

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 Biotechnology

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 Biotechnology".

In order to contribute to the advancement of the key industries that will play a role in the next generation, such as medicine, food, and environment, this program aims at developing engineers and researchers that possess professional expertise and technical skills in the elucidation and utilization of biological molecules and living organisms. Therefore, this program establishes a curriculum through which students can organically and systematically acquire comprehensive knowledge of the basic mechanisms of life and technical skills in the most-advanced fields, such as gene, protein, carbohydrate, and lipid engineering; microorganism, animal, and plant engineering; biochemical engineering; bioinformatics engineering; environmental biotechnology; immunology; and brewing technology. Students can also acquire the different abilities required for researchers and engineers, such as the ability to think logically, the ability to plan and conduct experiments, the ability to explain data analysis, the ability to discover and resolve the problems, and the ability to deal with practical issues. This program awards the Type-1 High School Teaching License (Industry) to students who have taken the required courses. Graduates gain employment and work actively for corporations in the pharmaceutical, food, brewing, environmental, and chemical industries, or in public research institutions. Graduates can go to graduate school (Graduate School of Integrated Sciences for Life) to obtain a higher degree of education and undertake research.

3. Academic Awards Policy (Policy for awarding degrees and goal of the program)

The Program of Biotechnology nurtures professionals that have acquired the basic knowledge, skills, and attitudes needed to work as bioengineering researchers and engineers and, further, to embrace opportunities for creativity in scientific thought.

Therefore, this program offers education aimed at cultivating a broad range of general knowledge, a global perspective to seek peace, a general sense of judgment, and a well-rounded character. The program awards a bachelor's degree in engineering to students who have completed sufficient liberal arts education and specialized education to achieve the following goals from (A) to (E), as well as the number of credits necessary to meet the standard of the course.

- (A) The ability to understand the relationship between people, society, nature, and engineering, and to demonstrate multifaceted and logical thinking skills
- (B) The ability to understand basic natural science
- (C) The ability to acquire basic knowledge of biotechnology and biological science, and to expand it widely to applied technology
- (D) The ability to come up with conceptual ideas and to implement ideas, as well as the ability to transmit learning and research results
- (E) The ability to adapt to the highly sophisticated information society with high level communication skills

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

To achieve the goals from (A) to (E) set by this program, the Program of Biotechnology organizes and implements a curriculum in which liberal arts education and specialized education are closely connected. After acquiring basic academic abilities and knowledge in liberal arts education subjects, students must learn the specialized fields of engineering and biotechnology. Students mainly study these subjects until the first and second terms of the second year, and then after the third and fourth terms of the second year, when students are assigned to the program, they mainly study specialized subjects. Learning specialized basic subjects before being assigned to the program is effective in raising awareness of students' field of specialization, and in developing incentives for learning. Furthermore, receiving lectures by the faculties in charge of programs other than the Program of Biotechnology (Program of Chemical Engineering, Program of Applied Chemistry) provides students with knowledge about surrounding fields.

In the curriculum described above, 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.

Knowledge and Abilities

Cultivation of understanding about the relationship between people, society, nature, and engineering, as well as an ethical outlook, which forms the basic knowledge that researchers and engineers are required to possess (Goal A). This is obtained through mastery of liberal arts education subjects, "Introductory Seminar for First-Year Students", "Peace Science Courses", "Introduction to University Education", "Information Subjects" and specialized basic subjects, "Introduction to Applied Chemistry, Chemical Engineering and Biotechnology", and "Introduction to Fundamental Industry" to be offered at the first year.

Basic knowledge of mathematical theory, physics theory, and experimental methods required of researchers and engineers in natural science (Goal B). This is obtained through mastery of mathematical fundamental subjects such as "Calculus" and "Linear Algebra" and fundamental physics subjects such as "General Mechanics I II" and "Experimental Methods and Laboratory Work in Physics" to be offered in the first year.

General understanding of biotechnology, life science, chemistry, and the basic knowledge required of experts in biotechnology (Goal B, C). This is obtained through mastery of specialized basic subjects, "Basic Life Science", "Basic Organic Chemistry I", "Basic Inorganic Chemistry" and "Basic Environmental Sciences" to be offered in the first year.

