิกส์เชิงเคมี ๓**

Seminars given by invited speakers and students on new findings and modern research topics in physical chemistry and chemical physics; published peer review publications; presentation and scientific explanation skills

การให้สัมมนาในหัวข้อที่ค้นพบใหม่และหัวข้อวิจัยที่ทันสมัยทางเคมีเชิงฟิสิกส์และฟิสิกส์เชิงเคมี โดยวิทยากรพิเศษและนักศึกษา เนื้อหาจากวารสารหรือเอกสารวิชาการ ทักษะการนำเสนอและตอบข้อซักถาม

**SCCH 803 Chemistry of Waste and Pollution 3 (3-0-6)**

**วทคม 803 เคมีของกากของเสียและมลพิษ**

Chemical principles related to waste and pollution; water, air, chemical and radioactive pollution, introduction of pollution laws and policy; real world examples and case studies of environmental remediation and waste management

หลักการเชิงเคมีเกี่ยวข้องกับของเสียและมลพิษ: มลพิษทางน้ำและอากาศ มลพิษจากวัตถุเคมีและวัตถุถุกัมมันตรังสี บทนำของกฎหมายและนโยบายด้านมลพิษ ตัวอย่างการใช้งานจริงและกรณีศึกษาด้านการบำบัดและการจัดการกากของเสีย

**SCCH 804 Concepts in Sustainability 3 (3-0-6)**

**วทศ 804 หลักการความยั่งยืน**

Relevance of sciences, particularly chemistry, and global issues such as food, agriculture, energy, climate change, environment, health and well-being; innovative uses of natural resources; research and development in bioeconomy; sustainability measuring tools such as life cycle analysis; sustainability indicators such as social-and-human, natural and economic capital

ภัยที่ต้องระวังระดับโลก เช่น ภัยด้านอาหาร เกษตรกรรม พลังงาน การเปลี่ยนแปลงสภาพอากาศ สิ่งแวดล้อม สุขภาพและการอยู่ดีกินดี ซึ่งเชื่อมโยงกับวิทยาศาสตร์โดยเฉพาะเคมี นวัตกรรมการใช้ทรัพยากรธรรมชาติ การวิจัยและการพัฒนาเพื่อการพัฒนาเศรษฐกิจชีวภาพ เครื่องมือตรวจวัดความยั่งยืน เช่น หลักการประเมินวัฏจักรชีวิตของผลิตภัณฑ์ ตัวชี้วัดความยั่งยืนด้านผลกระทบต่อสังคมและชุมชน รวมทั้งผลกระทบต่อธรรมชาติและทุนทางเศรษฐกิจ

Credit (lecture-practice-self-study)

**SCCH 805 Natural Fibers**

3 (3-0-6)

**วทศ 805 เส้นใยธรรมชาติ**

Classification of natural fibers; plant fibers, animal fibers and mineral fiber; structure of plant fibers; properties and characteristics of natural fibers; extraction, processing and chemical modification of plant fibers; industrial production of natural fibers; industrial uses of natural fibers and case studies, recent trend and future in natural fiber utilization

ประเภทของเส้นใยธรรมชาติ เส้นใยจากพืช สัตว์และหินแร่ โครงสร้างของเส้นใยจากพืช สมบัติและเอกลักษณ์ของเส้นใยจากพืช การสกัด กรรมวิธีเตรียมและการปรับสภาพเชิงเคมีของเส้นใยจากพืช การผลิตเส้นใยจากพืชระดับอุตสาหกรรม ตัวอย่างและกรณีศึกษาด้านการใช้เส้นใยจากพืชในระดับอุตสาหกรรม

**SCCH 806 Industrial Chemistry**

3 (3-0-6)

**วทศ 806 เคมีเชิงอุตสาหกรรม**

Real world examples and case studies of utilizing in-depth knowledge and application of chemistry and creativity with chemicals; research and development in petrochemicals, polymers, plastics food, cosmetics, pharmaceuticals, minerals and new materials; successful examples of modern business model

ตัวอย่างและกรณีศึกษาการใช้องค์ความรู้เชิงลึกร่วมกับการประยุกต์ใช้เคมีศาสตร์และความคิดสร้างสรรค์ด้านสารเคมีเพื่อการใช้งานจริง การวิจัยและพัฒนาด้านปิโตรเคมี พอลิเมอร์ พลาสติก อาหาร เครื่องสำอาง ยา แร่และวัสดุใหม่ ตัวอย่างโมเดลธุรกิจที่ประสบความสำเร็จ

**(3) Dissertation****Credit (lecture-practice-self-study)****SCCH 898 Dissertation****48 (0-144-0)****วทคม ๘๙๘ วิทยานิพนธ์**

Identifying research topic of interest and develop research proposal; conducting research study abiding research ethics; collecting data; data analysis, interpretation of the results, and report of the results in terms of the dissertation; presenting the dissertation; preparing manuscript and publishing research in an international peer-reviewed journal; ethics in dissemination the research results

การออกแบบและกำหนดโครงการวิจัย การเสนอเค้าโครงวิจัย การศึกษาวิจัยอย่างมีจริยธรรม การคัดกรองข้อมูล การวิเคราะห์ข้อมูล การสังเคราะห์และวิพากษ์ผลการวิจัย การนำผลการวิจัยมาเรียบเรียงเป็นวิทยานิพนธ์ การนำเสนอวิทยานิพนธ์ การเรียบเรียงผลงานวิจัยเพื่อเผยแพร่ การเผยแพร่ผลงานวิจัยในวารสารวิชาการระดับนานาชาติ จริยธรรมในการเผยแพร่ผลงานวิจัย

**SCCH 798 Dissertation****36 (0-108-0)****วทคม ๗๙๘ วิทยานิพนธ์**

Identifying research topic of interest and develop research proposal; conducting research study abiding research ethics; collecting data; data analysis, interpretation of the results, and report of the results in terms of the dissertation; presenting the dissertation; preparing manuscript and publishing research in an international peer-reviewed journal; ethics in dissemination the research results

การออกแบบและกำหนดโครงการวิจัย การเสนอเค้าโครงวิจัย การศึกษาวิจัยอย่างมีจริยธรรม การคัดกรองข้อมูล การวิเคราะห์ข้อมูล การสังเคราะห์และวิพากษ์ผลการวิจัย การนำผลการวิจัยมาเรียบเรียงเป็นวิทยานิพนธ์ การนำเสนอวิทยานิพนธ์ การเรียบเรียงผลงานวิจัยเพื่อเผยแพร่ การเผยแพร่ผลงานวิจัยในวารสารวิชาการระดับนานาชาติ จริยธรรมในการเผยแพร่ผลงานวิจัย

**SCCH 799 Dissertation****48 (0-144-0)****วทคม ๗๙๙ วิทยานิพนธ์**

Identifying research topic of interest and develop research proposal; conducting research study abiding research ethics; collecting data; data analysis, interpretation of the results, and report of the results in terms of the dissertation; presenting the dissertation; preparing manuscript and publishing research in an international peer-reviewed journal; ethics in dissemination the research results

การออกแบบและกำหนดโครงการวิจัย การเสนอเค้าโครงวิจัย การศึกษาวิจัยอย่างมีจริยธรรม การคัดกรองข้อมูล การวิเคราะห์ข้อมูล การสังเคราะห์และวิพากษ์ผลการวิจัย การนำผลการวิจัยมาเรียบเรียงเป็น

วิทยานิพนธ์ การนำเสนอวิทยานิพนธ์ การเรียบเรียงผลงานวิจัยเพื่อเผยแพร่ การเผยแพร่ผลงานวิจัยในวารสารวิชาการระดับนานาชาติ จริยธรรมในการเผยแพร่ผลงานวิจัย

**Attachment**  
**Appendix B Curricula Vitae**

**1. Name** Associate Professor Dr. Preeyanuch Sangtrirutnugul

**Education**

Degree	Field	Institution	Year
Ph.D.	Chemistry	University of California, Berkeley, USA	2007
B.Sc.	Chemistry	Massachusetts Institute of Technology, USA	2000

**Affiliation** Department of Chemistry, Faculty of Science, Mahidol University

**Research Interest/Expertise**

1. Homogeneous and heterogeneous catalysis
2. Organometallic synthesis
3. Polymerization

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

Sangtrirutnugul P., Chaiprasert T., Hunsiri W., Jitjaroendee T., Songkhum P., Laohhasurayotin K., Osotchan T., Ervithayasuporn V.\* Tunable porosity of cross-linked-polyhedral oligomeric silsesquioxane supports for palladium-catalyzed aerobic alcohol oxidation in water, *ACS Appl. Mater. Interfaces* 2017; 9: 12812-12822.

Kongkaew M., Sitthisuwannakul K., Nakarajouyphon V., Pornsuwan S., Kongsaree P., **Sangtrirutnugul P.\*** Benzimidazole–triazole ligands with pendent triazole functionality: unexpected formation and effects on copper-catalyzed aerobic alcohol oxidation, *Dalton Trans.* 2016; 45: 16810-16819.

Ervithayasuporn V., Kwanplod K., Boonmak J., Youngme S., **Sangtrirutnugul P.\*** Homogeneous and heterogeneous catalysts of organopalladium functionalized-polyhedral oligomeric silsesquioxanes for Suzuki–Miyaura reaction, *J. Catal.* 2015; 332: 62-69.

Thongkam P., Jindabot S., Prabpai S., Kongsaree P., Wititsuwannakul T., Surawatanawong P., Sangtrirutnugul P.\* Pyridine–triazole ligands for Cu-catalyzed aerobic alcohol oxidation, RSC Adv. 2015; 5: 55847-55855.

Sangtrirutnugul P.\*, Wised K., Maisopa P., Trongsirawat N., Tangboriboonrat P., Reutrakul V. Trimethylsilyl-substituted triazole-based ligand for copper-mediated single-electron transfer living radical polymerization of methyl methacrylate, Polym. Int. 2014; 63: 1869-1874.

### Current Teaching Duty

SCCH 111 General Chemistry	3 (3-0-6)
SCCH 119 Laboratory in Chemistry	1 (0-3-1)
SCCH 341 Inorganic Chemistry II	3 (3-0-6)
SCCH 348 Inorganic Chemistry Laboratory	1 (0-3-1)
SCCH 753 Homogeneous Catalysis	3 (3-0-6)
SCCH 754 Organotransition Metal Chemistry	3 (3-0-6)

### Teaching Duty in the Revised Program

SCCH 754 Organotransition Metal Chemistry	3 (3-0-6)
SCCH 898 Dissertation	48 (0-144-0)
SCCH 798 Dissertation	36 (0-108-0)
SCCH 799 Dissertation	48 (0-144-0)



**2. Name** Associate Professor Dr. Siwaporn Meejoo Smith

**Education**

Degree	Field	Institution	Year
Ph.D.	Chemistry	University of Birmingham, UK	2003
B.Sc.	Chemistry	Mahidol University, Thailand	1997

**Affiliation** Department of Chemistry, Faculty of Science, Mahidol University

**Research Interest/Expertise**

1. Catalysts and sorbents for environmental remediation
2. Natural resources and waste material utilization
3. Material synthesis/processing and characterization

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

Oopathump C., Kheowana O., Charoenphakdee A., Harnwunggmoungd A., **Smith S. M.\***, Smith C. B.\* Thermolectric characterization of multi-walled carbon nanotube/sodium cobalt oxide prepared by a low-cost flame sintering technique, *Ceram. Intl.* 2017; In press. <https://doi.org/10.1016/j.ceramint.2017.09.123>.

Chaveanghong S., **Smith S. M.\***, Oopathum C., Smith C. B., Luengnaruemitchai A. Fatty acid methyl ester (FAME) production from soybean oil under ambient conditions using strontium loaded bovine bone, *Renew. Energy.* 2017; 109: 480-486.

Koilraj P., **Smith S. M.**, Yu Q., Ulrich R., Sasaki K.\* Encapsulation of a powdery spinel-type Li<sup>+</sup> ion sieve derived from biogenic manganese oxide in alginate beads, *Powder Technol.* 2016; 301: 1201-1207.

Srikhaow A., **Smith S. M.\***, Uraisin K., Suttiponparnit K., Kongmark C., Chuaicham C. Catalytic remediation of phenol contaminated wastewater using Cu-Zn hydroxide nitrate, *RSC Adv.* 2016; 6: 36766-36774.

