Appended Form 1

Specifications for Major Program

Name of School (Program) School of Engineering Cluster 3 (Applied Chemistry, Biotechnology and Chemical Engineering)

Program name (Japanese)	
(English)	Program of Chemical Engineering

1. Academic degree to be acquired

Bachelor's degree in engineering

2. Overview

(1) Overview of "English-based Bachelor's Degree Program"

This program aims to foster and produce future members of a global society who have the knowledge to be innovative, creative, take leadership, and possess language abilities that will help them play an important role in the international world.

This program focuses specifically on producing individuals who are capable of addressing various global issues from an engineering perspective and contribute to the creation of new and valuable solutions that are significant to both the industrial and academic societies.

Students enrolled in the program will begin the curriculum from the first semester of their first year.

In the second year, students will set off on their major programs and take the designated courses which are offered at each cluster.Major program overview is as (2).

(2)Program overview of "Program of Chemical Engineering".

Chemical engineering is the academic system of engineering that is needed in order to make chemistry useful in real life. In other words, it is "the engineering of chemistry". For instance, in order for us to make use of newly-discovered or synthesized substances, which have highly useful functions, in real life, it is first necessary to efficiently produce the needed quantity of industrial products based on these substances at a reasonable price. Therefore, we must make effective use of limited resources and energy, and select or develop the most efficient production system that gives consideration to the environment. Essentially, we must first study which raw materials we can use to produce the intended product, by what reactions, processes, equipment, and operational conditions it can be produced, and how we can detoxify the waste products and return them to nature. Only after we have done these we can finally decide on the production system. Chemical engineering is the academic system that brings together the development of the optimal production system, the design of new plants and equipment, and the fundamentals necessary for operational management.

Chemical engineering has developed as an academic field necessary for the development of production process for chemical products. The production processes for other products, for instance those for food items, medical products, iron and steel, and those related to the energy industry, can be carried out in the same way as those used for chemical products and, therefore, engineers who have studied chemical engineering perform well in various industries. It is also possible to develop new functional materials by devising production processes based on the academic system of chemical engineering, and today's chemical engineering has been drawing attention to this. Furthermore, since the development of optimal production systems and new plants is conducted in harmony with nature, chemical engineering is also helpful in creating a sustainable society.

This program aims at developing professionals who have acquired the fundamentals of, and expertise in, chemical engineering through education and research into the efficient use of substances, energy, and reaction processes. The philosophy of chemical engineering has become an indispensable tool for solving environmental issues in which it is necessary to consider resources, energy, safety, economy, and society in an integrated manner,

while maintaining a global perspective. Therefore, developing professionals who can approach these environmental issues from a chemical engineering perspective is one of the objectives of this program.

Students who are enrolled in Cluster 3 (applied chemistry, biotechnology, chemical engineering) at the School of Engineering receive the common education for Cluster 3 by the end of the first semester of the second year, and are registered in this program from the second semester of the second year. From that point until graduation, under the integrated educational system, students can acquire expertise in chemical engineering to the level needed to pass the examination of Associate Professional Chemical Engineer.

Many of the graduates advance to graduate school and acquire a higher level of expertise and research capabilities. They often find employment with corporations working in areas such as chemicals, ceramics, textiles, medical products, foods, paper making, and other chemical-related industries, and they also gain employment with electricity, metals, machinery, construction, and food companies, energy and environment-related corporations, and in various other industrial areas. They work actively inside and outside the country, using their chemical engineering knowledge as their weapon. In addition, this program was approved in 2004 by the JABEE (Japan Accreditation Board for Engineering Education) for chemistry, chemistry-related fields, and chemical engineering courses. It also received an ongoing certification review in 2009, and was accredited in terms of educational activities, educational content, graduates' knowledge, and their ability to reach an adequate level.

3. Academic Awards Policy (Goals of the Program and Policy for Awarding Degrees)

Chemical engineering is the academic system of engineering needed when making use of chemistry in real life. In other words, it is the "engineering of chemistry". For instance, in order to make use of newly-discovered or synthesized highly functional substances in real life, it is necessary to efficiently produce the needed quantity of these industrial products at a reasonable price. Therefore, we must make effective use of limited resources and energy, while minimizing the burden on the environment, and select or develop the most efficient production system. Chemical engineering is the academic system that brings together development of the optimal production system, and design and operational management of new plants and equipment.