Mathematical method required of experts in biotechnology (Goal B). This is obtained through mastery of specialized basic subjects, "Applied Mathematics I II", and "Probability and Statistics" to be offered from the third and fourth term of the first year through the second year.

The expertise and grasp of concepts required of researchers and engineers in biotechnology (Goal C). This is obtained through mastery of the specialized subjects of the Program of Biotechnology such as "Microbiology I II", "Molecular Biology I II III", "Enzyme Chemistry", and "Biochemical Engineering" to be offered from the third and the fourth term of the second year through the fourth year.

Abilities and Skills

The ability to conduct experiments to resolve issues and problems that arise, and the ability to examine and resolve problems using experimental outcomes and related materials (Goal C, D, E). This is obtained through mastery of experimental subjects closely related to biotechnology, such as “Experimental Methods and Laboratory Work in Biology”, “Basic Experiments in Chemistry”, and “Training of Biotechnology I II”

The ability to make action plans on one’s own initiative in response to practical issues and challenges, to make adjustments, and to resolve problems and challenges by using basic and specialized knowledge and methods (Goal C, D, E). These are obtained through mastery of “Graduation Thesis” to be offered in the fourth year.

Overall Abilities

The ability to organize and analyze information from the literature to discover and resolve practical problems and challenges, and the ability to logically make research plans and carry them out (Goal C, D, E). These are obtained through mastery of “Group Discussion of Current Biotechnology Topics” to be offered in the third year and “Graduation Thesis” to be offered in the fourth year.

The ability to organize research results and write logically, including about the significance and validity of the obtained outcome, and to prepare presentation data, present it, and discuss it verbally in an easy-to-understand manner (Goal E). These are obtained through mastery of “Group Discussion of Current Biotechnology Topics” to be offered in the third year, and “Graduation Thesis” to be offered in the fourth year.

Teamwork ability, leadership ability, and communication ability in group work (Goal E). These are obtained through mastery of “Basic Experiments in Chemistry”, and “Training of Biotechnology I II” to be offered from the third and fourth term of the second year through the third year, and through “Group Discussion of Current Biotechnology Topics” to be offered in the third year.

The ability to read, write, and converse in the English language necessary for conducting research (Goal E). This is obtained through mastery of “Communication Basic I II” in the liberal arts education subjects, “Technical English” to be offered in the third and the fourth terms of the second year, and “Graduation Thesis” to be offered in the fourth year.

5. Program Timing and Acceptance Conditions

When to start the program:

The English-based Bachelor’s Degree programs begin in the first semester of the first year. Enrollment in Program of Biotechnology occurs in the second semester of the second year.

Cluster 3 offers distinctive education that organically integrates fields related to chemistry, biotechnology, and processes. Specifically, it aims at developing professionals that possess 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 process, environmental preservation and bioremediation, and the development of resources and energy, as well as having a high level of expertise and technical skill in a harmonious way. To achieve this aim, in addition to the common subjects and a wide range of specialized basic education, three programs are prepared that provide specialized education about chemistry, biotechnology and processes. These are the Program of Applied Chemistry, the Program of Biotechnology, and the Program of Chemical Engineering. Registration to these three programs is to be made in the second semester of the second year, so that students are able to choose the suitable specialized field or program while acquiring a wide range of specialized basic knowledge.

Requirements of Acquired Credits

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 Chemical Experiment and Technical English) and must acquire an overall total of 60 or more credits (including in liberal arts education subjects).

Program Quota

An upper limit is set f

Biotechnology and the Program of Chemical Engineering is decided after taking into account the requests of students and their academic results.

6. Qualifications to be Acquired

Type-

program, all the teachers of this program work together in cooperation with each other to carry out the system.

(2) Program Assessment

Criteria for program assessment:

Evaluation outcome of attainment levels against goals

Requests from students and demands of society

Evaluation outcome of self-assessment by faculties

Method of assessment (connection with class evaluation to be described)

In addition to attainment levels evaluation summary sheet completed by the Education and Student Evaluation Committee, questionnaires by students and graduates, and self-assessment evaluation by faculties, an external evaluation will be conducted.