Kan-orchai K., **Smith S. M.\***, Saesoo S., Treethong A., Puttipipatkachorn S., Pratontep S.,

- Ruktanonchai U. R.\* Surfactant effect on the physicochemical characteristics of  $\gamma$ -oryzanol containing solid lipid nanoparticles, *Colloids Surf. A Physicochem. Eng. Asp.* 2016; 488: 118-128.
- Anantachaisilp S., **Smith S. M.\***, Ton-That C., Pornsuwan S., Moon A. R., Nenstiel C., Hoffmann A., Phillips M. R.\* Nature of red luminescence in oxygen treated hydrothermally grown zinc oxide nanorods, *J. Lumin.* 2015; 168: 20-25.
- Anantachaisilp S., **Smith S. M.\***, Ton-That C., Osotchan T., Moon A., Phillips M.\* Tailoring deep level surface defects in ZnO nanorods for high sensitivity ammonia gas sensing, *J. Phys. Chem. C.* 2014; 118(46): 27150-27156.
- Karn-orachai K., **Smith S. M.\***, Treethong A., Phunpee S., Puttipipatkachorn S., Pratontep S., Ruktanonchai U. R.\* The effect of surfactant composition on the chemical and structural properties of nanostructured lipid carriers, *J. Microencap.* 2014; 31(6): 609-618.

#### Current Teaching Duty

SCCH 112 General Chemistry I	3 (3-0-6)
SCCH 113 General Chemistry I	3 (3-0-6)
SCCH 109 Laboratory in Chemistry	1 (0-3-1)
SCCH 230 Physical Chemistry I	3 (3-0-6)
SCCH 458 Industrial Visits	1 (0-3-1)
SCCH 778 Physico-chemical Techniques	3 (2-3-5)
SCCH 704 Seminar in Chemistry	1 (1-0-2)
SCME 202 Ceramic Technology	3 (3-0-6)

#### Teaching Duty in the Revised Program

SCCH 704 Seminar in Chemistry	1 (1-0-2)
SCCH 801 Environmental Materials	3 (3-0-6)
SCCH 803 Chemistry of Waste and Pollution	3 (3-0-6)
SCCH 898 Dissertation	48 (0-144-0)
SCCH 798 Dissertation	36 (0-108-0)
SCCH 799 Dissertation	48 (0-144-0)

**3. Name** Associate Professor Dr. Tienthong Thongpanchang

**Education**

Degree	Field	Institution	Year
Ph.D.	Chemistry	Columbia University, USA	1999
B.Sc.	Chemistry	Price of Songkla University, Thailand	1994

**Affiliation** Department of Chemistry, Faculty of Science, Mahidol University

**Research Interest/Expertise**

1. Organic Synthesis
2. Physical Organic Chemistry
3. Process Chemistry

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

Ackermann S. M., Dolsophon K., Monakhova Y. B., Kuballa T., Reusch H., **Thongpanchang T.**, Bunzel M., Lachenmeier D. W. Automated multicomponent analysis of soft drinks using 1D 1H and 2D 1H-1H J-resolved NMR spectroscopy, *Food Anal. Methods*. 2017; 10: 827-836.

Dolsophon K., Sophonpong J., Kornsakulkarn J., Thongpanchang C., Prabpai S., Kongsaree P., **Thongpanchang T.\*** F-THENA: a chiral derivatizing agent for the determination of the absolute configuration of secondary aromatic alcohols with a self-validating system, *Org. Biomol. Chem*. 2016; 14: 11002-11012.

Dolsophon K., Ruangsupapichat N., Sophonpong J., Sungsuwan S., Prabpai S., Kongsaree P., **Thongpanchang T.\*** Tetrahydro-1,4-epoxynaphthalene-1-carboxylic acid: a chiral resolving agent for the resolution and absolute configuration assignment of 7,7'-disubstituted 1,1'-bi-2-naphthols, *Tetrahedron-Asymmetry*. 2016; 27: 1113–1120.

Wongma K., Bunbamrung N., **Thongpanchang T.\*** Synthesis of bridged biaryl bisquinones and effects of biaryl dihedral angles on photo- and electro-chemical properties, *Tetrahedron*. 2016; 72: 1533-1540.

Daengrot C., Rukachaisirikul V., Tansakul C., **Thongpanchang T.**, Phongpaichit S., Bowornwiryapan K., Sakayaroj J. Eremophilane sesquiterpenes and diphenyl thioethers from the soil Fungus penicillium copticola PSU-RSPG138, J. Nat. Prod. 2015; 78: 615-622.

#### Current Teaching Duty

SCCH 119 Chemistry Laboratory	3 (3-0-6)
SCCH 224 Organic chemistry II	3 (3-0-6)
SCCH 301 Spectroscopy	3 (3-0-6)
SCCH 323 Organic chemistry III	3 (3-0-6)
SCCH 329 Organic chemistry Laboratory	2 (0-6-2)
SCCH 420 Special topics in Organic Chemistry	2 (2-0-4)

#### Teaching Duty in the Revised Program

SCCH 712 Molecular Structures and Functions	3 (3-0-6)
SCCH 715 Frontiers in Medicinal Chemistry	3 (3-0-6)
SCCH 898 Dissertation	48 (0-144-0)
SCCH 798 Dissertation	36 (0-108-0)
SCCH 799 Dissertation	48 (0-144-0)

**4. Name** Assistant Professor Dr. Chutima Jiarpinitnun

#### Education

Degree	Field	Institution	Year
Ph.D.	Chemistry	University of Wisconsin-Madison, USA	2008
B.Sc.	Chemistry	The University of Chicago, USA	2001

**Affiliation** Department of Chemistry, Faculty of Science, Mahidol University

#### Research Interest/Expertise

1. Bioorganic chemistry
2. Chemical biology
3. Organic synthesis

#### Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years

Chaiyakunvat P., Anantachoke N., Reutrakul V., **Jiarpinitnun, C.\***, Caged xanthenes: Potent inhibitors of global predominant MRSA USA300, *Bioorg. Med. Chem. Lett.* 2016; 26: 2980-2983.

Dhammaraj T., Phintha A., Pinthong C., Medhanavyn D., Tinikul R., Chenprakhon P., Sucharitakul J., Vardhanabhuti N., **Jiarpinitnun C.**, Chaiyen, P. p-Hydroxyphenylacetate 3-hydroxylase as a biocatalyst for the synthesis of trihydroxyphenolic acids, *ACS Catal.* 2015; 5: 4492-4502.

Phetsang W., Chaturongakul S., **Jiarpinitnun C.\*** Electron-withdrawing substituted benzenesulfonamides against the predominant community-associated methicillin-resistant *Staphylococcus aureus* strain USA300, *Monatsh. Chem.* 2013; 144(4): 461-471.

#### Current Teaching Duty

SCCH 121 Basic Organic Chemistry	3 (3-0-6)
SCCH 128 Organic Chemistry Laboratory	1 (0-3-1)
SCCH 224 Organic chemistry II	3 (3-0-6)
SCCH 229 Organic Chemistry Laboratory	1 (0-3-1)

SCCH 323	Organic chemistry III	3 (3-0-6)
SCCH 329	Organic chemistry Laboratory	2 (0-6-2)
SCCH 420	Special topics in Organic Chemistry	2 (2-0-4)
SCCH 425	Bioorganic Chemistry	2 (2-0-4)

**Teaching Duty in the Revised Program**

SCCH 715	Frontiers in Medicinal Chemistry	3 (3-0-6)
SCCH 716	Chemical Biology	3 (3-0-6)
SCCH 898	Dissertation	48 (0-144-0)
SCCH 798	Dissertation	36 (0-108-0)
SCCH 799	Dissertation	48 (0-144-0)

**5. Name** Assistant Professor Dr. Panida Surawatanawong

**Education**

Degree	Field	Institution	Year
Ph.D.	Chemistry	Texas A&M University, USA	2009
B.Sc.	Chemistry	Mahidol University	2004

**Affiliation** Department of Chemistry, Faculty of Science, Mahidol University

**Research Interest/Expertise**

1. Computational chemistry
2. Electronic structures and reactivity
3. Organometallic catalysis

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

Wititsuwannakul T., Tantirungrotechai Y., **Surawatanawong P.**\* Density functional study of nickel N-heterocyclic carbene catalyzed C-O bond hydrogenolysis of methyl phenyl ether: the concerted  $\beta$ -H transfer mechanism, ACS Catal. 2016; 6: 1477-1486.

Sawatlon B., **Surawatanawong P.**\* Mechanisms for dehydrogenation and hydrogenation of N-heterocycles using PNP-pincer-supported iron catalysts: a density functional study, Dalton Trans. 2016; 45: 14965-14978.

Dhammaraj T., Pinthong C., Visitsatthawong S., Thongsook C., **Surawatanawong P.**, Chaiyen P. A single-site mutation at Ser146 expands the reactivity of the oxygenase component of p-hydroxyphenylacetate 3-hydroxylase, ACS Chem. Biol. 2016; 11: 2889-2896.

Samae R., **Surawatanawong P.**, Eiamprasert U., Pramjit S., Saengdee L., Tangboriboonrat P., Kiatisevi S.\* Effect of thiophene spacer position in carbazole-based dye-sensitized solar cells on photophysical, electrochemical and photovoltaic properties, Eur. J. Org. Chem. 2016; 21: 3536-3549.

Wanwong S., **Surawatanawong P.**, Khumsubdee S., Kanchanakungwankul S.,

- Wootthikanokkhan J. Synthesis, optical, and electrochemical properties, and theoretical calculations of BODIPY containing triphenylamine, *Heteroatom Chem.* 2016; 27: 306-315.
- Visitsatthawong S., Chenprakhon P., Chaiyen P., **Surawatanawong P.\*** Mechanism of oxygen activation in a flavin-dependent monooxygenase: a nearly barrierless formation of C4a-hydroperoxyflavin via proton-coupled electron transfer, *J. Am. Chem. Soc.* 2015; 137: 9363-9374.
- Thongkam P., Jindabot S., Prabpai S., Kongsaree P., Wititsuwannakul T., **Surawatanawong P.**, Sangtrirutnugul P. Pyridine–triazole ligands for copper-catalyzed aerobic alcohol oxidation, *RSC Adv.* 2015; 5: 55847-55855.
- Pramjit S., Eiamprasert U., **Surawatanawong P.**, Lertturongchai P., Kiatisevi S. Carbazole-bridged double D–A dye for efficient dye-sensitized solar cell, *J. Photochem. Photobiol. A–Chem.* 2015; 296: 1-10.
- Sawatlon† B., Wititsuwannakul† T., Tantirungrotechai Y., **Surawatanawong P.\*** Mechanism of Ni N-heterocyclic carbene catalyst for C–O bond hydrogenolysis of diphenyl ether: a density functional study, *Dalton Trans.* 2014; 43: 18123-18133. (†These authors contribute equally.)
- Wongnate† T., **Surawatanawong† P.**, Visitsatthawong S., Sucharitakul J., Scrutton N. S., Chaiyen P. Proton-coupled electron transfer and adduct configuration are important for C4a-hydroperoxyflavin formation and stabilization in a flavoenzyme, *J. Am. Chem. Soc.* 2014; 136: 241-253. (†These authors contribute equally.)

### Current Teaching Duty

SCCH104	General Chemistry II	3 (3-0-6)
SCCH109	General Chemistry Laboratory	1 (0-3-1)
SCCH233	Physical Chemistry II	3 (3-0-6)
SCCH339	Physical Chemistry Laboratory	1 (0-3-1)

### Teaching Duty in the Revised Program

SCCH 771	Quantum Chemistry	3 (3-0-6)
SCCH 778	Physico-Chemical Techniques	3 (2-3-5)
SCCH 785	Advanced Physical Chemistry	3 (3-0-6)
SCCH 898	Dissertation	48 (0-144-0)



SCCH 798 Dissertation	36 (0-108-0)
SCCH 799 Dissertation	48 (0-144-0)

**6. Name** Assistant Professor Dr. Pasit Pakawatpanurut

#### Education

Degree	Field	Institution	Year
Ph.D.	Chemistry	Harvard University, USA	2005
M.A.	Chemistry	Harvard University, USA	2004
B.S.	Chemistry	The University of Chicago, USA	1999

**Affiliation** Department of Chemistry, Faculty of Science, Mahidol University

#### Research Interest/Expertise

1. Perovskite and dye-sensitized solar cells
2. Electrochemical capacitors
3. Hydrogen storage and related catalysts

#### Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years

Sudchanham J., Batmunkh M., Shapter J. G., Raston C. L.\*, **Pakawatpanurut P\***. Improved morphology of the  $\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$  film using vortex fluidic device for perovskite solar cells, *ChemistrySelect*. 2017; 2: 369-374.

