MINISTRY OF INDUSTRY AND TRADE
INDUSTRIAL UNIVERSITY OF HO CHI MINH CITY
FACULTY OF CHEMICAL ENGINEERING

PROGRAMME SPECIFICATION

UNDERGRADUATE PROGRAMME IN

CHEMICAL ENGINEERING

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ABBREVIATION

AUN-QA	ASEAN University Network – Quality Assurance
ABET	Accreditation Board for Engineering and Technology
CDIO	Conceive-Design-Implement-Operate
IUH	Industrial University of Ho Chi Minh city
FCE	Faculty of Chemical Engineering
ELOs	Expected Learning Outcomes
CLO	Course Learning Outcomes
QA	Quality Assurance
OAA	Office of Academic Affairs
OFM	Office of Facilities Management
TOEIC	Test of English for International Communication
MOET	Ministry of Education and Training
MOIT	Ministry of Industry and Trade
SCSC	Student Counseling and Support Center
OHRA	Office of Human Resources and Administration
HOD	Head of Department

1. GENERAL INFORMATION OF THE PROGRAMME

1.1. Programme Introduction

Programme is a system of course which shows programme objectives, expected learning outcomes about knowledge, skills and attitudes, admission criteria or requirements to the programme, programme structure, teaching and learning strategies, assessment methods for each course, type and major.

Programme in chemical engineering is developed with the CDIO approach aimed to provide students with comprehensive training for the technical knowledge, skills and ethics of chemical engineers, which emphasizes practical competence and a sense of social responsibility that assures students with active learning and hands-on experience. Graduates meet the requirements of employers and society about knowledge, professional qualifications.

Programme is designed regarding regulations, circulars, notifications and guidelines of IUH, MOET; matching development orientation of economic, industry, human resources and labor market needs in local, economic region; reference quality assurance models of nation and internation

Programme is also considered equivalent, accordance with the programmes of the International University. Graduates are accepted to continue learning, studying at major universities in the world such as: Thammasat University, Chulalongkorn University – Thailand; Universiti Malaysia Pahang – Malaysia; Sungkyunkwan University, Kyung Hee University, Changwon National University – Korea; National Taipei University, Chung Yuan Christian University – Taiwan, …

1.2. Genenal imformation of the programme

- Programme name: **Chemical Engineering**
- Programme code: **52510401**
- Type: **Undergraduate**
- Learning time: **4 years – 8 semester (maximum 6 years)**
- Name of the final award: **The Degree of Engineer in Chemical engineering**
- Awarding institution: **Industrial University of Ho Chi Minh City**

2. THE PROGRAMME OBJECTIVES

The programme objectives are clearly linked to the vision, mission of the FCE and also reflect the vision, mission, objectives and slogan of IUH to provide high quality human resource and develop scientific research applications which meet the social needs

2.1. Vision – Mission – Objectives of IUH

The Industrial University of Ho Chi Minh City (IUH) is a public higher education institution in Vietnam. IUH is approved for implying an autonomy mechanism in operation as a pilot innovation project by Vietnam government for the period of 2015 - 2017, started from the academic year of 2015 - 2016.

To meet the requirement of innovation, IUH's leaders have built the vision, mission, and objectives of the university from now to 2020, and up to 2025 with the slogan of "Innovating, attaining new height - Dynamizing, integrating into the globe".

2.1.1. Vision

The Industrial University of Ho Chi Minh City nationally becomes a key university, leading in the development among the institutions governed by Ministry of Industry and Trade, being ranked in the top ten of Vietnam leading universities in term of application-based development, and being as qualified as other advanced regional countries in term of high quality human resource.

2.1.2. Mission

Providing high quality human resource with high professional and practical skills in term of economics, engineering, science reseach, and technology transfer to create physical and mental values serving the socio-economic development of the industry and the country efficiently.

2.1.3. Objectives

Building advanced management, basically meeting the condition to provide high quality human resource for society, creating practical values and effectiveness from activities of technology transfer and international cooperation.

2.2. Vision – Mission of FCE

2.2.1. Vision

To become one of the leading research and education centers in the field of applied Chemical Engineering in Vietnam.

2.2.2. Mission

To provide human resources with high professional qualifications and skills in order to carry out operational requirements, management of production processes, scientific research and technology transfer in the field of Chemical Engineering.

2.3. The programme objectives

The objectives of the Chemical Engineering Programme are as follows:

A. Assume leadership roles of production process in the field of Chemical Engineering Technology.
B. Supervise and operate equipment, equipment systems and production processes in the field of Chemical Engineering.
C. Research and develop the product, process and production technology in the field of Chemical Engineering.
D. Demonstrate vocational ethics, sense of community development, professional attitude and behavior

3. EXPECTED LEARNING OUTCOMES

The graduates from this programme are able to demonstrate the following measurable outcomes

a. An ability to apply the knowledge of mathematics, science and engineering in the field of Chemical Engineering;
b. An knowledge of politics, culture and society to train themselves;
c. An ability to apply fundamental and specialized knowledge in one of the fields: Petrochemical Engineering; Inorganic Engineering; Organic Engineering;
d. An ability to monitor, operate equipment, system and product line in the field of Chemical Engineering;
e. An ability to calculate, design process units and systems of process units in the field of Chemical Engineering with consideration of environmental, safety, economic, ethical criteria and sustainable development;
f. An ability to conduct experiments, as well as to analyze and interpret process units and systems of process units;
g. An ability to work and collaborate effectively in multidisciplinary teams;
h. An ability to update knowledge widely enough to understand the impact of technical solutions in the global economic, environmental, social and global context;
i. An ability to communicate technique effectively;
j. An understanding of ethical and professional responsibilities;
k. An ability to engage in lifelong learning;
l. A health to work and develope Vietnam./.

The ELOs are reviewed, evaluated, and ensured in accordance with the programme objectives (*see Table 1*)

Table 1. Matrix Relating Programme Objectives to Expected Learning Outcomes

Programme Objectives	Expected Learning Outcomes											
	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.
A	√	-	√	√	√	-	√	√	√	√	√	√
B	√	-	√	√	√	-	√	√	√	√	√	√
C	√	-	√	√	√	√	√	√	√	√	√	√
D	-	√	-	√	√	√	√	√	√	√	√	√

The ELOs are the basis for the development and evaluation of the curriculum. To measure and assess ELOs, FCE constructed the performance indicators for each of ELOs (*see Table 2*)

Table 2. List of performance indicators (PIs)

ELOs	Performance indicators (PIs)	Contents
a	**a1**	An ability to apply differential, integrals and linear equations systems to solve problems of chemical and physical chemistry and equipment design;
	a2	An ability to apply knowledge of statistics, processing and analysis of data to organize the experiment, optimize the process;
	a3	An ability to apply the knowledge of mechanical, thermal, electric and optical in calculating and operating equipment and technological processes in the field of chemical engineering;
	a4	An ability to apply basic chemical knowledge to explain the structure and properties of substance and to calculate basic problems in thermodynamics, dynamics, electrochemistry and solution.
b	**b1**	An ability to recognize the principles, ways, ideas, politics to train yourself.
	b2	An ability to recognize the law, culture and society to live and work.
c	**c1**	An ability to explain structure, physical and chemical properties, presentation of methods of preparation and calculation of composition, process efficiency in the field of chemical engineering.
	c2	An ability to calculate, explain the parameters of thermodynamics, kinetics, electrochemical, chemical glue in chemical processes

ELOs	Performance indicators (PIs)	Contents
	c3	An ability to apply the basic knowledge of analysis to analyze a number of indicators in the field of chemical engineering;
	c4	An ability to apply specialized knowledge to the manufacturing sector in the petrochemical technology such as: fuel production, non-fuel and petrochemical, gas products;
	c5	An ability to apply specialized knowledge in the field of organic technology such as: production of polymer, plastic, rubber, composite, paper, dyeing, detergent, aromatherapy, and cosmetics technology
	c6	An ability to apply specialized knowledge in the field of Inorganic technology such as: production of basic inorganic substances, fertilizers, ceramics, cement, electrochemical and material protection;
d	**d1**	An ability to describe the structure and presentation of operating principles, scope of application of equipment, equipment systems.
	d2	An ability to identify processes in the production line
	d3	An ability to draw present detailed and process technology drawings
	d4	An ability to measure, adjust and control the technological parameters
e	**e1**	An ability to calculate material balance, energy balance, phase balance of mechanical processes, heat transfer, mass transfer and chemical reaction engineering
	e2	An ability to calculate the durability of the equipment and choose accessories of the chemical equipment
	e3	An ability to draw detailed equipment, process flow diagrams using specialized software.
f	**f1**	An ability to present process, experimental plan
	f2	An ability to use machines, equipment, tools
	f3	An ability to operate the laboratory equipment system
	f4	An ability to collect, analyze and evaluate experimental results
g	**g1**	An ability to work independently, team work
	g2	An ability to discuss and discuss technical issues
h	**h1**	An ability to update, select information
	h2	An ability to receive technical solutions

ELOs	Performance indicators (PIs)	Contents
i	i1	An ability to present
	i2	Minimum English level TOEIC 450 or equivalent
	i3	Computer skills in B or equivalent
j	j1	Understand of the ethical values associated with the profession.
	j2	Obey the highest standards of honesty and integrity in your relationships.
	j3	Knowledge of environmental and social sustainability in technology
	j4	An ability to apply knowledge of ethical to protect the environment and the community.
k	k1	An ability to self-study
	k2	An ability to self-orientate career development
	k3	A sense of cultivating, improving your knowledge
l	l1	Knowledge of military and security
	l2	A sense of health training to study, work and contribute to national development

4. JOB OPPORTUNITIES

Graduates from undergraduate programme in Chemical engineering are able to work in companies, factories, agencies such as:

- Management and operation of production processes and equipment in the field of organic technology, inorganic technology, petrochemical technology;
- Research, develop, process technology, receive and transfer technology;
- Calculation and design of equipment and processes in the field of chemical engineering;
- Organizing, managing production, business and participating in the development of production projects;
- Training and scientific research institutions in the field of chemical engineering.

