TQF3 Course Specification

Section 1 General Information

1. Course Code and Title

In Thai	ICCH 222	เคมีอินทรีย์ ๒
In English	ICCH 222	Organic Chemistry II

2. Number of Credits 4(4-0-8)
(Theory ... hrs. Self-study ... hrs Practice ... hrs. / week)

3. Curriculum and Course Type

3.1 Program of Study Bachelor of Science
3.2 Course Type Major required course

4. Course Coordinator and Instructor

4.1 Course Coordinator Assoc. Prof. Dr. Pakorn Bovonsombat
Science Division MUIC
02 500 7000 ext.3519
pakorn.bov@mahidol.ac.th
(Name – Department – Contact: phone no. and e-mail address)

4.2 Instructor Assoc. Prof. Dr. Pakorn Bovonsombat

5. Trimester/Class Level

5.1 Trimester 3 First, Third / Class Level
5.2 Number of Students Allowed 30 Students

6. Pre-requisite

ICCH 221 Organic Chemistry I
ICCH 221 เคมีอินทรีย์ ๑

7. Co-requisites

none

8. Study Site Location

Mahidol University, Salaya campus

9. Date of Preparation/Latest Revision of the Course Specifications

Day 9 **Month** April **Year** 2023

Section 2 Aims and Objectives

1. Course Goals

To provide a detailed overview of the principles of the organic chemistry and the reactivity of different functional groups by understanding bonding, structures, structural stability, conformations, stereochemistry, reactions and mechanism; to apply the concepts of organic chemistry to synthesis problems and structure determination; identify and solve problems related to organic chemistry using the concepts learned

Course Goals: From the overview perspective of the course instructor, based on the principles, knowledge and skills related to the Program, describe the learning skill the students can develop and apply for further study or work in the future according to the goals set by the instructor in-charge. This has to correspond to the program goals.

2. Objectives of Course Development/Revision

2.1 Course Objectives

Understanding of the principles of organic chemistry and reaction-mechanisms is essential for the student's future endeavors in all areas of the life sciences, including applied sciences such as environmental, medical, and food sciences. This course aims to offer the principles of organic chemistry, the structures and reactions of functional groups, as well as their applications and impacts in the real world.

Course Objectives: Describe in detail the knowledge, understanding, skills and abilities of students after the course learning achievement, from the perspective of the course instructor in-charge. The objectives can be written based on the domains of learning (cognitive, affective, psychomotor, etc.)

2.2 Course-level Learning Outcomes (CLOs)

By the end of the course, students are able to

1. CLO1 Describe the structure and reactivity of organic molecules

2. CLO2 Describe the outcome of an organic reaction
3. CLO3 Describe the stereochemistry of any organic molecules
4. CLO4 Apply any organic chemistry concepts to solve problem in organic chemistry
5. CLO5 Identify potential hazards associated to chemicals

Remarks:

A. "The course-level expected learning outcomes (CLOs)": Based on the course objectives, explain the knowledge, abilities and skills of students that can be measured and evaluated to make sure that the students get the learning experience, pass the course evaluation based on criteria defined, and achieve the objectives in section 2.1 and the performance based on the standards defined.

B. A good CLO should consist of 3 structural components:
   1. AN ACTION VERB: Identify the ability or skill that the students must perform to be observed or measured.
   2. LEARNING CONTENT: Identify the knowledge that the students will gain and apply for other courses in the program or for future work.
   3. CRITERIA OR STANDARD: Identify the criteria or standards of competency defined in the course to judge the students' achievement.

C. In a CLO, more than one learning domain can be included.

D. Each course should have about 4 – 8 CLOs.

Section 3 Course Description and Implementation

1. Course Description

(In Thai)..... Course Goals should be reflected

แนวคิดทางกลไกของปฏิกิริยาทางเคมีอินทรีย์ปฏิกิริยาแทนที่ของสารอะโรเมติกด้วยอิเล็กโทรไฟล์สเปกโทรสโกปี และการวิเคราะห์โครงสร้าง ปฏิกิริยาของแอลดีไฮด์และคีโตน กรดคาร์บอกซิลิกและอนุพันธ์ คาร์บอนไอออนอะมีน ฟีนอลและเอริลเฮไลด์ ไขมัน คาร์โบไฮเดรต กรดอะมิโน

(In English) Concepts of organic reactions through mechanistic approach; aromaticity and electrophilic aromatic substitution; spectroscopy and structure; aldehydes and ketones; carboxylic acids and derivatives; carbanions, amines, phenol and aryl halides; fats; carbohydrates; amino acids.