Sodtipinta J., leosakulrat C., Poonyayant N., Kidkhunthod P., Chanlek N., **Pakawatpanurut P\***. Interconnected open-channel carbon nanosheets derived from pineapple leaf fiber as a sustainable active material for supercapacitors, *Ind. Crop. Prod*. 2017; 104: 13-20.

Wood B. C.\*, Stavila V.\*, Poonyayant N., Heo T. W., Ray K. G., Klebanoff L. E., Udovic T. J., Lee J. R. I., Angboonpong N., Sugar J. D., **Pakawatpanurut P**. Nanointerface-driven reversible hydrogen storage in the nanoconfined Li-N-H system, *Adv. Mater. Interfaces*. 2017; 4: 1600803-1600809.

Thanacharoenchumrut S., Angboonpong N., **Pakawatpanurut P.\*** Cationic cetylpyridinium micelle as a novel electrolyte system for dye-sensitized solar cells, *J. Power Sources*. 2016; 307: 443-448.

Sodtipinta J., Kim H.-K., Lee S.-W., Smith S. M., **Pakawatpanurut P.\***, Kim K.-B.\* Microwave solvothermal synthesis of mixed pine tree seed-like/disc-shaped microstructures of  $\text{MnO}_x$  ( $x = 4/3$  and  $1$ ) with high specific capacitance for electrochemical capacitors, J. Electroceram. 2015; 35(1-4): 111-119.

Poonyayant N., Stavila V., Kartin M., Angboonpong N., **Pakawatpanurut P.**, Hecht E., Behrens R., Majzoub E. H., Klebanoff L. E.\* Intramolecular destabilization in  $\text{LiCa}(\text{BH}_4)_2(\text{NH}_2)$  and  $\text{NaCa}(\text{BH}_4)_2(\text{NH}_2)$ : improving hydrogen storage properties through hydridic-protic interactions, J. Phys. Chem. C. 2014; 118(27): 14759-14769.

### Current Teaching Duty

SCCH 100 Integrated Chemistry	3 (3-0-6)
SCCH 111 General Chemistry	3 (3-0-6)
SCCH 230 Physical Chemistry I	3 (3-0-6)
SCCH 330 Physical Chemistry III	3 (3-0-6)
SCCH 339 Physical Chemistry Laboratory	1 (0-3-1)
SCCH 778 Physico-chemical Techniques	3 (2-3-5)

### Teaching Duty in the Revised Program

SCCH 778 Physico-chemical Techniques	3 (2-3-5)
SCCH 785 Advanced Physical Chemistry	3 (3-0-6)
SCCH 774 Chemical Kinetics and Molecular Dynamics	3 (3-0-6)
SCCH 782 Seminar in Physical Chemistry and Chemical Physics I	1 (1-0-2)
SCCH 898 Dissertation	48 (0-144-0)
SCCH 798 Dissertation	36 (0-108-0)
SCCH 799 Dissertation	48 (0-144-0)

**7. Name** Assistant Professor Dr. Rattikan Chantiwas

**Education**

Degree	Field	Institution	Year
Ph.D.	Chemistry	Chiang Mai University,	2003
M.Sc.	Applied Analytical and Inorganic Chemistry	Thailand Mahidol University, Thailand	1999
B.Sc.	Chemistry	Mahidol University, Thailand	1996

**Affiliation** Department of Chemistry, Faculty of Science, Mahidol University

**Research Interest/Expertise**

1. Separation technique
2. Flow analysis method
3. Microfluidics analysis and microfabrication technique

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

Pruksatrakul T., Phoopraintra P., Wilairat P., Chaiyen P., **Chantiwas R.\*** Development of a sequential injection-liquid microextraction procedure with GC-FID for analysis of short-chain fatty acids in palm oil mill effluent, *Talanta*. 2017; 165: 612-618.

Pinthong C., Phoopraintra P., **Chantiwas R.**, Pongtharangkul T., Chenprakhon P., Chaiyen P. Green and sustainable biocatalytic production of 3,4,5-trihydroxycinnamic acid from palm oil mill effluent, *Process Biochem.* 2017; doi: 10.1016/j.procbio.2017.08.006.

Phonchai A., Wilairat P., **Chantiwas R.\*** Development of a solid-phase extraction method with simple MEKC-UV analysis for simultaneous detection of indole metabolites in human urine after administration of indole dietary supplement, *Talanta*. 2017; 174: 314-319.

- Chenprakhon P., Dhammaraj T., **Chantiwas R.\***, Chaiyen P. Hydroxylation of 4-hydroxyphenylethylamine derivatives by R263 variants of the oxygenase component of p-hydroxyphenylacetate-3-hydroxylase, Arch. Biochem. Biophys. 2017; 620: 1-11.
- Wiriyakun N., Nacapricha D., **Chantiwas R.\*** A simple method using two-step hot embossing technique with shrinking for fabrication of cross microchannels on PMMA substrate and its application to electrophoretic separation of amino acids in functional drinks, Talanta. 2016; 161: 574-582.
- Phonchai A., Wilairat P., **Chantiwas R.\*** Rapid simultaneous determination of four indole compounds in dietary supplements by micellar electrokinetic chromatography with a dilute and shoot step, Anal. Methods. 2016; 8(3): 637-643.
- Phonchai A., Srisukpan T., Riengrojpitak S., Wilairat P., **Chantiwas R.\*** Simple and rapid screening of the thiocyanate level in saliva for the identification of smokers and non-smokers by capillary electrophoresis with contactless conductivity detection, Anal. Methods. 2016; 8(25): 4983-4990.
- Phonchai A., Kim Y., **Chantiwas R.\***, Cho Y. K. Lab-on-a-disc for simultaneous determination of total phenolic content and antioxidant activity of beverage samples, Lab Chip. 2016; 16(17): 3268-3275.
- Uba F. I., Pullagurla S. R., Sirasunthorn N., Wu J., Park S., **Chantiwas R.**, et al. Surface charge, electroosmotic flow and DNA extension in chemically modified thermoplastic nanoslits and nanochannels, Analyst. 2015; 140(1): 113-126.

### Current Teaching Duty

SCCH 103 General Chemistry I	3 (3-0-6)
SCCH 217 Analytical Chemistry Laboratory I	1 (0-3-1)
SCCH 311 Analytical Chemistry I	2 (2-0-4)
SCCH 315 Trends in Analytical Science	2 (2-0-4)
SCCH 317 Practical Analytical Chemistry	2 (0-6-2)
SCCH 733 Separation Techniques	3 (3-0-6)
SCCH 732 Instrumental Analysis Laboratory	3 (1-6-4)
SCCH 734 Fluidic Technology for Analytical Science	3 (3-0-6)
SCCH 708 Special Problems in Chemistry	3 (3-0-6)

### Teaching Duty in the Revised Program

SCCH 733 Separation Techniques	3 (3-0-6)
SCCH 732 Instrumental Analysis Laboratory	3 (1-6-4)
SCCH 734 Fluidic Technology for Analytical Science	3 (3-0-6)
SCCH 708 Special Problems in Chemistry	3 (3-0-6)

SCCH 898 Dissertation	48 (0-144-0)
SCCH 798 Dissertation	36 (0-108-0)
SCCH 799 Dissertation	48 (0-144-0)

### Publication Records of the Faculty Members of the Program

1. Name Professor Dr. Pramuan Tangboriboonrat

#### Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years

- S. Nuasaen, P. Opaprakasit, P. Tangboriboonrat, Hollow latex particles functionalized with chitosan for the removal of formaldehyde from indoor air, *Carbohydr. Polym.*, 101 (2014), 179-187.
- C. Kaewsaneha, A. Bitar, P. Tangboriboonrat, D. Polpanich, A. Elaissari, Fluorescent-magnetic Janus particles prepared via seed emulsion polymerization, *J. Colloid Interf. Sci.*, 424 (2014), 98-103.
- T. Arpornwichanop, D. Polpanich, R. Thiramanas, T. Suteewong, P. Tangboriboonrat, PMMA-*N,N,N*-trimethyl chitosan nanoparticles for fabrication of antibacterial natural rubber latex gloves”, *Carbohydr. Polym.*, 109 (2014), 1-6.
- C. Kaewsaneha, K. Jangpatarapongsa, T. Tangchaikereee, D. Polpanich, P. Tangboriboonrat, Fluorescent chitosan functionalized magnetic polymeric nanoparticles: Cytotoxicity and *in vitro* evaluation of cellular uptake, *J. Biomater. Appl.*, 29 (2014), 761-768.
- S. Nuasaen, P. Tangboriboonrat, Optical properties of hollow latex particles as white pigment in paint film, *Prog. Org. Coat.*, 79 (2015), 83-89.
- J. Narongthong, S. Nuasaen, T. Suteewong, P. Tangboriboonrat, One-pot synthesis of organic-inorganic hybrid hollow latex particles via pickering and seeded emulsion polymerizations, *Colloid. Polym. Sci.* 293 (2015), 1269-1274.
- T. Arpornwichanop, D. Polpanich, R. Thiramanas, T. Suteewong, P. Tangboriboonrat, Enhanced antibacterial activity of NR latex gloves with raspberry-like PMMA-*N,N,N*-trimethyl chitosan particles, *Int. J. Biol. Macromol.*, 81 (2015), 151-158.
- C. Kaewsaneha, P. Tangboriboonrat, D. Polpanich, A. Elaissari, Multifunctional fluorescent-magnetic polymeric colloidal particles: Preparations and bioanalytical applications, *ACS Appl. Mater. Inter.*, 7 (2015), 23373-23386.

- W. Wichaita, D. Polpanich, T. Suteewong, P. Tangboriboonrat, Hollow core-shell particles via NR latex seeded emulsion polymerization, *Polymer*, 99 (2016), 324-331.
- CX. Wei, A. Plucinski, S. Nuasaen, A. Tripathi, P. Tangboriboonrat, K. Tauer, Swelling-induced deformation of spherical latex particles, *Macromolecules*, 50 (2017), 349-363.
- N. Sudjaiprapat, C. Kaewsaneha, S. Nuasaen, P. Tangboriboonrat, One-pot synthesis of non-spherical hollow latex polymeric particles via seeded emulsion polymerization”, *Polymer*, 121 (2017), 165-172.
- 

**2. Name** Professor Dr. Vichai Reutrakul

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- P. Pailee, C. Kuhakarn, C. Sangsuwan, S. Hongthong, P. Piyachaturawat, K. Suksen, S. Jariyawat, R. Akkarawongsapat, J. Limthongkul, C. Napaswad, P. Kongsaree, S. Prabpai, T. Jaipetch, M. Pohmakotr, P. Tuchinda, V. Reutrakul, “Anti-HIV and cytotoxic biphenyls, benzophenones and xanthenes from stems, leaves and twigs of *Garcinia speciosa*” *Phytochemistry* 2018, (147), 68-79.
- S. Chaturonrutsamee, C. Kuhakarn, P. Surawatanawong, S. Prabpai, P. Kongsaree, T. Jaipetch, P. Piyachaturawat, S. Jariyawat, R. Akkarawongsapat, K. Suksen, J. Limthongkul, C. Napaswad, N. Nuntasaeen, V. Reutrakul, “Polycyclic polyprenylated acylphloroglucinols and biphenyl derivatives from the roots of *Garcinia nuntasaenii* Ngerns. & Suddee” *Phytochemistry* 2018, (146), 63-74.
- J. Meesin, M. Pohmakotr, V. Reutrakul, D. Soorukram, P. Leowanawat, S. Saithong, C. Kuhakarn, “TBAI/TBHP-mediated cascade cyclization toward sulfonylated indeno[1,2-c]quinolines” *Organic Letters* 2017, 19, 6546-6549.
- 