5. ADMISSION INFORMATION, TRAINING PROCESS AND GRADUATION CONDITION

5.1. Admission information

Based on the regulations of the Ministry of Education and Training, notifications and guidelines of IUH (http://www.iuh.edu.vn/TuyenSinh)

- Enrollment area: in the country
- Admission object: high school graduatesas as prescribed by the Ministry of Education and Training.
- Admission criteria: selection score is the total score of the exams/subjects of each selection group of the high school exam according to the current regulations of the Ministry of Education and Training.
- Selection group:
  - Group A00: Mathematics, Physics, Chemistry
  - Group B00: Mathematics, Chemistry, Biology
  - Group D07: Mathematics, English, Chemistry
  - Group D90: Mathematics, English, Natural sciences
- Admissions number: 390

5.2. Training process

- The tranning regulations according to the credit systems, creating conditions for students to actively and actively adapt with the training process in order to achieve the best results in studying and practicing.
- The programme is designed to cover 8 semesters (4 academic years), including 143 credits. The learning duration is 4 years, the minimum learning duration is 3 years and the maximum learning duration is 6 years.
- Each academic year is divided into two main semesters what includes 16 weeks of learning, two weeks of examination, one week of reserve and a supplementary semester is 8 weeks.
- IUH organizes to test the English according to the TOEIC assessment test for freshmans to classify:
  - Freshmans who achieve from 200 points to less than 250 points, will be take English 1;
  - Freshmans who achieve from 250 points to less than 300 points will be take English 2 (will be exempted English 1);
  - Freshmans who achieve 350 points or more will be exempted both courses: English 1 and English 2;
- Registering courses in each semester will have warrant conditional decision of the course, learning sequence of programme and English criteria according to the TOEIC as follows

- Freshmans who have to achieve 250 points or more will be registered courses of 2nd year.
- Sophomore who have to achieve 300 points or more will be registered courses of 3rd year.

- All students must take part in graduate internship and graduation thesis.

5.3. Graduation Conditions

Students who meet the following requirements will be considered for graduation

- Until the time of graduation, without being examined for penal liability, or not discipline at the level of suspension;
- Accumulate enough courses in the programme;
- The cumulative GPA of all course is 2.00 or higher;
- Having national defense and physical education certificates;
- Having a TOEIC certificate of 450 points (or equivalent certificates);
- Having a certificate of basic information technology application.
- Students who are qualified for graduation must submit their applications to FCE, FCE will make the list and the procedures to submit the graduation council.

6. ACADEMIC STAFF AND INFRASTRUCTURE

FCE consists of five departments: Department of General Chemistry, Department of Machine and Equipment, Department of Analytical Chemistry, Department of Petrochemical Technology and Department of Chemical Technology and Materials. There are 71 qualified teaching staffs including 2 associate professors, 20 Ph. Ds holders (ratio 30%), 44 masters (62.9%) and 5 other degree (7.1%) [Table 3].

Table 3. Academic staff of FCE in year 2017

Level	Male	Female	Sum
Associate Professors	1	1	2
Ph. D	11	9	20
Masters	26	18	44
Engineer/Bachelor	4	1	5
Sum	42	29	71

In FCE, there are 30 laboratories in F Building for teaching and doing research of lecturers and students. The list of laboratories is presented in Table 4. The laboratories and equipment are assigned to each department. There are two staffs who are in charge of chemical, tool, material management and other issues related

to the operation of laboratories. Every year, FCE laboratories serve about 2,000 students and lecturers in which a class size of is not more than 25 students in a laboratory.

Table 4. List of laboratories in FCE

Laboratories	General	Specialized	Project	Advanced analysis
Department of Chemical Technology and Materials	2	2		
Department of Petrochemical Technology	1	2	1	
Department of General Chemistry	5	2	1	
Department of Analytical Chemistry	2	2	2	1
Department of Machine and Equipment	1	4		
Management of the Faculty				4

Laboratories, especially specialized laboratories, are equipped with advanced equipment and model-based system for higher training human resource in chemical engineering. The laboratory equipment are listed such as GC-MS, GC-FID, HPLC, IR, UV-Vis, nitrogen analyzer, compressive strength tester, ASTM based petrochemical products specifications analyzers, pulp systems, extraction systems, distillation systems, etc. In the period of 2006-2009, FCE benefited from the ADB-AFD project with 3.5 Million EUR for high technology equipment for teaching of chemical engineering programme. Additionally, the numerous equipment for teaching practical courses were the research outputs from our lecturers and students.

7. TEACHING LEARNING STRATEGIES

FCE employs the outcomes based approach for teaching and learning at undergraduate level. Based on the expected learning outcomes of the programme (PLOs), the expected learning outcomes for each course (CLOs) are designed, which in turn become the core for the construction and development of teaching plans, syllabi, teaching and learning methods and assessment tools. After the completion of the courses, the CLOs for each course will be evaluated. Subsequently, the program evaluation will be conducted to improve the PLOs - Diagram [*Figure 1*]

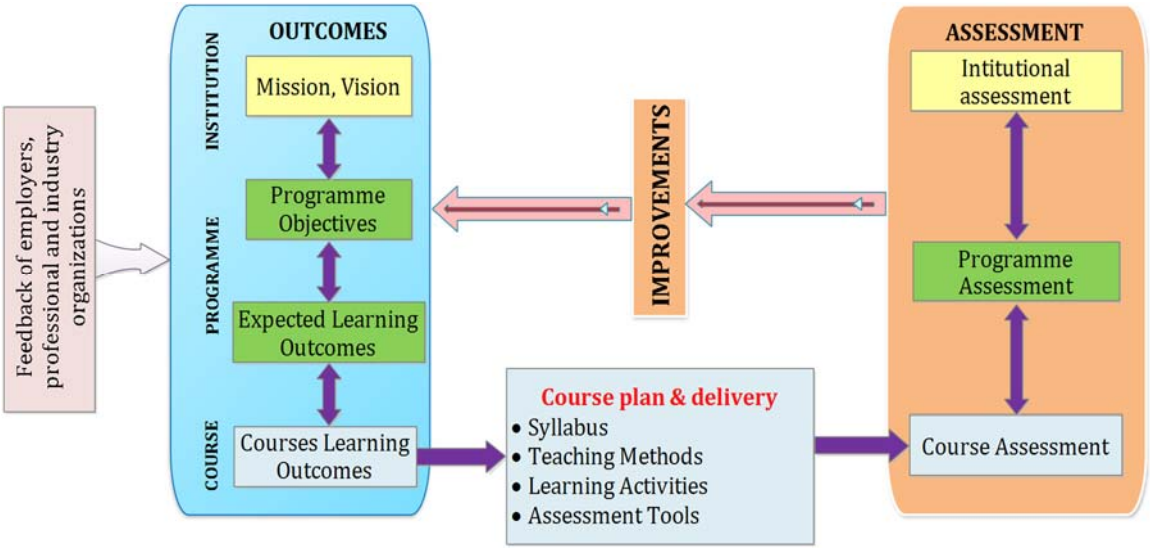


Figure 1. Outcomes-based education framework

List of teaching strategy and teaching methods are used in programme [*Figure 2*]

Table 4. Teaching strategies and methods

Teaching strategies	Description	Teaching methods
Direct instruction	Most theoretical subjects are taught by lecture, quiz, inquiry guided learning, assignments and student self-study through exercises, group discussion and seminars.	• Explicit Teaching • Lecture • Didactic Questions • Demonstrations • Drill & Practice
Indirect instruction	For some courses, lecturers do not actively giving the lessons but only assist the teaching process. Several subjects in the FCE program are chosen to conduct in a problem-based learning or project-based learning approach. For those, the learner is given the best possible environment in terms of funding and other resources for the learning process including business internship, study tour, course plan and graduation thesis.	• Inquiry • Problem Solving • Case Studies • Concept Formulation
Experiential learning	Several subjects of the FCE curriculum are designed based the experiential learning approach, such as fundamental science, discipline fundamental subjects, and specialized subjects. Students take part in practical classes/experiments, business internships, professional development, design blueprints and graduation theses.	• Simulations • Focused Imaging • Role Play • Models • Games • Field Trip • Experiment

Interactive teaching	This teaching strategy is employed in most of the courses in the curriculum. Students do group exercises, group presentations, group experiments, business internships, field trips and graduation theses.	• Debates • Discussions • Problem Solving • Brainstorming • Peer Learning • Reflection
Individual learning	This teaching approach is manifested in experimental work and design in the graduation thesis, thesis presentation, design projects, homework assignments, report writing, individual experiments and self-learning	• Work Assignment • Research Projects • Computer-Aided Instruction • Reflection

These CLOs-based learning methods and CLOs are consistent with the PLOS of the Chemical Engineering Undergraduate Programme, based on the characteristics and expectations of chemistry students. IUH's policy is to provide the best possible financial resources, qualified lecturers/instructors with pedagogical skills, research capabilities, and enthusiasm for teaching, the FCE's infrastructure has frequently improved, equipment is updated by each school year to meet the current and future learning needs, the development of soft skills for students is also paid attention. A variety of assessment methods ensuring the interactivity and time allocation are oulined in the IUH study and assessment plans.