2. Number of hours per trimester

Theory (hours)	Practice (hours)	Self-study (hours)
48 (4 hours x 12 weeks)	-	96 hours (8 hours x 12 weeks)

3. Number of Hours per Week for Individual Advice

1 hour/week

Identify the following information: The process or method that the person in-charge uses and time allocated for individual students.

Section 4: Development of the expected learning outcomes

1. A brief summary of the knowledge or skills expected to develop in students; the course-level expected learning outcomes (CLOs)
   By the end of the course, students who successfully complete the course will be able to:
   1. CLO1 Describe the structure and reactivity of organic molecules
   2. CLO2 Describe the outcome of an organic reaction
   3. CLO3 Describe the stereochemistry of any organic molecules
   4. CLO4 Apply any organic chemistry concepts to solve problem in organic chemistry
   5. CLO5 Identify potential hazards associated to chemicals

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

ICCH 221	Teaching methods	Evaluation Methods
CLO1	Reading assignment, problem assignment, group discussion, Interactive lecture	Quiz, Midterm and Final
CLO2	Reading assignment, problem assignment, group discussion, Interactive lecture	Quiz, Midterm and Final
CLO3	Reading assignment, problem assignment, group discussion, Interactive lecture	Quiz, Midterm and Final
CLO4	Reading assignment, problem assignment, group discussion, Interactive lecture	Quiz, Midterm and Final
CLO5	Reading assignment, problem assignment, group discussion, Interactive lecture	Quiz, Midterm and Final

Section 5 Lesson Plan and Evaluation

1. Lesson Plan

Week	Topic/Details*	Number of hours		On-Campus	Online Sessions	Instructors**	Note
		In-Class sessions	Lab sessions				
1	Mon 08.00-09.50 Conjugation (Ch. 14)	2	0	√	x	PkB	Google classroom, recorded lectures and textbook in conjunction with on-campus sessions
	Wed 08.00-09.50 Aromaticity	2		√	x		
2	Mon 08.00-09.50 Benzene and Aromaticity (Ch. 15)	2	0	√	x	PkB	
	Wed 08.00-09.50 Benzene and Aromaticity (Ch. 15)	2		√	x		
3	Mon 08.00-09.50 Benzene and Aromaticity (Ch. 15) continued;	2	0	√	x	PkB	
	Wed 08.00-09.50 Electrophilic Aromatic substitutions (Ch. 16)	2		√	x		
4	Mon 08.00-09.50 Electrophilic Aromatic substitutions (Ch. 16) continued	2	0	√	x	PkB	
	Wed 08.00-09.50 Electrophilic Aromatic substitutions (Ch. 16) continued	2		√	x		
5	Mon 08.00-09.50 Aldehyde/ketones (Ch. 17)	2	0	√	x	PkB	
	Wed 08.00-09.50 Aldehyde/ketones (Ch. 17)	2		√	x		

Week	Topic/Details*	Number of hours		On-	Online Sessions	Instructors**	Note
6	Mon 08.00-09.50 Exam	2	0	√	x	PkB	
	Wed 08.00-09.50 Enols, enolates and Aldol (Ch. 18)	2		√	x		
7	Mon 08.00-09.50 Enols, enolates and Aldol (Ch. 18)	2	0	√	x	PkB	
	Wed 08.00-09.50 Carboxylic acids (19)	2		√	x		
8	Mon 08.00-09.50 Carboxylic acids derivatives (Ch. 20)	2	0	√	x	PkB	
	Wed 08.00-09.50 Carboxylic acids derivatives (Ch. 20)	2		√	x		
9	Mon 08.00-09.50 Ester enolates and Claisen (Ch. 23)	2	0	√	x	PkB	
	Wed 08.00-09.50 Ester enolates and Claisen (Ch. 23)	2		√	x		
10	Mon 08.00-09.50 Amines (Ch. 21)	2	0	√	x	PkB	
	Wed 08.00-09.50 Benzene derivatives: Phenols, aromatic halides (Ch. 22)	2		√	x		
11	Mon 08.00-09.50 Amino acids, peptides (Ch. 26)	2	0	√	x	PkB	
	Wed 08.00-09.50 Amino acids, peptides (Ch. 26)	2		√	x		
12	Mon 08.00-09.50 Carbohydrates (Ch. 24)	2	0	√	x	PkB	
	Wed 08.00-09.50 Carbohydrates (Ch. 24)	2		√	x		