**3. Name** Associate Professor Dr. Atitaya Siripinyanond

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- N. Sirirat, K. Tetbuntad, A. Siripinyanond, Application of thermospray flame furnace atomic absorption spectrometry for investigation of silver nanoparticles, *Anal. Bioanal. Chem.*, 409 (2017) 1887-1894.
- P. Dawan, T. Satarpai, P. Tuchinda, J. Shiowatana, A. Siripinyanond, A simple analytical platform based on thin-layer chromatography coupled with paper-based analytical device for determination of total capsaicinoids in chilli samples, *Talanta*, 162 (2017) 460-465.
- T. Satarpai, J. Shiowatana, A. Siripinyanond, Paper-based analytical device for sampling, on-site preconcentration and detection of ppb lead in water, *Talanta*, 154 (2016) 504-510.
- P. Wimuktiwan, J. Shiowatana, A. Siripinyanond, Investigation of silver nanoparticles and plasma protein association using flow field-flow fractionation coupled with inductively coupled plasma mass spectrometry (FIFFF-ICP-MS), *J. Anal. At. Spectrom.*, 30 (2015) 245-253.
- R. Saenmuangchin, J. Mettakoonpitak, J. Shiowatana, A. Siripinyanond, Separation of silver nanoparticles by hollow fiber flow field-flow fractionation: Addition of tannic acid into carrier liquid as a modifier, *J. Chrom. A*, 1415 (2015) 115-122.
- 

**4. Name** Associate Professor Dr. Chutima Kuhakarn

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- P. Pailee, C. Kuhakarn, C. Sangsuwan, S. Hongthong, P. Piyachaturawat, K. Suksen, S. Jariyawat, R. Akkarawongsapat, J. Limthongkul, C. Napaswad, P. Kongsaree, S. Prabpai, T. Jaipetch, M. Pohmakotr, P. Tuchinda, V. Reutrakul, "Anti-HIV and cytotoxic biphenyls, benzophenones and xanthenes from stems, leaves and twigs of *Garcinia speciosa*" *Phytochemistry* 2018, (147), 68-79.
- S. Chaturonrutsamee, C. Kuhakarn, P. Surawatanawong, S. Prabpai, P. Kongsaree, T. Jaipetch, P. Piyachaturawat, S. Jariyawat, R. Akkarawongsapat, K. Suksen, J. Limthongkul, C. Napaswad, N. Nuntasaen, V. Reutrakul, "Polycyclic polyprenylated acylphloroglucinols and biphenyl derivatives from the roots of *Garcinia nuntasaenii* Ngerns. & Suddee" *Phytochemistry* 2018, (146), 63-74.

- J. Meesin, M. Pohmakotr, V. Reutrakul, D. Soorukram, P. Leowanawat, S. Saithong, C. Kuhakarn, "TBAI/TBHP-mediated cascade cyclization toward sulfonylated indeno[1,2-c]quinolines" *Organic Letters* 2017, 19, 6546-6549.
- 

**5. Name** Associate Professor Dr. Duangjai Nacapricha

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- W. Alahmad, T. Pluangklang, T. Mantim, V. Cerdà, P. Wilairat, N. Ratanawimarnwong, D. Nacapricha, Development of flow systems incorporating membraneless vaporization units and flow-through contactless conductivity detector for determination of dissolved ammonium and sulfide in canal water (2018) *Talanta*, 177, pp. 34-40.
- N. Chantipmanee, W. Alahmad, T. Sonsa-Ard, K. Uraisin, N. Ratanawimarnwong, T. Mantim, D. Nacapricha, Green analytical flow method for the determination of total sulfite in wine using membraneless gas-liquid separation with contactless conductivity detection (2017) *Analytical Methods*, 9 (43), pp. 6107-6116.
- S. Teerasong, A. Jinnarak, S. Chaneam, P. Wilairat, D. Nacapricha, Poly(vinyl alcohol) capped silver nanoparticles for antioxidant assay based on seed-mediated nanoparticle growth (2017) *Talanta*, 170, pp. 193-198.
- C. Karuwan, A. Wisitsoraat, P. Chaisuwan, D. Nacapricha, A. Tuantranont, Screen-printed graphene-based electrochemical sensors for a microfluidic device (2017) *Analytical Methods*, 9 (24), pp. 3689-3695.
- N. Wiriyakun, D. Nacapricha, R. Chantiwas, A simple method using two-step hot embossing technique with shrinking for fabrication of cross microchannels on PMMA substrate and its application to electrophoretic separation of amino acids in functional drinks (2016) *Talanta*, 161, pp. 574-582.
- P. Phansi, S. Sumantakul, T. Wongpakdee, N. Fukana, N. Ratanawimarnwong, J. Sitanurak, D. Nacapricha, Membraneless Gas-Separation Microfluidic Paper-Based Analytical Devices for Direct Quantitation of Volatile and Nonvolatile Compounds (2016) *Analytical Chemistry*, 88 (17), pp. 8749-8756.



- T. Chaloeisuwiwattanakan, A. Sangcakul, C. Kitiyakara, D. Nacapricha, P. Wilairat, P. Chaisuwan, Simple and fast analysis of iohexol in human serums using microhydrophilic interaction liquid chromatography with monolithic column (2016) *Journal of Separation Science*, 39 (18), pp. 3521-3527.
- A. Jinnarak, P. Anantavichian, A. Intanin, S. Fungladda, N. Choengchan, P. Wilairat, D. Nacapricha, S. Teerasong, Sequential injection for determination of gamma-aminobutyric acid based on its effect on second order light scattering of silver nanoparticles (2016) *Journal of Food Composition and Analysis*, 51, pp. 69-75.
- W. Alahmad, K. Uraisin, D. Nacapricha, T. Kaneta, A miniaturized chemiluminescence detection system for a microfluidic paper-based analytical device and its application to the determination of chromium(III) (2016) *Analytical Methods*, 8 (27), pp. 5414-5420.
- K. Uraisin, S. Janya, C. Phechkrajang, N. Choengchan, W. Tiyapongpattana, V. Cerdà, D. Nacapricha, Chemometrics-assisted cross injection analysis for simultaneous determination of phosphate and silicate (2016) *International Journal of Environmental Analytical Chemistry*, 96 (9), pp. 886-903.
- S. Nouanthavong, D. Nacapricha, C.S. Henry, Y. Sameenoi, Pesticide analysis using nanoceria-coated paper-based devices as a detection platform (2016) *Analyst*, 141 (5), pp. 1837-1846.
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**6. Name** Associate Professor Dr. Ekasith Somsook

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- S. Haesuwannakij, T. Poonsawat, M. Noikham, E. Somsook, Y. Yakiyama, R. N. Dhital, H. Sakurai, Size-controlled preparation of gold nanoclusters on hydroxyapatite through trans-deposition method, *J. Nanosci. Nanotech.*, 17 (2017), 4649-4657.
- N. Kumpan, T. Poonperm, L. Chaicharoenwimolkul, S. Pornsuwan, E. Somsook, Ferrocenated nanocatalysts derived from the decomposition of ferrocenium in basic solution and their aerobic activities for the rapid decolorization of methylene blue and the facile oxidation of phenylboronic acid, *RSC Adv.*, 7 (2017), 5759-5763.

C. Poochai, W. Veerasai, E. Somsook, S. Dangtip, Dealloyed ternary Cu@Pt-Ru core-shell electrocatalysts supported on carbon paper for methanol electrooxidation catalytic activity, *Electrochim. Acta*, 222 (2016), 1243-1256.

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**7. Name** Associate Professor Dr. On-Uma Kheowan

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

C. Oopathump, O.-U. Kheowan, A. Charoenphakdee, A. Harnwungmoung and S.M. Smith, Thermoelectric characterization of multi-walled carbon nanotube/ Sodium cobalt oxide prepared by a low-cost flame sintering technique, *Ceram. Int.*, 43 (2017) 17086-17092.

T. Somboon, P. Wilairat, S.C. Muller and O.-U. Kheowan, The effect of acetone on the dynamics of temporal oscillations and waves in the ruthenium-catalyzed Belousov-Zhabotinsky reaction, *Phys. Chem. Chem. Phys.*, 17 (2015) 7114-7121.

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**8. Name** Associate Professor Dr. Palangpon Kongsaree

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

A. Tantipanjaporn, S. Prabpai, K. Suksen, P. Kongsaree. A thiourea-appended rhodamine chemodosimeter for mercury (II) and its bioimaging application, *Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy*, 192 (2018), 101-107.

K. Tiensomjit, S. Prabpai, S., P. Kongsaree. Characterization of the selective alkylation site in hemoglobin A by dihydroartemisinin with tandem mass spectrometry, *International Journal of Biological Macromolecules*, 99 (2017), 358-364.

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- P. Srisuratsiri, P. Kanjanasirirat, A. Chairongdua, P. Kongsaree. Reversible rhodamine-alkyne Au<sup>3+</sup>-selective chemosensor and its bioimaging application. *Tetrahedron Letters*, 58 (2017), 3194-3199.
- K. Wechakorn, K. Suksen, P. Piyachaturawat, P. Kongsaree. Rhodamine-based fluorescent and colorimetric sensor for zinc and its application in bioimaging, *Sensors and Actuators, B: Chemical*, 228 (2016), 270-277.
- K. Wechakorn, S. Prabpai, K. Suksen, P. Piyachaturawat, P. Kongsaree. Rhodol-based fluorescent probe for Au<sup>3+</sup> detection and its application in bioimaging. *RSC Advances*, 6 (2016), 24752-24755.

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**9. Name** Associate Professor Dr. Shuleewan Rajviroongit

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

การพัฒนาบทเรียนออนไลน์ในรายวิชา เคมีอินทรีย์ (วทศ ๑๒๒) ขึ้นในระบบ MuX ของมหาวิทยาลัยมหิดล และนำไปใช้ในการเรียนการสอนนักศึกษาในปีการศึกษา ๒๕๕๙-๖๐

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**10. Name** Associate Professor Dr. Taweechai Amornsakchai

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- P. Pittayavinai, S. Thanawan, T. Amornsakchai, Comparative study of natural rubber and acrylonitrile rubber reinforced with aligned short aramid fiber, *Polym. Test.*, 64 (2017), 109-116.
- K. Prukkaewkanjana, T. Amornsakchai, Synchrotron WAXS studies of stretched natural and synthetic rubber networks showing an upturn in stress-strain curves, *KGK-Kaut. Gummi. Kunst.*, 70 (2017), 52-55.
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**11. Name** Associate Professor Dr. Vuthichai Ervithayasuporn

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- S. Chanmungkalakul, V. Ervithayasuporn, S. Hanprasisit, M. Masik, N. Prigyai, S. Kiatkamjornwong, Silsesquioxane cages as fluoride sensors, *Chem. Commun.*, 53 (2017), 12108-12111.
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**12. Name** Assistant Professor Dr. Arada Chaiyanurakkul

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**13. Name** Assistant Professor Dr. Darunee Soorukram

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- S. Chaimanee, M. Pohmakotr, C. Kuhakarn, V. Reutrakul, D. Soorukram, Asymmetric synthesis of *ent*-fragransin C<sub>1</sub>, *Org. Biomol. Chem.*, 15 (2017), 3985-3994.
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**14. Name** Assistant Professor Dr. Jonggol Tantirungrotechai

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**15. Name** Assistant Professor Dr. Kanchana Uraisin

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**16. Name** Assistant Professor Dr. Sirilata Yotphan

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**17. Name** Assistant Professor Dr. Soraya Pornsuwan

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**18. Name** Assistant Professor Dr. Supavadee Kiatisevi

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- U. Eiamprasert, J. Sudchanham, P. Surawatanawong, P. Pakawatpanurut, S. Kiatisevi, Additional donor bridge as a design approach for multi-anchoring dyes for highly efficient dye-sensitized solar cells, *Journal of Photochemistry and Photobiology A: Chemistry*, 352 (2018), 86–97.
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- T. Techalertmanee, S. Chanchaenrith, M. Namkajorn, S. Kiatisevi, L. Chaicharoenwimolkul, E. Somsook, Facile synthesis of zinc-iron mixed oxide/carbon nanocomposites as nanocatalysts for the degradation of methylene blue, *Materials Letters*, 145 (2015), 224–228.
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**19. Name** Lecturer Dr. Nopporn Ruangsapapichat

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- N.Ruangsapapichat, M. Ruamyart, P.Kanchanarugee, C.Boonthum, N.Prachumrak, T.Sudyoadsuk, and V.Promarak, Toward rational design of metal-free organic dyes based on indolo[3,2-b]indole structure for dye-sensitized solar cells, *Dyes and Pigments* (In press)
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**20. Name** Lecturer Dr. Pawaret Leowanawat

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P. Leowanawat, A. Nowak-Krol, F. Würthner, Tetramethoxy-bay-substituted perylene bisimides by copper-mediated cross-coupling. *Org. Chem. Front.* 3 (2016), 537-544.