This program develops professionals who have acquired the fundamentals of, and professional expertise in, chemical engineering, through education and research into the efficient use of substances, energy and reaction processes. It also develops professionals who are able to approach environmental problems from the perspective of chemical engineering. Therefore, the program sets the goals (A) to (E) below, and cultivates not only professional expertise in engineering in general, and chemical engineering in particular, but also the essential foundation indispensable for engineers and researchers, which includes creativity, communication skills, and the like. This program awards a "bachelor's degree in engineering" to students who have acquired the number of credits necessary to meet the standard of the course, and have achieved the following goals.

(A) Acquisition of a multiple thinking ability and understanding of relations among human, society, nature, and engineering. (engineering ethics)

(B) Acquisition of logical thinking ability

(C) Acquisition of basic chemistry and chemical engineering and cultivation of application ability

(D) Acquisition of flexible adapting ability and creativity and cultivating motivation for self-development and self-improvement

(E) Acquisition of presentation and communication ability and cultivation of application ability to high informatization.

4. Curriculum Policy (Policy for Preparing and Implementing the Curriculum)

To achieve the goals (A) to (E) in this program, a curriculum consisting of liberal arts education subjects and specialized basic subjects, which are common to Cluster 3, and specialized subjects, which are unique to this program, is organized as described below.

In the curriculum, teaching and learning will be implemented by utilizing active learning and online classes, depending on the delivery methods of the program, such as lectures and seminars.

In addition to strict grading using the standards clearly outlined in the syllabus, learning outcomes are evaluated

based on the degree to which the goals set by the educational program are achieved.

(A) Cultivation of multiple thinking ability and understanding of relations among human, society, nature, and engineering.

(C3) Chemical basis

Acquisition of basic knowledge of chemical fields such as organic chemistry, analytical chemistry, reaction engineering, polymer chemistry, electrochemistry, biochemistry, and energy chemistry, as well as basic knowledge of fields related to chemistry and experimental techniques, and the cultivation of abilities to utilize them for solving problems. These can be acquired by completing “Basic Organic Chemistry”, “Inorganic Chemistry”, “Chemical Reaction Engineering”, “Chemical Kinetics”, “Synthetic Polymer Chemistry”, “Electrochemistry”, “Biochemistry”, “Fermentation Technology”, “Biotechnology”, and “Basic Experiments in Chemistry”.

(C4) Chemical engineering field

Acquisition of expertise in chemical engineering fields such as heat transfer, fluids engineering, material transfer, reaction engineering, process control engineering, powder technology, drafting and design, and experimental technology, and cultivation of abilities to utilize them for solving problems, by completing “Heat Transfer”, “Fluids Engineering”, “Mass Transfer”, “Chemical Reaction Engineering”, “Powder Technology”, “Process Control Engineering”, “Chemical Equipment Design and Practice”, “Chemical Engineering Exercise”, and “Experimental Chemical Engineering”,

(C5) Chemical engineering application

Cultivation of management abilities and the ability to study, develop, and design the substances and energy processes that consider material circulation and environmental burdens while taking account of economy, safety, reliability, and social impact, by completing “Chemical Process Design”, ” Chemical Industry Process”, and “Chemical Process and Engineering Ethics”.

(D) Cultivation of flexible adapting ability and creativity and cultivating motivation for self-

education in chemistry, biotechnology, and chemical engineering. These are the Program of Applied Chemistry, the Program of Biotechnology, and the Program of Chemical Engineering.
Registration on these three programs is to be made in the second semester of the second year, so that students can choose a suitable specialized field or program while acquiring a wide range of specialized basic knowledge.

○ Credit Requirements

In order to be assigned to each program, students must acquire 16 or more credits out of a total of 18 credits in compulsory specialized basic subjects (excluding “Basic Experiments in Chemistry” and “Technical English”) and must acquire a total of 60 or more credits overall (including in Liberal Arts Education).

○ Program Quota

An upper limit is set for acceptance of students. Assignment to the Program of Applied Chemistry, the Program of Biotechnology and the Program of Chemical Engineering is decided after taking into account requests from students and their academic results.

