# For entrants in AY 2024

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 a	cquired
Bachelor's degree in e	ngineering

# 2. Overview

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 selfimprovement
- (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.

Cultivation of an understanding of the impact that technology has on society and nature, and the responsibility that engineers have towards society, as well as cultivation of the ability to think multilaterally, from a global perspective, about the relationship between engineering, people, society, and the natural environment. This is achieved through the study of liberal arts education subjects such as "Introduction to University Education", "Introductory Seminar for First-Year Students", "Peace Science Courses", "Area Courses", "Health and Sports Courses", "Chemical Process and Engineering Ethics", "Green Technology" and "Recycling Engineering".

### (B) Cultivation of logical thinking ability.

Acquisition of basic knowledge about natural science, such as mathematics and physics, and acquisition of basic knowledge about technology, as well as the reinforcement of logical thinking skills based on the acquired basic knowledge, is achieved through the study of foundation courses in liberal arts education such as the experiment-based subject "Experimental Methods and Laboratory Work in Physics", "Experimental Methods and Laboratory Work in Biology", and mathematics and physics subjects such as "Calculus", "Linear Algebra", "General Mechanics" and "Basic Electromagnetism".

# (C) Cultivation of basic chemistry and chemical engineering, and cultivation of application ability.

Cultivation of basic academic ability in engineering through a systematized and carefully selected educational curriculum, and cultivation of professional expertise and applied skills. Particularly, by focusing on exercises and experiments, aiming at acquisition of specialized subjects in chemical engineering that enable students to acquire the ability to become independent engineers and to acquire the basics needed to engage in advanced research in graduate school. Furthermore, cultivation of a high level of consciousness as engineers through plant tours and practical work related to chemical plant design, and through lectures by external instructors with rich, real-life business experience. Abilities are cultivated by focusing on the following five fields in achieving Goal (C) in this program.

#### (C1) Engineering basis

Cultivation of knowledge about basic engineering such as applied mathematics, information processing calculator utilization technology, basic chemistry, environmental science, material science, material mechanics, and cultivation of problem-solving abilities by completing "Applied Mathematics", "Applied Mathematics", "Mathematics for Chemical Engineers

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-development and self-improvement.

Cultivation of creativity, problem-solving abilities, and motivation for self-development and study, by actually engaging in engineering while coming into contact with people who have different ideas during experimentation, chemical process design, graduation work. This is achieved by completing "Introduction to University Education", "Introductory Seminar for First-Year Students", "Chemical Process Design", and "Graduation Thesis".

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

Reinforcement of the ability to write, present, and engage in discussion logically through liberal arts seminars, experiment subjects, chemical process design, and graduation work, as well as cultivation of the ability to collect and transmit information in the fields of engineering from an international perspective through promotion of technical English. In addition, cultivation of the ability to utilize information through thorough information literacy education by completing "Introductory Seminar for First-Year Students", "Elements of Information Literacy or Exercise in Information Literacy", "Communication Course", "Initial Foreign Languages", "Technical English", "Chemical Process Design", and "Graduation Thesis".

# 5. Program Timing and Acceptance Conditions

When to start the program:

The second semester of the second year

Cluster 3 offers distinctive education that has organically integrated the fields of chemistry, biotechnology, and chemical engineering. Specifically, it aims at developing professionals that possess technical expertise in harmony with a wide range of basic knowledge about the development of new functional substances and materials; the biotechnology of plants, animals and, microbes; the design and control of chemical processes; environmental preservation and purification; and the development of resources and energy. To achieve this aim, in addition to the common, wide-ranging specialized basic education, three programs have been prepared that provide specialized 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.

#### 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.

F	Result Evaluation	Conversion
S	90 points or more	4
Α	80 ~ 89 points	3
В	70 ~ 79 points	2
С	60 ~ 69 points	1

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

<sup>\*</sup> See the relationship between evaluation items and evaluation criteria in the attached sheet 2.

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)

<sup>\*</sup> See the relationship between evaluation items and class subjects in the attached sheet 3.

<sup>\*</sup> See the curriculum map in the attached sheet 4.