8. ASSESSMENT METHODS

8.1. Process assessment

Assessment methods are carried out based on the CLOs which ultimately reflect the achievement of the PLOs. The assessment must ensure the validity, reliability and fairness. Student assessments include entrance examinations, mid-term and final examinations. The employed assessment methods comprise of multiple choice, short tests, assignments, practical examinations, enterprise internships, laboratory measurement tests, presentation, case studies, research projects (PBL), poster presentations, paper writing for publication. Course evaluation is carried out based on the rubrics set out for each course. The rubric types include checklists, analytic rubrics, and holistic rubrics. Grading, feedback from students and lecturers are received and processed according to the IUH's procedure [*Figure 2*].

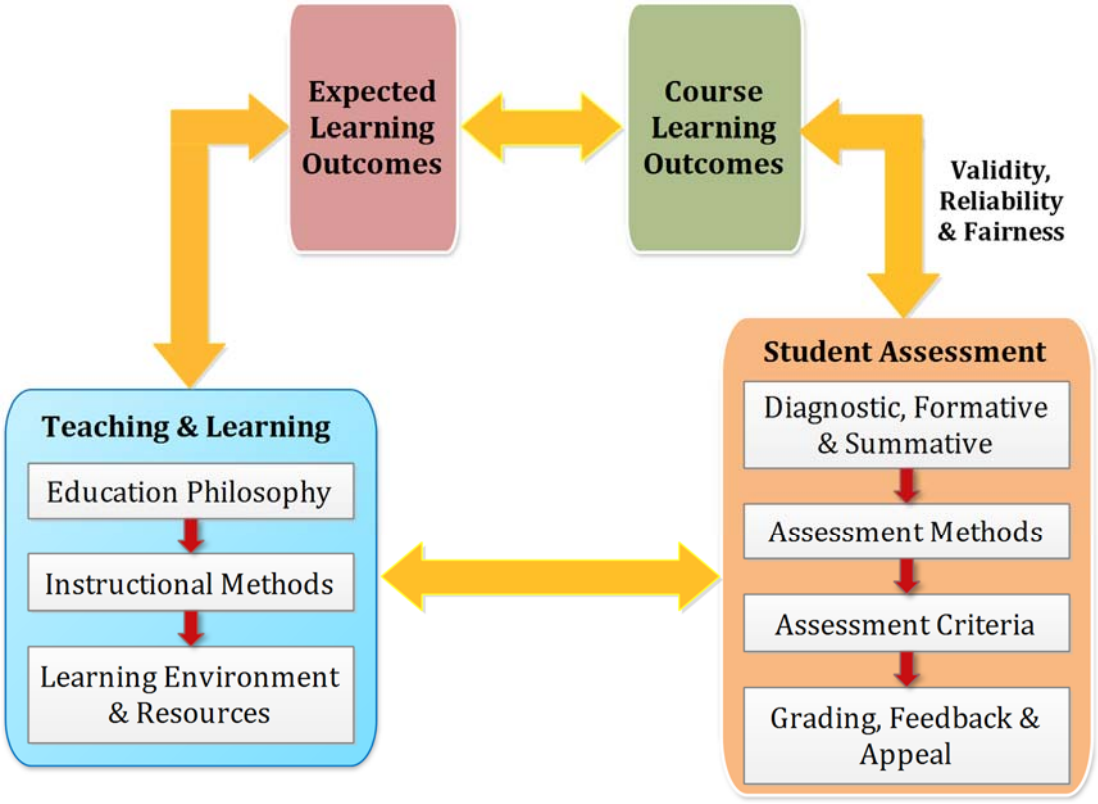


Figure 2. Process teaching - learning and student assessment

8.2. Some rubrics in programme

8.2.1. Poster assessment rubric

CLOs	Contents	Unsatisfactory	Evarage	Good	Excellent	Score limit
1	Introduction	+ The student does not explain why the thesis title was done.	+ The student try to explain why the thesis title was done, but do not understand the problem.	+ The student does not explain why the thesis title was done.	+ Student does not explain very well the context in which thesis title was done, and how important it is.	20
1-7	Contents	+ The contents appear to be incomplete, unsuccessful in addressing the stated purpose.	+ The contents contain major errors + The conclusion are some doubts	+ The contents contain some minors in experiment or designs that are weak main conclusions	+ The contents are not error, beautiful layout, harmony parts.	30

CLOs	Contents	Unsatisfactory	Evarage	Good	Excellent	Score limit
6-7	Layouts	+ The results are no argument or uncertainty and graphics and style are poor.	+ Many shortcomings, more than one goal, method, results and conclusion are unclear.	+ The objectives, methods, results and conclusions are presents clear, but only at the level of exploration. + Some minor aspects of poor presentation need to be re-arranged	+ The objectives, methods, results and conclusions are clearly presented. + Beautiful, clear, coherent and attractive of graphs, drawings and graphics.	30
	Answers questions (Maximum 2 questions)	+ The student does not solve the questions.	+ The student tries to answer the questions, but he/she doesn't understand the problems.	+ Students can answer questions related to the problems and the reviewer understands the problems.	+ Student listens carefully and answers questions easily, accurately.	20

8.2.2. Rubric for assessment of graduate thesis

CLOs	Contents	Unsatisfactory	Evarage	Good	Excellent	Score limit
1. Apply the knowledge of the discipline (chemical technology, materials, petrochemicals) to solve a particular problem in the field of chemical engineering	**Introduction**	+ The topic, scope and objectives of the thesis are poorly defined and inadequately contextualized; + They are not scientifically grounded. The significance of the study is unclear	+ Reasoning for the selection of thesis's topic is provided but not scientifically convincing or inadequately contextualised. + The objectives of the thesis are not well-defined and/or the scope is not suitable for a graduate project	+ Reasoning for selection of thesis's topic are provided, which are adequately contextualised and scientifically grounded + The objectives of the thesis are well-defined with an appropriate scope for a graduate project	+ The topic and objectives of the thesis are innovative and original. They are clearly defined, adequately contextualised and scientifically grounded. + The scope is appropriate for a graduate project.	5
	Literature review	+ Literature review is written with many errors and not show critical thinking + Do not provide tables, data to illustrate and explain problems + Can not evaluate the limitation and suggest the solution for the project. + References are of poor quality or have been omitted. The	+ Literature review is written with minor errors and not show critical thinking intensively; + Provide tables, data to illustrate and explain problems but not sufficient data + Evaluate the limitation and suggest the solution for the project at basic level; + The referencing has been done, but the	+ Literature review is written with with critical thinking, still minor errors but not important; + Provide tables, data to illustrate and explain problems sufficiently + Evaluate the limitation and suggest the solution for the project overally; + The referencing has been done in a proper manner and the layout of the bibliography is	+ Literature review on the project topic is presented logically with critical thinking; + Provide tables, data to illustrate and explain problems explicitly + Evaluate the limitation and suggest the solution for the project thoroughly; + The referencing has been done in a proper and extensive manner. The format and layout of the bibliography are correct and in line with	15

CLOs	Contents	Unsatisfactory	Evarage	Good	Excellent	Score limit
		format and layout are inconsistent and not in line with standard referencing techniques. + Neither important nor the most recent sources appear in the bibliography.	layout of the bibliography is neither consistent nor in line with internationally acceptable conventions. Some important and very relevant sources havebeen omitted.	largely in line with internationally acceptable conventions. There are, however, a number of in-consistencies. The ibliography includes most of the important sources (1-5 English references).	+ Internationally acceptable conventions. The bibliography contains the most important and most recent sources (in the last five years or old literature but still of high value, 1-5 English references).	
2. Operate laboratory equipment or equipment systems and production lines	**Discussion and conclusions**	+ Having troubles in operation /troubleshooting of equipment/ production lines and safety issues; + Can not calculate and explain reasonably the results obtained.	+ Able to operate and troubleshoot equipment and production lines but still have minor problems in operation and safety issues; + Calculate and explain the results obtained reasonably.	+ Operate and troubleshoot equipment and production lines proficiently. + Handle safety issues in the labs properly. + Calculate and elucidate the results obtained convincingly.	+ Operate and troubleshoot equipment and production lines proficiently. + Handle properly safety issues in the labs. + Calculate and elucidate the results obtained convincingly. + Data obtained from operation, design or calculations are systematically reliable and credible;	10
3. Work in labs or design system and production process	**Methods and finding**	+ There are dificiences in the description of the research frame. + Do not evaluate factors affecting the yield or production performance	+ The research frame is suggested basicly based on literature; + Evaluate factors affecting the yield or production performance at basic level	+ Research frame is originated from literature with modification. + Evaluate factors affecting the yield or production performance in details	+ Research frame is novel or originated from literature with great modification; + Evaluate the yield or production performance enhanced by the novel research procedure;	20