Procedure on giving feedback to students

In the case of problems with class subjects, faculties deal with these problems after taking into account the learning conditions of each individual student. The tutors or the Educational Improvement Committee members handle matters comprehensively, which is reflected in the improvement of the program through discussions in the committee.

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)

Subject Type		Required No. of credits	Class subjects	No. of credits	Semester																	
					1T	2T	3T	4T	1T	2T	3T	4T	1T	2T	3T	4T	1T	2T	3T	4T	Spring	Fall
Basic Courses in University Education	Introductory Seminar for First-Year Students	2		2	Compulsory elective																	
		2	Introduction to University Education	2	Required																	
		2	Introductory Seminar for First- Year Students	2	Required																	
		0		1	Free elective																	
		4	Courses in Arts and Humanities/Social Sc	2																		
	Common Subjects	Communication I	4	Courses in Natural Sciences	2																	
			2	Basic English Usage I	1	Required																
				Basic English Usage II	1																	
			2	Communication IA	1	Required																
				Communication IB	1																	
2		Communication IIA	1	Required																		
		Communication IIB	1																			
Health and Sports Courses			1 subjects from Basic language I	1																		
			1 subjects from Basic language II	1																		
		2	Introduction to Information and Data Sciences	2	Required	◎																
	2		1or2	Compulsor y elective																		
		Calculus I	2																			
		Calculus II	2																			
		Physics I	2																			
		Physics II	2																			
		General Mechanics I	2																			
		General Mechanics II	2																			
	Experimental Methods and Laboratory Work in Physics I	1																				
	Experimental Methods and Laboratory Work in Physics II	1																				
	Seminar in Basic Mathematics I	1																				
	Seminar in Basic Mathematics II	1																				
	Experimental Methods and Laboratory Work in Biology I	1																				
	Experimental Methods and Laboratory Work in Biology II	1																				
	Basic Electromagnetism	2																				
	2	From all Subject Type		Free elective																		

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[illegible]

Program of Biotechnology

Required subjects

Compulsory Elective subjects

[illegible]