- (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, th tr.6 (s)-8 b8 (al)3.2 (.)-13..6 (s)-(-)0.60 ( di)3.1 3.2 (.)-13..6ation o6(m)-24.4 (i)3.1 (t)-1

#### 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 class 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.

# Cluster 3 (Applied Chemistry, Biotechnology and Chemical Engineering)

Required subject (period of registration specified)
Compulsory elective subject (any of these subjects shall be registered)
Free elective subject (any of these subjects shall be registered)

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	Basic Courses in University Education			ry Seminar for Students	2	Introductory Seminar for First- Year Students	2	Required															
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		Aros	a Cours		4	Courses in Arts and Humanities/Social Sc	2	Compulsory															
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- Note 1 When students fail to acquire the credit during the term or semester marked with in the boxes for the year in which the course is taken, they can take the course in subsequent terms or semesters. Depending on class subject, courses may be offered in semesters or terms different from those scheduled. Please be sure to check the time schedule for Liberal Arts Education subjects to be issued every school year.
- Note 2 The credit obtained by mastery of self-directed study of "Online Seminar in English A B" cannot be counted towards the credit necessary for graduation. The credit obtained by Overseas Language Training can be recognized as Communication or if application is made in advance. For more details, please refer to the article on English in Liberal Arts Education in the student handbook.
- Note 3 We have a recognition of credit system for foreign language proficiency tests. For more details, please refer to the article on Foreign Language in Liberal Arts Education in the student handbook.
- Note 4 Students must take both Experimental Methods and Laboratory WorkI in Physics I 1credit and Experimental Methods and Laboratory WorkII in Physics II 1credit .
- Note 5: Experimental Methods and Laboratory Work in Biology I should basically be taken together with Experimental Methods and Laboratory Work in Biology II. Person who took Methods and Laboratory Work in Biology I can take Experimental Methods and Laboratory Work in Biology II.

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# Required

	Credits	Applied Chemistry Biotechnolog	y Chemical enneenering	1 1T		rade Fa 3T	all			grad Fa 3T	all	1Т	2Т	3Т	<b>4</b> T	Spi	ring	grad 3T	
Applied Mathematics I	2			11	~1	4	11		~ 1	01			~1	01			~ 1	01	
Applied Mathematics II	2							4											
Applied Mathematics III	2												4						
Basic Engineering Computer Programming	2							4											
Probability and Statistics	2											4							
Technical English	1										4								
Basic Environmental Sciences	2					4													
Chemical Stoichiometry	2								4										
Basic Organic Chemistry I	2					4													
Basic Organic Chemistry II	2						4												
Physical Chemistry I	2								4										
Biochemistry I	2								4										
Basic Experiments in Chemistry	4									12	12								
Basic Inorganic Chemistry	2					4													
Analytical Chemistry	2							4											
Basic life science	2						4												
$Introduction\ to\ Applied\ Chemistry,\ Chemical\ Engineering\ and\ Biotechnology$	2								4										
Introduction to Fundamental Industry	2								4										

# Cluster 3 Specialized Subjects Program of Chemical Engineering

Required subjects Compulsory Elective subjects

		0					Compulsory Elective subjects Class Hours/ Week													
	lits	Type of course registration	1:	st g	rac	le	2r	nd g				rd g		de	41	th g	rac	de	Not	
Class Subjects	Credits	ype of cours registration	Spr	ing			Spr				Spr					ing			e	
	J	Ty r		2T							1T					2T				
Experimental Chemical Engineering	3	-											9	9						
Chemical Equipment Design and Practice	2	-									4	4								
Fluids Engineering	2	-									4									
Heat Transfer	2	-											2	2						
Mass Transfer	2	-									2	2								
Chemical Engineering Thermodynamics	2	-									2	2								
Chemical Reaction Engineering	2	-											2	2						
Powder Technology	2	-									4									
Chemical Process Design	3	-													6	6				
Chemical Engineering Fundamentals	2	-							2	2										
Mechanics of Materials	2											4								
Chemical Engineering Exercise I	2								4	4										
Chemical Engineering Exercise II	2	-									4	4								
Chemical Engineering Exercise III	2	-											4	4						
Exercise of Chemical Engineering Thermodynamics	1	-									2	2								
Mathematics for Chemical Engineers	2	-							4											
Materials Science	2									4										
Process Control Eng.	2											4								
Numerical Calculation Method	2										4									
Chemical Process and Engineering Ethics	2	-												6						
Chemical Industrial Process	2														6					
Corrosion and Protection of Materials	2												4							
Green Technology	2												4							
Recycling engineering	2													4						
Inorganic Chemistry	2											4								
Physical Chemistry II	2	-							4											
Chemical Kinetics	2											4								
Synthetic Polymer Chemistry	2												4							
Electrochemistry	2												4							
Biochemistry II	2								4											
Fermentation Technology	2										4									
Biotechnology	2												4							
Graduation Thesis	5																			