CLOs	Contents	Unsatisfactory	Evarage	Good	Excellent	Score limit
		+ Experiment does not comply with the proposed process; + No data obtained + Do not recommend materials, chemicals and equipment related to reaction, design and production process;	+ Experiment complies with the proposed process; + Recommend materials, chemicals and equipment related to reaction, design and production process; + Apply a number of physicochemistry or biochemistry methods to basically evaluate the results obtained.	+ Experiment complies with the proposed process; + Recommend materials, chemicals and equipment related to reaction, design and production process; + Apply physicochemistry or biochemistry methods to evaluate the results obtained, from which the conclusions can be drawn.	+ Experiment complies with the proposed process; + Recommend materials, chemicals and equipment related to reaction, design and production process; + Apply physicochemistry or biochemistry methods to evaluate the results obtained, from which the conclusions can be drawn explicitly	
4. Analysis and evaluation of experimental data and research results	**Literature review, experimental and results**	+ No data analysis + No analysis of research problem, only list of data with low reliablitity + No conclusions drawn	+ Data analysis is performed with low reliability and the data size is insufficient, employing not many statistical methods; + Not much analysis of research problem presented. + No conclusions drawn from the analysis or the conclusions are not convincing.	+ Data analysis is performed with reliability and reasonable data size, employing a collection of statistical methods + Show complete analysis of research problem but some minor errors exist; + Most conclusions are based on the analysis or interpretation of the results, but some are not convincing.	+ Data analysis is performed thoroughly with high reliability and validity, employing a variety of statistical methods. + Analyze, evaluate and integrate all the results obtained exhautively, which shows that the author has studied the problem in depth, addressed completely the research problem and draw conclusions convincingly; + Evaluate the limitations or novelty of the research	20

CLOs	Contents	Unsatisfactory	Evarage	Good	Excellent	Score limit
			+ Do not evaluate the limitations of the problem + Do not propose further research.	+ Evaluate the limitations of the research problem + Propose further research moderately.	problem thoroughly (new material, methods or findings) + Propose further research.	
5. Stay abreast with new knowledge and technology in the field of Chemical Engineering	**Literature review, experimental and results**	+ Use outdated references in the field of current research + The experimental procedure or design model employed is outdated + The physicochemistry approaches /methods used to evaluate experimental results /designs are not update	+ Use less than 5 up-to-date references in the field of current research + Introduce at least one experimental procedure or design model that are new + The physicochemistry approaches/methods used to evaluate experimental results/designs are not updated	+ Use 5-10 up-to-date references in the field of current research Introduce at least one experimental procedure or design model that are new + Keep abreast of physicochemistry approaches/models to evaluate experimental results/designs	+ Use more than 10 up-to-date references in the field of current research and have at least one newly published reference; + Introduce the most up-to-date experimental procedure or design model; + Keep abreast of physicochemistry approaches/models to evaluate experimental results/designs or proposing methods for evaluating experimental results. + Knowledge gained from the study is completely new (not yet published)	10
7. Adhere to the values of professional ethics of chemical engineers	**Honesty in research work, compliance with intellectual property**	Lower than Evarage level	+ Honestly most of the data are consistent and honest in processing data;	+ Integrity and full consistency of data in processing data; + Honesty reference to specialized journals, books, thesis;	+ Integrity and full consistency of data in processing data; + Honesty reference to specialized journals, books, thesis;	20

CLOs	Contents	Unsatisfactory	Evarage	Good	Excellent	Score limit
	rights, safety procedures in operation of laboratory equipment, FCE laboratory and asset preservation		+ Honesty reference to specialized journals, books, theses; + The operation of the equipment or the proper operation of the equipment is mentioned + Use the right purpose and comply with copyright + Hardworking research and experimental note; + Follow group activities on information sharing. + Lend and return the tools and equipment in accordance with regulations + Submit the thesis is in time	+ The operation of the equipment or the proper operation of the equipment is fully mentioned; + Use the right purpose and comply with copyright; + Hardworking research and fullly experimental note; + Follow group activities on sharing; information; + Lend and return the tools and equipment in accordance with regulations; + Submit the thesis is in time;	+ The operation of the equipment or the proper operation of the equipment is fully mentioned; + Use the right purpose and comply with copyright; + Hardworking research and fullly experimental information science note; + Follow group activities on sharing information; + Lend and return the tools and equipment in accordance with regulations; + Submit the thesis is in time;	

9. CURRICULUM DESCRIPTION

The Curriculum distributed the courses from basic knowledge to specialized knowledge to ensure updated constantly, gradually increasing and have sufficient time to accumulate knowledge. The curriculum distributed system will also let students focus more on learning and archiving specific course learning outcomes and the program's ELOs. In the fundamental knowledge and specialized knowledge, students can choose one of three groups of courses (petrochemicals technology; inorganic technology; organic technology), so that students can select their specialized field for future careers.

The curriculum consists of general, fundamental and specialized knowledge and graduates helps the students who are able to accumulate the knowledge and improve their soft skills, information technology skills, foreign language, ... to practice the ethics, attitudes, safety when working. The curriculum also ensures flexibility for students to transfer to other majors in the first year, second year or to learn multiple programmes.

9.1. Brief

Total credit: **143 credits**

- Basic courses: 47 credits
  - General courses: 32 credits
  - Mathermatic courses: 08 credits
  - Natural science courses: 07 credits
- Intermediate courses: 58 credits
  - Compulsive: 52 credits
  - Elective: 06 credits
- Specialized courses: 28 credits
  - Compulsive: 08 credits
  - Elective: 20 credits
- Graduate Practice and internship: 10 credits
- Practical credits: 39 credits, ratio 28%

9.2. Curriculum

No	Course code	Course title	Credit number	Credit hours			Prerequisite course code
				Theory	*Practical*	*Self study*	
I	**Basic courses**		**47**	**38**	**9**	**81**	
I.1	***General courses***		***32***	***25***	***7***	***53***	
Compulsive			*30*	*23*	*7*	*49*	
1	2112007	Fundamental principles of Marxism and Leninism	5	5	0	10	

No	Course code	Course title	Credit number	Credit hours			Prerequisite course code
				Theory	*Practical*	*Self study*	
2	2112005	Ho Chi Minh Ideology	2	2	0	4	
3	2112008	Revolutionary lines of the Vietnam Communist Party	3	3	0	6	
4	2112006	Introduction to Vietnamese Law	2	2	0	4	
5	2111250	English 1	3	3	0	6	
6	2111300	English 2	3	3	0	6	
7	2120401	Constitution Educations	4	2	2	6	
8	2120002	National Defence Educations 1	4	1	3	5	
9	2120003	National Defence Educations 2	4	2	2	6	
Elective			*2*	*2*	*0*	*4*	
4	2107463	Customer Relationship Management	2	2	0	4	
5	2107467	Career Development Skills	2	2	0	4	
6	2107465	Production Management	2	2	0	4	
7	2113477	Logics	2	2	0	4	
I.2	***Mathermatic courses***		***8***	***6***	***2***	***14***	
Compulsive			*6*	*4*	*2*	*10*	
1	2113420	Calculus A1	2	1	1	3	
2	2113440	Calculus A2	2	1	1	3	
3	2113450	Calculus A3	2	2	0	4	
Elective			*2*	*2*	*0*	*4*	
1	2113473	Computational Mathematics	2	2	0	4	
2	2113474	Probability and Statistics	2	2	0	4	
3	2113475	Linear Programming	2	2	0	4	
I.3	***Natural science courses***		***7***	***7***	***0***	***14***	
Compulsive			*7*	*7*	*0*	*14*	
1	2113480	General Physics 1	2	2	0	4	
2	2113490	General Physics 2	2	2	0	4	
3	2104415	General Chemistry	3	3	0	6	
Elective			*0*	*0*	*0*	*0*	
II	**Intermediate courses**		**58**	**44**	**14**	**102**	
II.1	***Compulsive***		***52***	***38***	***14***	***90***	
1	2103454	Engineering Drawings	2	2	0	4	
2	2114479	Electrical Technique	2	2	0	4	
3	2104425	Inorganic chemistry	3	3	0	6	
4	2104461	Inorganic Chemistry Laboratory	2	0	4	4	2104425(a)
5	2104419	Organic chemistry	4	4	0	8	
6	2104458	Organic Chemistry Laboratory	2	0	4	2	2104419(a)
7	2104424	Analytical chemistry	4	4	0	8	2104415(a)
8	2104460	Analytical Chemistry Laboratory	3	0	6	3	2104424(a)
9	2104421	Physical Chemistry 1	5	5	0	10	
10	2104422	Physical Chemistry 2	4	4	0	8	2104415(a)
11	2104459	Physical Chemistry Laboratory	3	0	6	3	2104421(a)