6. Obtainable Qualifications

Type-1 High School Teaching License (Industry) (By completing “Vocational Guidance”, the prescribed “Liberal Arts Education Subjects” and “Specialized Education Subjects”, students can obtain a Type-1 High School Teaching License (Industry) upon graduation.)

Superintendent boiler operator (Graduates from the school of engineering, who have completed the boiler-related courses while in school and have undergone hands-on training about handling boilers for more than one or two years after graduation, are eligible to take the license examination for first-class boiler operator or the license examination for special-class boiler operator.)

Person responsible for handling hazardous materials (Graduates of this program are eligible to take the class A hazardous materials engineer qualification examination.)

Person responsible for handling poisonous and toxic substances (Graduates of this program are certified.)

7. Class subjects and course content

* For class subjects, see the subject list table on the attached sheet. (Subject list table to be attached)
* For course content, see the syllabus published each academic year.
* All courses are taught in Japanese. Course materials may be written in both Japanese and English or only English.

8 Academic Achievements

At the end of each semester, evaluation criteria are applied to each evaluation item of academic achievement to clearly demonstrate the level of attainment. Students’ grade calculations for each subject, from admission to the university to the current semester, are given in one of the three levels: “Excellent,” “Very Good,” and “Good,” based on evaluation criteria calculated by adding the weighted values to the numerically-converted values of their academic achievement (S = 4, A = 3, B = 2, and C= 1) in each subject being evaluated.

Result Evaluation	Conversion
S 90 points or more	4
A 80 ~ 89 points	3
B 70 ~ 79 points	2
C 60 ~ 69 points	1

Academic Results	Standard
Excellent	3.00 ~ 4.00
Very Good	2.00 ~ 2.99
Good	1.00 ~ 1.99

* See the relationship between evaluation items and evaluation criteria in the attached sheet 2.
* See the relationship between evaluation items and class subjects in the attached sheet 3.
* See the curriculum map in the attached sheet 4.

9. Graduation Thesis (Graduation Research) (Positioning, When and how it is assigned, etc.)

Based on the basic knowledge and basic skills in chemical engineering that students have acquired by the third year, students engage in the cutting-edge research in their selected research field.

○ Positioning

The graduation thesis is positioned as a major subject to achieve the following goals.

(A) Cultivation of multiple thinking ability and understanding of relations among human, society, nature, and engineering (Engineering ethics).

(C5) Chemical engineering application

(D) Cultivation of flexible adapting ability and creativity and cultivating motivation for self-development and self-improvement

(E) Improvement of presentation and communication ability and cultivation of application ability to high informatization.

The specific goals are as follows.

(1) The ability to understand the social background of, and previous research outcomes in, the chosen topic of research, as found in research papers (including English papers)

(2) The ability to understand the purpose of research and to establish specific goals and research schedules, as well as the ability to conduct research voluntarily

(3) The ability to understand the social requirements of research contents, their impact on society or on nature, and the significance of this impact, as well as the ability to recognize the contribution made by researchers, and their responsibilities, from a multifaceted perspective

(4) The ability to understand the principles, structure, and operational procedures of equipment, and the ability to use it properly, as well as the ability to observe the phenomena resulting from experimental operations, and to write down the necessary information in laboratory notebooks

(5) The ability to interpret the results gained, and to express the phenomena in terms of physics models

(6) The ability to collect the necessary information when identifying a problem, and to apply acquired knowledge in creative ways in order to solve the problem

(7) The ability to express the content of the oral or written research logically and effectively

(8) The ability to discuss research with others, express one’s own opinion adequately, take others’ opinions seriously, and digest these opinions for one's own improvement

(9) The ability to overcome problems and technical issues, find pleasure in achieving objectives and goals, and demonstrate a willingness to work on further intellectual activities

(10) The ability to develop in social skills and human qualities in order to live and act as part of a group

○ When and how it is assigned

When it is assigned: At the start of the fourth year (only those who meet “the conditions for undertaking a graduation thesis” are to be assigned.)

Conditions for undertaking a graduation thesis

(1) Students must acquire 8 credits in foreign languages and all of practical subjects and laboratory subjects to be taken (including experiments practical work in the basic subjects).