# Academic Achievements in Chemical Engineering

The Relationship between Evaluation Items and Evaluation Criteria

	1	Academic Achievements			
		Evaluation Items	Excellent	Very Good	Good
Knowledge and Understanding	(A)	To improve multiple thinking ability and understanding of relations among human, society, nature, and engineering.	Sufficient understanding of relations among human, society, nature, and engineering. Acquiring sufficient thinking ability with multiple perspectives.	Good understanding relations among human, society, nature, and engineering deeply. Acquiring thinking ability with multiple perspectives.	Understanding relations among human, society, nature, and engineering.
Know Unde	(B)	Development of logical thinking ability	Acquiring an excellent logical thinking ability.	Acquiring a good logical thinking ability .	Acquiring a logical thinking ability.
Abilities and Skills	(C4	Definite learning of basic chemistry and chemical engineering and cultivation of engineering basis.  I chemical engineering basis chemical basis.  I chemical basis.  I chemical engineering field chemical engineering application	Sufficiently learned basic chemistry and chemical engineering and the applied skills.	Learned basic chemistry and chemical engineering.	Well learned basic chemistry and chemical engineering and the applied skills.
Abilities	(D)	Developing the flexible adapting ability and creativity and cultivating motivation for self- development and self-improvement	Acquiring excellent flexibility and creativity; also to have a willingness for self-improvement and self-enlightenment.	Acquiring good flexibility and creativity; also to have a willingness for self-improvement and self-enlightenment.	Acquiring flexibility and creativity; also to have a willingness for self-improvement and self-enlightenment.
Overall Abilities	(E)	Improvement of presentation and communication ability and cultivation of application ability to high informatization.	Developed presentation and communication ability very well. Acquired application ability to high informatization very well.	Developed presentation and communication ability well. Acquired application ability to high informatization well.	Developed presentation and communication ability. Acquired application ability to high informatization.

# Placement of the Liberal Arts Education in the Major Program

Liberal Arts Education in this program assumes the role of establishing the academic foundation on which the specialized education will be built. It respects a voluntary, self-reliant attitude and cultivates scientific thinking based on information gathering abilities, analytical abilities, and critical thinking abilities. It establishes perspectives that make it possible to provide insight on the inner nature of things and their background from a wide broad viewpoint, and enhances linguistic abilities to the level appropriate for living as a global citizen. It also strengthens interest in peace, and integrates a broad range of knowledge into a body of knowledge that will be truly useful in solving problems. It cultivates the ability to explore and promote cross-disciplinary /comprehensive research that goes beyond the established frameworks.