No	Course code	Course title	Credit number	Credit hours			Prerequisite course code
				Theory	*Practical*	*Self study*	
12	2104418	Green chemistry	3	3	0	6	2104415(a)
13	2104405	Fluid Mechanics and Mechanical Operations	3	3	0	6	2104421(a)
14	2104468	Heat Transfer	3	3	0	6	2104421(a)
15	2104467	Mass Transfer	3	3	0	6	2104468(a)
16	2104466	Chemical Engineering Laboratory	3	0	6	3	2104467(a)
17	2104429	Chemical Reaction Engineering	3	3	0	6	2104468(a)
II.2	***Elective***		***6***	***6***	***0***	***12***	
Oil refining - petrochemical egineering			*12*	*12*	*0*	*24*	
1	2104401	Petroleum Safety	3	3	0	6	2104422(a)
2	2104427	Instrumentation and Process Control	3	3	0	6	2104405(a)
3	2104455	Storage and Transportation of Petroleum Products	3	3	0	6	2104405(a)
4	2104406	Petroleum Products	3	3	0	6	2104415(a)
Organic chemical engineering			*6*	*6*	*0*	*12*	
1	2104416	Color Chemistry	3	3	0	6	2104422(a)
2	2104414	Chemistry of Cellulose	3	3	0	6	2104415(a)
3	2104417	Polymer Chemistry	3	3	0	6	2104415(a)
Inorganic chemical engineering			*6*	*6*	*0*	*12*	
1	2104416	Color Chemistry	3	3	0	6	2104422(a)
2	2104413	Phase Diagram	3	3	0	6	2104422(a)
III	**Specialized courses**		**28**	**20**	**8**	**48**	
III.1	***Compulsive***		***8***	***8***	***0***	***16***	
1	2104431	Engineering Catalysis	4	4	0	8	2104422(a)
2	2104469	Material science	4	4	0	8	2104422(a)
III.2	***Elective***		***20***	***12***	***8***	***32***	
Oil refining - petrochemical egineering			*20*	*12*	*8*	*32*	
1	2104410	Petroleum Refining Technology	4	4	0	8	2104467(a)
2	2104408	Gas Processing Technology	4	4	0	8	2104467(a)
3	2104409	Petrochemical Technology	4	4	0	8	2104467(a)
4	2104448	Petroleum Processing Laboratory Experiments	4	0	4	4	2104467(a)
5	2104452	Petroleum Product Analysis Laboratory Experiments	4	0	4	4	2104467(a)
Organic chemical engineering			*44*	*24*	*20*	*68*	
1	2104404	Methods for Physical and Chemical Analysis	4	4	0	8	2104422(a)
2	2104407	Surfactant Technology	4	4	0	8	2104467(a)
3	2104446	Organic Synthesis	4	4	0	8	2104467(a)
4	2104430	Pulp and Paper Manufacture	4	4	0	8	2104467(a)
5	2104428	Dyeing Technology	4	4	0	8	2104467(a)
6	2104447	Advanced Organic Synthesis	4	4	0	8	2104467(a)

No	Course code	Course title	Credit number	Credit hours			Prerequisite course code
				Theory	*Practical*	*Self study*	
7	2104451	Catalyst Technology Laboratory Experiments	4	0	4	4	2104467(a)
8	2104454	Material Synthesis Laboratory Experiments	4	0	4	4	2104467(a)
9	2104450	Green Technology Laboratory Experiments	4	0	4	4	2104467(a)
10	2104449	Polymer Technology Laboratory Experiments	4	0	4	4	2104467(a)
11	2104453	Physical and Chemical Analysis Laboratory	4	0	4	4	2104467(a)
Inorganic chemical engineering			*24*	*16*	*8*	*40*	
1	2104402	Corrosion and Protection of Materials	4	4	0	8	2104422(a)
2	2104412	Fertilizer Technology	4	4	0	8	2104467(a)
4	2104411	Basic Inorganic Technology	4	4	0	8	2104467(a)
5	2104438	Characterization of Materials	4	4	0	8	2104424(a)
6	2104451	Catalyst Technology Laboratory Experiments	4	0	4	4	2104467(a)
7	2104454	Material Synthesis Laboratory Experiments	4	0	4	4	2104467(a)
IV	**Graduate Practice and internship**		**10**	**2**	**8**	**12**	
1	2104996	Field trip	2	0	2	2	2104467(a)
2	2104997	Graduate Practice	3	0	3	3	2104469(a)
2	2104999	Graduate Project	5	0	5	5	2104469(a)
Total			**143**	**102**	**39**	**247**	

9.3. Matrix of integrated courses and expected learning outcomes

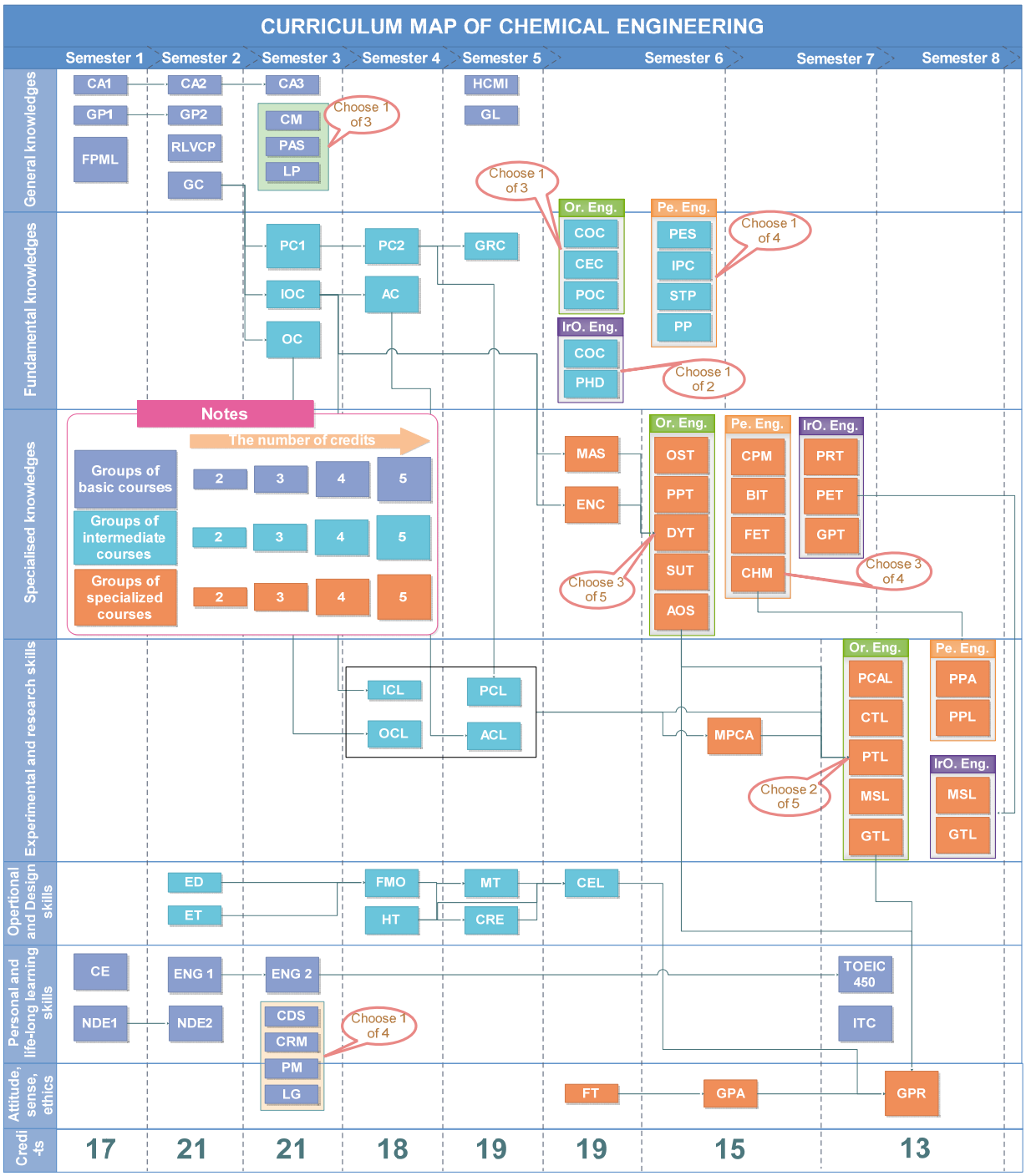
Code	Course	Signal	Expected learning outcomes										
			a	b	c	d	e	f	g	h	i	j	k	l
2112007	Fundamental Principles of Marxism and Leninsm	FPML	-	3	-	-	-	-	-	-	-	-	-	-
2112005	Ho Chi Minh Ideology	HCMI	-	3	-	-	-	-	-	-	-	-	-	-
2112008	Revolutionary Lines of the Vietnam Communist Party	RLVCP	-	3	-	-	-	-	-	-	-	-	-	-
2112006	Introduction to Vietnamese Law	GL	-	2	-	-	-	-	-	-	-	2	-	-
2107467	Career Development Skills	CDS	-	3	-	-	-	-	-	-	-	-	2	-
2107463	Customer Relationship Management	CRM	-	3	-	-	-	-	-	2	-	-	-	-
2107465	Production Management	PM	-	3	-	-	-	-	1	2	-	-	-	-
2113477	Logics	LG	-	3	-	-	-	-	-	-	-	-	-	-
2111250	English 1	ENG1	-	-	-	-	-	-	1	-	3	-	-	-
2111350	English 2	ENG2	-	-	-	-	-	-	1	-	3	-	-	-
2113420	Calculus A1	CA1	3	-	-	-	-	-	-	-	-	-	-	-