Week	Topic/Details*	Number of hours		On-	Online Sessions	Instructors**	Note
	Total	48	0	48	0		

*K. Peter C. Vollhardt; Neil E. Schore, Organic Chemistry – Structure and Function, 6th Edition, W.H. Freeman and Company, New York, 2011.

Supplementary:

L. G. Wade, Organic Chemistry 8th Edition, Pearson, New York, 2013

* PB = Assoc. Prof. Pakorn Bovonsombat

2. Evaluation of the CLOs

2.1 Measurement and Evaluation of learning achievement

a. Formative assessment

- Individual quiz results
- Midterm results
- Class discussion
- Reflective questions
- Answer comparison

b. Summative assessment

(1) Tool and weight for measurement and evaluation

Learning Outcomes	Assessment Methods	Assessment Ratio (Percentage)	
CLO1 Describe the structure and reactivity of organic molecules	Midterm	15	20
	Quiz	5	
CLO2 Describe the outcome of an organic reaction	Midterm	10	40
	Final	25	
	Quiz	5	
CLO3 Describe the stereochemistry of any organic molecules	Midterm	10	20
	Final	5	
	Quiz	5	
CLO4 Apply any organic chemistry concepts to solve problem in organic chemistry	Midterm	15	15
	Quiz	0	
CLO5 Identify potential hazards associated to chemicals	Midterm	0	5
	Final	5	
			100

(2) Measurement and evaluation

Grade	Achievement	Final Score (% Range)	GPA
A	Excellent	90-100	4.0

B+	Very good	85-89	3.5
B	Good	80-84	3.0
C+	Fairly good	75-79	2.5
C	Fair	70-74	2.0
D+	Poor	65-69	1.5
D	Very Poor	60-64	1.0
F	Fail	Less than 60	0.0

Judgment of the learning outcomes in the general education courses

a. Use the symbols O, S, and U or the A, B, ... and F.

b. Identify the judgment standard for each symbol.

c. Identify the symbol deemed as "pass."

(3) Re-examination (if the course allows any)

N/A - (Not applicable with MUIC)

Re-examination: Explain the situation in which the course will provide students with re-examination and the judgement of the re-examination results.

3. **Students' Appeal** In writing to the Associate Dean of Academic Affairs

Identify the following information: The method or channel the students will appeal to the course, the staff member who receives the appeals and processes or procedures

Section 6 Teaching Resources

1. Required Texts

1) Vollhardt, K.P.C. and Schore, N.E. Organic chemistry structure and function 6th Edition USA: W.H. Freeman and Company; 2011.

2. Suggested Materials

1) L. G. Wade, Organic Chemistry 8th Edition, Pearson, New York, 2013.
2) Streitweiser, A., Heathcock, C.H. and Kosower, E. Introduction to organic chemistry 4th Edition USA: MacMillan; 1992.
3) **Other Resources (if any)**

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Section 7 Evaluation and Improvement of Course Implementation

1. **Strategy for Course Effectiveness Evaluation by Students**

   1.1 Student feedback of instructors, teaching methods and materials, and course content through MUIC student evaluation forms

2. **Strategy for Teaching Evaluation**

   2.1 Evaluation of effectiveness based on student evaluation scores and comments

   2.2 Evaluation through peer observations by co-instructor or other Division faculty

3. **Teaching Improvement**

   3.1 Adjustments based on student feedback, personal observations, comments from peer observations and discussions with supervisor and/or other Division faculty in one-on-one and/or group meetings as specified by MUIC guidelines

4. **Verification of Standard of Learning Outcome for the Course**

   4.1 Verification through student performance on assessments based on MUIC/Division standards

   Describe the process used to verify student achievement in accordance with the course learning outcomes, such as the passing score test, test analysis, or assignment. The processes may be different for different courses or for different learning outcomes.

