NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

COURSE CONTENT

Academic Year	2022/2023	**Semester**	2
Course Coordinator	Assoc. Prof. Pu Kanyi / Assoc. Prof. Zaher Judeh		
Course Code	CB1103		
Course Title	Organic Chemistry for Engineers		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	39 hours lecture, 6 hours tutorial		
Proposal Date	5/11/2019		

Course Aims

This course aims to teach students organic chemistry at the intermediate level. The course focuses on the fundamentals of bonding in organic compounds and basic reactions of selected organic functional groups with stereochemistry in mind.

Intended Learning Outcomes (ILO)

Upon completion of the course, students will be able to:

1. Describe orbitals, bonding, hybridization and resonance of organic compounds
2. Identify the different classes of organic compounds and their reactions and industrial applications
3. Describe the reaction mechanisms and stereochemistry of different organic reactions
4. Apply the knowledge to perform organic transformation reactions for synthesis of simple compounds.

Course Content

Key topics taught:

1. Introduction to organic chemistry
2. Stereochemistry
3. Chemistry of alkanes, alkyl halides and alkenes
4. Chemistry of alcohols, esters, phenols, epoxides
5. Chemistry of aromatic compounds and conjugated systems
6. Chemistry of amines, carboxylic acids and derivatives

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team /Individual	Assessment rubrics
Continuous Assessment: Quiz 1	1, 2, 3, 4, 5	a, b, c, d	20%	Individual	Appendix 1
Continuous Assessment: Quiz 2	1, 2, 3, 4, 5,	a, b, c, d	20%	Individual	Appendix 1
Final Examination (60%) (2hrs Closed Book)	1, 2, 3, 4, 5	a, b, c, d	60%	Individual	Appendix 1
Total			100%		

Mapping of Course ILOs to EAB Graduate Attributes

Course Intended Learning Outcomes	Cat	EAB's 12 Graduate Attributes*											
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	Core		●	●	●			◐		◐			
Grasp the knowledge of orbitals, bonding, hybridization and resonance of organic compounds										b, c, d, g, i			
Identify the different classes of organic compounds and their reactions and industrial applications										b, c, d, g, i			
Understand the reaction mechanisms and stereochemistry of different organic reactions										b, c, d, g, i			
Apply the knowledge to perform organic transformation reactions for synthesis of simple compounds										b, c, d, g, i			

Legend:
- ● Fully consistent (contributes to more than 75% of Intended Learning Outcomes)
- ◐ Partially consistent (contributes to about 50% of Intended Learning Outcomes)
- š Weakly consistent (contributes to about 25% of Intended Learning Outcomes)
- Blank Not related to Student Learning Outcomes

Formative feedback

Examination results;
Marks will be uploaded to NTUlearn.
Quiz answers will be discussed in class. Common mistakes and misunderstanding in concepts will be addressed.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lecture	Lecture will primarily discuss the key concepts related to orbitals, bonding and hybridization, stereochemistry, chemistry of organic compounds including alkanes, alkyl halides and alkenes, alcohols, esters, phenols, epoxides, aromatic compounds and conjugated systems, amines, carboxylic acids and derivatives.
Tutorial	Tutorial questions comprise relevant applications of the concepts introduced in lectures. Students are encouraged to have discussion with the instructor to clarify doubts and to explore reaction schemes.

Reading and References

1. Main Text: Organic Chemistry (6th Edt.) by L.G. Wade.
2. References: Organic Chemistry (6th Edition) by J. McMurry; Organic Chemistry (6th Edition) by Morrison & Boyd; A Guidebook to Mechanisms in Organic Chemistry (5th Edition) by Peter Sykes; The Third Dimension in Organic Chemistry by Alan Bassindale

Course Policies and Student Responsibilities

General: Students are expected to complete all online activities and take all scheduled assignments and tests by due dates. Students are expected to take responsibility to follow up with course notes, assignments and course related announcements. Students are expected to participate in all tutorial discussions and activities.