(2) Students must acquire a total of 112 credits or more, excluding chemical process design, out of which students must acquire a total of 66 credits or more in specialized basic subjects and specialized subjects (excluding “Chemical Process Design”)

○ How it is assigned

The research details of each laboratory to which students can be assigned are explained during the lectures of “Introduction to Applied Chemistry, Chemical Engineering and Biotechnology” and at the explanatory meeting on assignment. After the number of students acceptable to each laboratory is given, students who can begin their graduation theses are assigned as requested. However, as the number of acceptable students is limited, adjustment

may be made.

○ How guidance is given

Research is highly diverse from the outset, and how guidance is given varies slightly depending on the mentor, but basically guidance is given as described below. Not only mentors, but also graduate students and other staff in the program give guidance to students.

Research topics are set, an overview is given and research approaches are explained.

Students set the purpose and the goal of the research, arrange long-term and short-term research schedules, and are given guidance about the contents as needed.

A seminar is held for the entire laboratory, lectures are given about safety control, specialized experimental technics, and basic knowledge in related fields and research contents, and students are trained in presentation skills, question and answer sessions, and writing summaries.

Students conduct research, experiments, calculations, and analysis, and consider their achievement of the purpose and goal of the research.

Meetings will be held as needed about the status of the research; guidance will be given about the research results, their interpretation, considerations that should be made, etc., and training will be given in communication and logical thinking skills.

The interim graduation thesis presentation (December) and the final presentation (February) will be held, and students will receive training in presentation of results, summary writing, and question and answer sessions, and all the staff check and evaluate educational effects of the graduation thesis.

Guidance is given about how to compose reports and how to think logically through the writing of the graduation thesis.

10. Responsibility System

(1) PDCA Responsibility System (“Plan,” “Do,” “Check,” and “Act”)

To work on the evaluation of the program, this program organizes three committees (the Educational Evaluation Committee, the Student Evaluation Committee, and the Educational Improvement Committee), the Managing Committee, which oversees these three committees, and the Program Evaluation Committee, which is an external evaluation committee consisting mainly of business people. The following are the major roles of each committee.

The Educational Evaluation Committee conducts questionnaires to evaluate attainment levels against the goals (class improvement questionnaires directed at students and staff), questionnaires to evaluate the validity of the goals (questionnaires at the time of students’ graduation, and questionnaires targeting graduates and their superiors). The committee checks, evaluates, and improves the educational systems such as curricula, educational environments, and support systems. Based on the results of the questionnaires, the committee checks and evaluates the validity of the current educational system.

The Student Evaluation Committee mainly evaluates and improves the system that assesses the students’ educational status. The committee evaluates the attainment levels of each subject against the students’ goals by the use of the class improvement questionnaires and grade summary sheets, and, for the purpose of increasing consciousness of learning and educational effects, it surveys the students’ learning situation and makes recommendations for improvement as necessary.

The Educational Improvement Committee reviews the curricula in terms of achievement of the goals, based on the recommendations for improvement and the results of the various of questionnaires submitted by the Student Evaluation Committee and the Educational Evaluation Committee, and devises new goals as needed. Furthermore, the committee makes recommendations about improvement of the educational environments and support systems. The task of each committee overlaps partially, and this system enables the committees to check each other while working in collaboration with each other. All of the staff in charge of the program belong to one of the committees.

The Managing Committee, which oversees the Educational Evaluation Committee, the Student Evaluation Committee, and the Educational Improvement Committee, has the program supervisor as its chairperson. To move

ahead with the educational program (DO), the committee checks and evaluates the students' goal attainment levels and the educational systems (educational tools, educational environments, etc.) (CHECK), suggests educational improvements (ACT) and sets the goals to be achieved, including the level or achievement necessary to meet these goals (PLAN). In this way, the Managing Committee gives guidance to each other committee for the smooth running of the PDCA system. As such, this program has in place a system under which all the staff in charge cooperate and move ahead together, with the program supervisor taking overall responsibility.

(2) Program assessment

○ Criteria for program assessment

This program evaluates and improves the program in PDCA cycles from the following evaluation perspectives.