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**21. Name** Lecturer Dr. Phoonthawee Saetear

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

Cassandra L. Retzlaff, Amanda Kussrow, Tim Schorkopf, Phoonthawee Saetear, Darryl J. Bornhop, J. Andrew Hardaway, Sarah M. Sturgeon, Jane Wright, and Randy D. Blakely. Metallo- $\beta$ -lactamase Domain-Containing Protein 1 (MBLAC1) Is a Specific, High-Affinity Target for the Glutamate Transporter Inducer Ceftriaxone. *ACS Chemical Neuroscience* (2017) 8, 2132-2138.

Phoonthawee Saetear, Joseph Chamieh, Michael N. Kammer, Thomas J. Manuel, Jean-Philippe Biron, Darryl J. Bornhop, Hervé Cottet. Taylor Dispersion Analysis of polysaccharides using backscattering interferometry. *Analytical Chemistry* (2017) 89, 6710-6718.

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22. Name Lecturer Dr. Teera Chantarojsiri

Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years

Teera Chantarojsiri, Joseph Ziller and Jenny Yang. Incorporation of redox-inactive cations promotes iron catalyzed aerobic C-H oxidation at mild potentials. *Chem. Sci.* (2017) 9, 2567-74.

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23. Name Lecturer Dr. Tinnakorn Tiensing

Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years

Poungtong Pongploy and Tinnakorn Tiensing, Bilayer Surfactants of Fatty Acid and Cetyltrimethylammonium Bromide on Magnetic Nanoparticles for Preconcentration of Polycyclic Aromatic Hydrocarbons in Water Samples, *Chromatographia*. 2017, Online published 7/13/17. DOI 10.1007/s10337-017-3354-7.

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24. Name Lecturer Dr. Torsak Luanphaisarnnont

Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years

T. Luanphaisarnnont, Asymmetric Diels–Alder reactions of *N*-allenoyloxazolidinones catalyzed by Cu(II)–bis(oxazoline) complexes, *Tetrahedron Lett.*, 50 (2014), 6803-6807.

### Curriculum Vitae of Part-Time Instructors of the Curriculum

**1. Name** Professor Dr. Juwadee Shiowatana

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- P. Dawan, T. Satarpai, P. Tuchinda, J. Shiowatana, A. Siripinyanond, A simple analytical platform based on thin-layer chromatography coupled with paper-based analytical device for determination of total capsaicinoids in chilli samples, *Talanta*, 162 (2017) 460-465.
- T. Satarpai, J. Shiowatana, A. Siripinyanond, Paper-based analytical device for sampling, on-site preconcentration and detection of ppb lead in water, *Talanta*, 154 (2016) 504-510.
- P. Wimuktiwan, J. Shiowatana, A. Siripinyanond, Investigation of silver nanoparticles and plasma protein association using flow field-flow fractionation coupled with inductively coupled plasma mass spectrometry (FLFFF-ICP-MS), *J. Anal. At. Spectrom.*, 30 (2015) 245-253.
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**2. Name** Associate Professor Dr. Prapin Wilairat

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

- W. Alahmad, T. Pluangklang, T. Mantim, V. Cerdà, P. Wilairat, N. Ratanawimarnwong, D. Nacapricha, Development of flow systems incorporating membraneless vaporization units and flow-through contactless conductivity detector for determination of dissolved ammonium and sulfide in canal water (2018) *Talanta*, 177, pp. 34-40.
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**3. Name**      Lecturer Dr. Waret Veerasai

**Publication that are not parts of any degree study and are complied with the criteria for academic position appointment within 5 years**

Poochai, C., Veerasai, W., Somsook, E., Dangtip, S. Dealloyed ternary Cu@Pt-Ru core-shell electrocatalysts supported on carbon paper for methanol electrooxidation catalytic activity (2016) *Electrochimica Acta*, 222, pp. 1243-1256

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## Attachment

## Appendix C Curriculum Mapping

● Major Responsibility    ○ Minor Responsibility

Course	1. Morality and Ethics				2. Knowledge			3. Intellectual Development				4. Interpersonal Skills and Responsibility			5. Skills in Numerical Analysis, Communication, and Information Technology				
	1	2	3	4	1	2	3	1	2	3	4	1	2	3	1	2	3	4	5
<b>1) Compulsory</b>																			
SCCH 701 Frontiers in Chemistry	○	○		●	○	●	●		●	●	●	○	○	○		●	●		○
SCCH 702 Chemical Safety and Risk Management	●	●	●	●	●		○	●	○		○	●	●	●		○			○
SCCH 703 Scientific Communications	○	○	●	●		●	●				●	●	●		●	●	●	●	●
SCCH 704 Seminar in Chemistry	●	○	●	●	●	●	●	○	○	○	●	●	●	●	●	●	●		●
SCCH 705 Progress in Chemistry		●	●	●	●	●	○	●	●	●		●	●		●	●	●	○	●
SCCH 706 Research Skill Development I		●	●	●	●	●	○	●	●	●		●	●		●	●	●	○	●
SCCH 707 Research Skill Development II		●	●	●	●	●	○	●	●	●		●	●		●	●	●	○	●
SCCH 708 Special Problems in Chemistry	●	○		●	●	●	●	●	●	●	●	●	●	●	●	●	●	○	●
SCCH 711 Organic Structure Determination		●		●	●	●		●	●		○	○	●	○		○	○		●
SCCH 712 Molecular Structures and Functions		●			●	●		○	●		○		●	○		○	○		●
SCCH 731 Advanced Techniques in Analytical Chemistry		●		●	●	●		○	○	●	○	○	●	○	○	●		○	●
SCCH 732 Instrumental Analysis Laboratory	○	●		●	●	●		●	●	○	●	●	●	●	●	○		●	●
SCCH 763 Inorganic Structure and Bonding		●		○	●	●		●	●	○	●	●	●	○		○	○		○
SCCH 764 Characterization Techniques in		●		○	●	●		●	●	○	○	○	●	○		○	●	○	○

Course	1. Morality and Ethics				2. Knowledge			3. Intellectual Development				4. Interpersonal Skills and Responsibility			5. Skills in Numerical Analysis, Communication, and Information Technology				
	1	2	3	4	1	2	3	1	2	3	4	1	2	3	1	2	3	4	5
Inorganic Chemistry																			
SCCH 778 Physico-Chemical Techniques		●	●	●	●	●	●		●		●	○	●	●	●	●	●	●	●
SCCH 785 Advanced Physical Chemistry		●	●	●	●	●	●		●	●		○	●	●		●	●	●	●
SCCH 801 Environmental Materials			●	●	●	○				●		○	●			○	○		●
SCCH 802 Lignocellulosic Chemistry	○	●	●	○	●	●			○	○	○	○	●			○			
<b>2) Elective</b>																			
SCCH 713 Advanced Organic Synthesis		●			●	●		○	●		○		●			○	○		●
SCCH 714 Advanced Organic Reaction Mechanism		●		●	●	●		●	●			●	●			○			●
SCCH 715 Frontiers in Medicinal Chemistry		●		●	●	●		●	●	●	●	●	●	○		○	○		●
SCCH 716 Chemical Biology		●		●	●	●		●	●	●	●	●	●	○		○	○		●
SCCH 717 Advanced Natural Product Chemistry		●		●	●	●		○	●	○	●	●	●	○		●	○		●
SCCH 718 Asymmetric Synthesis		●		●	●	●		●	●	○	●	●	●	○		●	●		●
SCCH 719 Advanced Heterocyclic Chemistry		●		●	●	●		○	●	○	○	●	●	○		●	●		●
SCCH 720 Current Topics in Organic Chemistry		●		●	●	●		●	●			●	●			●	●		●
SCCH 733 Separation Techniques		●		●	●	●		○	○	○	●	○	●	○	○	○			○
SCCH 734 Fluidic Technology for Analytical Science		●		●	●	●		○	○	○	●	○	●	○		○			○
SCCH 735 Chemometrics		●		●	●	●		○	●	○	●	○	●	○	●	○		●	○
SCCH 736 Solution Chemistry		●		●	●	●		○	○	○		○	●	○	○	○			○
SCCH 737 Environmental Chemistry		●		●	●	●			●	○	●	○	●	○	●	○	○	○	○
SCCH 738 Special Topics in Analytical Chemistry		●		●	●	●			○	○	●	○	●	○		○			○



Course	1. Morality and Ethics				2. Knowledge			3. Intellectual Development				4. Interpersonal Skills and Responsibility			5. Skills in Numerical Analysis, Communication, and Information Technology				
	1	2	3	4	1	2	3	1	2	3	4	1	2	3	1	2	3	4	5
SCCH 739 Current Topics in Analytical Chemistry I	●	●	●	●	●	●			○	●	●	○	●	○		●	●		●
SCCH 740 Current Topics in Analytical Chemistry II	●	●	●	●	●	●			○	●	●		●	○		●	●		●
SCCH 754 Organotransition Metal Chemistry		●		○	●	●		●	○	●	○	●	●	○		○	●		●
SCCH 757 Solid State Chemistry		●		○	●	●		●	●	●	●	●	●	○		○	●		●
SCCH 765 Main Group Chemistry		●		○	●	●		●	●	○	●	●	●	○		○	○		○
SCCH 766 Inorganic Reaction Mechanisms		●		○	●	●		○	●	○	○	○	●	○		○	●		○
SCCH 767 NMR Spectroscopy in Inorganic Chemistry		●		○	●	●		●	●	●	●	●	●	○		○	●		●
SCCH 768 Special Topics in Inorganic Chemistry		●		●	○	●		●	●	○	●	●	●	○		○	○		○
SCCH 769 Bioinorganic Chemistry: from Metals in Biology to Modern Applications		●		●	○	●		●	●	○	●	●	●	○		○	○		○
SCCH 771 Quantum Chemistry		●	○	●	●	●	○		○		●	○	●	○	●	●	●	●	●
SCCH 772 Thermodynamics and Statistical Mechanics		●	○	●	●	●	○		○		●	○	●	○	●	●	●	●	●
SCCH 774 Chemical Kinetics and Molecular Dynamics		●	○	●	●	●	○		○		●	○	●	○	●	●	●	●	●
SCCH 775 Modern Chemical Physics		●	○	●	●	●			○		●	○	●	○	●	●	●	●	●
SCCH 776 Mathematical Methods		●	○	●	●	●		○	●		●	○	●	○	●	●	●	●	●
SCCH 779 Surface Chemistry and Advanced Electrochemistry		●	○	●	●	●			○		●	○	●	○	●	●	●	●	●
SCCH 780 Special Topics in Physical Chemistry		●	○	●	●	●	○		○		●	○	●	○	●	●	●	●	●
SCCH 781 Special Topics in Chemical Physics		●	○	●	●	●	○		○		●	○	●	○	●	●	●	●	●

Course	1. Morality and Ethics				2. Knowledge			3. Intellectual Development				4. Interpersonal Skills and Responsibility			5. Skills in Numerical Analysis, Communication, and Information Technology				
	1	2	3	4	1	2	3	1	2	3	4	1	2	3	1	2	3	4	5
SCCH 782 Seminar in Physical Chemistry and Chemical Physics I		●	○	●	●	●		○	○		●	●	●	○	●	●	●	●	●
SCCH 783 Seminar in Physical Chemistry and Chemical Physics II		●	○	●	●	●		○	○		●	●	●	○	●	●	●	●	●
SCCH 784 Seminar in Physical Chemistry and Chemical Physics III		●	○	●	●	●		○	○		●	●	●	○	●	●	●	●	●
SCCH 803 Chemistry of Waste and Pollution		●		○	●	●		●		○	○		●	○	○			●	
SCCH 804 Concepts in Sustainability	●	●	○	○	●	●	○	●	●	●	○	●	●	●	○	●	●	○	●
SCCH 805 Natural Fibers		●	○		●			●	●			●	●		○		●		
SCCH 806 Industrial Chemistry	●	●	○	●	●	●				●	○		●	○		○	○		●
<b>3) Dissertation</b>																			
SCCH 898 Dissertation	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SCCH 798 Dissertation	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SCCH 799 Dissertation	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

