### Appended Form 1

#### Specifications for Major Program

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

Program	name	生物工学プログラム
(Japanese)		
)	(English	Program of Biotechnology
1. Academic De	egree to be A	Acquired
	222	2

### 2. Overview

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 (Department of Molecular Biotechnology, Graduate School of Advanced Sciences of Matter) to obtain a higher degree of education and undertake research.

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 2 2 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. O 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). -Year 2 2 Introduction to · 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 2ics I · II and · General understanding of biotechnology, life science, chemistry, and the basic knowledge required of experts in biotechnology (Goal B, C). This is first year. · Mathematical method required of experts in biotechnology (Goal B). This is obtained through mastery of · 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 · II . Molecular Biology I · II · III , 2 2 2 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 Experimental Methods and Laboratory • II 2 2 adjustments, and to resolve problems and challenges by using basic and specialized knowledge and methods (Goal O Overall Abilities

The ability to orga	anize and a	nalyze inf	ormation fro	m the literat	ure to discover	r and resolve	practical proble	ems and
challenges, and the	ability to lo	ogically ma	ake research	n plans and	carry them out	t (Goal C, D,	E). These are o	obtained
		2	2	2			2	2
2		2 the f	ourth year.					
The ability to org	ganize rese	arch resul	Its and write	e logically, ir	cluding about	the significa	ince and validit	ty of the
obtained outcome,	and to pre	pare prese	entation data	a, present it	, and discuss	it verbally in	an easy-to-une	derstand
manner (G		2			2	2	2	
2	2	2	2	2				
·Teamwork ability,	leadership	ability, and	d communic	ation ability i	n group work (	Goal E). The	se are obtained	l through
	2	2	2	22	2	· II to be off	ered from the t	third and
	2			2		2	2t Bioteo	chnology
	2							
•The ability to read	, write, and	converse i	in the Englis	h language i	necessary for o	conducting re	search (Goal E	). This is
2		2	2 ·  ·	in the libera	al arts educatio	on subjects,	Technical Engli	sh to be
2	2		2	2	2		2	

5. Program Timing and Acceptance Conditions

• When to start the program:

E The s25062& 2001e(s) er 00(ht)) re(s) e5 duids y & end 82 BDC q4 82 a(ha)4(t)-10()-9(I)5e106(T)-15(h824()-292BDC qc)-7(d

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 tjoenPotigram of Appn ed4\*3MC P 0055>3003m0 g0 G[ )]TJETQ EMC P MCID 56-BDC MC

#### 8. Academic Achievements

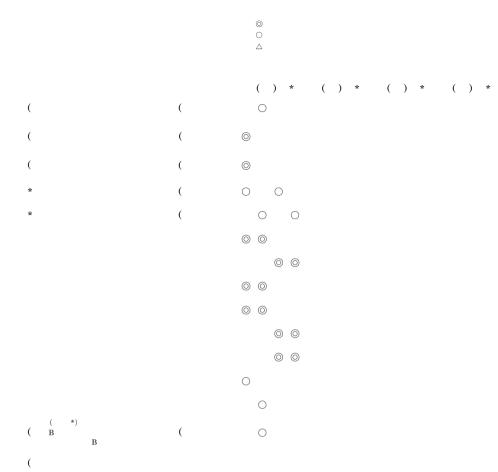
At the end of each semester, evaluation criteria are applied to each evaluation item and indicate academic

	2	2	2	2	2		2	2			2
2	2		2		2	2			2	2	

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
S (90 points or more)	4
A (80 ~ 89 points)	3
B ( <b>70 ~ 79 points</b> )	2