Code	Course	Signal	Expected learning outcomes											
			a	b	c	d	e	f	g	h	i	j	k	l
2113440	Calculus A2	CA2	3	-	-	-	-	-	-	-	-	-	-	-
2113450	Calculus A3	CA3	3	-	-	-	-	-	-	-	-	-	-	-
2113480	General Physics 1	GP1	3	-	-	-	-	-	-	-	-	-	-	-
2113490	General Physics 2	GP2	3	-	-	-	-	-	-	-	-	-	-	-
2104480	General Chemistry	GC	3	-	-	-	-	-	-	1	-	-	-	-
2113473	Computational Mathematics	CM	3	-	-	-	1	-	-	-	-	-	-	-
2113474	Probability and Statistics	PAS	3	-	-	-	-	-	-	-	-	-	-	-
2113475	Linear Programming	LP	3	-	-	-	-	-	-	-	-	-	-	-
2120401	Constitution Educations	CE	-	-	-	-	-	-	-	-	-	-	-	3
2120402	National Defence Educations 1	NDE1	-	-	-	-	-	-	-	-	-	1	-	3
2120403	National Defence Educations 2	NDE2	-	-	-	-	-	-	-	-	-	1	-	3
2103454	Engineering Drawings	ED	-	-	2	-	-	-	-	-	-	-	-	-
2114479	Electrical Technique	ET	-	-	2	-	-	-	-	-	-	-	-	-
2104425	Inorganic Chemistry	IOC	-	-	3	-	-	-	1	1	1	-	-	-
2104461	Inorganic Chemistry Laboratory	ICL	-	-	-	-	-	3	-	-	-	1	-	-
2104419	Organic Chemistry	OC	-	-	3	-	-	-	1	1	1	-	-	-
2104458	Organic Chemistry Laboratory	OCL	-	-	-	-	-	3	-	-	-	1	-	-
2104424	Analytical Chemistry	AC	-	-	3	-	-	-	-	-	-	1	-	-
2104460	Analytical Chemistry Laboratory	ACL	-	-	-	-	-	3	-	-	2	1	-	-
2104421	Physical Chemistry 1	PC1	-	-	3	-	-	-	-	-	-	-	1	-
2104422	Physical Chemistry 2	PC2	-	-	3	-	-	-	-	-	-	-	1	-
2104459	Physical Chemistry Laboratory	PCL	-	-	-	-	-	3	-	-	-	-	-	-
2104418	Green Chemistry	GRC	-	-	3	-	-	-	2	1	1	2	2	-
2104405	Fluid Mechanics and Mechanical Operations	FMO	-	-	-	3	3	-	-	-	-	-	-	-
2104468	Heat Transfer	HT	-	-	-	3	3	-	-	-	-	-	-	-
2104467	Mass Transfer	MT	-	-	-	3	3	-	-	-	-	-	-	-
2104466	Chemical processes and equipmentes Laboratory	CEL	-	-	-	3	3	2	2	-	2	-	1	-
2104429	Chemical Reaction Engineering	CRE	-	-	-	3	3	-	-	-	-	-	-	-
2104401	Petroleum Safety	PES	-	-	3	-	-	-	-	1	-	2	-	-
2104427	Instrumentation and Process Control	IPC	-	-	3	-	1	-	-	-	-	-	-	-
2104455	Storage and Transportation of Petroleum Products	STP	-	-	3	2	2	-	-	2	-	1	-	-
2104406	Petroleum Products	PP	-	-	3	-	-	-	2	2	-	2	2	-
2104416	Color Chemistry	COC	-	-	3	-	-	-	2	-	-	-	1	-
2104414	Cellulose Chemistry	CEC	-	-	3	-	-	-	2	-	-	-	1	-

Code	Course	Signal	Expected learning outcomes										
			a	b	c	d	e	f	g	h	i	j	k	l
2104417	Polymer Chemistry	POC	-	-	3	-	-	-	2	-	-	-	1	-
2104413	Phase Diagram	PHD	-	-	3	-	-	-	2	-	-	-	1	-
2104431	Engineering Catalysis	ENC	-	-	3	-	-	-	2	2	2	-	-	-
2104469	Material Science	MAS	-	-	3	-	-	-	2	-	-	-	1	-
2104410	Petroleum Refining Technology	PRT	-	-	3	2	-	-	2	2	2	1	1	-
2104408	Gas Processing Technology	GPT	-	-	3	2	-	-	2	2	2	1	1	-
2104409	Petrochemical Technology	PET	-	-	3	2	-	-	2	2	2	1	1	-
2104462	Petroleum Product Analysis Laboratory	PPA	-	-	-	3	-	3	-	2	-	2	-	-
2104448	Petroleum Processing Laboratory Experiments	PPL	-	-	-	3	-	3	-	2	-	2	-	-
2104446	Organic Synthesis	OST	-	-	3	2	-	-	2	-	-	-	1	-
2104430	Pulp and Paper Technology	PPT	-	-	3	3	-	-	-	-	-	-	1	-
2104428	Dyeing Technology	DYT	-	-	3	2	-	-	2	-	2	-	2	-
2104407	Surfactant Technology	SUT	-	-	3	2	-	-	2	-	2	-	2	-
2104447	Advaced Organic Synthesis	AOS	-	-	3	2	-	-	2	-	-	-	1	-
2104404	Methods for Physical and Chemical Analysis	MPCA	-	-	3	-	-	-	2	-	-	-	-	-
2104453	Physical and Chemical Analysis Laboratory	PCAL	-	-	2	-	-	-	3	-	-	-	-	-
2104451	Catalyst Technology Laboratory Experiments	CTL	-	-	-	3	-	3	-	2	-	2	-	-
2104454	Material Synthesis Laboratory Experiments	MSL	-	-	-	3	-	3	-	2	-	2	-	-
2104450	Green Technology Laboratory Experiments	GTL	-	-	-	3	-	3	-	2	-	2	-	-
2104449	Polymer Technology Laboratory Experiments	PTL	-	-	-	3	-	3	-	2	-	2	-	-
2104402	Corrosion and Protection of Materials	CPM	-	-	3	2	-	-	2	-	2	-	2	-
2104411	Basic Inorganic Technology	BIT	-	-	3	2	-	-	2	-	2	-	2	-
2104412	Fertilizer Technology	FET	-	-	3	2	-	-	2	-	2	-	2	-
2104438	Characterization of Materials	CHM	-	-	3	2	-	-	2	-	2	-	2	-
2104996	Field Trip	FT	-	-	2	-	-	-	2	3	-	2	2	-
2104997	Graduate Intership	GPA	-	-	2	2	-	2	3	2	2	3	2	-
2104999	Graduate Project	GPR	2	-	3	3	3	2	2	3	3	3	2	-
2199450	TOEIC 450										3			
2199406	Informatic Certification	ITC									3			

Note: 3: Fully fulfilled, 2: Moderately fulfilled, 1: Parially fulfilled; -: No fulfilled at all

9.4. Curriculum map



9.5. Abstract of Courses

1 - Fundamental principles of Marxism and Leninsm – 5 credits: In preface, Marxism-Leninism and some general issues are introduced. Based on course objective the content is structured in three parts, nine chapters. The first part contains three chapters covering the basic contents of the worldview and the methodology of Marxism. – Lenin. The second part contains three chapters presenting three central themes of Marxism-Leninism's economic theory of capitalist production. The third part contains three chapters which summarize the basic contents of the theory of Marxism-Leninism on socialism

2 - Ho Chi Minh Ideology – 2 credits: Together with a preface, content consists of 7 chapters: chapter I presents the foundation, process of formation and development

of Ho Chi Minh ideology; chapters II to VII present the basic contents of Ho Chi Minh ideology according to the course objectives.

3 - Revolutionary lines of the Vietnam Communist Party – 3 credits: Together with a preface, content includes of 8 chapters: Chapter I: The birth of the Communist Party of Vietnam and the first political program of the Party; Chapter II: The Way to Fight for Government (1930-1945); Chapter III: The resistance war against the French colonialists and American invaders (1945-1975); Chapter IV: Industrialization; Chapter V: The way to build a socialist-oriented market economy; Chapter VI: The Way to Build a Political System; Chapter VII: The Way to Build Culture and Solve Social Problems; Chapter VIII: Foreign Policy. The main content of the course is to provide students with a basic understanding of the Party's policies, especially in the renovation process.

4 - Introduction to Vietnamese Law – 2 credits: The first part of the module equips students with general theoretical issues on state and law such as state origin, concept, nature of state, state function, state form; origin, concept, nature, function and role of law, types and forms of law; legal and legal system; legal relationship; violates the law and liability. After completing theoretical part, the module will equip students with the most common problems in some basic laws in the Vietnamese legal system such as constitution law, civil law and civil procedure law, the law on marriage and family, the criminal law and the criminal procedure code, the labor code, the anti-corruption law.

5 – Foreign Languages – 4 credits: This course consists of 4 parts combining theory and exercises. The course provides basic grammar, vocabulary for everyday communication as well as some common vocabulary. After completing this course, student's competence reach at level from A2 to B1 in listening, speaking, reading and writing skills in accordance with European standards creating a common knowledge base for students to meet B1 output standards as required by the university.

6 - Calculus A1 – 2 credits: The subject provides basic concepts of real and complex numbers and how to calculate them with limits, continuity, derivatives, differentiable function of one real variables, survey and graph of functions expressed in terms of parameters, poles, integrals and integral applications for area, volume, generalized integrals and chain theory.

7 - Calculus A2 – 2 credits: The module equips students with basic concepts of determinant, matrix, and utilizing them to solve linear equations, the properties of matrix and determinant, the formulas of high-level determinants, methods of solving system of linear algebraic equations. In addition, students also have access to n-dimensional vector knowledge, Rn space, linear mapping, convert from quadratic form to canonical form, applied to conic lines and quadricular surfaces.

8 - Calculus A3 – 2 credits: The subject provides basic concepts: multivariate differential function calculus, limit, continuous, partial derivative, differential, extreme free radical, global extremism, two and three-layer integration, applications in physics such as focus, momentum inertia, how to solve the differential equation, the system of differential equations using the exponential matrix.