Academic Achievements in Biotechnology Program

The Relationship between Evaluation Items and Evaluation Criteria

Relationships between the evaluation items and class subjects

Subject type	Class subjects	credits	Type of course registration	Period	Evaluation items												Total weighted values of evaluation items in the subject
					Knowledge and Understanding						Abilities and Skills		Comprehensive Abilities				
					(1)		(2)		(3)		(1)		(1)		(2)		
					Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	
Liberal Arts Education	Introductory Seminar for First-Year Students	2	Required	1st semester	40	1							40	1	20	1	100
Liberal Arts Education	Introduction to University Education	2	Required	1st semester	100	1											100
Liberal Arts Education	Peace Science Courses	2	Elective	1st semester	100	1											100
Liberal Arts Education	Area Courses	8	Elective	1st semester	100	1											100
Liberal Arts Education	Basic English Usage I	1	Required	1st semester											100	1	100
Liberal Arts Education	Basic English Usage II	1	Required	1st semester											100	1	100
Liberal Arts Education	Communication I	1	Required	1st semester											100	1	100
Liberal Arts Education	Communication I	1	Required	1st semester											100	1	100
Liberal Arts Education	Communication II	1	Required	2nd semester											100	1	100
Liberal Arts Education	Communication II	1	Required	2nd semester											100	1	100
Liberal Arts Education	Basic language I	1	Required	1st semester	100	1											100
Liberal Arts Education	Basic language II	1	Required	1st semester	100	1											100
Liberal Arts Education	Information and Data Science Courses	2	Required	1st semester											100	1	100
Liberal Arts Education	Information and Data Science Courses	2	Required	1st semester	100	1											100
Liberal Arts Education	Calculus I	2	Required	1st semester			100	1									100
Liberal Arts Education	Calculus II	2	Required	2nd semester			100	1									100
Liberal Arts Education	Linear Algebra I	2	Required	1st semester			100	1									100
Liberal Arts Education	Linear Algebra II	2	Required	2nd semester			100	1									100
Liberal Arts Education	General Mechanics I	2	Required	1st semester			100	1									100
Liberal Arts Education	General Mechanics II	2	Required	2nd semester			100	1									100
Liberal Arts Education	Experimental Methods and Laboratory Work in Physics I-2	2	Required	3rd semester			50	1			30	1	20	1			100
Liberal Arts Education	Seminar in Basic Mathematics I	1	Elective	1st semester			100	1									100
Liberal Arts Education	Seminar in Basic Mathematics II	1	Elective	2nd semester			100	1									100
Liberal Arts Education	Experimental Methods and Laboratory Work in Biology I-2	2	Elective	2nd semester							80	1	20	1			100
Liberal Arts Education	Basic Electromagnetism	2	Elective	2nd semester			100	1									100
Specialized Education	Applied Mathematics I	2	Required	2nd semester					100	1							100
Specialized Education	Applied Mathematics II	2	Required	3rd semester					100	1							100
Specialized Education	Applied Mathematics III	2	Elective	5th semester					100	1							100
Specialized Education	Probability and Statistics	2	Elective	5th semester					100	1							100
Specialized Education	Technical English	1	Required	4th semester					20	1					80	1	100
Specialized Education	Basic Engineering Computer Programming	2	Required	3rd semester					100	1							100
Specialized Education	Basic Environmental Sciences	2	Elective	2nd semester	60	1			40	1							100
Specialized Education	Chemical Stoichiometry	2	Required	3rd semester					100	1							100
Specialized Education	Basic Organic Chemistry I	2	Required	2nd semester					100	1							100
Specialized Education	Basic Organic Chemistry II	2	Elective	2nd semester					100	1							100
Specialized Education	Physical Chemistry I	2	Required	3rd semester					100	1							100
Specialized Education	Biochemistry I	2	Required	3rd semester					100	1							100
Specialized Education	Basic Experiments in Chemistry	4	Required	4th semester							80	1	20	1			100
Specialized Education	Basic Inorganic Chemistry	2	Required	2nd semester					100	1							100
Specialized Education	Analytical Chemistry	2	Required	3rd semester					100	1							100
Specialized Education	Basic life science	2	Elective	2nd semester	40	1			60	1							100
Specialized Education	Introduction to Applied Chemistry, Chemical Engineering and Biotechnology	2	Elective	3rd semester	40	1			60	1							100
Specialized Education	Introduction to Fundamental Industry	2	Elective	3rd semester	40	1			60	1							100
Specialized Education	Training of Biotechnology I	4	Required	5th semester							60	1	20	1	20	1	100
Specialized Education	Experiments on Biotechnology II	4	Required	6th semester							60	1	20	1	20	1	100
Specialized Education	Microbiology I	2	Required	4th semester					100	1							100
Specialized Education	Microbiology II	2	Required	5th semester					100	1							100
Specialized Education	Molecular biology I	2	Required	4th semester					100	1							100
Specialized Education	Molecular biology II	2	Required	5th semester					100	1							100
Specialized Education	Biochemistry II	2	Required	4th semester					100	1							100
Specialized Education	Biochemistry III	2	Required	5th semester					100	1							100
Specialized Education	Enzyme Chemistry	2	Elective	4th semester					100	1							100
Specialized Education	Bioorganic Chemistry	2	Elective	5th semester					100	1							100
Specialized Education	Fermentation Technology	2	Required	5th semester					100	1							100
Specialized Education	Biochemical Engineering	2	Required	5th semester					100	1							100