### Mapping of the TQF Learning Outcomes to the Core Values of Mahidol University

Learning Outcome (According to TQF)	Core values of Mahidol University
<b>1. Morality and Ethics</b>	
1.1 Have professional integrity and compassion.	Altruism, Integrity
1.2 Have self-discipline and self-responsibility.	Altruism, Integrity
1.3 Respect rules and regulations of the program and institution.	Integrity
1.4 Possess professional ethics.	Integrity
<b>2. Knowledge</b>	
2.1 Possess basic knowledge, theories and concepts, and in-depth understanding of relevant chemical research.	Originality, Mastery
2.2 Remain updated on new research advances.	Originality
2.3 Can disseminate knowledge and research findings to the public at an international level.	Mastery
<b>3. Intellectual Development</b>	
3.1 Systematically plan the experiments and perform analysis.	Mastery, Determination , Originality
3.2 Solve problems analytically and logically.	Mastery, Determination , Originality
3.3 Understand a contribution of a research finding toward a broader chemical knowledge.	Mastery, Originality
3.4 Apply academic knowledge to real-life situations or events.	Mastery, Originality
<b>4. Interpersonal Skills and Responsibility</b>	
4.1 Be open-minded toward different opinions and possess good human relations.	Harmony
4.2 Be responsible for assigned task and duty.	Altruism, Determination

Learning Outcome (According to TQF)	Core values of Mahidol University
4.3 Be a constructive team member in various roles.	Mastery, Harmony, Leadership
<b>5. Skills in Numerical Analysis, Communication, and Information Technology</b>	
5.1 Record and analyze data using appropriate technology.	Mastery, Determination, Originality
5.2 Choose appropriate information technology platforms that suit research inquiry.	Mastery, Determination
5.3 Use English speaking, listening, reading, and writing skills to communicate with others.	Mastery, Harmony
5.4 Analyze numerical data and use basic statistics correctly.	Mastery, Determination
5.5 Communicate chemical information to other people effectively by using appropriate media.	Mastery, Originality

Attachment  
Appendix D AUN-QA

**Table 1** The comparison of objectives between previous and revised programs

Objectives of previous program in 2012	Objectives of revised program in 2018
<p>๑.มีความรู้ในศาสตร์ทางเคมีเป็นอย่างดีและสามารถถ่ายทอดองค์ความรู้ได้อย่างมีประสิทธิภาพ</p> <p>๒.วิเคราะห์ สังเคราะห์ ประเมิน และแก้ปัญหาที่เกี่ยวข้องกับศาสตร์ทางเคมีได้อย่างเป็นระบบ มีประสิทธิภาพ และมีความรับผิดชอบต่อสภาวะแวดล้อม</p> <p>๓.บูรณาการองค์ความรู้ด้านเคมี ในการค้นคว้าวิจัย และการสร้างนวัตกรรมขั้นสูง เพื่อพัฒนางานด้านวิทยาศาสตร์และเทคโนโลยีในระดับนานาชาติ</p> <p>๔.สื่อสารและใช้เทคโนโลยีสารสนเทศได้อย่างเหมาะสมและทันสมัย</p> <p>๕.สร้างความสัมพันธ์อันดีต่อเพื่อนร่วมงาน เป็นผู้นำ และทำงานเป็นทีมได้และมีความรับผิดชอบต่อ</p> <p>๖.ดำรงไว้ซึ่งคุณธรรม จริยธรรม และจรรยาบรรณในการปฏิบัติงานทางวิชาการและการวิจัย</p>	<p>1. Graduates have good moral understanding and conform to scientific ethics.</p> <p>2. Graduates possess comprehensive knowledge and experience in chemistry for their future careers in private and government sectors.</p> <p>3. Graduates have capability of making well-informed decisions, conducting a task effectively, and creating original work.</p> <p>4. Graduates show good responsibility and are able to work as a team.</p> <p>5. Graduates attain analytical, communication, and information technology skills that enable them to compete at the international level.</p>

**Table 2** Program objectives and expected program learning outcomes

Program Objective	PLO*								
	1	2	3	4	5	6	7	8	9
1. Graduates have good moral understanding and conform to scientific ethics.	✓	✓			✓				✓
2. Graduates possess comprehensive knowledge and experience in chemistry for their future careers in private and government sectors.		✓	✓	✓	✓		✓	✓	✓

Program Objective	PLO*								
	1	2	3	4	5	6	7	8	9
3. Graduates have capability of making well-informed decisions, conducting a task effectively, and creating original work.	✓	✓	✓	✓	✓	✓	✓	✓	✓
4. Graduates show good responsibility and are able to work as a team.	✓	✓				✓		✓	
5. Graduates attain analytical, communication, and information technology skills that enable them to compete at the international level.		✓	✓	✓	✓		✓	✓	✓

**\*Program Learning Outcomes (PLOs)**

1. Graduates adhere to scientific ethics and respect rules and regulations of the program and the institution.
2. Graduates are able to use English speaking, listening, reading, and writing skills to communicate with others on advanced research topics.
3. Graduates are able to correctly explain advanced principles, theories, and chemical research in selected discipline.
4. Graduates are able to describe principles of operation and select appropriate scientific equipment for specific tasks.
5. Graduates are able to conduct experiments and evaluate the resulting data.
6. Graduates possess good working discipline and teamwork skills.
7. Graduates are able to choose appropriate information technology platforms that suit their research inquiries, analyze numerical data, and use basic statistics in a research project.
8. Graduates are able to propose hypotheses and design suitable experiments to verify them.
9. Graduates are able to evaluate the relationship among chemical research, innovation, and society.

**Table 3** Teaching and evaluation strategies for interpretation of expected Program Learning Outcomes

PLO	Teaching Strategy	Evaluation Strategy
1. Graduates adhere to scientific ethics and respect rules and regulations of the program and the institution.	1.1 Give advice, directly or indirectly, during the teaching of the courses and the dissertation period. 1.2 Give a clear timeline emphasis on assignments and class attendance. 1.3 Arrange group activities and encourage group assignments in relevant courses.	1.1 Monitor students' behavior. 1.2 Observe and make record of punctuality for class attendance and assignments. 1.3 Evaluate the performance of group activities or assignments.
2. Graduates are able to use English speaking, listening, reading, and writing skills to communicate with others on advanced research topics.	2.1 Qualifying examination 2.2 Dissertation period that includes proposal, progress report, and defense 2.3 Participation in national or international conferences 2.4 Workshops on English skills 2.5 Manuscript preparation	2.1 Evaluation of qualifying examination 2.2 Dissertation progress reports, proposal examination, and defense 2.3 Record of conference participations 2.4 Examinations and self-evaluation 2.5 Publication of the manuscript

PLO	Teaching Strategy	Evaluation Strategy
3. Graduates are able to correctly explain advanced principles, theories, and chemical research in selected discipline.	3.1 Courses 3.2 Qualifying examination 3.3 Dissertation period that includes proposal, progress report, and defense 3.4 Participation in national or international academic conference 3.5 Manuscript preparation	3.1 Course evaluation, as well as dissertation proposal examinations and defense 3.2 Evaluation of qualifying examination 3.3 Evaluation of students' works or seminar presentations 3.4 Record of conference participations 3.5 Publication of manuscript
4. Graduates are able to describe principles of operation and select appropriate scientific equipment for specific tasks.	4.1 Courses 4.2 Qualifying examination 4.3 Dissertation period that includes proposal, progress report, and defense	4.1 Evaluation of qualifying examination 4.2 Course evaluation, as well as dissertation proposal examinations and defense.
5. Graduates are able to conduct experiments and evaluate the resulting data.	5.1 Courses 5.2 Dissertation period that includes proposal, progress report, and defense	5.1 Course evaluation, as well as dissertation proposal examinations and defense
6. Graduates possess good working discipline and teamwork skills.	6.1 Laboratory sessions in appropriate courses 6.2 Dissertation period that includes proposal, progress report, and defense 6.3 Group activities and group assignments in relevant courses	6.1 Course evaluation, as well as dissertation proposal examinations and defense 6.2 Evaluation of group activities or assignments



PLO	Teaching Strategy	Evaluation Strategy
7. Graduates are able to choose appropriate information technology platforms that suit their research inquiries, analyze numerical data, and use basic statistics in a research project.	7.1 Courses 7.2 Group research and assignment 7.3 Qualifying examination 7.4 Dissertation period that includes proposal, progress report, and defense	7.1 Course evaluation 7.2 Group reports 7.3 Evaluation of qualifying examination 7.4 Dissertation proposal examination, progress report, and defense
8. Graduates are able to propose hypotheses and design suitable experiments to verify them.	8.1 Courses 8.2 Dissertation period that includes proposal, progress report, and defense	8.1 Course evaluation 8.2 Dissertation proposal examination, progress report, and defense
9. Graduates are able to evaluate the relationship among chemical research, innovation, and society.	9.1 Courses 9.2 Dissertation period that includes proposal, progress report, and defense	9.1 Course evaluation, as well as dissertation proposal examinations and defense.

**Table 4** The relationship between courses in the program structure and the expected Program Learning Outcomes (PLOs)

Course	Credit	PLO								
		1	2	3	4	5	6	7	8	9
<b>Compulsory</b>										
SCCH 701 Frontiers in Chemistry	3 (3-0-6)		I-P	I-P	I-P			I-P		I-P
SCCH 702 Chemical Safety and Risk Management	1 (1-0-2)	I-P	I-P	I-P			I-P	I-P		
SCCH 703 Scientific Communications	1 (1-0-2)	I-P	I-P				I-P	I-P		
SCCH 704 Seminar in Chemistry	1 (1-0-2)	R	R	R	R		R	R	I-P	R

Course	Credit	PLO								
		1	2	3	4	5	6	7	8	9
SCCH 705 Progress in Chemistry	3 (3-0-6)	R	R	R	R	R	R	R	R	R
SCCH 706 Research Skill Development I	3 (3-0-6)	R	R	R	R	I-P	R	R	R	R
SCCH 707 Research Skill Development II	3 (3-0-6)	R	R	R	R	P-R	R	R	R	R
SCCH 708 Special Problems in Chemistry	3 (3-0-6)	R	R	R	M	M	P-R	P-R	P-R	R
SCCH 711 Organic Structure Determination	3 (3-0-6)		R	M	R-M					
SCCH 712 Molecular Structures and Functions	3 (3-0-6)		R	M						
SCCH 731 Advanced Techniques in Analytical Chemistry	3 (3-0-6)		R	R	R			R		
SCCH 732 Instrumental Analysis Laboratory	3 (1-6-4)	R	R	R	R	R	P-R	P-R		
SCCH 763 Inorganic Structure and Bonding	3 (3-0-6)		R	R						R
SCCH 764 Characterization Techniques in Inorganic Chemistry	3 (3-0-6)		R	R	R					R
SCCH 778 Physico-Chemical Techniques	3 (2-3-5)		R	R	R		R	R	R	R
SCCH 785 Advanced Physical Chemistry	3 (3-0-6)		R	R						R
SCCH 801 Environmental Materials	3 (3-0-6)		R	R	R					R
SCCH 802 Lignocellulosic Chemistry	3 (3-0-6)		R	R						R