9 - General Physics 1 – 2 credits: This course presents general concepts, laws of motion of point, point system, solid, fluid and ideal gas, the principles of thermodynamics, efficiency of heat machine.

10 - General Physics 2 – 2 credits: This course provides concepts, general laws of static electricity, static magnetic fields, conductors, constant currents, electromagnetic induction and electromagnetic fields.

11 - General Chemistry – 3 credits: The content of this module consists of 9 chapters describing basic concepts and laws of chemistry, atomic and molecule structure, bonds, periodic table of elements, physical state, thermodynamics, kinetics, solution and electrochemistry.

12 - Constitution educations – 4 credits: The target of this course to contribute to the training of comprehensive human resources with ethics, knowledge, professional skills and health serving the society, detecting and training talented athletes for the country.

13 - National defence educations 1 – 8 credits: First step to get acquainted with the military style, school team, some movements such as standing, severely, resting, walking… and discipline style in the community at the school.

14 - Computational mathematics – 2 credits: this course provides skills to solve equations and system of equations, calculate integral and differential equations approximately. Students can process measurement data by linear regression and nonlinear functions.

15 - Probability and statistics – 2 credits: this course provides basic knowledge of probability and its properties. Student will be able to identify and calculate probabilities, establish distribution tables (density functions) and distribution functions of event types, specific numbers of random variables, and their practical meanings. Student will learn how to distinguish and use the basic distributions: binomial, Poisson, exponent, uniform, standard. The subject also provides research methods of mathematical statistic, methods for estimating unknown parameters, comparing two means, two scales, two variances, using the appropriate standard, independence and multiple scaling tests, finding the highest and lowest ratios, the formula for calculating the correlation coefficient and the experimental linear regression line between the two variables.

16 - Linear programming – 2 credits: The subject presents how to solve problems with practical content by single-valued algorithms, duality, zero charge (also known as positioning algorithm) ... and application to solve some common problems in fact.

17 - Customer Relationship Management – 2 credits: The module provides insights and knowledge into enterprise management and their application to business operations. Student can improve communication skills, adapt to common situation occuring in the business. After completing this course, student understand the basic functions and coordination of the internal components of the enterprise.

18 – Logics – 2 credits: This course is about propositional logic, predicate logic, reasoning... and application to some arguments in scientific texts.

19 - Engineering Drawings – 2 credits: After learning this subject, student can know, understand and apply the basic knowledge to read and create technical drawings. At the same time, students are trained in thinking skills, self-study, careful

working style, persistence, sense of discipline ... in the process of learning, doing exercises.

20 - Electrical Technique – 2 credits: The module includes basic knowledge of electricity, electrical circuits and circuit analysis methods. Students will be able to solve problem on circuit.

21 - Inorganic chemistry – 3 credits*:* The content includes the basic laws of inorganic chemistry, the properties of single substance and compound in the periodic table of chemical elements.

22 - Inorganic Chemistry Laboratory – 2 credits: The content of the module includes experiments on the preparation of single substance and basic compounds in inorganic chemistry.

23 - Organic chemistry – 4 credits: The content of organic chemistry consists of three parts. Part I is about Fundamentals of organic chemistry such as basic concepts of organic chemistry, electronic effects, organic reaction mechanisms. Part II is about Hydrocarbons including basic concepts, preparation, physical and chemical properties of alkanes, cycloalkanes, alkene, alkadiene, alkyn, aren. Part III is about Hydrocarbons derivatives: basic concepts, modulation methods, physical properties, chemical properties of halogen derivatives, metal orgnic framework, hydroxides, carbonyl, acids, amines, carbohydrates, amino acids, peptides.

24 - Organic Chemistry Laboratory – 2 credits: The content of this module includes qualitative tests of organic compounds and synthesis of some organic compounds.

25 - Analytical chemistry – 4 credits: The content of the module includes general analytical chemistry, volumetric analysis, weight analysis, ionic reactions in aqueous solution, statistical analysis of experimental results.

26 - Analytical Chemistry Laboratory – 3 credits: The content includes qualitative analysis of cation of group 1, 2, 3, 4, 5; mixture of cationic groups (1, 2, 3, 4 and 5) and experiments quantifying some basic compounds by volumen and weight analysis.

27 - Physical Chemistry 1 – 5 credits: The module includes application of two thermodynamic principles to investigate the thermal effects of reaction, determine the self-evolution of chemical processes, equilibrium position and equilibrium transfer of chemical reactions, phase transitions; studying the laws of evolution of chemical reactions, i.e the reaction rate and mechanism.

28 - Physical Chemistry 2 – 4 credits: This module presents phenomena related to the reversible transformation between chemical potential and electric potential, processes occurring on the phase boundary, mechanism and dynamic of electrode reactions. Gel chemical physics of multi-dispersion systems and surface phenomena studying the formation condition and properties of particles in the dispersion system.

29 - Physical Chemistry Laboratory – 3 credits: The module consists of 17 practical exercises on electrolyte solutions, phase equilibrium, chemical equilibrium, adsorption, colloidal solution, reaction kinetic and electrochemistry.

30 - Green chemistry – 3 credits: This course presents environmental issues and the history of green chemistry, principles of green chemistry, green catalysts and green solvents, green energy, modern methods of organic synthesis, green chemistry in chemical technology such as textile, dyeing, paper, pesticide, ...

31 - Fluid Mechanics and Mechanical Operations – 3 credits: The content of module includes the basis of processes and hydraulic equipment such as pump, fan, compressor; stirring, mixing the liquid; separation by mechanical methods such as settling, filtration; the knowledge of grain and grain mass such as mixing, beating, grinding, sieving.

32 - Heat Transfer – 3 credits: The basis of processes and thermal equipment includes methods of heat transfer such as conduction, convection and radiation; knowledge of heat transfer processes such as heating, cooling, condensation, evaporation and calculation of heat exchangers.

33 - Mass Transfer – 3 credits: This course provides the basis, principle of mass transfer processes, characteristic, composition of mass transfer equipment, calculation of material and energy balance of mass transfer processes.

34 - Chemical Engineering Laboratory – 3 credits: This course helps student remember and rearrange the knowledge of process and equipment, structure, working principles of equipment, calculation of material and energy balance of basic processes in chemical technology, calculation and design processes and basic equipment in the chemical industry.

35 - Chemical Reaction Engineering – 3 credits: The module provides the knowledge of reactor design including ideal reactor design (semi-continuous and continuous stirring, tubular reactor), calculation for single and multiple reaction types in isothermal condition, kinetic data analysis and rate equation from the data of the component reactions. In addition, the course also provides concepts of heterogeneous reaction and its parameters.

36 - Petroleum Safety – 3 credits: Overview of labor safety, leakage treatment, oil spill control, waste gas treatment from petroleum industry, safety in exploration and exploitation of petroleum, operation of the petroleum plant and petrochemical processing, working with petroleum and petrochemical products.

37 - Instrumentation and Process Control – 3 credits: This subject provides basis of measurement and automatic process control; how to determine errors in measurement including equipment, instruments for measuring temperature, pressure, flow, viscosity, density; how to identify specific parameters for ON / OFF, P, PI, PD, and PID controllers.

38 - Storage and Transportation of Petroleum Products – 3 credits: The module includes general knowledge of tanks and pipelines, principles of design and construction, auxiliary systems and basic operating rules for petroleum products.

39 - Colour Chemistry – 3 credits: The content of the module includes theory of color and light, color perception, mechanism and process of color formation, systems and color space, colorimetric technique and the applicability of color in chemical and material technology.

40 - Chemistry of Cellulose – 3 credits: The content of the module includes basic concepts of carbohydrate, molecular structure, structural morphology and

physicochemical characterization of cellulose, chemical reactions of cellulose such as chain reaction transformation of ester, ether and the application of cellulose in the paper, textile, membrane, fiber, energy industries.

41 - Polymer Chemistry – 3 credits: Basic concepts of polymeric compounds, addition polymerization, ionic polymerization, condensation polymerization, chemical reactions occurring in polymer molecules, polymer solution and mechanical properties of polymer materials.

42 - Phase Diagram – 3 credits: The content of the module includes phase rules - phase diagrams, methods of calculation and construction of phase diagrams for system of 2, 3, 4 and 5 ingradients, schematic of solubility calculus, multi-heat crystallization, isothermal, conjugate linear rule, mass center rule.

43 - Petroleum Products – 3 credits: Overview of petroleum products, natural gas and liquefied petroleum gas, gasoline, jet fuel, kerosene, diesel oil, fuel oil, lubricants, grease, bitumen, industrial solvents.

44 - Engineering Catalysis – 4 credits: Basic theory of catalyst and catalysis, classification of catalyst, catalytic kinetic, catalytic chemistry processes, catalyst manufacturing processes and modern catalytic evaluation methods.

45 - Material science – 4 credits: Chemical structure and basic properties of materials, defects and diffusion in materials, preparations, processing and application of materials.

46 - Corrosion and Protection of Materials – 4 credits: The content of the module includes the basic theory of chemical erosion, electrochemical corrosion, factors affecting corrosion and some methods of metal protection from erosion in different environments.

47 - Methods for Physical and Chemical Analysis – 4 credits: The content of the module includes classification of physicochemical analysis; spectral analysis techniques such as UV-VIS, AAS-AES, structural spectral analysis techniques such as IR, MS, NMR; chromatographic analytical techniques such as HPLC, GC; electrochemical analytical techniques such as amperometric titration, volt-ampere method ...