5. **Revision Process and Improvement Plan for Course Effectiveness**

   5.1 Course instructors (and coordinator/supervisor) will meet to discuss results of student evaluations and student performance based on learning outcomes in order to identify point for improvement

   5.2 Strategy for improvement set according to MUIC/Division guidelines

Remarks:

a. Identify ways to gain information used as input to evaluate the course effectiveness. The information includes teaching assessment, such as data from classroom observers and a teaching team or the student's academic performance. Also identify the analysis methods of the input data for teaching and course management improvement.

b. Describe mechanisms and methods to improve the course teaching and effectiveness such as an Executive Board Meeting to review and improve the course (which is reported in the TQF5 in every trimester), classroom research, and workshops for teaching improvement.

Appendix

Relations between the course and the program

Table 1 Relations between the course and the PLOs

ICCH 222	Learning Outcomes in Chemistry Program					
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
CLO1 Describe the structure and reactivity of organic molecules	1.2	2.2				
CLO2 Describe the outcome of an organic reaction	1.7	2.2		4.3		6.3
CLO3 Describe the stereochemistry of the product	1.2 1.7					
CLO4 Apply any organic chemistry concepts to solve problem in organic chemistry	1.2	2.2				6.1
CLO5 Identify potential hazards associated to chemicals					5.2	

Table 3 The description of Program LOs and Sub LOs of the cou

LOs	**Sub LOs**
1. Apply knowledge in both basic and applied chemistry and related scientific disciplines to systematically solve	1.1 Identify and apply concepts related to physical, organic, analytical, inorganic chemistry and biochemistry to solve problems at undergraduate level. 1.2 Use appropriate mathematical, statistical and computational tools to

LOs	Sub LOs
problems involving chemistry in academia and industry	analyze information and solve problems. 1.3 Synthesize information to arrive at logical reasoning in the context of chemistry.
2. Retrieve and appraise scientific literature critically and integrate information for problem solving and scientific research	2.1 Retrieve relevant scientific information from electronic and printed sources independently. 2.2 Analyze and draw meaningful conclusion from the learning materials. 2.1 Manage scientific literatures using reference management software in research.
3. Communicate concepts of chemistry and other sciences using effective excellent English in both written and oral forms to present ideas or solutions purposefully to both the scientific community and the public both locally and globally.	3.1 Communicate ideas and findings effectively in both oral and written forms, proper for audience groups to exchange, debate, demonstrate alternative counterviews as part of a collaboration, scientific discussions or research presentation 3.2 Prepare and deliver a purposeful and organized oral presentation with appropriate visual aids and give credits to others' original works 3.3 Prepare written documents to communicate information, ideas, and results of experiments under standard academic honesty guidelines
4. Demonstrate moral and appropriate conduct as a collaborative scientist with integrity, professionalism and ethics	4.1 Demonstrate moral and appropriate behavior 4.2 Recognize ethical issues related to chemistry research and professional practices 4.3 Identify national and global current issues and their relations to chemistry 4.4 Apply internationally and nationally accepted ethical standards to resolve issues and conflicts 4.5 Collaborate effectively with others as a responsible team member
5. Apply the principles of chemical safety practices for health and the environment in accordance with OSHA and MU standards	5.1 Understand and follow established safety protocols from MU and OSHA such as appropriate use of PPEs, fire alarm, fire extinguishers and other emergency equipment 5.2 Identify potential hazards associated to chemicals and use this information for proper storage or disposal of the chemicals 5.3 Assess risks associated to chemical experiments or processes, plan for prevention and mitigation or propose safer alternatives
6. Apply laboratory techniques and instrumentations in chemistry and other sciences to experiment, verify theory or formulate meaningful original solutions to novel situations, as part of theoretical discussion, experimentation, analysis, or research	6.1 Identify and apply appropriate procedures such as synthesis, extraction, separation, purification, formulation, measurement, quantitation and characterization of chemical compounds 6.2 Understand, predict and interpret chemical spectra from various chemical analysis instruments, including UV-Vis spectrophotometer, FTIR, mass spectrometry, and NMR 6.3 Predict and reason the relationship between structure and reactivity by chemical reasoning and computational/theoretical approach 6.4 Integrate obtained skills and knowledge in pure and applied chemistry and related disciplines to independently formulate his/her own solution to situations/problems