Part	TVCTGCTGT	inps between the eval			reems and era		J						E	riolizati	ion itor									
Calculation						Knowl	edge and	l Unders	tanding	Evaluation items  Abilities and Skills Comprehensive Abilitie												nilities	Total	
Section of the property in t	1									((	(1)	((					(4)	((	C5)					weighte d values
Part	Subject type	Class subjects	dits	course	Pariod	1	,		,		, 1,		,,		,		1)		,				_, [	of
Part	Subject type	Class subjects	cre	registr	renod	values of		values of	Weightsed	values of		values of	Weightsed	values of		values of		values of		values of	Weightsed	values of		evaluati
Second				ation			values of evaluation										values of evaluation							on items in the
Mile Controlled   Mile Control   M							items		items		items		items		items				items		items		items	subject
Comment	Liberal Asta Physician	Introduction to University	2	Demotoral		40	4			-		· ·		-		-								100
Marchander   Mar																								100
Second	Liberal Arts Education		-	Required		40	4													40	4	20	2	100
Marchander   Mar	Liberal Arts Education	Peace Science Courses	2	Elective	1semsester- T	100	10																	100
Market Ma	Liberal Arts Education	Area Courses	8	Elective		100	10																	100
Market Ma	Liberal Arts Education	Basic English Usage I	1	Required																				100
Communication   Communicatio			-		Iconmoston T																			100
Communication 10			ļ-	Required	isensester- i																			
Section	Liberal Arts Education	Communication IA	1	Required																		100	10	100
	Liberal Arts Education	Communication IB	1	Required																		100	10	100
March   Marc	Liberal Arts Education	Communication IIA	1	Required																		100	10	100
March   Marc	Liberal Arts Education	Communication IIB	1	Required																		100	10	100
Marke   Mark   Marke	Liberal Arts Education		1	Flactiva																		_		100
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Control   Cont	Liberal Arts Education		-																					100
Section   California   P.   Section   Sectio	Liberal Arts Education		2	Required	1semsester- T					40	4											60	6	100
Section   Cachelle	Liberal Arts Education		2	Elective		100	10					L								L				100
Section   Cachelle	Liberal Arts Education	Calculus I	2	Required				100	10															100
Second Second Medical Control   Second Sec	Liberal Arts Education		_					<del>                                     </del>																100
See Algebra   1   2   2   2   2   2   2   2   2   2								<del>                                     </del>				-				-				-		-		-
March   Marc			_	required				<del>                                     </del>														-		100
Section   Section   Section   Mark Mathematical   1   1   1   1   1   1   1   1   1	Liberal Arts Education	Linear Algebra II	2	Required				10010	0															
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Section   Control   Cont			-																			-		100
Department Methods and   Department Methods	Liberal Arts Education	Seminar in Basic Mathematics I	1	Required				100	10															100
Security May 1   Security Week   Righton   1   2   2   2   2   2   2   2   2   2	Liberal Arts Education		1	Elective				100	10															100
Federal Process   Federal Pr	Liberal Arts Education	Experimental Methods and	1	Elective				100	10															100
Marchest Transmiss   Marchest Marchest   2   Entre	Liberal Arts Education		1	Elective				100	10															100
Production   Applied Mathematists   2   Series	Liberal Astr Physics		ļ-																					
Product Flower   Product Machine   Product   Product Flower   Product Fl		_	-					100	10															100
Productification   Productific	Specialized Education	Applied Mathematics I	_	Required						100	10													100
Particular Engineering Computer   2   Barrier   100   100   10   10   10   10   10	Specialized Education	Applied Mathematics II	2	Required						100	10													100
Processition   Proc	Specialized Education	Applied Mathematics III	2	Elective						100	10													100
Proceedings   Process	Specialized Education		2	Required						80	8											20	2	100
Particular Description   Technical English   1   No.	-		_																			20	~	100
Particular Filtering   Basic Environmental Sciences   2   2   2   2   2   2   2   2   2			-	Elective						100	10													
Parallel Holman   Chemical Stoichimentry   2   Separa	Specialized Education	Technical English	1	Required																		100	10	100
Particular Hanness   Reside Organic Chemistry   1   2   Repose   100   100   10   10   10   10   10	Specialized Education	Basic Environmental Sciences	2	Elective		40	4			60	6													100
Second-life common   Physical Chemistry   2   Second   100	Specialized Education	Chemical Stoichiometry	2	Required								100	10											100
Second-life common   Physical Chemistry   2   Second   100	Specialized Education	Basic Organic Chemistry I	2	Required						100	10													100
Paper   Pape	-		_																					100
Special December   Special Dec			_																					
Paper   Pape	Specialized Education	Physical Chemistry I	-							100	10													100
Specialized Education   Sanic Intergranis Chemistry   2   Supposed   100   10   10   10   10   10   10	Specialized Education	Biochemistry I	2	Required						100	10													100
Special Analytical Chemistry   2   Separal	Specialized Education	Basic Experiments in Chemistry	4	Required								20	2	80	8									100
Special Analytical Chemistry   2   Separal	Specialized Education		_	Required						100	10													100
Specialized Education   Basel Elife science   2   Electrice																								100
Specialized Education   International to Applical Chemistry   Specialized Education   Education (Chemical Education of Fundamental Industry)   2   Education (Chemical Education Of Fundamental Industry)   3   3   3   3   3   3   3   3   3						-						-				-				-		1		
Commission Engineering and Biotechnology   2   Electric   70   7   30   3			-																			_		100
Experimental Chemical Equipment Design and Practice   Experimental Chemical Engineering   2   Experimental Chemical Engineering Exercise   3   Experimental Chemical Engineering Exercise   4   Exercise of Chemical Engineering Exercise   4   Exercise of Chemical Engineering Exercise   4   Exercise of Chemical Engineering Exercise   5	Specialized Education	Chemical Engineering and Biotechnology	2	Elective						30	3	40	4			30	3							100
Fourthment Design and particle   Specialized Education   Fluid's Engineering   2   Required	Specialized Education		2	Elective		L				70	7	30	3							L				100
Production of Education   Production of Ed	Specialized Education		3	Required										5	1	95	9							100
Practice	Specialized Education	Chemical Equipment Design and		Required						30	3	30	3											100
Specialized Education Heat Transfer 2 Required Specialized Education Mass Transfer 2 Required Chemical Engineering Thermodynamics Chemical Reaction Engineering Specialized Education Chemical Reaction Engineering Specialized Education Chemical Reaction Engineering Specialized Education Chemical Process Design 3 Required 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Practice								30	,	30	,											
Specialized Education   Mass Transfer   2   Required			_																			-		100
Chemical Engineering	Specialized Education	Heat Transfer														100	10							100
Demands   Chemical Reaction Engineering   Specialized Education   Chemical Engineering   Specialized Education   Chem	Specialized Education		2	Required		L						L				100	10			L				100
Information Engineering   2   Required	Specialized Education		2	Required								100	10											100
Specialized Education   Powder Technology   2   Required	Specialized Education		-	Required										50	5	50	5							100
Specialized Education   Chemical Process Design   3   Required   10   1   1   1   1   1   1   1   1	-		_											30	,									
Specialized Education Specialized Education Mechanics of Materials Specialized Education Mechanics of Materials Specialized Education Specialized Educatio		-	_			-										-				l		-		100
Fundamentals	Specialized Education	-	_	Required		10	1									10	1	60	6	10	1	10	1	100
Specialized Education   Spec	Specialized Education	Chemical Engineering Fundamentals	2	Required								100	10											100
Specialized Education    Chemical Engineering Exercise   2   Elective	Specialized Education		2	Elective						100	10													100
Chemical Engineering Exercise   Chemical Engineering Exercis	Specialized Education		+-									100	10											100
Chemical Engineering Exercise   Chemical   Chemical Engineering Exercise   Chemical   Chemical Engineering Exercise   Chemical   Chemical Exercise of Chemical   Chemical Engineering   Chemi		0 0	_									100	10			100	10							-
II		II				-																-		100
	Specialized Education	III	2	Elective												100	10							100
Engineers   2   Elective   100   10	Specialized Education	Exercise of Chemical Engineering Thermodynamics	1	Elective								100	10											100
Specialized Education   Materials Science   2   Elective   100   10   10   10   10   10   10	Specialized Education		2	Elective						100	10					1								100
Specialized Education Process Control Engineering 2 Elective 100 10	Specialized Education		_																					100
			+-			-		-		100		<b>—</b>				100	10			<b>—</b>				-
Specialized Education   Numerical Calculation Method   2   Elective   100   10			_													100	10							100
	Specialized Education	Numerical Calculation Method	2	Elective						100	10													100