Course	Credit	PLO								
		1	2	3	4	5	6	7	8	9
<b>Elective</b>										
SCCH 713 Advanced Organic Synthesis	3 (3-0-6)		R	R						R
SCCH 714 Advanced Organic Reaction Mechanism	3 (3-0-6)		R	R						R
SCCH 715 Frontiers in Medicinal Chemistry	3 (3-0-6)		R	R						R
SCCH 716 Chemical Biology	3 (3-0-6)		R	R						R
SCCH 717 Advanced Natural Product Chemistry	3 (3-0-6)		R	R						R
SCCH 718 Asymmetric Synthesis	3 (3-0-6)		R	R						R
SCCH 719 Advanced Heterocyclic Chemistry	3 (3-0-6)		R	R						R
SCCH 720 Current Topics in Organic Chemistry	3 (3-0-6)		R	M						R
SCCH 733 Separation Techniques	3 (3-0-6)		R	R	R					R
SCCH 734 Fluidic Technology for Analytical Science	3 (3-0-6)		R	R	R					R
SCCH 735 Chemometrics	3 (2-3-5)		R	R	R					R
SCCH 736 Solution Chemistry	3 (3-0-6)		R	R						R
SCCH 737 Environmental Chemistry	3 (3-0-6)		R	R						R
SCCH 738 Special Topics in Analytical Chemistry	3 (3-0-6)		R	R	R					R
SCCH 739 Current Topics in Analytical Chemistry I	3 (3-0-6)		R	R	R					R

Course	Credit	PLO								
		1	2	3	4	5	6	7	8	9
SCCH 740 Current Topics in Analytical Chemistry II	3 (3-0-6)		R	R	R					R
SCCH 754 Organotransition Metal Chemistry	3 (3-0-6)		R	R						R
SCCH 757 Solid State Chemistry	3 (3-0-6)		R	R						R
SCCH 765 Main Group Chemistry	3 (3-0-6)		R	R						R
SCCH 766 Inorganic Reaction Mechanisms	3 (3-0-6)		R	R						R
SCCH 767 NMR Spectroscopy in Inorganic Chemistry	3 (3-0-6)		R	R	R					R
SCCH 768 Special Topics in Inorganic Chemistry	3 (3-0-6)		R	R				R		R
SCCH 769 Bioinorganic Chemistry: from Metals in Biology to Modern Applications	3 (3-0-6)		R	R				R		R
SCCH 771 Quantum Chemistry	3 (3-0-6)		R	R						R
SCCH 772 Thermodynamics and Statistical Mechanics	3 (3-0-6)		R	R						R
SCCH 774 Chemical Kinetics and Molecular Dynamics	3 (3-0-6)		R	R						R
SCCH 775 Modern Chemical Physics	3 (3-0-6)		R	R						R
SCCH 776 Mathematical Methods	3 (3-0-6)		R	R				R		R

Course	Credit	PLO								
		1	2	3	4	5	6	7	8	9
SCCH 779 Surface Chemistry and Advanced Electrochemistry	3 (3-0-6)		R	R	R					R
SCCH 780 Special Topics in Physical Chemistry	3 (3-0-6)		R	R				R		R
SCCH 781 Special Topics in Chemical Physics	3 (3-0-6)		R	R				R		R
SCCH 782 Seminar in Physical Chemistry and Chemical Physics I	1 (1-0-2)		R	R	R	R		R		R
SCCH 783 Seminar in Physical Chemistry and Chemical Physics II	1 (1-0-2)		R	R	R	R		R		R
SCCH 784 Seminar in Physical Chemistry and Chemical Physics III	1 (1-0-2)		R	R	R	R		R		R
SCCH 803 Chemistry of Waste and Pollution	3 (3-0-6)		R	R						R
SCCH 804 Concepts in Sustainability	3 (3-0-6)		R	R				R		R
SCCH 805 Natural Fibers	3 (3-0-6)		R	R						R
SCCH 806 Industrial Chemistry	3 (3-0-6)		R	R	R					R
<b>Dissertation</b>										
SCCH 798 Dissertation	36 (0-108-0)	M	M	M	M	M	M	M	M	M
SCCH 799 Dissertation	48 (0-144-0)	M	M	M	M	M	M	M	M	M
SCCH 898 Dissertation	48 (0-144-0)	M	M	M	M	M	M	M	M	M

I = ELO is introduced &amp; assessed

P = ELO is practiced &amp; assessed

R = ELO is reinforced &amp; assessed

M = Level of Mastery is assessed



**Attachment Appendix E**  
**The Revision of the Doctor of Philosophy Program in Chemistry**  
**(International Program)**  
**Revised Program 2012**  
**Faculty of Science and Faculty of Graduate Studies**  
**Mahidol University**

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1. The curriculum was approved by the Office of the Higher Education Commission on December 20, 2012, and was revised twice. The first and the second revisions were approved by the Office of the Higher Education Commission on April 8, 2015, and December 16, 2017, respectively.
2. The Mahidol University Council has approved this revised curriculum in the meeting no.531 on April 18, 2018.
3. The revised curriculum will be effective in the first semester of the academic year 2018 onward.

#### 4. Rationale of Revision

A highly trained and skilled personnel who also has thorough knowledge in chemistry with proficient English skills is highly desirable to the industry and the academics both in Thailand and outside. The Doctor of Philosophy Program in Chemistry at the Faculty of Science, Mahidol University, strives to produce graduates of such quality to the society at large. Nevertheless, the expertise in chemistry required by the domestic and international markets can change rapidly due to government policy and global development outlook. Just recently, Thailand has adopted a far-reaching economic model called Thailand 4.0, with a rollout of the Eastern Economic Corridor project as one of the first concrete implementations of Thailand 4.0. These new developments inevitably change the picture of the modern workforce, calling for every sector of human resource development to adjust and refocus accordingly.

Along with the abovementioned economic and social transformation, the quality assurance for higher education has recently been updated. Nationally, the Office of the Higher Education Commission already revised its Thai Qualifications Framework for Higher Education (TQF) in 2015. Internationally, many universities around the world significantly restructured their curriculums to emphasize more on the learning outcomes of students, rather than insular academic excellence in conventional disciplines. Mahidol University likewise embraces the philosophy of outcome-based education and adopts the ASEAN University Network–Quality Assurance (AUN-QA) as its quality guideline.

Therefore, the Doctor of Philosophy Program in Chemistry was revised to maintain the highest quality of curriculum under changing environments. The curriculum was revised using feedbacks from all stakeholders and the new social and economic developments mentioned above. In addition, the curriculum was also revised with conscience of an increasingly borderless, more interconnected global society. The goal of the program then lies not only in academic and professional excellence for the modern-day workforce, but also in the cultivation of sensible global citizens who contribute constructively to others and the society.

## 5. Contents of Revision

### 5.1 Add Plan 1

### 5.2 Revision of the Members of the Program

New Program 2012	Revised Program 2018
<i>Faculty Responsible of the Program</i>	<i>Faculty Responsible of the Program</i>
1. Prof. Dr. Pramuan Tangboriboonrat	-
2. Assist. Prof. Dr. Darunee Soorukram	-
3. Assoc. Prof. Dr. Duangjai Nacapricha	-
4. Assoc. Prof. Dr. Palangpon Kongsaree	-
5. Assist. Prof. Dr. Pasit Pakawatpanurut	1. Assist. Prof. Dr. Pasit Pakawatpanurut
6. Assoc. Prof. Dr. Preeyanuch Sangtrirutnugul	2. Assoc. Prof. Dr. Preeyanuch Sangtrirutnugul
7. Assoc. Prof. Dr. Shuleewan Rajviroongit	-
8. Assoc. Prof. Dr. Thammasit Vongsetskul	-
-	3. Assoc. Prof. Dr. Siwaporn Meejoo Smith



New Program 2012	Revised Program 2018
-	4. Assoc. Prof. Dr. Tienthong Thongpanchang
-	5. Assist. Prof. Dr. Chutima Jiarpinitnun
-	6. Assist. Prof. Dr. Panida Surawatanawong
-	7. Assist. Prof. Dr. Rattikan Chantiwas
<p><i>Faculty of the Program</i></p> <p>1. Prof. Dr. Jitladda Sakdapipanich</p> <p>2. Prof. Dr. Manat Pohmakotr</p> <p>3. Prof. Dr. Patoomratana Tuchinda</p> <p>-</p> <p>4. Prof. Dr. Vichai Reutrakul</p> <p>5. Assoc. Prof. Dr. Atitaya Siripinyanond</p> <p>6. Assoc. Prof. Dr. Chakrit Sirisinha</p> <p>7. Assoc. Prof. Dr. Chutima Kuhakarn</p> <p>-</p> <p>8. Assoc. Prof. Dr. Ekasith Somsook</p> <p>9. Assoc. Prof. Dr. Kalyanee Sirisinha</p> <p>10. Assoc. Prof. Dr. Khamphree Phomphrai</p> <p>11. Assoc. Prof. Dr. Nittaya Rattanasom</p> <p>12. Assoc. Prof. Dr. On-Uma Kheowan</p> <p>-</p> <p>13. Assoc. Prof. Dr. Panya Sunintaboon</p> <p>14. Assoc. Prof. Dr. Pranee Pinyocheep</p> <p>15. Assoc. Prof. Dr. Siwaporn Meejoo Smith</p> <p>-</p> <p>16. Assoc. Prof. Dr. Sombat Thanawan</p> <p>17. Assoc. Prof. Dr. Taweechai Amornsakchai</p> <p>18. Assoc. Prof. Dr. Tienthong Thongpanchang</p> <p>19. Assoc. Prof. Dr. Vuthichai Ervithayasuporn</p> <p>20. Assist. Prof. Dr. Arada Chaiyanurakkul</p> <p>21. Assist. Prof. Dr. Chayanisa Chitichotpanya</p> <p>22. Assist. Prof. Dr. Chutima Jiarpinitnun</p>	<p><i>Faculty of the Program</i></p> <p>-</p> <p>-</p> <p>-</p> <p>1. Prof. Dr. Pramuan Tangboriboonrat</p> <p>2. Prof. Dr. Vichai Reutrakul</p> <p>3. Assoc. Prof. Dr. Atitaya Siripinyanond</p> <p>-</p> <p>4. Assoc. Prof. Dr. Chutima Kuhakarn</p> <p>5. Assoc. Prof. Dr. Duangjai Nacapricha</p> <p>6. Assoc. Prof. Dr. Ekasith Somsook</p> <p>-</p> <p>-</p> <p>-</p> <p>7. Assoc. Prof. Dr. On-Uma Kheowan</p> <p>8. Assoc. Prof. Dr. Palangpon Kongsaree</p> <p>-</p> <p>-</p> <p>-</p> <p>9. Assoc. Prof. Dr. Shuleewan Rajviroongit</p> <p>-</p> <p>10. Assoc. Prof. Dr. Taweechai Amornsakchai</p> <p>-</p> <p>11. Assoc. Prof. Dr. Vuthichai Ervithayasuporn</p> <p>12. Assist. Prof. Dr. Arada Chaiyanurakkul</p> <p>-</p> <p>-</p>

New Program 2012	Revised Program 2018
23. Assist. Prof. Dr. Darapond Triampo -	- 13. Assist. Prof. Dr. Darunee Soorukram
24. Assist. Prof. Dr. Jonggol Tantirungrotechai	14. Assist. Prof. Dr. Jonggol Tantirungrotechai
25. Assist. Prof. Dr. Kanchana Uraisin	15. Assist. Prof. Dr. Kanchana Uraisin
26. Assist. Prof. Dr. Manthana Jariyaboon	-
27. Assist. Prof. Dr. Panida Surawatanawong	- -
28. Assist. Prof. Dr. Rattikan Chantiwas	16. Assist. Prof. Dr. Sirilata Yotphan
29. Assist. Prof. Dr. Sirilata Yotphan	17. Assist. Prof. Dr. Soraya Pornsuwan
30. Assist. Prof. Dr. Soraya Pornsuwan	-
31. Assist. Prof. Dr. Sunanta Vibuljan	-
32. Assist. Prof. Dr. Supa Wirasate	18. Assist. Prof. Dr. Supavadee Kiatisevi
33. Assist. Prof. Dr. Supavadee Kiatisevi - - -	19. Lecturer Dr. Nopporn Ruangsupapichat 20. Lecturer Dr. Pawaret Leowanawat 21. Lecturer Dr. Phoonthawee Saetear -
34. Dr. Ratana Chanthateyanonth -	22. Lecturer Dr. Teera Chantarojsiri
35. Dr. Tinnakorn Tiensing	23. Lecturer Dr. Tinnakorn Tiensing
36. Dr. Torsak Luanphaisarnont	24. Lecturer Dr. Torsak Luanphaisarnont

### 5.3 Revision of the Course Contents Based on Feedbacks and Current Situation

New Program 2012	Revised Program 2018	Remark
<i>Compulsory Courses</i>		
SCCH 701 Frontiers in Chemistry 3 (3-0-6)	SCCH 701 Frontiers in Chemistry 3 (3-0-6)	No change
SCCH 702 Chemical Safety and Risk Management 1 (1-0-2)	SCCH 702 Chemical Safety and Risk Management 1 (1-0-2)	No change