Subject type	Class subjects	credits	Type of course registration	Period	Evaluation items												Total weighted values of evaluation items in the subject
					Knowledge and Understanding					Abilities and Skills		Comprehensive Abilities					
					(1)		(2)		(3)	(1)		(1)		(2)			
					Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	
Specialized Education	Glyotechnology & Immunotechnology	2	Elective	6semester				100	1							100	
Specialized Education	Molecular BiologyIII	2	Elective	6semester				100	1							100	
Specialized Education	Genetic and protein engineering	2	Elective	6semester				100	1							100	
Specialized Education	Molecular Bioinformatics	2	Elective	6semester				100	1							100	
Specialized Education	Biotechnology	2	Elective	6semester				100	1							100	
Specialized Education	Group Discussion of Current Biotechnology Topics	2	Required	6semester	40	1						40	1	20	1	100	
Specialized Education	FoodProcess Engineering I	1	Elective	5semester	20	1		80	1							100	
Specialized Education	Food Process Engineering II	1	Elective	6semester	20	1		80	1							100	
Specialized Education	FermentationProcess Engineering I	1	Elective	7semester	20	1		80	1							100	
Specialized Education	Fermentation process engineeringII	2	Elective	5semester	20	1		80	1							100	
Specialized Education	Fermentation Process Engineering III	1	Elective	6semester	20	1		80	1							100	
Specialized Education	Physical Chemistry II	2	Elective	6semester				100	1							Total	
Specialized Education	Chemical Kinetics	2	Elective	5semester				100	1							100	
Specialized Education	Organic Structural Analysis	2	Elective	6semester				100	1							100	
Specialized Education	Advanced Organic Chemistry IV	2	Elective	6semester				100	1							100	
Specialized Education	Chemical Engineering Exercise I	2	Elective	6semester				100	1							100	
Specialized Education	Chemical Engineering Fundamentals	2	Elective	6semester				100	1							100	
Specialized Education	Green Technology	2	Elective	6semester				100	1							100	
Specialized Education	Recycling engineering	2	Elective	6semester				100	1							100	
Specialized Education	Graduation Thesis	5	Required	7,8semester	10	1				50	1	20	1	20	1	100	



Basic CalculusI(◎)		Basic life science(Δ)		Introduction to Fundamental IndustryIII(○)	
Linear AlgebraI(◎)		CalculusII(◎)		Experimental Methods and Laboratory Work in Physics I()	
(2T)General Mechanics I(◎)		Linear AlgebraII(◎)		(3T)General Mechanics II(◎)	
Seminar in Basic Mathematics I()		Seminar in Basic Mathematics II()		()	
		T)Basic Electromagnetism		()	
Experimental	Methods	• 2 (Δ&I)	Laboratory	Work	Technical English(◎)
Basic Organic Chemistry II		Basic Engineering Computer Programming		Physical Chemistry II ()	
Applied Mathematics I (◎)		Applied Mathematics II (◎)		Applied Mathematics III ()	
Basic life science (Δ)		Physical Chemistry I (◎)		MicrobiologyII (◎)	
Basic Environmental Sciences (Δ)		Chemical Stoichiometry (◎)		Molecular biology I (◎)	
Basic Organic Chemistry I ()		Biochemistry I(◎)		Molecular biology II (◎)	
Basic Inorganic Chemistry()		Analytical Chemistry(◎)		BiochemistryIII(◎)	
		Introduction to Applied Chemistry: Chemical Engineering and Biotechnology		Enzyme Chemistry ()	
		Introduction to Fundamental Industry(Δ)		Bioorganic Chemistry()	
				Chemical Engineering Fundamentals ()	
				Fermentation Technology ()	
				Biochemical Engineering(◎)	
				Chemical Kinetics (○)	
				FoodProcess Engineering I ()	
				Fermentation process engineeringII ()	
Experimental	Methods	• 2 (Δ&I)	Laboratory	Work	Basic Experiments in Chemistry(◎)
				Training of Biotechnology I(◎)	
				Experiments on Biotechnology II(◎)	
				Graduation Thesis(◎)	
				Graduation Thesis(◎)	

Introductory Seminar for First-Year Students(◎)	Experimental Methods and Laboratory Work in Biology I-5 (Δ)	Basic Experiments in Chemistry(◎)	Training of Biotechnology I(◎)	Experiments on Biotechnology II(◎)	Graduation Thesis(◎)	Graduation Thesis(◎)
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Group Discussion of Current Biotechnology Topics (◎)

Introductory Seminar for First-Year Students(◎)	Technical English(◎)	Training of Biotechnology I(◎)	Experiments on Biotechnology II (◎)	Graduation Thesis(◎)	Graduation Thesis(◎)
Communication IA (◎)					
Communication IB (◎)					
Basic English UsageI()					
Basic English UsageII ()					
(1T)Information and Data Science Courses (◎)					
(Ex) Liberal Arts Education Subjects					
	Basic Specialized Subjectie.4 6 14.7321				