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					Knowl	edge and	Unders	tanding					ilities						Com	nrahan	sive Ab	ilitiae	Total
			Type			A)		B)	(C	11)	((	(2)		(3)		24)	((	C5)		D)		E)	weighte
		ts	of		,	H.)	(,	D)		1)	(C	, L)	(C	,3)	,(c	· <del>1</del> )	_ `	JJ)	,	D)	(,	L)	d values
Subject type	Class subjects	credit	registr ation	Period	Weighted values of evaluation items in the subject	Weightsed values of evaluation items	evaluation	Weightsed values of evaluation items	evaluation	Weightsed values of evaluation items	Weighted values of evaluation items in the subject	Weightsed values of evaluation items	evaluation	Weightsed values of evaluation items	evaluation	evaluation	evaluati on items in the subject						
Specialized Education	Chemical Process and Engineering Ethics	2	Required		40	4									20	2	40	4					100
Specialized Education	Chemical Industrial Process	2	Elective		20	2							20	2	20	2	40	4					100
Specialized Education	Corrosion and Protection of Materials	2	Elective												100	10							100
Specialized Education	Green Technology	2	Elective		50	5			20	2					30	3							100
Specialized Education	Recycling Engineering	2	Required		50	5			20	2					30	3							100
Specialized Education	Inorganic Chemistry	2	Elective										100	10									100
Specialized Education	Physical Chemistry II	2	Required								100	10											100
Specialized Education	Chemical Kinetics	2	Elective										100	10									100
Specialized Education	Synthetic Polymer Chemistry	2	Elective										100	10									100
Specialized Education	Electrochemistry	2	Elective										100	10									100
Specialized Education	Biochemistry II	2	Elective										100	10									100
Specialized Education	Fermentation Technology	2	Elective										100	10									100
Specialized Education	Biotechnology	2	Elective										100	10									100
Specialized Education	Graduation Thesis	5	Required	7semsester, 8semsester	10	1											20	1	50	5	20	2	100

#### (2) Structure of Program