Continuous assessments: Students are required to attend all continuous assessments. Absenteeism: Continuous assessments make up a significant portion of students' course grade. Absence from continuous assessments without officially approved leave will result in no marks and affect students' overall course grade.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Pu Kanyi	CCEB, N1.3, B2-05	6513 8077	kypu@ntu.edu.sg
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Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to orbitals, hybridization and bonding in organic compounds	1	Textbook, lecture notes, tutorial questions
2	Chemistry of alkanes and cycloalkanes	2, 3, 4, 5	Same as above
3	Stereochemistry	2, 3, 4, 5	
4	Chemistry of alkyl Halides	2, 3, 4, 5	
5	Chemistry of alkenes and alkynes	2, 3, 4, 5	
6	Chemistry of alcohols	2, 3, 4, 5	
7	Chemistry of ethers, epoxides and sulfides	2, 3, 4, 5	
8	Conjugated Systems	2, 3, 4, 5	
9	Benzene and aromaticity	2, 3, 4, 5	
10	Reactions of aromatic compounds	2, 3, 4, 5	
11	Chemistry of Phenols	2, 3, 4, 5	
12	Chemistry of Amines	2, 3, 4, 5	
13	Chemistry of carboxylic Acids and Derivatives	2, 3, 4, 5	

Appendix 1: Assessment Criteria

Criteria	Unsatisfactory: <40%	Borderline: 40% to 49%	Satisfactory: 50% to 69%	Very good: 70% to 89%	Exemplary: >90%
Grasp the knowledge of orbitals, bonding, hybridization and resonance of organic compounds	Unable to distinguish different types of orbitals, bonding, hybridization and resonance	Able to name different types of orbitals, bonding, hybridization and resonance	Able to identify different types of orbitals, bonding, hybridization and resonance of organic compounds with given molecular structures	Able to identify different types of orbitals, bonding, hybridization and resonance organic compounds with given molecular structures; meanwhile, able to draw the resonance of given molecular structures	Able to identify different types of orbitals, bonding, hybridization and resonance of organic compounds with given molecular structures; meanwhile, able to draw the resonance of some typical organic compounds without given molecular structures
Identify the different classes of organic compounds and their reactions	Unable to identify the different classes of organic compounds and their reactions	Able to identify the 80% different classes of organic compounds; but unable to associate them with their reactions wherein they can serve as the substrates	Able to fully identify the different classes of organic compounds and know their 70& reactions wherein they can serve as the substrates	Able to identify the different classes of organic compounds and know their all reactions wherein they can serve as the substrates but not products.	Able to fully identify the different classes of organic compounds and know their all reactions wherein they can serve as the substrates and the products
Understand the reaction mechanisms and stereochemistry of different organic reactions	Unable to understand the reaction mechanisms and stereochemistry of different organic reactions	Familiar with the reaction mechanisms but unable to draw the reaction mechanism for a given reaction	Familiar with the reaction mechanisms and able to draw the reaction mechanism for a given reaction	Familiar with the reaction mechanisms and able to draw the reaction mechanism for a given reaction but not fully understand the stereochemistry involved in the reaction	Familiar with the reaction mechanisms and able to not only draw the reaction mechanism for a given reaction and fully understand the stereochemistry involved in the reaction
Apply the knowledge to perform organic transformation reactions for synthesis of simple compounds.	Unable to design the reaction schedule using the organic compounds to synthesize a given compound	Able to partially identify some of the reagents and intermediator required for the synthesis of a given compound but not able to design the reaction schedule/procedures	Able to partially design the reaction schedule using the typical organic reagents to reach and synthesize some intermediators but not the final produce (the given compound)	Able to design the reaction schedule using the typical organic reagents to synthesize a given compound	Able to design one than more reaction schedules using the typical organic reagents to synthesize a given compound and able to identify which on is most effective

Appendix 2: The EAB (Engineering Accreditation Board) Accreditation SLOs (Student Learning Outcomes)

a) **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems
b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e) **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
f) **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.
h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l) **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change