SCCH 703 Scientific Communications 1 (1-0-2)	SCCH 703 Scientific Communications 1 (1-0-2)	No change
SCCH 704 Seminar in Chemistry 1 (1-0-2)	SCCH 704 Seminar in Chemistry 1 (1-0-2)	No change
SCCH 705 Progress in Chemistry 3 (3-0-6)	SCCH 705 Progress in Chemistry 3 (3-0-6)	No change
SCCH 706 Research Skill Development I 3 (3-0-6)	SCCH 706 Research Skill Development I 3 (3-0-6)	No change
SCCH 707 Research Skill Development II 3 (3-0-6)	SCCH 707 Research Skill Development II 3 (3-0-6)	No change
SCCH 708 Special Problems in Chemistry 3 (3-0-6)	SCCH 708 Special Problems in Chemistry 3 (3-0-6)	No change
SCCH 711 Organic Structure Determination 3 (3-0-6)	SCCH 711 Organic Structure Determination 3 (3-0-6)	Change in course description.
SCCH 712 Molecular Structures and Functions 3 (3-0-6)	SCCH 712 Molecular Structures and Functions 3 (3-0-6)	Change in course description.
SCCH 731 Advanced Techniques in Analytical Chemistry 3 (3-0-6)	SCCH 731 Advanced Techniques in Analytical Chemistry 3 (3-0-6)	No change
SCCH 732 Instrumental Analysis Laboratory 3 (1-6-4)	SCCH 732 Instrumental Analysis Laboratory 3 (1-6-4)	Change in course description.
SCCH 751 Molecular Orbital Theory of Transition Metal Complexes 3 (3-0-6)	-	Closed
-	SCCH 763 Inorganic Structure and Bonding 3 (3-0-6)	New course
SCCH 752 Characterization Techniques in Catalysis 3 (3-0-6)	-	Closed
-	SCCH 764 Characterization Techniques in Inorganic Chemistry 3 (3-0-6)	New Course
SCCH 771 Quantum Chemistry 3 (3-0-6)	-	Course is reclassified as elective in the revised program.
<b>New Program 2012</b>	<b>Revised Program 2018</b>	<b>Remark</b>
-	SCCH 778 Physico-Chemical Techniques 3 (2-3-5)	Course is reclassified as compulsory in the revised program.
SCCH 772 Thermodynamics and Statistical Mechanics 3 (3-0-6)	-	Course is reclassified as elective in the revised program.

-	SCCH 785 Advanced Physical Chemistry 3 (3-0-6)	New course
SCCH 791 Polymer Chemistry 3 (3-0-6)	-	Closed
-	SCCH 801 Environmental Materials 3 (3-0-6)	New course
SCCH 792 Polymer Physics 3 (3-0-6)	-	Closed
-	SCCH 802 Lignocellulosic Chemistry 3(3-0-6)	New course
<b>Elective Courses</b>		
SCCH 713 Advanced Organic Synthesis 3 (3-0-6)	SCCH 713 Advanced Organic Synthesis 3 (3-0-6)	No change
SCCH 714 Advanced Organic Reaction Mechanism 3 (3-0-6)	SCCH 714 Advanced Organic Reaction Mechanism 3 (3-0-6)	No change
SCCH 715 Frontiers in Medicinal Chemistry 3 (3-0-6)	SCCH 715 Frontiers in Medicinal Chemistry 3 (3-0-6)	No change
SCCH 716 Chemical Biology 3 (3-0-6)	SCCH 716 Chemical Biology 3 (3-0-6)	No change
SCCH 717 Advanced Natural Product Chemistry 3 (3-0-6)	SCCH 717 Advanced Natural Product Chemistry 3 (3-0-6)	No change
SCCH 718 Asymmetric Synthesis 3 (3-0-6)	SCCH 718 Asymmetric Synthesis 3 (3-0-6)	No change
SCCH 719 Advanced Heterocyclic Chemistry 3 (3-0-6)	SCCH 719 Advanced Heterocyclic Chemistry 3 (3-0-6)	No change
SCCH 720 Current Topics in Organic Chemistry 3 (3-0-6)	SCCH 720 Current Topics in Organic Chemistry 3 (3-0-6)	No change
SCCH 733 Separation Techniques 3 (3-0-6)	SCCH 733 Separation Techniques 3 (3-0-6)	Change in course description.
SCCH 734 Fluidic Technology for Analytical Science 3 (3-0-6)	SCCH 734 Fluidic Technology for Analytical Science 3 (3-0-6)	Change in course description.
<b>New Program 2012</b>	<b>Revised Program 2018</b>	<b>Remark</b>
SCCH 735 Chemometrics 3 (2-3-5)	SCCH 735 Chemometrics 3 (2-3-5)	No change
SCCH 736 Solution Chemistry 3 (3-0-6)	SCCH 736 Solution Chemistry 3 (3-0-6)	No change
SCCH 737 Environmental Chemistry 3(3-0-6)	SCCH 737 Environmental Chemistry 3 (3-0-6)	No change
SCCH 738 Special Topics in Analytical Chemistry 3 (3-0-6)	SCCH 738 Special Topics in Analytical Chemistry 3 (3-0-6)	No change

SCCH 739 Current Topics in Analytical Chemistry I 3 (3-0-6)	SCCH 739 Current Topics in Analytical Chemistry I 3 (3-0-6)	No change
SCCH 740 Current Topics in Analytical Chemistry II 3 (3-0-6)	SCCH 740 Current Topics in Analytical Chemistry II 3 (3-0-6)	No change
SCCH 753 Homogeneous Catalysis 3 (3-0-6)	-	Closed
SCCH 754 Organotransition Metal Chemistry 3 (3-0-6)	SCCH 754 Organotransition Metal Chemistry 3 (3-0-6)	No change
SCCH 755 Catalysis in Ring-Opening Polymerization 3 (3-0-6)	-	Closed
SCCH 756 Heterogeneous Catalysis 3 (3-0-6)	-	Closed
SCCH 757 Solid State Chemistry 3 (3-0-6)	SCCH 757 Solid State Chemistry 3 (3-0-6)	No change
SCCH 758 Small Molecule Activation 3 (3-0-6)	-	Closed
SCCH 759 Olefin Polymerization Catalysis 3 (3-0-6)	-	Closed
SCCH 760 Biorefinery 3 (3-0-6)	-	Closed
SCCH 761 Nanocatalysis 3 (3-0-6)	-	Closed
SCCH 762 Special Topics in Catalysis 3 (3-0-6)	-	Closed
-	SCCH 765 Main Group Chemistry 3 (3-0-6)	New course
-	SCCH 766 Inorganic Reaction Mechanisms 3 (3-0-6)	New course
-	SCCH 767 NMR Spectroscopy in Inorganic Chemistry 3 (3-0-6)	New course
-	SCCH 768 Special Topics in Inorganic Chemistry 3 (3-0-6)	New course
-	SCCH 769 Bioinorganic Chemistry: from Metals in Biology to Modern Applications 3 (3-0-6)	New course
<b>New Program 2012</b>	<b>Revised Program 2018</b>	<b>Remark</b>
-	SCCH 771 Quantum Chemistry 3 (3-0-6)	Course is reclassified as elective in the revised program.
-	SCCH 772 Thermodynamics and Statistical Mechanics 3 (3-0-6)	Course is reclassified as elective in the revised program.

SCCH 773 Structure and Chemical Bonding 3 (3-0-6)	-	Closed
SCCH 774 Chemical Kinetics and Molecular Dynamics 3 (3-0-6)	SCCH 774 Chemical Kinetics and Molecular Dynamics 3 (3-0-6)	No change
SCCH 775 Modern Chemical Physics 3 (3-0-6)	SCCH 775 Modern Chemical Physics 3 (3-0-6)	No change
SCCH 776 Mathematical Methods 3 (3-0-6)	SCCH 776 Mathematical Methods 3 (3-0-6)	No change
SCCH 777 Green Energy Technology 3 (3-0-6)	-	Closed
SCCH 778 Physico-Chemical Techniques 3 (2-3-5)	-	Course is reclassified as compulsory in the revised program.
SCCH 779 Surface Chemistry and Advanced Electrochemistry 3 (3-0-6)	SCCH 779 Surface Chemistry and Advanced Electrochemistry 3 (3-0-6)	No change
SCCH 780 Special Topics in Physical Chemistry 3 (3-0-6)	SCCH 780 Special Topics in Physical Chemistry 3 (3-0-6)	No change
SCCH 781 Special Topics in Chemical Physics 3 (3-0-6)	SCCH 781 Special Topics in Chemical Physics 3 (3-0-6)	No change
SCCH 782 Seminar in Physical Chemistry and Chemical Physics I 1(1-0-2)	SCCH 782 Seminar in Physical Chemistry and Chemical Physics I 1(1-0-2)	No change
SCCH 783 Seminar in Physical Chemistry and Chemical Physics II 1(1-0-2)	SCCH 783 Seminar in Physical Chemistry and Chemical Physics II 1(1-0-2)	No change
SCCH 784 Seminar in Physical Chemistry and Chemical Physics III 1(1-0-2)	SCCH 784 Seminar in Physical Chemistry and Chemical Physics III 1(1-0-2)	No change
SCCH 793 Polymer Colloids 3 (3-0-6)	-	closed
SCCH 794 Polymer Characterization 3(3-0-6)	-	closed
<b>New Program 2012</b>	<b>Revised Program 2018</b>	<b>Remark</b>
SCCH 795 Techniques in Polymer Science 3 (3-0-6)	-	closed
SCCH 796 Nanomaterials 3 (3-0-6)	-	closed
SCCH 797 Special Topics in Polymer Science and Technology 3 (3-0-6)	-	closed

SCCH 798 Current Topics in Polymer Science 3 (3-0-6)	-		closed
-	SCCH 803 Chemistry of Waste and Pollution 3 (3-0-6)		New course
-	SCCH 804 Concepts in Sustainability 3 (3-0-6)		New course
-	SCCH 805 Natural Fibers 3 (3-0-6)		New course
-	SCCH 806 Industrial Chemistry 3 (3-0-6)		New course
<b>Dissertation</b>			
SCCH 699 Dissertation 36 (0-108-0)	SCCH 699 Dissertation 36 (0-108-0)		No change
-	SCCH 898 Dissertation 48 (0-144-0)		New course
SCCH 799 Dissertation 48 (0-144-0)	SCCH 799 Dissertation 48 (0-144-0)		No change

6. The Comparison Table of the Curriculum Structure between the Current Program and Revised Program Based on Criteria on Graduate Studies B.E. 2558 (set by Ministry of Education)

#### 6.1 For Students Holding M.Sc. Degree (Plan 1.1)

Course Category	Credit		
	Criteria on Graduate Studies B.E.2558	Curriculum Structure of the Current Program	Curriculum Structure of the Revised Program
Dissertation	Not less than 48	-	48
<b>Total Not less than</b>	<b>48</b>	<b>-</b>	<b>48</b>

#### 6.2 For Students Holding M.Sc. Degree (Plan 2.1)

Course Category	Credit				
	Criteria on Graduate Studies B.E.2558	Curriculum Structure of the Current Program		Curriculum Structure of the Revised Program	
		M.Sc. in Chemistry	M.Sc. in Related	M.Sc. in Chemistry	M.Sc. in Related

			<b>Fields</b>		<b>Fields</b>
1. Compulsory	} Not less than	6	9	6	9
2. Elective		12	Not less than 6	Not less than 6	Not less than 3
3. Dissertation		36	36	36	36
<b>Total not less than</b>		<b>48</b>	<b>48</b>	<b>48</b>	<b>48</b>

### 6.3 For Students Holding B.Sc. Degree (Plan 2.2)

Course Category	Credit			
	Criteria on Graduate Studies B.E.2558	Curriculum Structure of the Current Program	Curriculum Structure of the Revised Program	
1. Compulsory	} Not less than 24	24	21	
2. Elective		48	Not less than 9	Not less than 9
3. Dissertation			48	48
<b>Total not less than</b>		<b>72</b>	<b>81</b>	<b>78</b>