(1) Whether goals being set are appropriate
(2) Whether the amount of learning (learning hours) is sufficient
(3) Whether curricula being set are appropriate
(4) Whether classes are conducted in accordance with the syllabus
(5) Whether equipment and facilities are sufficient
(6) Whether the student support system is sufficient
(7) Whether the goal attainment levels are sufficient
(8) Whether educational improvement is undertaken
(9) Whether continuous improvement is undertaken
(10) Whether the records of activities are publicized or disclosed

The Educational Evaluation Committee, the Student Evaluation Committee, the Educational Improvement Committee, and the Managing Committee evaluate this program on a daily and continuous basis, in a planned manner, from the above-mentioned evaluation perspectives. Therefore, the committees prepare unique questionnaires, grade summary sheets, and the survey on attainment levels, and put them into action. (Major evaluation perspectives and when to implement evaluation are described.)

Class questionnaires to evaluate the amount of learning (learning hours), class accordance with the syllabus, attainment levels against the goals (class improvement questionnaires targeting students and staff)

Teachers' comments on students' class improvement questionnaires for educational improvement, improvement reports by teacher in charge of subjects (implemented at the end of each semester)

Questionnaires to evaluate the validity of the goals and suitability of the established curriculum, the questionnaires at the time of students' graduation (targeted at fourth year students, implemented immediately after presenting graduation theses), the questionnaires targeting graduates and their superiors (conducted once every three years, for graduates who graduated 3, 4, or 5 years ago)

The amount of learning (learning hours), class accordance with the syllabus, grade summary sheet for each class subject to evaluate the attainment levels against the goals, attendance record (conducted at the end of each semester)

Drawing up of program syllabus (once a year)

Preparing the survey on attainment levels of students' academic results in order to understand the academic results of individual students and of the entire grade (conducted at the end of each semester)

FD activities, such as class observations of all staff (conducted on a regular basis)

○ How to assess the program

The Educational Evaluation Committee, the Student Evaluation Committee, and the Educational Improvement Committee gather the above data according to each task, and compile the results of various questionnaires, academic results of class subjects and comprehensive evaluations, and attainment levels against the goals. The committees then submit recommendations for improvement with reference to the students' requests, and improvement reports by the teacher in charge of each subject. The Managing Committee that oversees the three committees discusses these ideas in comprehensive way and draws up the final evaluation and ideas for

improvement. Evaluation and improvement plans, and items decided here, are discussed at the meeting of staff in charge, to disseminate to all staff in charge of the programs and to gain their approval. Furthermore, the committee has a consultation with the tutors or the staff in charge of each subject directly, or through three committees, as needed about evaluation and improvement of classes.

As for the issues extend across the other programs, the committee has a consultation with the Self-check and Evaluation Committee of the Graduate School of Engineering, and the Cluster 3 Curriculum Exploratory Committee, and proceeds with evaluation and improvement while working together with them.

As for the suitability of the evaluation methods of attainment levels, and of the evaluation criteria from the point of view of society, the Program Evaluation Committee, which is an external evaluation committee held once a year, gives its evaluation.

These activities are conducted on a daily and continuous basis in a planned manner. The outcome and the activity records of each committee are shared by all faculty members of this program.

○ Feedback to students

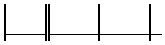
To improve student education, this program has introduced a new system for tutors and various questionnaires. In other words, by use of the attainment table, the tutors in each grade understand not only individual student's academic results and attainment level, but also the entire grade's academic results and attainment levels, and are in a position to identify improvements. Based on this, by conducting interviews with individual students, this program promotes improvement of student education in close consultation with the Managing Committee. By asking of the staff in charge of subjects at a lass for comments about the questionnaire, based on the results of the class improvement questionnaires completed by students, or on the class check and evaluation results given by the students, we make improvements of the lecture that correspond to the students' requests. Furthermore, the comments on the questionnaire are made public to students, so that students are able to understand how the questionnaires are utilized for class improvement.