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

		Type	e of co														veq	uirea			
	its	istry.		Chemical <u>o</u> teener in g	1:	st g	irac	de	2	nd	grad	de	3	rd g	rac	le	4th grade			le	
Class Subjects	Credits	Applied Chemistry	Bi at ech nal agy	Chemical enneenering	Spr	ing	Fa	all	Spring Fall		Spring Fall			Spr	Spring Fa		all	note			
	0		Bi	Φ		2T	3T	4T	1T	2T	3T	4T	1T	2T	3T	4T	1T	2T	3T	4T	
Applied Mathematics I	2	$\bigcirc$	$\bigcirc$	$\bigcirc$			4														
Applied Mathematics II	2	$\bigcirc$	$\bigcirc$	$\bigcirc$					4												
Applied Mathematics III	2													4							
Basic Engineering Computer Programming	2	$\bigcirc$	$\bigcirc$	$\bigcirc$					4												
Probability and Statistics	2												4								
Technical English	1	$\bigcirc$	$\bigcirc$	$\bigcirc$		_						4									
Basic Environmental Sciences	2						4														
Chemical Stoichiometry	2	$\bigcirc$	$\bigcirc$	$\bigcirc$						4											
Basic Organic Chemistry I	2	$\bigcirc$	$\bigcirc$	$\bigcirc$			4														
Basic Organic Chemistry II	2								4												
Physical Chemistry I	2	$\bigcirc$	$\bigcirc$	$\bigcirc$						4											
Biochemistry I	2	$\bigcirc$	$\bigcirc$	$\bigcirc$						4											
Basic Experiments in Chemistry	4	$\bigcirc$	$\bigcirc$	$\bigcirc$							12	12									
Basic Inorganic Chemistry	2	$\bigcirc$	$\bigcirc$	$\bigcirc$				4													
Analytical Chemistry	2	$\bigcirc$	$\bigcirc$	$\bigcirc$					4												
Basic life science	2						4														
Introduction to Applied Chemistry, Chemical Engineering and Biotechnology	2									4											
Introduction to Fundamental Industry	2									4											

◎Required

## Cluster 3 Specialized Subjects (Program of Biotechnology)

## Required subjects

OCompulsory Elective subjects

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Class Subjects	Credits	Type of o	Spr	ing				ing			Spr	-				ing		all	Note
	0	Typ rec	1T	2T	3T	1						2T						4T	
Training of Biotechnology I	4	$\bigcirc$	-									12							
Experiments on Biotechnology II	4	$\bigcirc$											12	12					
Microbiologyl	2	$\bigcirc$								4									
MicrobiologyII	2	$\bigcirc$										4							
Molecular biology I	2	$\bigcirc$								4									
Molecular biology II	2	$\bigcirc$										4							
Biochemistry II	2	$\bigcirc$							4										
BiochemistryIII	2	$\bigcirc$									4								
Enzyme Chemistry	2	$\bigcirc$							4										
Bioorganic Chemistry	2	$\bigcirc$									4								
Fermentation Technology	2	$\bigcirc$									4								
Biochemical Engineering	2	$\bigcirc$										4							
Glycotechnology & Immunotechnology	2	$\bigcirc$												4					
Molecular BiologyIII	2	$\bigcirc$												4					
Genetic and protein engineering	2	$\bigcirc$												4					
Molecular Bioinformatics	2	$\bigcirc$											4						
Biotechnology	2	$\bigcirc$											4						
Group Discussion of Current Biotechnology Topics	2	$\bigcirc$											2	2					
FoodProcess Engineering I	1											2							
Food Process Engineering II	1													2					
FermentationProcess Engineering I	1														1	1			
Fermentation process engineeringII	2											4							
Fermentation Process Engineering III	1													2					
Physical Chemistry II	2								4										
Chemical Kinetics	2	$\bigcirc$										4							
Organic Structural Analysis	2											4							
Advanced Organic Chemistry IV	2												4						
Chemical Engineering Exercise I	2	$\bigcirc$							4	4									
Chemical Engineering Fundamentals	2	$\bigcirc$							2	2									
Green Technology	2													4					
Recycling engineering	2													4					
Graduation Thesis	5	$\bigcirc$																	

