

COURSE CONTENT

Academic Year	2023/2024	Semester	1
Course Coordinator	Goh, Ghim Song / Zhang, Jie		
Course Code	CH4223		
Course Title	Petroleum Refining		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	39 hours lecture, 0 hours tutorial		
Proposal Date	1/10/2021		

Course Aims

The objective of this course is to introduce CBE students to the hydrocarbon/ refining/ petrochemical industry. By the end of the course, you should understand and be able to describe the standard key processes in a refinery and petrochemical complex. You will be able to understand the fundamentals of each type of processes and be able to do simple troubleshooting or impact assessment of different mode of operations. You will be made aware of current updates in the Health, Safety, Environmental regulations in the industry and able to apply ideas of barriers in these regulations. Finally, you will also be able to understand the economics & energy aspects of running a refinery and petrochemical complex and apply simple calculations to optimize energy usage and profit for a site.

Intended Learning Outcomes (ILO)

Upon successful completion of the course, you will be able to:

- 1) describe and explain the standard processes
- 2) apply concepts and perform simple calculations
- 3) List some renewable technologies and environmental issues
- 4) discuss the current challenges the industry faces

Course Content

Energy, Crude distillation, Hydrotreating, Platforming, Hydrocracking, Thermal cracking, Long residue catalytic cracker unit, Product quality, Oil movements, Process Safety, Environmental Regulation, Economics & Scheduling / Refinery Integration, Ethylene Cracker Complex.

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team /Individual	Assessment rubrics
1. Class Participation	1,2,3,4	a, b, c, d, f, g, h, l	20%	Individual	Appendix 1
2. Assignments	1,2,3,4	a, b, c, d, f, g, h, l	40%	Individual	Appendix 1
3. Final Examination (2hrs Closed Book)	1,2,3,4	a, b, c, d, f, g, h, l	40%	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	●	●	●	●		●	●	●				●
1. Describe and explain the standard processes		a,b,c, d											
2. Apply concepts and perform simple calculations		a,b,c, d											
3. List some renewable technologies and environmental issues		f,g,h,l											
4. Discuss the current challenges the industry faces		a,b,c,d,f,g,h,l											

Legend:

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

Formative feedback

Examination results;

Marker's report on overall examination performance will be uploaded to NTUlearn;

Quiz answers will be discussed in class

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lecture	Demonstrate how to carry out a procedure such as working through a problem and use incomplete handouts which enable you to participate in class.
Tutorial	N/A

Reading and References

1) Petroleum Refining – Technology and Economics by Dr. James H. Gary, Glenn E. Handwerk, and Mark J. Kaiser. Fifth edition. CRC press.

2) Handbook of Petroleum Refining Processes by Robert A. Mayers. Third edition. McGrawHill.

Course Policies and Student Responsibilities

General: You are expected to complete all online activities and take all scheduled assignments and tests by due dates. You 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: You are required to attend all continuous assessments.

Absenteeism: Continuous assessments make up a significant portion of your course grade.

Absence from continuous assessments without officially approved leave will result in no marks and affect your 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
Goh Ghim Song	Bukom Manufacturing Site	62634606	Ghim-Song.Goh@shell.com
Zhang, Jie	Bukom Manufacturing Site	63205212	Jie.J.Zhang@shell.com

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Reading	1,2,3,4	Readings
2	Process Unit Technology 1	2,3,4	Lecture
3	Process Unit Technology 2	1,2,4	Lecture
5	Process Unit Technology 3	1,2,4	Lecture
6	Process Unit Technology 4	1,2,4	Lecture
7	Process Unit Technology 5	1,2,4	Lecture
8	Process Unit Technology 6	1,2,4	Lecture
9	Process Safety (1.5h) Environment (1.5h)	1,2,3,4	Lecture
10	CO ₂ and Energy (1h) Shell's Energy Transition (2h)	1,2,3,4	Lecture
11	Refinery Integration & Economics	1,2,4	Lecture
12	Special Topic	4	Interactive session
13	Final Exam Revision	1,2,3,4	Lecture

Appendix 1: Assessment Criteria

<u>Criteria</u>	<u>Unsatisfactory: <40%</u>	<u>Borderline: 40% to 49%</u>	<u>Satisfactory: 50% to 69%</u>	<u>Very good: 70% to 89%</u>	<u>Exemplary: >90%</u>
Understand and be able to describe the standard key processes in a refinery and petrochemical complex.	Unable to understand and describe the standard processes in a petrochemical complex	Able to show limited understanding and description of the standard processes in a petrochemical complex	Able to show good understanding and description of the standard processes in a petrochemical complex with little or no demonstration of interdependency of one or more process on downstream processes	Able to show good understanding and description of standard processes in a petrochemical complex and is able to demonstrate good understanding of the interdependency of one or more process on other downstream processes.	Able to show good understanding and description of standard processes in a petrochemical complex and is able to demonstrate excellent understanding of the interdependency of all process on other downstream processes.
Understand the fundamentals of each type of processes and be able to do simple troubleshooting or impact assessment of different mode of operations.	Little or no demonstration of understanding of fundamentals of each types of processes	Demonstration of understanding of fundamentals of processes but unable to resolve simple troubleshooting or different mode of operations problems	Clear demonstration of understanding of fundamentals of processes and able to resolve simple troubleshooting or different mode of operations problems	Clear demonstration of understanding of fundamentals of processes and able to resolve complex troubleshooting or different mode of operations problems	Clear demonstration of understanding of fundamentals of processes and able to resolve complex and ambiguous issues related to troubleshooting or different mode of operations problems
Aware of current updates in the Health, Safety, Environmental regulations in the industry and able to apply ideas of barriers in these regulations.	Demonstrate little or no awareness in the Health, Safety, Environmental regulations in the industry	Demonstrate some awareness in the Health, Safety, Environmental regulations in the industry but cannot relate ideas of barriers to these regulations.	Demonstrate some awareness in the Health, Safety, Environmental regulations in the industry and is able to relate ideas of barriers to these regulations.	Demonstrate good awareness in the Health, Safety, Environmental regulations in the industry and is able to demonstrate clear relationships of barriers to these regulations.	Demonstrate good awareness in the Health, Safety, Environmental regulations in the industry and is able to demonstrate existing and think of new barriers to these regulations
Understand the economics & energy aspects of running a refinery and petrochemical	Demonstrate no understanding of economics and energy aspects of running a petrochemical complex.	Demonstrate some understanding of economics and energy aspects of running a petrochemical	Demonstrate good understanding of economics and energy aspects of running a petrochemical complex and can	Demonstrate good understanding of economics and energy aspects of running a petrochemical complex and can	Demonstrate good understanding of economics and energy aspects of running a petrochemical complex and can apply calculations

al complex and apply simple calculations to optimize energy usage and profit for a site.		complex but unable to do simple calculations to optimize energy and hydrocarbon margins.	apply calculations to either optimize energy or hydrocarbon margins but not both	apply calculations to optimize both energy and hydrocarbon margins	to optimize both energy and hydrocarbon margins. Able to come up with innovative solutions to improve energy and hydrocarbon margins for a petrochemical complex.
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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