)

。

						○														
					○		○													
						○		○												
					○															
						○														
					○	○	○	○												
								○												
							○													
								○												
								○												

。



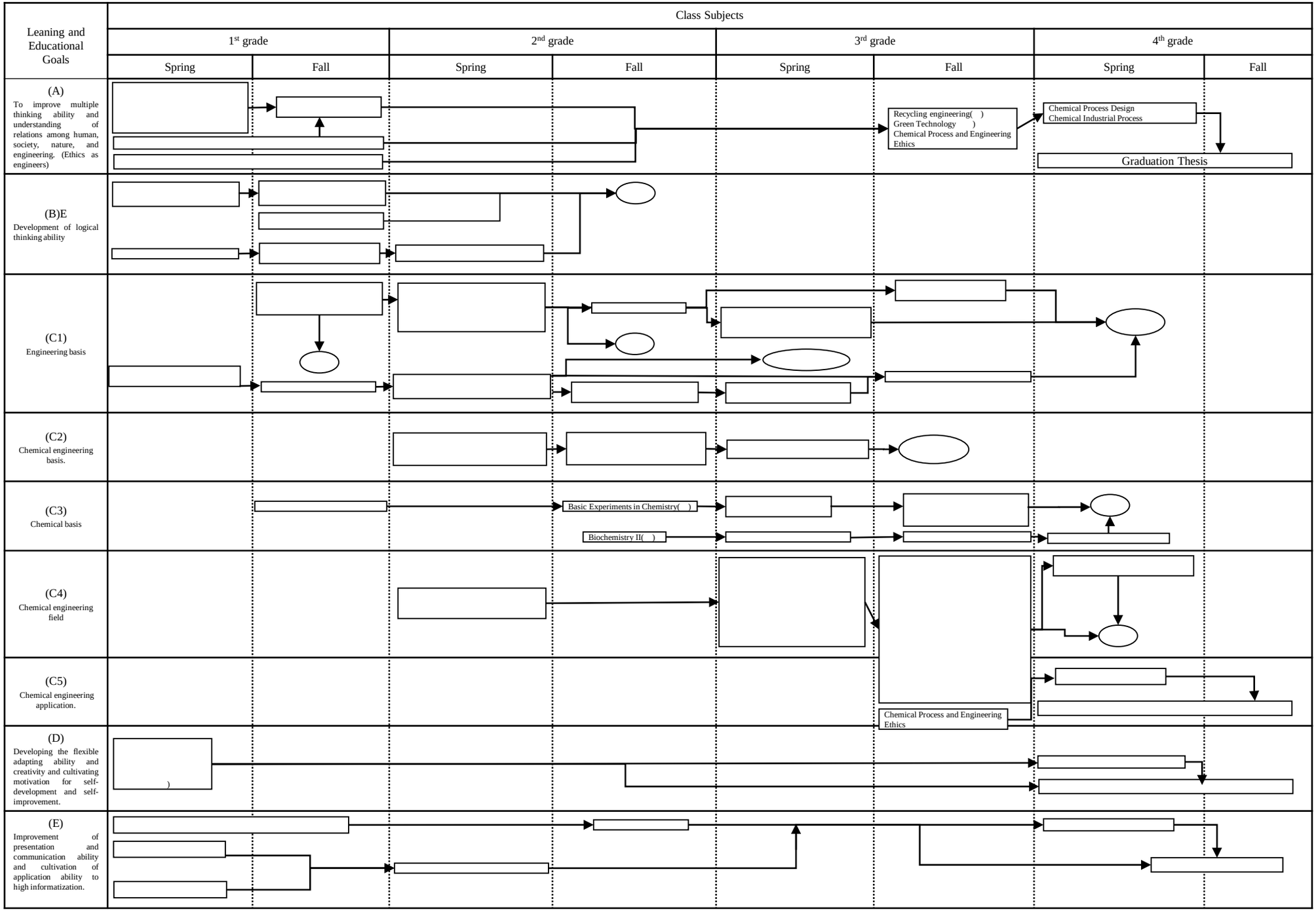
○

		○																	
		○																	
		○																	
		○																	
		○																	
		○																	
		○																	
		○																	

				1semester- T																			
				1semester- T																			
				1semester- T																			
									30	3	40	4			30	3							100
									70	7	30	3											100

				7semsester， 8semsester																			

（２）



Note Subjects with ( ) symbol have direct relation with next subject, and the subjects without symbol are incidentally influence.