# Sheet

### Academic Achievements in Biotechnology Program The Relationship between Evaluation Items and Evaluation Criteria

		Academic Achievements		Evaluation Criteria	
		Evaluation Items	Excellent	Very Good	Good
and ding		Understanding of relations among human, society, nature, and engineering. (Target A	Being able to fully understand diversity of sense of values and ways of thinking in areas other than engineering and able to take various consideration.	Being able to understand the relations and differences between engineering and other areas and being to take consideration to the standard level.	Being able to well understand the relations and differences between engineering areas and other areas and take various consideration to the standard level.
edge stano		Understanding of basic natural science (target B)	Being able to fully understand mathematics and physics which are a base of engineering.	Being able to understand mathematics and physics in the standard level.	Being able to understand mathematics and physics well.
K nowledge Understan	(3)	and life science. (Target/Lecture class)	Being able to understand chemistry, applied mathematics, process engineering, basic biological science, and applied biological science, which are essential to biotechnologists.	Being able to understand chemistry, applied mathematics, process engineering, basic biological science and applied biological science to the standard level.	Being able to understand basic and advanced discipline described on the left well.
Abilities and Skills	(1)	Acquisition of basic and advanced skills relating to biotechnology and life science. (Target/ Research class)	Being able to display abilities required for biotechnological engineers: logical thinning ability, ability to conduct experiment along with a plan, ability to analyze data and explanation.	Being able to demonstrate standard level abilities to think logically, to plan and carry out research and to analyze data.	Being able to well demonstrate the ability described on the left.
Abilities		Cultivation of ability creating concept and solving problesms (achievement target D)	Being able to display abilities, required for biotechnologists, such as to make plan and carry out research, to demonstrate research outcome, to discuss, and to solve problems.	To be able to demonstrate standard level abilities to make plan and carry out research, to show outcomes and to solve problems.	Being able to demonstrate the ability described on the left.
Over all	(2)	Cultivation of communication skills (achievement target E)	Being able to show logical writing abilities, information transmission abilities to domestic and overseas, debating and information utilization.	To be able to demonstrate standard level abilities to make plan and carry out research, to show outcomes and to solve problems.	Being able to demonstrate the ability described on the left.

### 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 of biotechnology.

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# Sheet 4

grade	3rd g	grade	4th	grade
Fall	Spring	Fall	Spring	Fall
	FoodProcess Engineering I ( )	Food Process Engineering II( )	Graduation Thesis	Graduation Thesis
	Fermentation process engineeringII ( )	Fermentation Process Engineering III( )	FermentationProcess Engineering I( )	
		Group Discussion of Current Biotechnology Topics( )		
Area Courses ( )				
Technical English	Probability and Statistics ( )			
Physical Chemistry II ( ) MicrobiologyI ( )	Applied Mathematics III ( ) MicrobiologyII ( )	Molecular BiologyIII		
		Genetic and protein engineering Molecular Bioinformatics		
Biochemistry II ( )	BiochemistryIII()	Biotechnology		
Enzyme Chemistry ( )	Bioorganic Chemistry( )	Advanced Organic Chemistry IV ( )		
Chemical Engineering Fundamentals ( )		Green Technology		
Chemical Engineering Exercise I ( )	Biochemical Engineering( )	Recycling engineering ( )		
	Chemical Kinetics ( )	Food Process Engineering II( )		
	Organic Structural Analysis	Fermentation Process Engineering III( )		
	FoodProcess Engineering I ( )			
D - B	Fermentation process engineeringII ( ) Training of Biotechnology I		Graduation Thesis	Graduation Thesis
Basic Experiments in Chemistry	Training of Biotechnology I	Experiments on Biotechnology II	Graduation Thesis	Graduation Thesis
				J 1 1
Basic Experiments in Chemistry	Training of Biotechnology I	Experiments on Biotechnology II	Graduation Thesis	Graduation Thesis
		Group Discussion of Current Biotechnology Topics ( )		
Technical English	Training of Biotechnology I	Experiments on Biotechnology II	Graduation Thesis	Graduation Thesis
		Group Discussion of Current Biotechnology Topics( )		
			-	
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Specialized Subjects	Graduation Thesis	Required	Compulsory electiv	ve Free elective