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 Biotechnologyorgani

sms. 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. Learning outcomes are evaluated based on the grade calculation for each subject and the level of attainment against the goals set by the educational program.

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 though 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 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 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 the requests of students and their academic results.

6. Qualifications to be Acquired

Type-1 High School Teaching License (Industry) (By mastering “Vocational Guidance”, the prescribed “liberal arts education subjects” and “specialized education subjects”, students can obtain the Type-1 High School Teaching License (Industry) upon graduation.)

Details are described in the student handbook and guidance materials.

7. Class Subjects and Course Content

* For class subjects, see the subject list in the attached Tables 1 and 2.

(Subject list to be attached.)

8 Academic Achievements

At the end of each semester, evaluation criteria are applied to each evaluation item and indicate academic achievement by indicating the attainment level. Students' grade calculations for each subject, from admission to the university until the current semester, is given as 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 achievements (S = 4, A = 3, B = 2, and C= 1) in each subject being evaluated.

Result Evaluation	Conversion
90 points or more	
80 ~ 89 points	
70 ~ 79 points	
60 ~ 69 points	

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.)

Students receive practical guidance through graduation work in a research laboratory where world-leading research is conducted in various fields of biotechnology, and acquire a fundamental capability as bioengineering researchers and engineers.

Students are to be assigned at the start of the fourth year. As requirements for undertaking a graduation thesis, students must acquire 8 credits in foreign languages and must have completed all experiment subjects and practical subjects to be taken. Furthermore, students must acquire a total of 115 or more credits (including liberal arts education subjects) including a total of 69 or more credits in specialized basic subjects and specialized subjects. (Refer to the attached Table 1 and Table 2)

10. Responsibility System

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

The Educational Evaluation Committee (in charge of examining and handling the faculties' evaluation of the curriculum and the content of lectures), The Student Evaluation Committee (in charge of examining and handling evaluation of the students, such as attainment levels against goals), and the Educational Improvement Committee (in charge of planning and handling curricula based on self-assessment and questionnaires) are set up within the committee for this program (see the attached sheet 54). Under the leadership and responsibility of the head of the 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　Specialized Basic Subjects

◎Required

Class Subjects	Credits	Type of course registration			Class Hours/ Week																note
		Applied Chemistry	Biotechnology	Chemical enneenering	1st grade				2nd grade				3rd grade				4th grade				
					Spring		Fall		Spring		Fall		Spring		Fall		Spring		Fall		
					1T	2T	3T	4T	1T	2T	3T	4T	1T	2T	3T	4T	1T	2T	3T	4T	
Applied Mathematics I	2						4														
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											

Required subjects
Compulsory Elective subjects

		1T	2T	3T	4T	1T	2T	3T	4T	1T	2T	3T	4T	1T	2T	3T	4T
Training of Biotechnology I	4									12	12						
Experiments on Biotechnology II	4											12	12				
MicrobiologyI	2								4								
MicrobiologyII	2																

Academic Achievements in Biotechnology Program

The Relationship between Evaluation Items and Evaluation Criteria

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Weighted values of evaluation items in the subject	Weightsed values of evaluation items	Weighted values of evaluation items in the subject	Weightsed values of evaluation items	Weighted values of evaluation items in the subject	Weightsed values of evaluation items	Weighted values of evaluation items in the subject	Weightsed values of evaluation items	Weighted values of evaluation items in the subject	Weightsed values of evaluation items	Weighted values of evaluation items in the subject	Weightsed values of evaluation items	Total weighted values of evaluation items in the subject

Curriculum Map of Biotechnology

Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Introductory Seminar for First-Year Students( )				FoodProcess Engineering I ( )	Food Process Engineering II( )	Graduation Thesis	Graduation Thesis
Introduction to University Education	Peace Science Courses ○			Fermentation process engineeringII ( )	Fermentation Process Engineering III( )	FermentationProcess Engineering I( )	
Area Courses (○)	Area Courses (○)				Group Discussion of Current Biotechnology Topics( )		
Health and Sports Courses ○)	Health and Sports Courses ○)						
Area Courses (○)	Area Courses(○)	Area Courses (○)	Area Courses (○)				
Basic language I ○	Basic Environmental Sciences	Introduction to Applied Chemistry, Chemical Engineering and Biotechnology					
Basic language II ○	Basic life science	Introduction to Fundamental Industry					
CalculusI( )	CalculusII( )	Experimental Methods and Laboratory Work in Physics I ( )					
Linear AlgebraI ( )	Linear AlgebraII( )						
(2T)General Mechanics I( )	T)General Mechanics II( )						
Seminar in Basic Mathematics I(○)	Seminar in Basic Mathematics II (○)						
	T)Basic Electromagnetism (○)						

	Experimental Methods and Laboratory Work in Biology I		Technical English	Probability and Statistics ( )	Glycotechnology & Immunotechnology ○		
Basic Organic Chemistry I( )	Basic Organic Chemistry II	Basic Engineering Computer Programming	Physical Chemistry II ( )	Applied Mathematics III ( )	Molecular BiologyIII ○		
Basic Inorganic Chemistry( )	Applied Mathematics I ( )	Applied Mathematics II ( )	MicrobiologyI ( )	MicrobiologyII ( )	Genetic and protein engineering ○		
	Basic life science	Physical Chemistry I	Molecular biology I ( )	Molecular biology II ( )	Molecular Bioinformatics ○		
	Basic Environmental Sciences	Chemical Stoichiometry	Biochemistry II ( )	BiochemistryIII( )	Biotechnology ○		
		Biochemistry I	Enzyme Chemistry (○)	Bioorganic Chemistry(○)	Advanced Organic Chemistry IV ( )		
		Analytical Chemistry	Chemical Engineering Fundamentals (○)	Fermentation Technology ( )	Green Technology		
		Introduction to Applied Chemistry, Chemical Engineering and Biotechnology	Chemical Engineering Exercise I (○)	Biochemical Engineering( )	Recycling engineering ( )		
		Introduction to Fundamental Industry		Chemical Kinetics (○)	Food Process Engineering II( )		
				Organic Structural Analysis	Fermentation Process Engineering III( )		
				FoodProcess Engineering I ( )			
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