48 - Organic Synthesis – 4 credits: The content includes starting-material, catalyst, solvent, new methods and basic organic synthesis techniques to create C – C bond, C – heteroatom bond, ring closing and ring opening reaction, oxidation-reducing, carbon-based synthesis.

49 - Pulp and paper manufacture – 4 credits: The content of the module includes materials for pulp manufacturing, methods of producing wood pulp, non-wood pulp and recycled paper; chemistry and bleaching of pulp; additives and fillers in paper manufacturing technology, preparation of pulp and paper pulp; paper quality control, waste water issues in the paper industry and some problem solving techniques.

50 - Dyeing Technology – 4 credits: The course content includes introduction to textile material, theoretical background of dyeing process, color compositing processes, pre-treatment processes, dyeing and printing technology and fabric finishing method.

51 - Basic Inorganic Technology – 4 credits: The content of module includes the most basic processes such as firing, dissolution, and crystallization processes; sulfuric acid and SO_2 manufacturing as well as oxidation and adsorption of SO_3; methods of producing phosphoric acid by heat and extraction techniques; synthetic gas manufacturing and purification processes; ammonia synthesis; soda-chloro and inorganic salts manufacturing process.

52 - Fertilizer Technology – 4 credits: The content of the module includes basic fundamental of fertilizer and nutrient, phosphate fertilizer, material for phosphate fertilizer manufacturing, urea fertilizer, raw material and processing of urea synthesis, multi-nutrient fertilizer, raw materials and procedure of NPK mixed fertilizer manufacturing.

53 - Petroleum Refining Technology – 4 credits: The content of the module includes overview of petroleum refining processes, initial process, separation and cracking process, octane enhancement process, blending processes, heavy oil processing and development trends of future refineries.

54 - Gas processing technology – 4 credits: This module includes basic concepts of natural gas, phase state and hydrodynamic properties of hydrocarbon, preparation and treatment in gas processing plant, petrochemical technology from gas and some typical gas processing technologies in Vietnam.

55 - Petrochemical Technology – 4 credits: The content of module include overview of petrochemical technology; preparation of petrochemical materials from petroleum; production of non-hydrocarbon-based compounds; production of petrochemical products from intermediate materials such as paraffin, olefin, BTX, synthesis gas, acetylene; overview of polymer and rubber manufacturing; production of synthetic detergents; introducing some petrochemical technologies in Vietnam.

56 - Surfactant technology – 4 credits: The content of module includes basic theory of surfactants, physical and chemical properties of surfactant such as emulsifying ability, foaming ability, dispersion and suspension stability, application of surfactants in many manufacturing areas.

57 - Characterization of Materials – 4 credits: The content of the module includes basic principles of equipment and how to use of different materials analysis techniques such as spectral analysis (NMR, FTIR), X-ray analysis (XRD, XRF_X-ray fluorescence), optical analysis, electron microscopy and Reflected-Light Optical Microscopy (SEM, TEM, AFM), surface analysis (BET, XPS_X-ray photoelectron spectroscopy, AES_Auger electron spectroscopy, SIMS_secondary ion mass spectrometry), mechanical property, conductivity and thermal analysis (DSC_ Differential scanning calorimetry, TGA).

58 - Advaced organic synthesis – 4 credits: The content of the module includes: material, catalyst, solvent, new method and basic organic synthesis, evaluation of organic synthesis strategy, i.e chemical transformation, cubic structure, fuctional synthesis, functional protection.

59 - Catalyst technology laboratory experiments – 4 credits: The content of this module includes experients on preparation and application of some homogeneous and heterogeneous catalysts, solid catalyst, phase transfer catalyst and green catalyst.

60 - Material Synthesis Laboratory Experiments – 4 credits: This course consists of experients on preparation and application of organic, inorganic and nano-materials in chemical technology.

61 - Green Technology Laboratory Experiments – 4 credits: This module includes experiments in green technologies for synthesis of organic, biodiesel, dyeing, emulsion, film membrane, paper.

62 - Polymer Technology Laboratory Experiments – 4 credits: The content of the module includes: Natural rubber processing, determination of molecular weight of rubber, vulcanization of vulcanized rubber, synthetic resins UF, PF, UPE and Epoxy_ester, Alkyd paint production, composite processing.

63 - Petroleum Processing Laboratory Experiments – 4 credits: This module consists of 10 experiments on petroleum refining simulation using PRO II and HYSYS software; mixing and evaluating the quality of lubricating oil and grease; manufacturing and evaluating catalyst in catalytic cracking; investigating bio-mass pyrolysis into bio-oil; separating of n-paraffin by crystallization and biodiesel synthesis using either KOH or K_2CO_3 catalyst.

64 - Physical and chemical analysis laboratory – 4 credits: The content of module includes: practical exercises on optical measurement method, chromatography method, electrochemical analysis method.

65 - Petroleum product analysis laboratory experiments – 4 credits: This module consists of 17 experements about checking and evaluating the quality of petroleum products on ASTM D standard equipment such as ASTM D86, ASTM D130, ASTM D287, ASTM D611, ASTM D2500, ASTM D95, ASTM D445, ASTM D2265, ASTM D217, ASTM D92, ASTM D56, ASTM D1322, ASTM D473, ASTM D156, ASTM D87, and ASTM D874.

66 – Field trip – 2 credits: The subject is organized for students to visit, discuss the technology process, actual equipment in the factory. Students will initially assess and visualize the content and majors orientation majors.

67 - Graduate Intership – 3 credits: The subject organizes students to contact the process of technology, equipment, and tools in factories in order to put knowledge gained in practice.

68 - Graduate Project – 5 credits: This course is a type of research project about applying or calculating to solve a practical technical problem relating to speciality.

10. BENCHMARKING THE CURRICULUM OF OTHER UNIVERSITIES

10.1. Introducion the curriculum of other universities

The curriculum was also benchmarked with the similar curriculum of other universities. Results of benchmark were a basis for evaluation, improvement and development programme

- STANFORD: Chemical Engineering Program, Stanford University School of Engineering

- CHULA: Chemical Engineering, Faculty of Engineering, Chulalongkorn University
- UPS: Chemical Engineering, University of the Philippines Diliman
- USM: Chemical Engineering, Universiti Sains Malaysia
- HUST: Chemical Engineering Technology, Hanoi University of Science and Technology
- HUS: Chemical Engineering Technology, Hanoi University of Science
- HCMUS: Chemical Engineering Technology, University of Science, Vietnam National University - Ho Chi Minh City
- HCMUT: Chemical Engineering, Ho Chi Minh City University of Technology

10.2. Benchmarking

Curriculum	Maths/Sciences		Engineering		Skills		Sum credits
	Credit number	Ratio	Credit number	Ratio	Credit number	Ratio	
STANFORD	54	28,7%	69	36,7%	65	34,6%	188
CHULA	21	14,5%	103	71,0%	21	14,5%	145
UPD	46	25,0%	97	52,7%	41	22,3%	184
USM	6	4,4%	108	80,0%	21	15,6%	135
HUST	32	19,6%	115	70,6%	16	9,8%	163
HUS	28	20,0%	78	55,7%	34	24,3%	140
HCMUS	21	15,0%	92	65,7%	27	19,3%	140
HCMUT	23	16,4%	93	66,4%	24	17,1%	140
IUH	13	9,2%	98	69,5%	30	21,3%	143

This is similar to engineering courses of CHULA and HUST. The number of credits for skills course are as much as the programme of HUS, HCMUS, HUS and higher than that of CHULA, USM and HUST. However, the percentage of credits for mathematics and natural sciences is lower than that of the others because IUH is an application-oriented university while the others are research-based universities. Furthermore, the progamme also integrates knowledge of mathematics, natural science in the groups of fundamental and specialized courses, so reduce percentage of these courses.

11. APPROVAL OF PROGRAMME SPECIFICATION

Programme specification was checked, approved and revised according to the process and regulations of the Inductrial University Industry of Ho Chi Minh city./.

Ho Chi Minh City, , 2017

Trainning department Dean of FCE

APPENDIX A: REFERENCES TO DEVELOP PROROGRAMME

A. Regulation of MOET and IUH

1. Documentary 2196/BGDĐT-GDĐH, April 22, 2010 of MOET.
2. Decision 32/2007/QĐ-BGDĐT, June 18, 2007 of MOET about issue the higher education framework programme on undergraduate and college
3. Guide to AUN-QA Assessment at Programme Level, Version 3.0, Thailan, 2015.
4. Criteria for accrediting engineering technology programs, ABET, 2015
5. Documentary 2435/BGDĐT-GDĐH, April 12, 2013 about review the outcomes and documents
6. Higher education law, 2012
7. Decision 1215, April 4, 2013 of MOET about issue action plan of education sector
8. Decision 52/2008/QĐ-BGDĐT, September 18, 2008 of MOET
9. Circular 12/2012/VBHN of MOET about issue the list of education and training of level IV for undergraduate and college progarmme
10. Notification 284/ĐHCN, January 15, 2014 of IUH.
11. Regulation 01/HD-ĐHCN, February 14, 2014 of IUH.

B. Curriculum of other universities

1. Chulalongkorn University
2. Universiti Sains Malaysia
3. Hanoi University of Science and Technology
4. Hanoi University of Science
5. University of Science, Vietnam National University - Ho Chi Minh City
6. Ho Chi Minh City University of Technology.